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INDEX

Agriculture & Food: e-Newsletter **Volume 2 – Issue 6 - June 2020**
www.agrifoodmagazine.co.in

INDEX

INDEX

Agriculture & Food: e-Newsletter Volume 2 – Issue 6 - June 2020
www.agrifoodmagazine.co.in

INDEX

INDEX

INDEX

INDEX

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Crop Simulation Modeling - A Tool of Risk Assessment and Adaptation Strategies Under Changing Climatic Scenario

Article ID: 30400

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Introduction

Indian agriculture sector accounts to about 18 per cent of India's gross domestic product (GDP) and provides employment to 50% of the countries workforce. Projected changes in global climate on weather like increasing temperatures, variability in rainfall and changing atmospheric carbon dioxide concentration will have significant effects on crop plants. Crop simulation models are used over past 20 to 30 years by scientists to hypothesize ways to improve agricultural production under seasonal and daily variability in weather. These models in connection with different General Circulation Models (GCM) predict the future agricultural practices that can adapt to different climate change scenarios. In this way it is more important for planning and policy of food security and national development strategies.

Impacts of Climate Change

Climatic Element	Expected Changes By 2050's	Confidence In Prediction	Effects On Agriculture
CO_2	Increase from 360 ppm to 450 - 600 ppm.	Very high	Good for crops: increased photosynthesis; reduced water use.
Temperature	Rise by 1-20C. Winters warming more than summers. Increased frequency of heat waves.	High	Faster, shorter, earlier growing seasons, heat stress risk, increased evapo-transpiration.
Precipitation	Seasonal changes by ± 10%.	Low	Impacts on drought risk, soil workability, water logging, irrigation supply, transpiration.

Crop Growth Models

Crop growth models are the representations of the real-world system. The models simulate or imitate the behaviour of real crop by predicting the reactions that occur within the plant and the interactions between the plant and its environment. The growth components, such as leaves, roots, stems and grains are analyzed. Thus, crop growth models estimate not only the final yield but also the major process involved in growth and development of plant.

Steps in Model Building

1. Define Goals: Agricultural system

2. Define system and its boundaries: Crop model

3. Define key variables in system:
- **a. State variables:** Variables that can be measured. Eg. Soil moisture content.
- **b. Rate variables:** Variables that measure the rate of various processes. Eg. Photosynthesis rate, Transpiration rate.
- **c. Driving variables:** Variables that are not part of the system but are essential for analysis. Eg: Climate.
- **d. Auxiliary variables:** Variables which are the intermediate products. Eg: Drymatter partitioning.

4. Quantify relationships (evaluation)

5. Calibration

6. Validation

7. Sensitivity analysis.

Model Calibration

In many instances, in crop models the simulated values do not exactly comply with the observed data and minor adjustments have to be made for some parameters. To make the model work correctly, some of the parameters in the equations and even some of the relationships have to be adjusted. This process is called as calibration.

Sometimes it is necessary to recalibrate a model when a different soil type, cultivar, etc., is to be simulated. For example, in soybeans, much of the variation between cultivars can be explained by maturity group number. The existence of parameters that have to be altered alerts us to the fact that our model is not as universally applicable as we might have supposed. Either there is a problem with some mechanism or we need additional input data. Even when simulation models have to be recalibrated for different situations, they can still be useful so long as the recalibration procedure is simple.

Model Validation

A practical model should be rigorously validated under widely differing environmental conditions to evaluate its accuracy on overall yield predictions, as well as the performance of major processes in the model. Normally, the results from the validation process are used to refine the model or to guide modellers to further experiments that will produce a better model. Only after extensive experimental validation, a crop model becomes an actual working tool capable of providing guidance on the practical management of agricultural systems.

Sensitivity Analysis

Most crop simulation models have a large number of parameters, many of which are not directly measurable. Sensitivity analysis of the crop models has become necessary due to the multiplicity and diversity of the model's uses. This may involve providing a standard set of parameters for adapting the model to a new plant, to new specific pedo-climatic situations or for adapting the model to crop measurements made during a growing season. The objectives of sensitivity analysis will differ according to the intended use of the model. A sensitivity analysis consists of estimating the influence of parameters on the state variables or on the model outputs.

Role of Crop Models in Evaluating Adaptation Strategies

Farmers can adapt to climate changes to some degree by:
1. Shifting planting dates.
2. Choosing varieties with different duration.
3. Irrigation options.
4. Efficient fertilizer use.
5. Resource conservation technologies
6. Agroforestry practices.
7. Greenhouse gas monitoring.

Adjusting Planting Dates

This is the only climatic adaption strategy and is a non-monetary input. Once after the realization of higher yields, farmers can readily adapt it. Altering plant dates help the crop to overcome the heat stress at the critical stages and compensate the yield loss. Crop modelling helps to find out the suitable sowing window for different crops in particular agro climatic region.

Suitable Variety / Hybrid Selection

Suitable hybrid selection is also a non-monetary input. Hybrid / variety which can sustain and prevent the yield loss under changing climatic conditions can be assessed with the help of integrated crop models. This adaption option can be combined with other strategies for getting high yields.

Efficient Fertilizer Use

Current fertilizer recommendations are for the realization of higher yields. Agriculture being the contributor for 65% of N_2O emissions, which are mainly from nitrogenous fertilizers, we are in urge need to optimum use of fertilizers in face of changing climatic scenario. Crop models help to optimize the fertilizer rates for getting maximum yields at the same time to minimize the GHG emission.

Resource Conservation Technologies

Resource conservation technologies like conservation agriculture can help in combating to the climate change. With the addition of crop residues, it will reduce the evaporation rate and also adds carbon to the soil thereby improving the soil health and hence higher yields. Crop models predict the yield stability under conservation agriculture in future climatic conditions.

Irrigation Options

Water being one of the limiting resources under future conditions, with limited water availability realization of higher yields will be one of the adaptions to climate change. Models predict the yield and water productivity under various management practices with respect to climate change thereby helping the farmers to adopt best option.

Agroforestry Practices

Agroforestry is an emerging climate smart option which has the greatest potential to sequester carbon. Developing country like India can earn carbon credits with these adaption options. Specific models like CO_2 FIX model help to simulate carbon sequester potential of forest cover in integration with remote sensing data.

Greenhouse Gas Monitoring

Greenhouse gases are the main reasons for climate change because of their global warming effect. Agriculture contributes to 10% of GHG emissions from rice cultivation, livestock production, anaerobic decomposition, fertilizer application etc., DNDC models help to monitor the GHG emissions from agricultural activities in the order to reduce the emission reduction.

Conclusion

Food security is both directly and indirectly linked with climate change. Any alteration in the climatic parameters such as temperature and humidity which govern crop growth and development will have a direct impact on yield levels. With 27.5% of the population still below the poverty line, reducing vulnerability to the impacts of climate change is essential. Coping with the impact of climate change on agriculture will require careful management of resources like soil, water and biodiversity. Against this backdrop, vulnerability assessment to crops through crop modelling and acting to it by suitable management practices is essential and need of the hour.

Application of Ozone in the Food Processing

Article ID: 30401

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Introduction

Ozone, first discovered in 1840, being utilized as a disinfection agent in the production of potable water in France in the early 1900's. The majority of early development was limited to Europe where it became more widely used in drinking water treatment. The potential utility of ozone to the food industry lies in the fact that ozone is 52% stronger than chlorine and has been shown to be effective over a much wider spectrum of microorganisms than chlorine and other disinfectants. The preservation of food has been a challenge for mankind throughout the ages. Preservation of food can be defined as the extension of shelf-life of raw materials or prepared foods beyond their natural decay times.

The food industry has generally concentrated on inactivating or killing of microorganisms and enzymes as a means of preservation by using a number of physical methods, mostly involving heat (Jakob and Hensen, 2005). Heat, particularly through cooking, has long been the principle method of eliminating pathogens. New technologies, including steam pasteurization, steam vacuuming, flash pasteurization and others continue to rely on heat to control or reduce harmful microorganisms in food. Many of the products resulting from these processes have become established in the diet throughout the world for decades and are important in own right. However, the application of heat results in products that are radically changed from their fresh counter parts (Leadley and Williams, 2006). Also, the effectiveness of heat processing is dependent on treatment temperature and time. Though thermal treatment helps kill vegetative organisms and some spores, however, the magnitude of treatment-time and process temperature is also proportional to the amount of nutrient loss, development of undesirable flavors and deterioration of functional properties of the food products.

Non-thermal technologies, such as chemical rinsing and others work without heat, affects the composition and cellular activity of pathogens and ultimately killing them but, the consumers demand for safe and fresh-like products. The food industry is therefore currently in need of innovative processing technologies in order to meet the consumer's needs and demands. This has given impetus to research and led to studies for development of alternative processing methods. Hence, a wide range of novel processes have been studied over the last 100 years. Attention is now focused on ozone which is a powerful sanitizer that may meet expectations of the industry, approval of the regulatory agencies and acceptance of the consumer (Khadre et al., 2001). Sanitizers have been used in food processing facilities to control contaminant microorganisms, particularly those causing food borne diseases. However, use of some sanitizers has been limited or banned because of the potential health hazards. On the other hand, the need for potent antimicrobial agent has increased in recent years due to increasing outbreaks and emergence of new food pathogens. Therefore, the food industry is in search of disinfectants that are effective against food borne pathogens and safe to use in many specific applications of food processing. One such compound is ozone (Kim et al., 1999).

What is Ozone?

Ozone (O_3) is an allotropic form of oxygen (O_2), i.e. it is made up of same atoms, but they are combined in different form. The difference is the presence of three oxygen atoms, whereas "common oxygen" has only two. It has low molecular weight (MW = 48) whose three oxygen atoms chemically are arranged in chain. Ozone is then enriched oxygen (O_3). Ozone is a gaseous compound which is naturally present in the atmosphere and formed as a result of lightning or high energy UV radiation. Ozone has high potential applications in the food industry. Food preservation through ozone is a non-thermal processing technology which helps in enhancing food safety without compromising quality and desirability of food products. Ozone acts as a potential oxidizing agent and helps in eliminating pathogens due to its antimicrobial properties without leaving any residue in the treated food. Aqueous ozone may have a good potential for short-time surface treatment (decontamination) of fruit and vegetables and as a disinfectant for process water in food producing plants. When used in industry, ozone is usually generated at the point of application and in closed systems. Ultraviolet radiation (188 nm wave length) and corona discharge methods can be used to initiate free radical oxygen formation and thereby generate ozone. In order to generate commercial levels of ozone, the corona discharge method is usually used (Gonçalves, 2009).

Application of Ozone in the Food Industry

Today, the use of ozone is steadily replacing conventional sanitation techniques such as chlorine, steam or hot water. It's gaining momentum in the food processing industry as the safest, most cost-effective and chemical-free way of dealing with food safety management. Ozone has been used in the food processing industry, both as gaseous ozone and dissolved in water to reduce bacteria on a wide range of food products and contact surfaces.

Fruits and Vegetables

The fresh produce typically contains a complex mix of bacteria, fungi and yeast whose population and kinds are highly variable. Chlorine is the primary sanitizing agent used in fruits and vegetables washing but it produces residual by-product such as trihalomethanes which are potential carcinogens. Ozone is shown to be a good alternative sanitizer for fresh fruits and vegetables. Ozone processing within the food industry has been carried out for fresh fruits and vegetables either by gaseous treatment or washing with ozonated water. Two types of washing systems: spray and fume can be used to reduce microbial counts on the surface of produce.

Dried Fruits

Najafi and Khodaparast, showed that when ozone was applied in gas form at three concentrations (1, 3, and 5 ppm) for four different periods (15, 30, 45 and 60 min) on Iranian date fruit, there is a reduction in the total count of mesophilic microorganisms, coliforms, *S. aureus* and yeast/mould. The results also suggested that a minimum of one-hour ozone treatment at 5 ppm could be successfully used for reducing the coliform and *S. aureus* of date fruits but longer exposure times are required for elimination of the total mesophilic bacteria as well as yeast/mould counts which were statistically lower than those of untreated control samples.

Liquid Foods

Ozonation of liquid foods is mainly carried out in bubble columns. Bubble columns are utilized as multiphase contactors and reactors in various food, chemical, petrochemical, biochemical and metallurgical industries A typical bubble column reactor is a cylindrical vessel with a gas diffuser to spurge ozone in a gaseous state into either a liquid phase or liquid solid dispersion. When gaseous ozone is spurge into a liquid phase, agitation occur inducing turbulent shear stresses. This causes the liquid film to become thinner. Consequently, higher rates of diffusion through the liquid film occur, resulting in an increased local mass transfer coefficient (kL). In a bubble column ozone gas interacts with liquid food, where ozone is consumed followed by a chemical reaction involving oxidation. The overall reaction rate is governed by two steps first is the mass transfer from the gas phase to the liquid phase and then the chemical reaction in the liquid phase.

Spices

Ozone has been used experimentally as a substitute for ethylene oxide for the decontamination of whole and ground black peppercorns. Ozone treatment of ground black pepper resulted in slight oxidation of volatile oil constituents but ozone had no significant effect on the volatile oils of whole peppercorns. Because ozonation successfully reduced microbial loads and did not cause significant oxidation of the volatile oils in whole black peppercorns, this method was recommended for industrial treatment of the spice.

Sea Foods

Ozone pre-treatment (6 ppm) of tilapais helps to increase shelf life of the product by 12 days. The combination of ozone pre-treatment with storage at 0°C appears to be a feasible means of prolonging the storage life of fish. Ozonated water was used for dipping and washing fish or fish fillets showed an effective reduction of microbiological flora and had no effect on the product. The catfish showed highly statistically significant reductions in plate counts when live fish and fillets were washed in ozonated water ozonated water technology can be successfully used as a germicidal agent in seafood processing to extend the shelf life and quality of wild shrimp in a time when efforts are been made to eliminate the use of commonly used chlorine due to its ability to form potential carcinogens on reacting with organic matter.

Advantages

1. Ozone can be generated on-site.
2. Ozone is one of the most active, readily available oxidizing agents.
3. Ozone rapidly decomposes to oxygen leaving no traces.
4. Reactions do not produce toxic halogenated compounds.

5. Ozone acts more rapidly and completely than other common disinfecting agents.
6. Ozone reacts swiftly and effectively on all strains of all kinds of microorganisms.

Disadvantages

1. The major operating cost of producing ozone is the electrical energy.
2. Ozone is a potent oxidant and can reduce bacterial levels in pure culture; the use in food processing operations where bacteria exist within organic material is more difficult.
3. Ozone is the most powerful oxidizing agent available; it is also potentially the most dangerous of oxidants. This danger was recognized in the early stages of ozone research and techniques have been developed to insure the absence of ozone accidents

Future Perspective

As we can see above, ozone has found applications in various sectors in the food industry. It's potential to warrantee microbial quality of the various products as well as a potent sanitizer for plant equipment clearly predicts that this technology has a bright future and potential in the industry. The effectiveness of ozone being influenced by many factors, such as, method of the use, temperature and pH, besides the quality of used water.

Conclusion

There is great potential for using the reactive, antimicrobial properties of a natural environmentally friendly compound such as ozone when synthesized in a controlled system for food-based applications. Although ozone technology has existed for over a hundred years, its recent acceptance fuelled by environmental and health concerns now poises this technology for future longevity and increased successful usage, whether based on water purification, water recycling, air quality improvement, product extended storage and/or equipment surface sanitation.

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Hyperspectral Imaging: A Novel Technology in Food Industry

Article ID: 30402

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Introduction

Hyperspectral imaging (HSI) is an emerging and innovative technique, which has advantages, that it is rapid, non-invasive, reliable for quality inspection, but compared to NIR spectroscopy, it also integrates traditional spectroscopy and digital imaging into one system, making it possible for providing spectral and spatial information of a certain object simultaneously (Zheng et al. 2006). The outstanding advantages of HSI make it possible to accomplish the evaluation of external features such as size, appearance, colour, defects, and so on, and estimation of internal properties that moisture, protein, fat, carbohydrates, etc., concurrently. These days， HSI has been widely applied to provide good results on the assessment of quality properties of foods, such as grain and oil, fruits and vegetables, animal and aquatic products, and others. In the field of grain and oil, the existing research is concerned with products' quality (component determination, germination test, variety classification and safety (fungal detection, pest detection).

Principle of Working

Hyperspectral imaging, like other spectral imaging, collects and processes information from across the electromagnetic spectrum. The goal of hyperspectral imaging is to obtain the spectrum for each pixel in the image of a scene, with the purpose of finding objects, identifying materials, or detecting processes. In hyperspectral imaging, the recorded spectra have fine wavelength resolution and cover a wide range of wavelengths.

Data Acquisition and Processing

Application and data acquisition techniques vary among different groups of investigators. In practice, there are five different NIRS measurement modes fitting different applications. These modes are transmittance, interactance, transflectance, diffuse transmittance and diffuse reflectance (Huang et al. 2008). Before spectroscopic analysis, the spectra are first extracted from regions of interest (ROIs), which are mostly determined by thresholding an image at a single waveband or at a ratio and/or difference image. While, for image processing, limited number of images (preferably less than 10) should be chosen from the massive images available to facilitate fast computation.

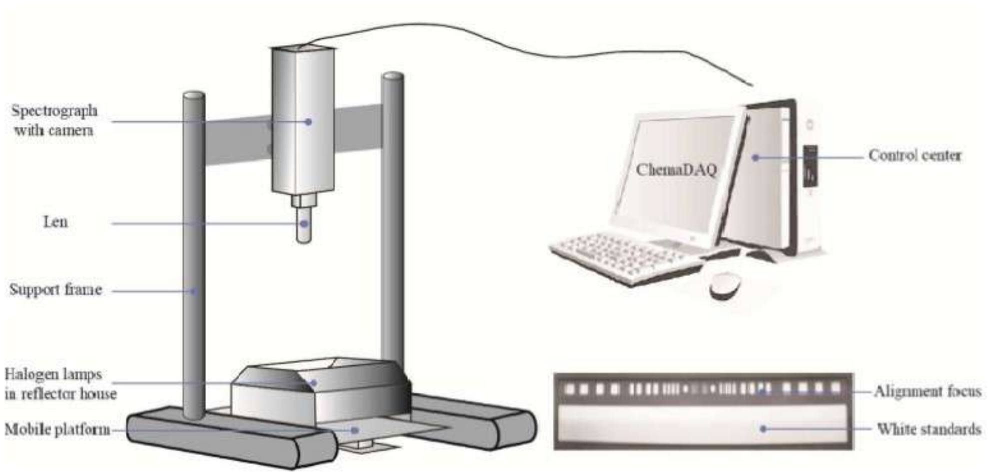

Fig.1. Sketch of hyperspectral imaging system

To reach the same goal, chemometric methods, such as principal component analysis (PCA) and partial least square regression (PLSR), can be employed where the loadings and importance in projection (VIP) scores can be examined to find out vital wavelengths (ElMasry et al., 2008).

Applications of Hyperspectral Imaging

1. Physical contamination and defects.
2. Detection of foreign materials.

3. Detection of defects in fruits and vegetables.
4. Detection of chemical contamination.
5. Adulteration of melamine.
6. Microbiological contamination.

Advantages

The main advantages of these techniques are related with the possibility of acquiring either single or multiple images as needed, at selected wavelengths in the NIR, MIR, and Vis range, providing with the ability to detect individual traits or properties directly associated with quality, in an extensive range of raw materials and products used in the manufacturing of foods. However, the potential of these techniques to obtain spatial, spectral, and multi-constituent information about the sample being analysed is the most attractive advantages in food analysis. The main advantages that these techniques that are present over the traditional chemical and chromatographic methods are the timeliness and the simplicity of use in routine operations.

Disadvantages

Cost of the device is very high. Issues that are related with the availability of commercial and robust instrumentation, the large amount of data generated during the analysis, the need to complex data analysis and algorithms, the small number of samples in most of the applications reported in the literature are still a drawback on the use of this technology in the food industry. However, the lack of academic training is still a barrier for the worldwide application of these technologies in research and by the industry.

Conclusion

Hyperspectral imaging integrates two popular technologies, that is, spectroscopy and computer vision, to present both spectral and image information of food products at the same time. Such richness in information provides a broad platform for applying various chemometric algorithms and multivariate data analyses to reveal quality and safety parameters in the food commodities. Furthermore, this platform can be widened by introducing different spectral profiles, that is, NIR, Raman, and fluorescence spectra, and its effectiveness has been preliminarily confirmed in some aspects of food safety.

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Impact of COVID-19 on Industries

Article ID: 30403

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Abstract
Due to this pandemic, which is trending across the globe, the situation of lock down or home quarantine has been arise since March 23rd to date, is likely to be increased. As a result, there are some industries in India facing acute problem not only in India the similar situation is seen in throughout the globe. I have used mostly secondary data for my Article.

Keywords: pandemic, trending, quarantine, industries.

Introduction
The outbreak of 2019 novel corona virus disease (COVID-19) is a public health emergency of international concern (WHO, 2020) that had spread to more than 100 countries by March 8, with more than 100,000 infections and 3,830 deaths (NHC, 2020; WHO, 2020), seriously affecting economic and social development. On February 28, UN Secretary-General Guterres called on governments to take action to do everything possible to control COVID-19 pneumonia (New.cn, 2020).

The United Nations Sustainable Development Goals (SDGs) aim to address social, economic, and environmental issues from 2015 to 2030 and move towards sustainable development (SDG, 2015). The United Nations SDGs contain 17 goals and 169 targets. SDG 3 aims to ensure healthy lives and promote well-being for all at all ages. More specifically, SDG 3.3 aims to end epidemics of AIDS, tuberculosis, malaria and neglected tropical diseases and to combat hepatitis, water-borne diseases and other communicable diseases by 2030 (SDG, 2015).

COVID-19 pneumonia directly threatens the achievement of SDG 3, especially SDG 3.3, and affects the realization of economic and social goals. In the context of global environmental changes, the transmission characteristics of the COVID-19 epidemic have not yet been sufficiently recognized (CDC, 2020). Additionally, the acceleration of global urbanization, increased concentration of populations, more frequent and complex interactions, and shortage of medical protection in developing countries all increase the difficulties of the prevention and control of COVID-19.

Agriculture
Agriculture is a foremost one. According to some reports, an average of about one farmer is committing suicide for every 30minutes due to debt. Today situation of agriculture has become so worse than earlier that shortage of harvest labour, improper transport facilities were added as special hardships to farmer society. These situations have led to a reduction in production from farmer's side.

Tourism
More than one lakh of people in India depend on tourism for livelihood whereas in today, from Chandni - chowk market in Delhi till rushy Streets of charminar have come to a stand-still positions. Also, whole tourism department has been locking down due to pandemic fear. According to estimates, complete lock down of tourism has thrown government in to economic loss of about 20000 to 30000 crores.

Trade
Import and export are always two sides of a coin i.e., trade. Due to trade decline, aviation International flights are affecting with great hit. The former two aspects play a crucial role towards Indian economy in day-to-day. In such widespread situation Indian government is forced to run in major loss of trade economy.

Textile Industry

Textile industry was on good hike previously but now, situations have changed otherwise and we're running in great losses.

Electronics

India is a major importer of electronics. Most of the electronic items that are imported now fell lie in storages in due situation and their maintenance has become greater challenge to the company service men. If situation continues, there might be a great hike in rates of electronic goods after the relaxation of pandemic corona. Electronic department is trying their best to come out of this critical situation although it's becoming meagre.

Automobile

In general, about lakhs of cars and bikes would be produced every year by the industries, but as of now not even a single industry is opened for production. Also, there's a great scope for losses to automobile industries if this continues.

Iron & Steel and Mineral Processing

Iron and steel are the basic raw material for many industries. All the industries are shut down due to their less usage. Mining and mineral processing were totally shut across the world. So, there's almost less supply of minerals. Due to this petroleum and its products supply has come down. The import of petroleum has declined in such a great range i.e., from few million litres in normal days to mere thousands of tons today.

Real Estate

Real Estate businesses have paused-up since last few weeks. All the construction work has come to stand-still due to various reasons although, main reason being lock down.

Software

There are many software industries rooted-out in every corner of the society. These software workers are now aiming at work from home projects but sitting and working for longer hours may affect them in the form of scoliosis.

Human Resource

As the corona virus pandemic hits jobs and wages in many sectors of the global economy that depend on migrants, a slowdown in the amount of money these workers send back home to their families looks increasingly likely. These international remittances will be crucial in transmitting the unfolding economic crisis in richer countries to poorer countries. They will fundamentally shape how, and the pace at which, the world recovers from coronavirus.

Remittances shelter a large number of poor and vulnerable households, underpinning the survival strategies of over 1 billion people. In 2019, an estimated 200 million people in the global migrant workforce sent home US$715 billion (£571 billion). Of this, it's estimated US$551 billion supported up to 800 million households living in low- and middle-income countries. Migrant workers sent home billions in cash every year. This money is vital for local communities and economies. The disruption caused by coronavirus could have a significant impact on these remittance flows.

Education

COVID-19 also had a greater impact over students. Not even a single school or an institute is open for students to attend. Since it's started amidst the SSC and intermediate board examination, they were cancelled and the new exam schedule is yet to be declared.

Even in banking sector, investments and transactions are totally on hold. Even some pharma industries are on their way in work increasing their pace they are also on throw back. Paper industry also affected very badly as the usage of paper has declined to a maximum extent due to closure of various government and social institutions.

Transport

Railways is another important corner which is at most affected. There will arise huge loss per single day railway lock down whereas today one can imagine how much economic loss may occur in today situation. Along with the above, Roadways also stopped working. During the RTC strike also wheels on roads were paused which later fined government to spend cores of rupees for repairing those buses, again today similar situation may arise loading double burden on government amidst the lock down crisis.

Conclusion

Last but not the least two divisions of society are being affected to the superlative stage during this pandemic. They are poor and middle-class. These sections are now workless and some middle class of the elderly may be nil at their bank balance leading them to starvation. In such pathetic situations some people are helping the people by donating groceries etc. On behalf, we salute to those hands that are lending forward to feed the empty stomachs of needy and poor in such difficult situations, for their humanistic deeds.

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Bioecology, Incidence and Management of Deudorix epijarbas Moore in India

Article ID: 30404

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Pomegranate, *Punica granatum* L. is an important fruit crop of tropical and subtropical regions of the world. It is widely cultivated crop due to its different properties *viz*., wide range of adaptability, high keeping quality, draught tolerance, nutritive qualities etc. In India, area under Pomegranate has been expanded up to 2,34,000 ha with a production of 28,45,000 MT (Anonymous, 2018). *Deudorix epijarbas* Moore has been recorded in many fruit crops like pomegranate, guava, aonla, sweet orange etc. But pomegranate is the most favorite host of this pest. Many insect-pests have been recorded to attack pomegranate, but fruit borer, *D. epijarbas* is the most obnoxious pest and has been found to be a major limiting factor hindering production of pomegranate (Prasad, 1987). The pest is mainly prevalent in Himachal Pradesh and Jammu and Kashmir. Life cycle of *D. epijarbas* varies under different ecological conditions. Therefore, location specific studies on the biology and feeding behaviour of *D. epijarbas* are necessary for implementing a good pest management programme.

Nature of Damage and Losses Caused by D. epijarbas in Pomegranate

The damage is caused by caterpillars. The caterpillars penetrate the soft skin of young fruits after hatching from the eggs and feed on internal contents (seeds and pulp). The rate of feeding of first and second instars is very low as compared to mature larvae. The anal segment of larva is clearly visible plugging the penetration hole. The excreta produced by larvae can be seen around the entry holes in the form of wet pellets (Fig 1.). The damage holes made by caterpillar act as a source of secondary infection by fungus and bacteria causing rotting and dropping of fruits. The infestation is generally commenced during the month of June and peaked during August-September. In mid hills of Himachal Pradesh, a very high infestation ranging from 60-90 per cent has been recorded due to the attack of *D. epijarbas* (Gupta and Dubey, 2005; Anonymous, 2008). In another study, fruit infestation ranging between 12 - 94 per cent has been recorded in Himachal Pradesh (Prasad el al., 1987). About 50 per cent losses in pomegranate were recorded due to pomegranate butterfly by Balikai *et al*. (2011). Thakur *et. al*., (1995) reported 17.33 to 36.66 per cent losses caused by *D. epijarbas* in different places of Jammu regions. According to Srivastava and Dhaliwal (2011), this pest may cause 40 to 90 per cent fruit damage in pomegranate growing areas of the country.

Biology D. epijarbas

The female butterfly lays eggs singly on calyx end of young fruits and on upper surface of leaves. More than 50 per cent of egg laying occurs on calyx end of developing fruits. Mohi-ud-in *et al*., (2018) recorded 52.46 per cent of egg laying by *D. epijarbas* on calyx cup of young fruits. The eggs are small, rounded and whitish with yellowish tinge. The incubation period was recorded to be ranging from 7-9 days (Mohi-ud-in *et al*., 2018; Kumar *et al*., 2017). There are five larval instars. Larval stage is the only stage which is longer than other stages. According to Verma (1985), the total larval period of *D. epijarbas* was 15-24 days. Pupation generally takes place inside the fruit but occasionally may pupate outside attaching themselves to the stalk of the fruit (Srivastava and Dhaliwal, 2011). Pupal period of 8-10 days was recorded by Verma (1985). The wings of male butterfly are dark orange in colour. The coastal region of forewing and hindwing of male is marked with dark brown colour. Whereas female butterfly is dull brown in colour (Fig 1). The adult longevity was found to be ranging from 7-13 days (Khandare *et. al*., 2018). The females live for a longer duration than males. This pest completes more than two generations in a year. The second generation is generally longer than first generation. The total life cycle completes within in about two months.


(a)


(b)


(c)


(d)

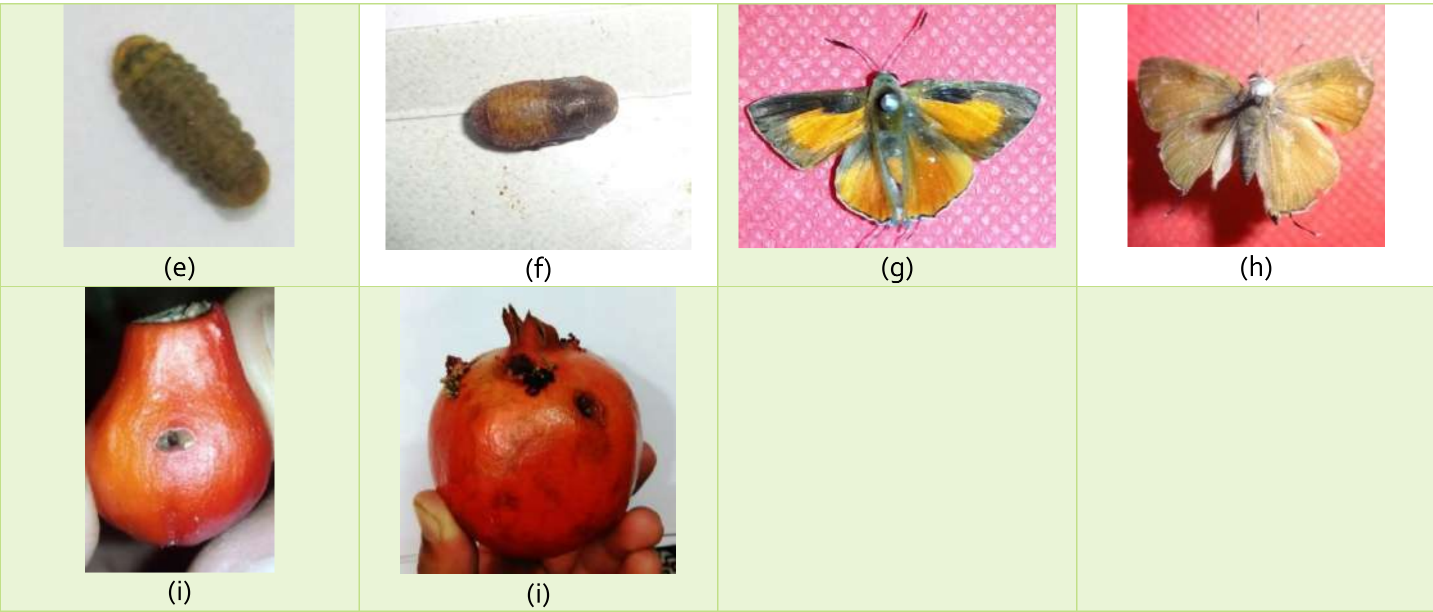

Fig 1. (a) Eggs on calyx and leaves; (b) 2nd instars; (c) 3rd instar; (d) 4th instar; (e) 5th instar; (f) Pupa; (g) Male (h) Female; (i) Damage symptoms on fruits.

Management

Once the tree has started flowering, monitor this pest by using light trap. Look at the top of the fruit for the presence of the insect and its eggs. Bagging of fruits before maturity is a very effective practice. Covering of developing fruits is of immense help because it checks the entry of pest inside fruit. For the successful implementation of this practice one should be well aware of the time of onset of this pest. Once caterpillars bore the fruit skin, it is very difficult to control the damage. Regular monitoring should be done to detect the damage at early stage. The fruits those have fallen and those showing exit holes should be removed and destroyed immediately to prevent further buildup of the pest. Clean cultivation practices should be followed in the orchard. The regular weeding should be done to remove unwanted plants which may act as alternate host for this pest. Clipping off the calyx cup immediately after pollination will reduce the egg load. After removing calyx cups, two rounds of sprays with neem oil @ 3 per cent can also control pest infestation effectively (Kambrekar and Kalaghatagi, 2012). Release of biocontrol agent, *Trichogramma chilonis* @ 1.0 lakhs/ acre four times at 10 days interval is also beneficial (Anonymous, 2014). Adult butterflies prefer to lay eggs on fruits and flowers. These eggs are exposed outside until hatching and after hatching, the first instar larvae remain outside for some time before puncturing the fruit. Therefore, efficient control can be achieved by properly timing the sprays of recommended insecticides when eggs or young larvae are still on the fruits. Sprays should be done during the initiation of fruit setting to control pest effectively.

Conclusion

D. epijarbas can survive under various environmental conditions and thus, a more detailed study on biological parameters is needed under different agro-ecological regions at the same time. Moreover, a thoroughly recommended integrated approach is the need of the hour for its management.

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Protected Cultivation of Sweet Pepper

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Introduction

Capsicum, commonly known as bell pepper or *shimla mirch* in hindi is a cool season crop, but it can be cultivated the whole year under protected cultivation. It is good source of Vitamin A, Vitamin C, calcium, magnesium, phosphorus and potassium. The conventionally grown green capsicum usually yields 20-40 tons per hectare in about 4-5 month depending upon variety and season but in the greenhouse, green and coloured capsicums yields about 80-100 tons per hectare in 7-10 months. The crop grows best under 25-30°C day temperature and 18-20°C night temperature and 50-60% relative humidity which can be maintained as per requirement under protected structures. The fruit setting is greatly affected if temperature exceeds 35°C or falls below 12°C.

Production Practices: Selection of Site

Care should be taken while selecting site for protected cultivation to prevent any time, location, crop and financial damage. Location with high rainfall and humidity triggers many foliar diseases, the areas with high wind velocity may bring damage to the structure frequently, thereby augmenting the maintenance cost of the structure. Hence, such locations have to be avoided for establishment of protected structure to reduce the losses. Land with sandy loam soils with soil pH 6 to 7, EC <1 mm hos/cm and good percolation is ideal for growing capsicums.

Green House Structures

There are several categories of protected structures based on the local climatic conditions. However, in India most commonly used structures for capsicum cultivation are cost effective polyhouse and net house.

1. Shade net house: Net house provides cost-effective system of growing vegetable crops mainly in southern states particularly around Bangalore. Their construction requires granite stone pillars of 12 feet height, 8x4 inch thickness which give strength to the structure. A galvanized iron (GI) wire grid has to be provided on the top of granite pillar to give support to the shade net. Over this wire grid, white shade net (50% HDPE) is fixed to give support to another layer of shade net (black or green providing 35% shade) that is utilized during hot summers (Feb-June) or whenever the sunlight is more (11.00 am to 3.00 pm). All the four sides of net house have to be covered with UV stabilized nylon net (40 mesh). Cost of construction of net house is about Rs.180-200 per sq. mitre.

2. Poly house: Poly house provides total avoidance of rain water entry and lowers incidence of leaf diseases, and enhances the yield normally by 15-20 per cent more as compared to net house. Generally, GI pipes or stone or wooden pillars can be used to build poly house. Transparent 200 µ thick UV stabilized polyethylene film is used as covering material of the poly house. A retractable shade nets, at about 11 feet height from ground level, is provided just below the roof. Three feet height of all the sides of the polyhouse are covered with polyethylene film (200 µ thick), to protect from rain splash while the remaining height of side wall is covered with white insect proof net of 40 µ. Cost of construction of poly house is about Rs.500 per sq. mitre.

An ante chamber with two doors in opposite directions is provided to both the structures which should not be opened together to prevent the doorway of pests inside the structures. A disinfectant solution like potassium permanganate in a 2-inch-deep concrete trough of dimensions 2 m length and 1 m breadth should be kept in antechamber for washing feet to avoid contamination inside the polyhouse/net-house.

Cultural and Nursery Practices

1. Selection of cultivars: The immature capsicum hybrids are green in colour which turn red, orange or yellow on maturing depending on the hybrid. The selected cultivar should be high yielding bearing fruits of uniform shape, size, colour and weighing greater than 150 g at complete maturity. The fruits should have preferably four lobes, shorter internodal lengths (7 to 10 cm) and shelf life of at least 5 days under normal conditions. The hybrids selected should have a long crop duration period of 8 to 10 months. Commercial hybrids that are commonly grown in India are Yamuna, Indra (Green); Natasha, Triple star, Inspiration (Red); Swarna, Bachata (Yellow).

2. Nursery raising: The nursery sowing is done in the pro-trays of 98 cells filled with growing medium i.e. sterilized cocopeat so that one seed is placed in each cell at 0.5 cm depth at rate of 400-500 gm for transplanting in one hectare and covered with thin layer of same media. These trays are stacked and covered with plastic sheets till seed germinates i.e. for about one week. The trays are then shifted in net house/ polyhouse followed by light irrigation. The seedlings should be drenched with mono ammonium phosphate (12:61:0) (3 g/L) at 15 DAS and 19:19:19 NPK (3 g/L) solution at 22 DAS. Seedlings can be transplanted in 30-35 days. Before transplanting, drenching with COC @ 3 g/L should be done.

Land Preparation

Plough the land thoroughly to a fine tilth. Always mix well decomposed organic manure with soil at the rate of 20-25 kg per sq. mitre. Note that one application is plenty enough to grow three capsicum crops successively. Raised beds of 90-100 cm wide and 15-22 cm height are prepared leaving a walking space of 45 cm to 50 cm between the beds.

Fumigation

Fumigation can be done using Basamid or formaldehyde. Drenching the beds using 4 per cent formaldehyde *i.e.* 4 L/ m^2 of bed is followed by covering with black polyethylene mulch sheet. The use of apron, gloves and face mask is recommended when treating with formalin. The polyethylene cover can be removed after four days of formalin treatment and the beds should be raked daily so that the trapped formalin fumes are removed completely, before transplanting. It helps in preventing crop from soil borne diseases and should be repeated whenever necessary or after three crop cycles.

Fertilizer Application

Apply a basal fertilizer dose of 20:25:20 NPK per acre to the beds uniformly before transplanting in the form of 80 kg calcium ammonium nitrate, 125 kg super phosphate and 32 kg murate of potash or 40 kg sulphate of potash.

Application of Neem Cake and Microbial Bio-Control Agents

Neem cake is useful to reduce the problem of soil borne pathogens and nematodes. About 200 kg of neem cake is powdered and slightly moistened then mixed with *Trichoderma harzianam*, *Pseudomonas lilacinous* and *Paecilomyces chlamydosporia* @ 2 kg each. This mixture is covered with wet gunny bags or dry grass and left for 8-10 days away from direct sunlight and rainfall. After 10 days, this mixture of neem cake and bio-agent and 600 kg of neem cake has to be applied uniformly to the beds for an area of one acre. Nitrogen fixing bacteria like *Azospirillum, Azoctobacter* or *VAM* can also be applied to the bed.

Mulching and Spacing

Mulching is done by covering the beds with black polyethylene film of 30-100 micron thick. The film should be with 1.2 m wide and holes of 5 cm diameter are made on the polyethylene film based on the recommended spacing of 45 x 30 cm. The edges of the film across the beds should be covered firmly in soil so that it does not get removed. Mulching has many benefits like it reduces evaporation from soil, reduces weed growth and infestation of pests and diseases leading to the higher yield and quality of the produce.

Transplanting

Pre-sowing irrigation up to field capacity should be done before transplanting. Seedling should be uprooted from plug tray without damaging the roots. Seedlings should be transplanted at a depth of 5 cm into holes made in mulch film. Transplanting should be followed by drenching to the base of seedlings with captan or copper oxychloride @ 3 g/L. Watering the beds regularly for a week during afternoon is important to lower mortality rate caused by heat.

Training and Pruning

Pruned is done to retain four stems on plant. It is performed 30 days after transplanting at an interval of 8-10 days. It is done to gain bigger sized fruits of better quality and higher productivity. While training, the main stem of plants is twined with four chords along GI wire grid running over top of the plants. It is done four weeks after transplanting.

Drip irrigation and Fertigation

Irrigation is done by drip system as and when required based on the stage of plant and season of cultivation. Irrigation along with water soluble fertilizers, known as fertigation, is given three weeks after transplanting for entire crop growth period. Fertigation is to be given twice a week with NPK (19:19:19) @ 4 kg/acre, potassium nitrate @ 1.5 kg/acre and calcium nitrate 1.5 kg/acre. Foliar application of potassium nitrate and calcium nitrate can be done after 2 months of transplanting @ 3g/L at three weeks interval.

Harvesting and Yield

The harvesting is done by clip harvest technique. Harvesting of green capsicum takes 55 to 60 days, yellow capsicum 70-75 days and red capsicum 80-90 days after transplanting. Fruits can be picked at interval of 3-4 days. Harvesting should be done in the early morning hours. It is followed by keeping the produce in cool and shady place away from direct exposure to sunlight. The average yield of capsicum per acre is 30-40 tons.

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Various Technology, Needs, Adoption Strategies and Scope of Precision Farming in India

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Introduction

The focus on enhancing the productivity during the Green Revolution coupled with total indifference of proper management of inputs and devoid of the ecological impacts, has resulted into environmental degradation. The only substitute left to enhance productivity in a sustainable manner from the limited natural resources at the disposal, without any adverse consequences, is by take advantage of the resource input use efficiency. It is also certain that even in developing countries, availability of labour for agricultural activities is going to be in short supply in future. The time has now arrived to exploit all the modern tools available by bringing information technology and agricultural science together for improved economic and environmentally sustainable crop production (Mishra et al., 2019). Many of the tools use in Precision Farming like- Variable Rate Application, Yield Mapping, Crop Manager, Leaf Colour Chart, SPAD (Soil plant analysis development) Meter, Green Seeker etc. The concept Precision agriculture is based upon observing, interpreting, measuring and responding to field variability in crops or in aspects of animal rearing by using the four pillars - Right place, Right source, Right quantity and Right time.

Tools Use in Precision Farming

1. Variable rate application: Variable rate application (VRA) refers to the application of a material, such that the rate of application is based on the precise location, or qualities of the area that the material is being applied to. The way in which the materials are applied is based on data that is collected by sensors, maps, and GPS. These materials include things like fertilizers, chemicals, and seeds, and they all help optimize one's crop production (https://medium.com/remote-sensing-in-agriculture/variable-rate-application-in-precision-agriculture-70a8b2be871d).

2. Crop manager: It is a web-based decision support precision agriculture tool for calculating fertilizer requirement for crop management principally developed for rice based cropping system. Crop Manager for Rice-based Systems (CMRS) aims to increase farmer's net income and sustain the productivity for rice-based cropping systems. CMRS uses a farmer's questions to answers on farming practices by design generate rice, wheat, or rabi maize management to reduce risk of financial loss.

Table 1: Crop Manager developed by: India

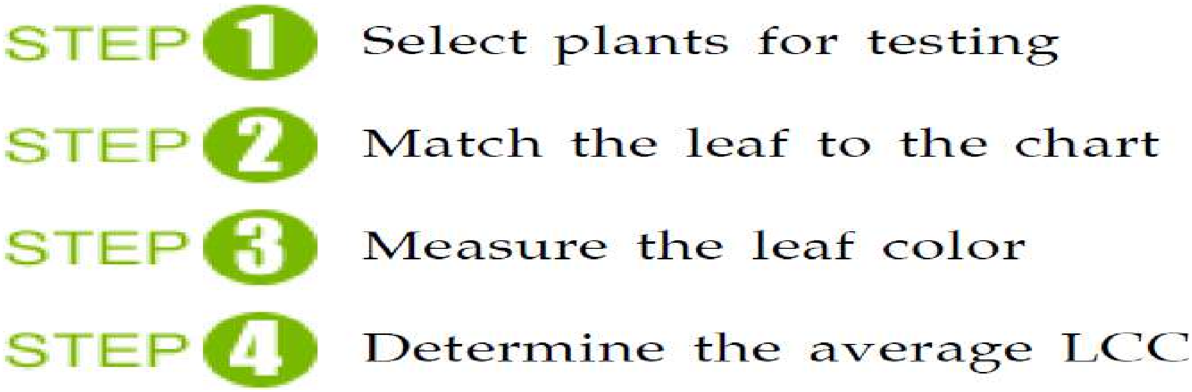
States	Crop Manager
Bihar:	Crop Manager for Rice-based Systems
Eastern UP	Rice-Wheat Crop Manager
Odisha	Rice Crop Manager

3. Leaf Color Chart (LCC):

Fig: 2 IRRI Leaf Colour Chart

LCC has four green strips, with colour ranging from yellow green to dark green. It determines the greenness of the rice leaf, which indicates its N content (Rice Knowledge Bank, IRRI). They determine the N fertilizer needs of rice crops.

How to use the Leaf Colour Chart



4. SPAD (Soil Plant Analysis Development) Meter: The SPAD 502 Plus Chlorophyll meter rapidly measures chlorophyll content or "greenness" of plants to reduce the risk of yield-limiting deficiencies or costly over fertilizing. It has been employed widely in both research and agricultural applications, with a range of different plant species (Ling et al., 2011).

Fig: 3 SPAD- Meter

5. Green Seeker: Green Seeker® is an optical sensor technology enables you to measure, in real time, a crop's variability, and variably apply the "prescribed" fertilizer or chemical requirements, enables you to also collect data during existing farming operations such as spraying, cultivation and mowing, also predicts yield potential for the crop using the agronomic vegetative index (NDVI).

Type of Green Seeker

1. RT200
2. RT100 Green Seeker
3. Handheld Green Seeker.

Fig: 4 RT 100 Green Seeker

Fig: 5 Trimble® Green Seeker

Need and Adoption Strategies of Precision Farming in India

To bump into the huge food grain requirement of 480 million tonnes (MT) by the year 2050, with the increasing challenges of abiotic and biotic stresses experienced by crops, introduction and adoption of modern technology in Indian agriculture is inevitable. The worldwide food system faces difficult challenges and that will increase over the next 40 years. More fundamental changes to the food system and investment in research are required to manage with future challenges and their solutions.

The drop in the total productivity, degrading natural resources and diminishing, stagnating farm incomes, shortage of eco-regional approach, declining and fragmented land holdings, trade liberalization on agriculture, narrow employment opportunities in non-farm sector, and universal climatic variation have become key concerns in agricultural growth and development. Three components, namely, 'single precision agriculture technology', 'Precision agriculture technology package' (for the user to select one or combination) and 'integrated precision agriculture technology, have been identified as a part of adoption strategies of precision agriculture in the developing countries like India.

Scope of Precision Farming

Precision agriculture for small farms can use small farm machinery and robots not destruct or compact the soil and may also keep going renewable fuels like bio-oil, compressed biogas (CNG) and through agricultural residues produced electricity on farms. For small farms, precision agriculture may include sub-surface drip irrigation for precise water and fertilizer application, weed removal, harvesting and other cultural operations. India's small farms, therefore, are ideal for the large-scale use of precision agriculture.

Precision Farming in Sugarcane Agriculture is expected as India is second largest producer of sugar and sugarcane. Sugarcane is cultivated in about 4.09 million hectares, producing about 283 million tonnes (MT) of cane with an average productivity 69.19 MT/ha. Of the number of agriculture crops, sugarcane is the best remunerative; its requirement for water and fertilizer is also equally very high.

Conclusion

Precision agriculture in several developing countries together with India has various opportunities for farmers to recognize better high yielding location specific crops and in fact a farmer turns in to a breeder to produce better and higher yielding varieties by using precision agriculture system. Three components, namely, 'single precision agriculture technology', 'Precision agriculture technology package' and 'integrated precision agriculture technology', have been recognized as part of the general adoption strategies of precision agriculture in developing countries.

High-tech Precision agriculture therefore can help in bringing next green revolution in India and can produce wonderful rural wealth in a sustainable and ecologically sound way. In the light of today's crucial need, there should be an all-out struggle to use new technological inputs to make the 'Green Revolution' as an 'Evergreen Revolution'.

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Locust Swarming

Article ID: 30407

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Insect Migration - Locusts

Understanding insect migration can be important in applied entomology, such as pest management, as the large-scale movement of herbivorous insects can have substantial economic consequences. By understanding the ecology of these migratory insects, models to predict outbreak patterns and management strategies to minimize crop losses can be developed. Locusts are migratory insect pests that have had economic impacts over the globe.

Locust Swarming

Several species of short-horned grasshoppers will develop as a solitary form as long as population densities remain low and sufficient food is available. In some species, the developmental trajectory shifts when population densities are high, to a gregarious and migratory form. These migratory grasshoppers are commonly called locusts.

The type of phenotypic plasticity responsible for the shift between solitary and migratory forms in locusts is called Polyphenism. Phenotypic plasticity is the phenomenon whereby a single organism's behavior, physiology, or morphology changes based on environmental conditions, while polyphenism is a specific case that occurs when an organism has two or more *discrete* forms based on environment conditions.

Overcrowding causes morphological, behavioral, and physiological differences in the swarming phase compared to the solitary phase of the same species. Although morphological changes vary between species, migratory forms often have bolder or darker coloration. Behavioral changes of form include aggregation rather than a voidance of conspecifics, light during the day instead of at night, and long-distance migrations. The aptly named migratory locust, *Locusta migratoria* exemplifies many of the characteristics of locusts, and travels an average of 200km each day.

Physiological changes from the solitary form to the migratory form include higher metabolic requirements, shorter lifespans, and fewer eggs per egg pod. Although the lifespan and number of eggs produced by migratory locusts may be lower than their solitary counterparts, there may still be thousands of eggs deposited in square meter of soil as locusts aggregate. The aggregation forms as locusts respond to chemical and visual cues, which results in a Swarm that feeds, and moves as a unit.

Swarms may contain thousands, millions, or even billions of individuals It is no wonder that locusts have devastated crops for centuries, consuming thousands of tons of crops as they migrate across a landscape.

Plant Responses Under Anthropogenic Stress Condition

Article ID: 30408

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Natural ecosystems are progressively exposed to multiple anthropogenic stressors, including deforestation, accumulation of heavy metals, agricultural intensification, land-use change and urbanisation, all of which have led to widespread habitat fragmentation, which is also likely to be amplified further by predicted climate change. Anthropogenic activities increased the emission of greenhouse gases such as CO_2, CH_4, N_2O and O_3; have increased dramatically since pre-industrial times, as the human footprint on the planet's ecosystems have become ever larger. Rapid and large-scale environmental warming due to GHGs, is evident from rising global surface and ocean temperatures, widespread melting of snow and ice, and rising sea levels, which influence the frequency and severity of flooding, droughts and salinity. These extreme events caused loss of a large number of biodiversity, which greatly affects the food web and ecosystem sustainability. Heavy metals and other pollutant matters accumulate in environment through industries, agriculture, and municipal waste, which uptake by crops and enter in food chain. The particle of heavy metals and other pollutant hazardous for plants growth and development. Agriculture intensification and land use planning also affects crop growth due crop competition, logging and loss of nutrients. The losses from anthropogenic stresses also depend on various factors such as soil temperature, pH, clay minerals, organic matter, inorganic anions and cations, and chemical forms of the metal.

Under these stress condition, reactive oxygen species (ROS) production increased in plants, which caused oxidative stress and damage cell membrane and organelles such as chloroplast, mitochondria etc. These oxidative stresses also alter physiological, biochemical and metabolic function of plants. Seed germination, seedling length and weight, activity of germinating enzymes, sugar and protein content are severely affected by stress condition. Physiological function such as photosynthesis, respiration, water and mineral absorption; and metabolism process also affected by oxidative damage, which ultimately reduced the crop yield and quality.

Antioxidant defence system of plants helps to hinders the adverse effect of these stresses, and improves plant growth traits. Antioxidant system consisting both enzymatic such as superoxide dismutase (SOD), catalase (CAT), peroxidase (POD), ascorbate peroxidase (APX), glutathione reductase (GR), glutathione peroxidase (GPX), monodehydroascorbate reductase (MDHAR), dehydroascorbate reductase (DHAR) etc. and nonenzymatic antioxidant compounds such as ascorbate (AsA), glutathione (GSH), carotenoids, ascorbate, amino acids like proline and proteins like LEA protein, dehydrins (DHN), anti-freezing proteins, heat shoched proteins (HSPs), mRNA binding protein and secondary metabolites like phenolic compound like flavonoids, isoflavonoids; terpenoid and nitrogen-containing metabolites like glucosinolates alkaloids. Growth regulators such as abscisic acid (ABA), ethylene, jasmonates and salicylic acid also induced during stress condition. During stress condition the stimulation of these enzymatic and non-enzymatic antioxidant enhanced to endure the destructive effects of oxidative stress.

Role of Panchagavya in Agriculture

Article ID: 30409

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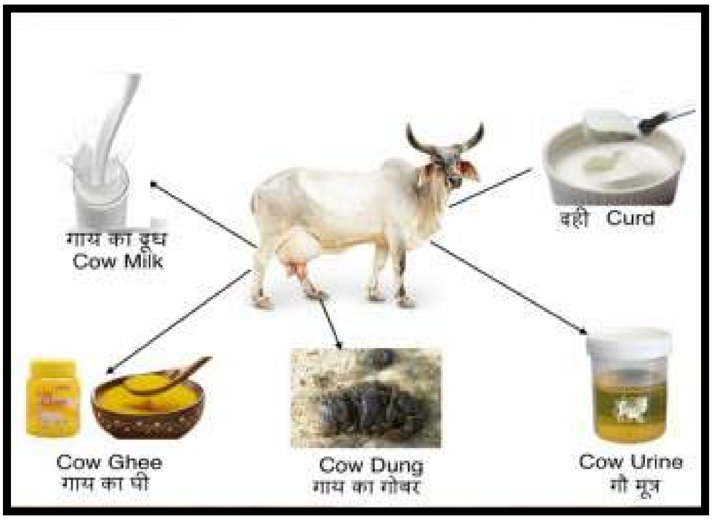
Since the advent of green revolution, the chemical agriculture has gained upper hand as it seems to be able to achieve the food security in our country, where feeding the huge population was the major issue after independence. In the journey of agricultural development, the chemical agriculture apparently won over traditional no chemical farming, because of certain benefits like high yield and chances to improve the food security.

Now, the scenario is again changing. The benefits that we obtained due to continuous long-term use of chemical farming are turning very costly, if we talk in terms of soil quality, environmental quality and human health. The continuous use of chemicals in agriculture is not only deteriorating the health of soil but also polluting the environment in various ways. The residues of chemical fertilizers and pesticides are entering in our food chain and their level is increasing continuously and certainly reaching beyond the safe limits.

Therefore, it is the right time to popularize the indigenous knowledge or indigenous practices once again in order to regain the environmental balance that we are losing. Use of panchagavya that is obtained from cow helps in preserving the reproductive and regenerative capacity of the soil. Panchagavya not only act as a biofertilizer, but it also acts as a pest repellent. Apart from this, panchagavya is also beneficial for milch animals such as goat and sheep and also in poultry and fish production, as it acts as an organic growth stimulator.



Panchagavya

It is an organic product that is prepared by mixing five products viz. Cow dung, cow urine, milk, curd and ghee obtained from cow. Apart from these five products, four more products viz. Jaggery, banana, tender coconut and water are added in order to make it a miraculous product for use in agriculture in order to make the agricultural systems self-sustainable.

How to Prepare Panchagavya

1. In order to prepare panchagavya for agricultural use the following nine products viz. Cow dung, cow urine, milk, curd, jaggery, ghee, banana, tender coconut and water are mixed with each other. First of all, cow dung @ 7 kg and ghee @ 1 kg are mixed and it should be kept for three days.

2. Care should be taken to turn it thoroughly in morning and evening hours. After the time span of three days mix 10 L of cow urine and 10 L of water in it and leave it for 15 days. Regular mixing should be done in both morning and evening hours.

3. After 15 days, rest of the ingredients i.e. cow milk @ 3 L, curd made from cow milk @ 2 L, tender coconut water @ 3 L, jaggery @ 3 kg and 12 well ripened bananas. After 30 days panchagavya becomes ready for use.

4. All the materials should be kept in an earthen pot, concrete pot or a plastic tank, but care should be taken to keep it under shade and it should be covered with a mesh to prevent the infestation of any insect.

Beneficial Effects of Using Panchagavya

1. It serves as a growth promoter as it contains plant growth regulators and amino acids and it also helps the plants to gain immunity.

2. It helps in enhancing the yield and quality of the agricultural produce. It also enhances the sugar content of fruits as well as their aroma.

3. Plants sprayed with panchagavya produced bigger leaves and they develop denser canopies.

4. Use of panchagavya, induces the tolerance to water stress, thus it helps the plants in sustaining the conditions of water stress.

5. Early maturity of the products can be achieved.

6. Panchagavya promotes profuse growth of roots and also promotes root penetration in deeper layers of the soil.

7. Panchagavya contains several macro nutrients such as NPK, and micronutrients that are beneficial for the growth and development of plants.

8. The presence of microorganisms like Pseudomonas, Azotobacter and Phosphobacteria makes it a potent product.

9. When panchagavya is used in agriculture, the use of chemicals is restricted. Therefore, there is a major reduction in the cost of cultivation.

10. It is also beneficial for the health of farm animals.

Recommended Dose of Panchagavya

1. In general for all the crops 3 % spray of panchagavya is found effective.

2. The panchagavya solution can also be mixed with irrigation water @ 50 L/ha and can be supplied to various crops.

3. For seed treatment or for treating the roots of seedling, 3 % solution of panchagavya can be used. Seed soaking is generally recommended for 20 minutes, but in case of sugarcane setts and turmeric and ginger rhizome it should be done for 30 minutes.

4. Before storing, the seeds can be treated with 3 % panchagavya solution and then they are dried and can be stored.

Time of application of panchagavya in different crops.

Crops	Time schedule
Rice	10, 15, 30 and 50th days after transplanting
Sunflower	30, 45 and 60 days after sowing
Black gram	Rainfed: 1st flowering and 15 days after flowering Irrigated: 15, 25 and 40 days after sowing
Green gram	15, 25, 30, 40 and 50 days after sowing
Castor	30 and 45 days after sowing
Groundnut	25 and 30th days after sowing
Bhendi	30, 45, 60 and 75 days after sowing
Tomato	Nursery and 40 days after transplanting: seed treatment with 1 % for 12 hrs

Conclusion

In the current agricultural scenario where, synthetic chemicals are not only hazardous for environment, but also have residual effect in the soil. Under these situations when we are looking for sustainable agricultural practices, Panchagavya seems to be a potent agricultural input that has immense potential to increase the agricultural productivity.

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Zero Budget Natural Farming: A Boon for Sustainable Agriculture

Article ID: 30410

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Sustainability in Agriculture is one of the major concerns of humanity as on today. To find farming systems which works in harmony with nature rather against it. Alternative low-input farming practices have emerged in India and across the world likely to reduce input costs and higher yields for farmers, chemical-free food for consumers and improved soil fertility. Zero Budget Natural Farming, as the name implies, is a method of farming where the cost of growing and harvesting plants is zero. This means that farmers need not purchase fertilizers and pesticides in order to ensure the healthy growth of crops. Crops uptake only 2-4 per cent as nutrients remaining 96 per cent will obtained from air, water and solar energy.

History

Mr. Subhash Palekar studied natural system and verified natural processes of the forest on his farm for six year, since 1989 to 1995. There were about 154 research projects during these six years of research work. After six years of verified research work, he got the package of technique about Zero Budget Natural Farming; which he is giving to the farmers throughout India. He (Krishi ka Rishi) also awarded by many awards some are: BASAVA SHRI AWARD (2005), GOPAL GAURAV AWARD (2007) and PADMA SHRI (2016).

What is Zero Budget?

The word budget refers to credit and expense, thus the phrase Zero Budget means without using any credit, and without spending any money on purchased input. Zero Budget Natural Farming (ZBNF) or holistic agriculture is a method of agriculture that counters the commercial expenditure and things required for the growth of plant are present around the root zone.

Palekar's Vision for ZBNF

This model eliminates the cost of fertilizers, pesticides and seeds, hence its evocative title ZERO BUDGET NATURAL FARMING. According to Palekear, plants do not need any external inputs if soil fertility is taken care of. He believes in a method of cultivation which makes the already existing nutrients in the soil such as phosphate, potash, zinc and calcium available in absorbable form by the plants.

Why Do We Need ZBNF?

The consumption expenditure has been higher than income for the lower farm size groups - farm sizes with less than 4 hectares (ha) in 2002-03, and for with less than 1 ha in 2012-13. These constituted more than 95 per cent of the farmer households in 2002-03 and nearly70 per cent of the farmer households in 2012-13. The relatively lower income of the farmer households in general and the persistence of shortfalls in income among small holders, in spite of being efficient. Problem of indebtedness in Indian agriculture. Increased Risk and Vulnerability. Smaller proportion of marginal farmers have a greater share of credit.

Four Pillars of ZBNF

1. Jeevamrut: Jeevamrut is a fermented microbial culture. Beneficial micro-organisms in Jeevamrut convert the nutrients in non-available form into dissolved form, when it is inoculated to the soil. Jeevamrut is either sprayed/sprinkled on the crop field or added to the irrigation tank in regular interval of 15 days until the soil is enriched. Jeevamrut also helps to prevent fungal and bacterial plant diseases. Palekar suggests that Jeevamrut is only needed for the first 3 years of the transition, after which the system becomes self-sustaining.

How to prepare jeevamrut: Put 200 liters of water in a barrel; Add 10 Kg fresh local cow dung and 5 to 10 litres aged cow urine; Add 2 Kg of Jaggery, 2 Kg of pulse flour and a handful of soil from the bund of the farm. Stir the solution well and let it ferment for 48 hours in the shade. Now jeevamrutha is ready for application. 200 liters of jeevamruta is sufficient for one acre of land.

2. Bijamrita / Beejamrutha: It is a mixture of water, cow dung, cow urine, lime and forest soil which is used to treat seeds, seedlings or any planting material which protects from soil and seed borne pathogens. It is composed of similar ingredients as jeevamrutha - local cow dung, a powerful natural fungicide, and cow urine, a strong anti-bacterial liquid, lime, soil.

3. Acchadana:

a. Mulching: According to Palekar, there are three types of mulching i.e., Soil Mulch, Straw Mulch and Live Mulch.

b. Soil Mulch: This protects topsoil during cultivation and does not destroy it by tilling. It promotes aeration and water retention in the soil. Palekar suggests avoiding deep ploughing.

4. Whapasa – moisture: Whapasa is the condition where there are both air molecules and water molecules present in the soil and he encourages reducing irrigation, irrigating only at noon, in alternate furrows ZBNF farmers report a significant decline in need for irrigation in ZBNF.

Other Important Principles of ZBNF

1. Intercropping: Intercropping gives additional yield income/ unit area than sole copping and provide shade and support to the other crop.

2. Mixed cropping: Mixed cropping lead to an improvement in the fertility of the soil and hence increase in crop yield because when the two crops are properly chosen, the products and refuse from one crop help in the growth of the other crop plant and vice-versa.

3. Tillage: Annual tillage, chemical fertilization and pesticides use consistently affect populations of earthworms. When tillage is avoided, soil moisture content is increased, augment the propagation of earthworms. Earthworms are known to make the soil porous and enrich the soil with their castings. Seeds are scattered and covered by straw before harvesting the previous crop. Seeds are germinated by the arrival of next favourable season.

4. Cow dung: The entire ZBNF method is centred on the Indian cow, dung from the *Bos indicus* is most beneficial and has the highest concentrations of micro-organisms.

The Benefits of ZBNF are

1. Little or no cost
2. Zero chemical usage (will restore soil organic matter and soil carbon and thereby facilitate greater productivity)
3. Use local seeds (less costly, resilient to climate change compared to hybrids); less water requirement (more crop per drop)
4. Zero budget (through poly crop and trees) facilitate income throughout the year and reduces risk
5. Protective irrigation better; climate friendly and carbon neutral agriculture; and increases consumer access to healthy food among others.

Note

"ZBNF works not just in terms, but also brings about a variety of social and economic benefits. It reduces farmers' costs through eliminating external inputs and utilising in-situ resources to rejuvenate the soil, simultaneously increasing incomes, restoring ecosystem, soil health and climate resilience through diverse, multi-layered cropping systems."

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Bacterial Secretion System

Article ID: 30411

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Introduction

Bacteria have evolved a remarkable number of pathways for the transport of several substrates across the cell envelope. These systems are multi-protein complexes forming Nano machines that allow regulated exchanges with the extracellular milieu. The secreted substrates fulfil numerous functions in processes such as acquisition of nutrients, motility and intercellular communication. Pathogenic bacteria use these systems to secrete many harmful toxins, adhesions, degradative enzymes and other translocated effectors to help during the colonization of host organisms. The secretion systems used by bacteria are essential for their virulence. These are grouped into different classes according to their mechanism, composition and evolutionary relationship.

In Gram-negative bacteria, there are six general classes of protein secretion systems and each shows considerable diversity. Gram-positive bacteria possess some of the same secretion systems as Gram-negative bacteria and also display one system specific to that group, i.e., the Type VII system.

Secretion Across the Inner Membrane

The first impediment any protein will encounter when trying to exit a bacterial cell will be the inner membrane, regardless of whether the bacterium is Gram-positive or Gram-negative. There are three major systems involved in the transport of proteins through the inner membrane alone:
1. sec (General Secretory or GSP) system
2. SRP (Signal Recognition Particle)
3. tat (twin-arginine translocation) pathways.

The sec pathway is produced via the interaction of several different proteins, which are conserved across both prokaryotes and eukaryotes and is involved in transport across the membrane of rough endoplasmic reticulum. Several of these proteins are also common to the SRP system.

Secretion Across the Outer Membrane

This model eliminates the cost of fertilizers, pesticides and seeds, hence its evocative title ZERO BUDGET NATURAL FARMING. According to Palekear, plants do not need any external inputs if soil fertility is taken care of. He believes in a method of cultivation which makes the already existing nutrients in the soil such as phosphate, potash, zinc and calcium available in absorbable form by the plants.

Why Do We Need ZBNF?

Secretion across the outer membrane is only undertaken by Gram-negative bacteria. Gram-negative bacteria have evolved a series of mechanisms which allow them to either export proteins:
1. As a two-step process, utilizing one of the systems mentioned earlier to export the protein across the inner membrane.
2. As a one-step process, where the protein is exported to the outside of the cell from the cytosol without any intermediate steps.

TYPE I Secretion System (T1SS)

The Type I secretion system has been found in large number of Gram-negative bacteria. T1 Secretion is carried out by a translocator made up of three proteins that span the cell envelope. One of these proteins is specific Outer Membrane Protein (OMP) and other two are cytoplasmic membrane protein i.e., ATP Binding Cassette (ABC) and Membrane Fusion Protein (MFP). The ABC protein consists of a cytoplasmically located nucleotide binding domain and a transmembrane domain. ABC proteins function as homodimers or trimers in producing a functional pore through which the secreted proteins can traverse. T1SS is sec-independent and bypasses the periplasm. This pathway allows the secretion of protein of diverse sizes and functions via a C-terminal uncleaved secretion signal. This C-terminal secretion signal specifically recognizes the ABC proteins triggering the efficiency of the functional transenvelope complex.

TYPE II Secretion System (T2SS)

General Secretory (sec) system that exports numerous proteins across the cytoplasmic membrane is present in all organisms. By control, twin-arginine targeted translocase (tat) which export a small number of proteins across the cytoplamic membrane are widespread in nature, but are not ubiquitous. Main Terminal Branch (MTB) system responsible for transporting many sec and tat translocated protein across the outer membrane of Gram-negative bacteria are exclusively restricted to this organism. ATP or GTP may energize the export of unfolded or partially folded proteins via the sec and MTB system while tat translocases secrete fully folded redox enzymes using the Proton Motive Force (PMF) for energy. Some protein substrates of the sec system move from the periplasm to the external milieu using protein specific systems while outer membrane proteins are inserted into this structure via a distinct protein complex. Sec system consists of several protein sub units. That system forms large complexes that interact with fully folded substrate proteins with N-terminal twin-arginine leader motifs. Main terminal branch complexes include a secretion an outer membrane pore forming protein which is homologous to the corresponding constituent of the T3SS. Secretions form dodecameric ring structure with large central gated pores.

TYPE III Secretion System (T3SS)

T3SSs are possibly the most complex among all the secretion systems of bacteria. This system allows secretion of cytoplasmically synthesized proteins across both membranes of the cell envelope. This is one-step process that utilizes a needle like appendage with a tip on the end which allows for a hole to be made in the cell membrane for the secreted proteins to be translocated into it. The T3SS is found in Gram-negative bacteria that interacts with both plant and animal hosts, either as pathogens or mutualists. The machinery of the T3SS is termed as injectisome which appears to have a common evolutionary origin with the flagellum. The important function of the injectisome is to deliver effector proteins across the bacterial and host membranes into the cytosol of the host cells, where they may modulate functions of a large variety of host cell, including immune and defence responses. Among Gram-negative pathogens, these systems often are involved in secreting virulence factors. Many of these proteins are homologous to those involved in exporting bacterial flagellar protein (Fla) and flagellar export systems are capable of exporting virulence factor.

TYPE IV Secretion System (T4SS)

T4SSs are unique amongst the systems characterized to date, in that they can translocate proteins both in a one-step and two-step manner. However, T4SSs are not just limited to the transport of proteins. They can also function to transport DNA. The best-known example of T4SSs is that of *Agrobacterium tumefaciens*, which utilizes a T4SS to export transfer-DNA (t-DNA) into dicotyledonous plants, where the single stranded DNA which is transferred, contains oncogenes, resulting in tumour formation in the plant. These systems are capable of transporting DNA protein complexes into other bacteria, yeast and plants.

TYPE V Secretion System (T5SS)

T5SSs can be grouped into three major categories. These are Type Va- the autotransporters (AT), Type Vb- the two-partner system (TPS) and Type Vc- the Oligomeric coiled-coil adhesions (Oca) family (also known as the AT-2 system). Each of these three sub-systems has some identical characteristics, which include the presence of a N-terminal GSP signal sequence for transport through the inner membrane, formation of periplasmic intermediates and formation of β-barrel pore in the outer membrane to permit secretion into the external environment. However, beyond these similarities, there are a number of differences between the three sub-systems of T5SS. These differences create a series of obstacles for the export of proteins via these systems.

In TPS systems, the separation of the pore and exported protein means that they are spatially separated. In order to direct the protein to its pore, it is necessary to have some sorts of signal recognition events between the two. For the proteins, in order to associate the secreted protein contains what is termed a TPS domain in its N-terminal region which interacts specifically with the pore forming protein to initiate translocation through the outer membrane. Oca systems also require regions within the protein to allow for the assembly of the monomers into the trimer necessary for the formation of a complete pore in the outer membrane.

TYPE VI Secretion System (T6SS)

The T6SS is a recently characterized secretion system that appears to constitute a phage-tail-spike-like injectisome that has the potential to introduce effector proteins directly into the cytoplasm of the host cells, analogous to the T3SS and T4SS machineries. The T6SS machinery was first noticed as a conserved family of pathogenicity islands in Gram-negative bacteria and then it was identified as encoding secretory machinery in 2006. More than a quarter of sequenced bacterial genomes contain genes for T6SS components, mostly within the proteobacteria and few within the planctomycetes and acidobacteria. The T6SS is required for the virulence in human and animal pathogens. Some components of the machinery may also act as effectors, translocated into the host cells.

TYPE VII Secretion System (T7SS)

Gram-positive bacteria have only a single membrane. But some species, most notably the mycobacteria have a cell wall that is heavily modified by lipids, called a mycomembrane. As a result, the genomes of these species encode a family of specialized secretion systems collectively called type VII secretion system (T7SS).

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Induced Systemic Resistance (ISR)

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Many plants respond to local attack by herbivores or pathogen with a *de novo* production of compounds reducing or inhibiting further attack by, or performance of their enemies. Response occur both in the plant organ originally attacked (local response) and in distant, yet unaffected parts (systemic response). One of these responses is induced systemic resistance.

ISR: The Phenomenon

Interaction between the plants and pathogens can lead either to a successful infection (compatible response) or resistance (incompatible response). In incompatible interactions, infection by viruses, bacteria or fungi will elicit a set of localized responses in and around the infected host cells. These responses include an oxidative burst, which can lead to cell death. Thus, the pathogen may be trapped in dead cells and appears to be prevented from spreading from the site of initial infection. Further local responses in the surrounding cells include changes in cell wall composition that can inhibit penetration by the pathogen, and de novo synthesis of antimicrobial compounds such as phytoalexins and pathogenesis-related (PR) proteins.

In case of induced systemic resistance, signalling molecules like jasmonic acid and ethylene acts as a major signalling molecule, and induces the defence mechanisms against pathogen. It is activated against both pathogens, herbivores and also during stress conditions.

History

Induced resistance in plants were reported as early as late 1800s and early 1900s (Beauverie, 1901; Ray, 1901; Chester, 1993). Muller and Borger (1940) described the phenomenon of induced local resistance (ILR) in potatoes to late blight (*Phytophthora infestans*). Induced systemic resistance (ISR) was analytically established by Kuc *et al*. (1959) and Ross (1996).

Characteristics of ISR

1. The defensive capacity of the plant is enhanced through microbial stimulation or similar stresses.
2. The enhanced defensive capacity is expressed systemically throughout the plant.
3. ISR is active against fungi, bacteria, viruses and sometimes nematodes and insects.
4. Once induced, resistance is maintained for prolonged periods.

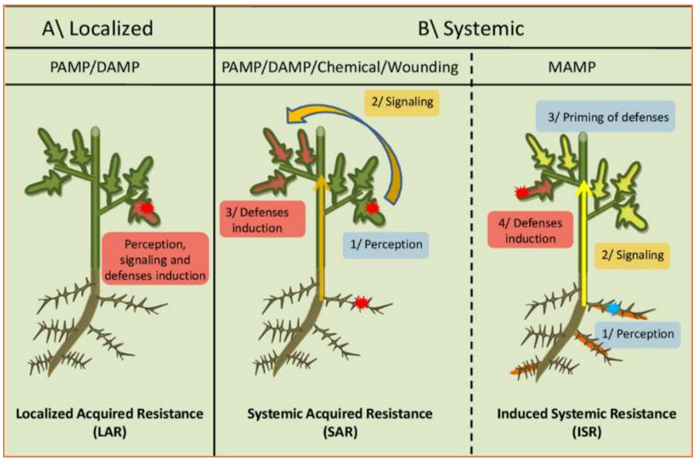
Agents Reported to Elicit ISR

Cause	Chemicals as ISR molecules
Fungi	Jasmonic acid (JA)
Bacteria	Ethylene
Virus	Beta-amino butyric acid (BABA)
Insects	Gamma-amino butyric acid (GABA)

Comparison Between ILR, SAR and ISR

In case of localized resistance, it acts only at the site of infection, through PAMP (pathogen associated molecular pattern) or DAMP (Damage associated molecular pattern). This type of resistance is also called as localized acquired resistance.

In case of systemic acquired resistance, some of the chemicals like salicylic acid are produced as the signalling molecule in response to the pathogen infection. This molecule travels throughout the plant system and induces the systemic resistance which is noticed at the distant site of infection.



Mechanisms of ISR

1. Developmental escape: this is related to growth promotion. Vigorous growth overcomes the damage caused.

2. Physiological tolerance: host plant inhibits the symptom expression and its development by altering its physiological functions.

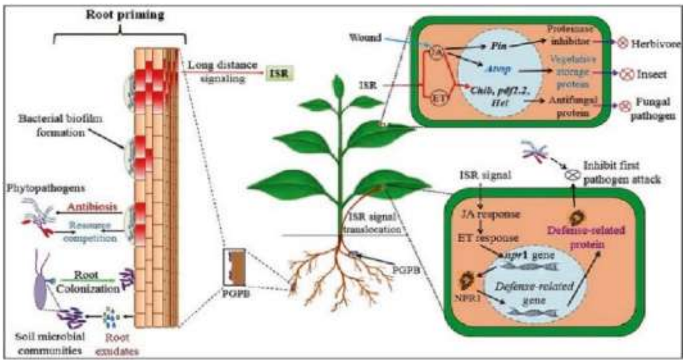
3. Environmental: it is associated with the microbial antagonism in the rhizosphere, altered host-pathogen interaction.

4. Biochemical resistance: it includes oxidative burst, cell wall reinforcement, incompatible reaction between host and pathogen during recognition, release of phenols, phytoalexins and PR proteins, and increasing the expression of resistance governing genes.

5. Induction of phytoalexins and PR-proteins through SAR, ISR and LAR induced systemic resistance.

6. Priming of defence response: The biochemical changes, characteristic of ISR-expressing plants become obvious only in response to a further infection and only in plant parts where an effective resistance is required. (Sticher et al., 1997; Conrath et al., 2001). This effect can be elicited by chemical ISR-inducer, such as β-amino butyric acid (Jakab et al., 2001).

Pathway of ISR



In the rhizosphere of the plant there will be presence of plant growth promoting bacteria, which is generally belongs to rhizobacterial group. These bacteria colonize the roots and send signals by inducing the production of jasmonic acid/ethylene, which translocate in the plant system in the form of methyl jasmonate and induces the expression on defense-related gene (npr1 gene), which translates the gene into defense related proteins. These proteins inhibit the first attack of the pathogen. The same gene may also induce the priming of the defence mechanism which acts up on secondary infection.

When secondary infection occurs, defense system activates the jasmonic acid/ethylene pathway which induces the expression of specific genes against type agent which caused the damage to the plant. For example: pin gene which codes proteinase inhibitor is activated against herbivores. Against insects Arvsp gene, which codes for vegetative storage protein is activated. In case of fungal pathogens many genes like pdf 1, 2 and Hel etc. will be activated depending up on species, specific gene and specific protein is activated.

Some of the Elicitors and Resistance Inducing Agents Reported

Elicitor/resistance inducer	Protected plant	Targeted pathogen
	Chemical inducers	
Acibenzolar -S-methyl(ASM)	Cucumber	*Colletotrichum lagenarium*
	Cabbage	*Peranospora parasitica*
	Tomato	*Ralstonia solanacearum*
	Mango	*Colletotrichum gleosporides*
	Rice	*Xanthomonas oryzae pv oryzae*
β-Aminobutyric acid (BABA)	Pea	*Uromyces pisi*
	Tomato	*Phytophthora infestans*
	Cabbage	*Peranospora parasitica*
Saccharin	Soybean	*Phakospora pachyrhizi*
Potassium phosphite	Grapevine	*Plasmopara viticola*
Thiamine	Bajra	*Sclerospora graminicola*
Silicon	Rose	*Podosphaera pannosa*
Biochar	Tomato	*Botrytis cinereal*
	Biological inducers (PGPR)	
Pseudomonas fluorescens WCS417r	Arabidopsis	*Pseudomonas syringae pv. tomato*
Bacillus subtilis FZB24	Strawberry	*Sphaerotheca macularis*
Azospirillum brasilense REC3	Strawberry	*Colletotrichum acutatum*
(PGPF) Fusarium equiseti	cucumber	*Rhizoctonia solani*
Biocontrol fungi		
Trichoderma asperellum SKT-1	Arabidopsis	*Pseudomonas syringae pv. Tomato*
T. harzianum T39	Grapevine	*Plasmopara viticola*
T. atroviride	Pine	*Diplodia pinea*
	Arbescular mycorrhizal fungi	
Glomus intraradices	Rice	*Magnoporthe oryzae*
Glomus mosseae	Maize	*Rhizactonia solani*

Conclusion

Induced systemic resistance operates in both abiotic and biotic stresses due to the production of chemical signals. It is the important mechanism operates in resistant varieties. We can manage the disease by knowing the chemicals involved in inducing the resistance and can synthesize those chemicals artificially and used as protecting chemicals against disease causing pathogens.

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Aloe Vera Gel as a Novel Edible Coating to Enhance the Shelf Life of Fresh Fruits and Vegetables

Article ID: 30413

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Summary
Postharvest losses of fruits and vegetables are a serious problem because of rapid deterioration during handling, transport and storage. Reducing these losses can not only improve farmers' incomes but could also encourage more consumption of this highly nutritious fruits. Application of an edible coating is a technique that can be used to increase fruit storability. These can be also safely eaten as part of the product and do not add unfavourable properties to the foodstuff. Aloe vera gel has been proven one of the best edibles and biologically safe preservative coatings for different types of foods, because of its film-forming properties, antimicrobial actions, biodegradability and biochemical properties.

Introduction
Fruits and vegetables are essential constituents of daily diet and are highly demanded in the recent years from most of the population. They are reservoir of vitamins, essential minerals, antioxidants, bio-flavonoids, dietary fibres and flavour compounds which fall easily victim to abiotic and biotic adversities. Fruits and vegetables are highly perishable and during the post- harvest, there are considerable losses due to microbes, insects, respiration and transpiration. The external factors include atmospheric composition such as O_2, CO_2, ethylene ratios, temperature and the stress factors while the internal factors include the species, cultivar and its growth stage. In addition, contamination of the fruits and vegetables flesh can occur from the skin increasing the fruits and vegetables spoilage leading to biochemical deterioration such as browning, off flavour and texture break down, decreasing the fruits and vegetables quality and the risk to the consumers due to the presence of pathogenic microorganism. The important quality factors of fresh produce contributing to the marketability are texture, colour, appearance, flavour, nutritional value and microbial safety. These quality factors are measured by plant variety, ripening stage, maturity stage pre-harvest and post-harvest conditions. The Post-harvest losses of fruits and vegetables are a serious problem because it rapidly deteriorates them during handling, transport and storage. Edible coating over fruits and vegetables are used to improve their quality and shelf life.

Edible Coatings for Increasing Shelf Life
Edible coatings are used for extension of shelf life of fruits and vegetables. These can also be safely eaten as part of the product and do not add unfavourable properties to the foodstuff. These coatings or films increase the shelf life of fruits and vegetables and are environment friendly. These films can extend the shelf life of foods through the inhibition of the migration of moisture, oxygen, carbon dioxide and aroma. Edible coatings prevent oxidative browning and decrease growth of microorganism in fruits and vegetables for example, Tomato, papaya, pomegranate, Cucumber and Cherries etc.

Edible coatings and films are natural polymers obtained from products or by-products of agricultural origin, such as animal and vegetable proteins, gums, lipids, and celluloses. Generally, its thickness is less than 0.3 mm. The edible coatings are served as carrier of texture enhancer, antioxidants and it is used as a nutraceutical. Under high relative humidity, edible coating should be stable, generally recognised as safe. Edible coating or edible films are mostly tasteless, colourless and odourless they should have good mechanical properties. Generally, coatings can be divided into proteins, lipids, and polysaccharides, alone or in combination. The first kind of edible coatings were water–wax micro emulsions, used since the 1930s to increase brightness and colour in fruits, as well as fungicide carriers. Water loss is another problem that can be controlled with edible wax coatings.

Advantages
Advantage of edible coatings are:
1. Edible coatings improve retention of acids, colour, flavour and sugar.

2. Maintain quality of fruits and vegetables during storage.
3. Reduce weight loss and firmness loss.
4. Decrease polymer packaging and waste.
5. Edible coatings can be consumed along with fruits and vegetables; they contain health beneficial nutrients.

Disadvantages

Edible coatings have some disadvantages:
1. Thick coating can prohibit Oxygen exchange, causes off- flavour development.
2. Edible coatings have good gas barrier properties which causes anaerobic respiration due to this normal ripening process is disturbed in fruits and vegetables.
3. Some edible coatings are hygroscopic in nature, which helps to increase microbial growth.

Importance of Aloe Vera

Aloe Vera, commonly referred to as a "medicinal plant", is known for its wide range of therapeutic properties. The most common species are *Aloe barbadensis* and *Aloe arborescens*. This semi-tropical plant, Aloe Vera, has a long and illustrious history dating from biblical times. It has been mentioned throughout recorded history and given a high ranking as an all-purpose herbal plant. The two major liquid components of Aloe Vera are a yellow latex (exudate) and clear gel (mucilage), which proceeds from the large leaf parenchymatic cells.

Aloe Vera is a plant made up of many complex ingredients including polysaccharides, glycoproteins, phenolic compounds, salicylic acid, lignins, hormones, amino acids, vitamins, saponins and enzymes which give Aloe Vera its many beneficial properties. Aloe vera gel is used as an antibacterial, antifungal and anti-inflammatory gel. The main use of Aloe vera gel is in the cosmetic industry including treatment of burns and scars and wound healing. Recently, the use of Aloe Vera gel as an edible coating has been reported to prolong the shelf life and delay senescence in various fruits and vegetables. Aloe vera gel based edible coatings have been shown to prevent moisture loss and softening decrease, control respiration and senescence rate, delay oxidative browning and reduce microorganism proliferation in fruits and vegetables such as sweet cherries, table grapes, nectarines, papaya, pomegranate, tomato, cucumber etc.

Preparation of Aloe Vera Gel

The gel was prepared from matured leaves of A. vera plants. At first, leaves were washed with tap water, followed by 70% alcohol to sterilize the surface. Gel was then separated from the outer cortex of leaf, the colorless hydroparenchyma was grounded in a blender and resulting mixture was filtered to remove the fibers. According to Misir et al., the gel was pasteurized at 70 °C for 45 min, cooled immediately at ambient temperature for stabilization and 1% gelatine was used as a gelling agent to facilitate coating the gel.

Methods of Application of Edible Coating

Edible coatings should be applied on fruits and vegetables by different methods. These methods are:
1. Dipping.
2. Brushing.
3. Extrusion.
4. Spraying.
5. Solvent casting.

The dipping method is used widely for applying edible coatings on fruits and vegetables, in this method Fruits and Vegetables are dipped in coating solution for 5-30 sec. It is easy to apply on mostly fruits. While Brushing method gives good result, Edible Coatings applied on generally, Beans and highly perishable Fruits and Vegetables such as strawberry, berries. Other three methods spraying, extrusion and solvent castings are also used in food industry. Extrusion method depends on thermoplastic properties of edible coatings; it is best technique for applying of EC for industrial purpose as compared to other methods.

Role of Aloe vera in Increasing Self Life in Fruits

1. Grapes: Postharvest treatment of grape berries by salicylic acid and Aloe Vera gel and has potential for increasing storage life of table grapes and maintaining their quality. Aloe Vera gel used at concentration of 33% and 2 mmol/L-

1salicylic acid treatments also retained the soluble solid content, total phenolic, antioxidant, of berry juice after the shelf life period. (Asghari et. al., 2013).

2. Sweet Cherry: Treatment of sweet cherry with 5 and 10µmolL-1 nitric oxide and 33% Aloe vera gel significantly maintained fruit quality during 30 days of cold storage.

3. Papaya: In case of Papaya, the Aloe vera coated fruits survived the storage period of 15 days at low temperature whereas all the uncoated controls decayed within 10 days. Marketability was also found to be better for coated fruits (Marpudi et. al., 2011).

4. Tomato: Tomato fruit coated with 10% and 15% Aloe vera gel shows reduced ethylene production. The ripening index (total soluble solids/ titratable acidity) decreased after 7 days of storage in 10% Aloe-coated fruits, maintaining the overall quality of the tomato fruit. Ascorbic acid content was increased in 10% Aloe-coated fruits. Thus, an edible coating of 10% A. vera could be considered as a promising treatment to maintain tomato quality during postharvest storage (Chrysargyris et. al., 2016).

Conclusion

Edible coatings are traditionally used to improve food appearance and conservation due to their environmentally friendly nature, because they are obtained from both animal and vegetable agricultural products. They act as barriers to moisture and oxygen during processing, handling, and storage and do not solely retard food deterioration but also enhance its safety due to their natural biocide activity or the incorporation of antimicrobial compounds. There has thus been an increased interest in using Aloe Vera gel as an edible coating material for fruits driven by its antifungal activity. Aloe Vera gel based edible coatings have been shown to prevent loss of moisture and firmness, control respiratory rate and maturation development, delay oxidative browning, and reduce microorganism proliferation in fruits such as sweet cherry, table grapes and nectarines.

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Weed Management from Hand Hoes to Robotic Weeders

Article ID: 30414

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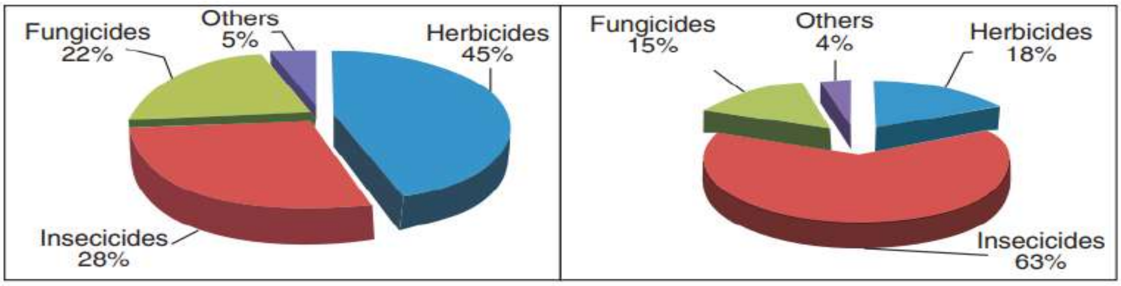
Introduction

Weed problems have increased in modern agriculture.
1. Large scale adoption of dwarf HYV and hybrids.
2. Increased use of irrigation.
3. Increased use of fertilizers.
4. Altered Agronomy of crops.
5. Monocropping and multiple cropping
6. Reduced tillage.

Cost of Weeds

1. Weeds reduce productivity of crops
2. They deplete soil nutrients and moisture
3. Harbor pests, diseases and nematodes
4. Weeds reduce quality of farm products
5. They affect health of animals & quality of products
6. Increase production and processing cost
7. Weeds affect human health
8. Reduce land value and crop choice
9. Invasive weeds endanger biodiversity.

Pesticide Use Pattern



Life in Digital Era

Modern tools and technologies in communication have revolutionized our life to a level which was considered unbelievable a decade or two earlier.
1. Most traditional communication media, including telephony, radio, television, paper mail and newspapers are reshaped, redefined, or even bypassed by the Internet, giving birth to new services such as email, Internet telephony, Internet television, online music, digital newspapers, and video streaming websites.
2. Newspaper, book, and other print publishing are adapting to website technology, or are reshaped into blogging, web feeds and online news aggregators.
3. New forms of personal interactions - instant messaging, Internet forums, and social networking.
4. Online shopping and digital payments have grown exponentially.

ICT Tools / Technologies in Agriculture

1. Radio, Television : Technology info, Advisories, alerts, forecasts.
2. Geospatial technology :Remotely sensed information, Weather information.

3. Mobile Technology: Advisories, alerts, forecasts, market info.
4. Web application : App on Google store / IOS network.
5. Digital repositories.
6. IoTs : Wireless Sensors.
7. UMVs : drones.
8. Self-driven machineries, robots.
9. Imaging technologies: Multispectral cameras.

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Mobile Telephony – in Agriculture

1. Bridging the digital divide.
2. Provides level playing field - rich/poor, literate/illiterate, male/female.
3. Last mile connectivity.
4. Addresses imbalance in low extension personnel : farmer ratio.
5. Adds efficiency in to Ag Extension system.
6. Improved quality of life!

Satellite Based Remote Sensing

1. In the past two decades, there has been significant progress made in utilizing remote sensing technologies in agricultural production.
2. More suitable than ground-based sensors for gathering broad-scale spatial information.
3. Useful in soil mapping, fertility assessments, crop monitoring, yield estimation etc.
4. Less useful under cloud cover - the spatial, spectral and radiometric resolutions are typically low.
5. Thus not sufficient for effective weed management applications at individual field-scales.

Unmanned Aircraft Vehicles (UAV) / Drones

1. Used for specific tasks where high-resolution images are required
2. Captures images at low altitudes
3. Fitted with sensors and a geospatial data handling framework that includes data acquisition, data storage, and possibly data transfer using communication protocols
4. The utilization of UAS-based technologies for weed management applications is currently in its infancy.

UAVs – Indian Context

1. Useful in harvesting and spot application of pesticides in plantation crops.
2. Unlikely to be approved for application of pesticides aerially, including herbicides.
3. Aerial application of endosulfon in Kerala in 1990s led to serious problems.
4. Strict regulation in place for its use – registration is compulsory.

Precision Weed Management (PWM)

1. Weeds are not uniformly distributed in space and time.
2. Uniform control measure is therefore unwise/inappropriate.
3. Results in wastage of resources, increases cost.
4. With chemicals, there is additional increased negative impact on the environment.
5. Site-specific management strategy is therefore ideal/desirable.

PWM Using Ground Vehicle-Mounted Sensors

1. The majority of PWM research conducted so far have utilized sensors mounted on ground vehicles (i.e., proximal sensing)
2. Optical sensors such as Green Seeker®, Weed Seeker® (NTech Industries Inc., Ukiah, CA, USA) and other similar optoelectronic sensors have been used to identify plants based on surface reflectance of green tissues in agricultural fields.
3. However, these optoelectronic sensors are not suitable for discriminating between weed species.
4. In the recent past, artificial intelligence (AI) and machine learning technologies have been successfully used for crop and weed detection and discrimination.

Significant Breakthrough in Crop and Weed Differentiation

1. Through artificial intelligence (AI), advanced image processing techniques and machine learning technologies, it has been made possible to identify weeds and to differentiate them from crop plants
2. The system is better than Agronomists!

Mechanical Weed Control Revisited

Problem of HR weeds and demand for organically grown food have led to the design and development of smart machines for mechanical removal of weeds.

Precision Hoeing

1. Tractor guidance and auto-steer Precision hoes.
2. Operated by tractor that is guided by GPS.
3. Utilizes RTK-GPS tracking technology.
4. High resolution cameras to differentiate crop and weeds.
5. Implements are equipped with simple row-following vision technology, enabling them to actively and precisely follow rows.
6. Crop must be planted in straight rows with equal spacing.
7. Inter-row and in-row weeding smart machines are commercially available.

Sense and Spray or See and Spray Technology Taking Weed Management to a New Level

Using computer vision and artificial intelligence, these smart machines can detect, identify and make management decisions about every single plant in the field. Saves 50-90% herbicide use.

Robotic Weeders

1. Aided by advanced vision technology, they move autonomously in the field scouting for weeds
2. Capable of distinguishing between crops and weeds & take site-specific weeding action
3. Versions with mechanical plucking tools, burning weeds with lasers/ steam or micro-dose of herbicide spray are being tested.
4. Operated by batteries powered through electricity or solar energy
5. Prototypes of highly intelligent robotic implements are under trial in many countries.

Conclusion

1. Technology will continue to contribute to make agriculture more profitable and sustainable
2. Development of smart machines/implements for PWM is a major breakthrough in weed management
3. Save cost and drastically reduce the herbicide load (by almost 50-90%) & the associated negative impact on the environment.

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4. Could address HR problem by enabling herbicide rotation & use of herbicides that have lower selectivity levels.
5. May bypass the controversial HRC technology.
6. The development of inter-row and in-row mechanical weeding smart machines will benefit organic growers.

Soil Erosion and Control Measures

Article ID: 30415

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Introduction

Erosion changes, creates and destroys form of things on the Earth's surface, through the power of wind, water and huge rivers of ice also known as glaciers. Sometimes the process of erosion can be slow; it can take up to hundreds of thousands even millions of years. Sometimes the changes are sudden. Erosion has a positive side to it. The positive side is; it helps give us soil, which forms a beach. Erosion also has a negative side. People have speeded up erosion in most places. Farming can be a major cause of soil erosion especially over-grazing. Each year the planet losses billions of acres of rich topsoil because of over-grazing and poor farming. Cutting down trees is also another cause of erosion. The roots of the trees hold the soil in place, so it won't be that easily eroded.

Extent of Soil Erosion in India

A precise estimation of the extent of land affected by soil erosion is still lacking. As per earlier estimates; out of 305.9 mha of the India about 50% [145mha] needs conservation measures and about 25% of the reported utilizable land is precariously degraded, needing immediate soil-conservation measures. This includes sub-humid and per-humid regions, western ghats, coastal and north-eastern hill regions afflicted with severe erosion and facing soil loss of 20-40 tonnes/ha/year.

Soil Erosion

Soil erosion is defined as the detachment of soil particles, their transportation from one place to another and deposition elsewhere through water, wind, coastal waves, snow gravity and other forces.

Or

Soil erosion is the process of weathering and transport of solids (sediment, soil, rock and other particles) in the natural environment or their source and deposits them elsewhere.

Types of Soil Erosion

There are two basic types of erosion:

1. Geological erosion
2. Accelerated erosion

Geological Erosion

It refers to natural or normal erosion. it represents the soil erosion in its natural condition without the influence of human being. It contributes the formation of soils & their distribution on the earth surface.

Accelerated Soil Erosion

Accelerated erosion is in excess of geologic erosion. It is activated by natural & human's activities which have brought about changes in natural cover & soil conditions.

Accelerated Erosion Can Further Be Sub-Classified as

1. Wind erosion
2. Water erosion
3. Glacier erosion
4. Land slippage.

Wind erosion

It is the loss of soil due to the movement of wind over the land. It usually occurs in dry climates where the soil is loose. Wind erosion occurs on:
1. Newly-ploughed fields.
2. Construction sites cleared by large equipment.
3. land where vegetation has been grazed too short.

Process of Wind Erosion

There are three process:
1. Saltation: It occurs when the wind lifts medium-sized soil particles into the air. They are too heavy to remain in suspension, so they fall to the ground loosening other soil particles. This process repeats itself.

2. Suspension: It occurs when very small soil particles become airborne and enter the main airstream. They are carried in the same general direction as the wind. Because the soil particles are small, they remain in suspension.

3. Surface creep: It occurs as saltation takes place. The soil particles that are too heavy to be moved by saltation are moved along the surface by the impact of soil particles being displaced by saltation.

Water Erosion

It is the loss of soil due to water movement. It is the major cause of soil loss. Water erosion occurs when excess rainfall creates runoff that carries soil away. Runoff occurs when rain falls faster than it can be absorbed into the soil. Runoff water carries soil particles into streams and rivers This causes water pollution and sediment. Sediment is the deposition of soil in the bottom of streams, riverbeds, ditches, etc.

Kinds of Water Erosion

There are three kinds:
1. Sheet erosion: It results when thin layers or sheets of soil are worn away. Sheet erosion can occur on nearly level land or on sloping land. If muddy water is moving off a field, sheet erosion is occurring. It may go unnoticed since no channels form. However, it may be just as problematic as erosion that is more apparent.

2. Rill erosion: It usually occurs on sloping land where small channels are formed by running water. The signs of rill erosion can be masked by normal tillage practices.

3. Gully erosion: It occurs when rills continue to wash away and become more severe. It is more likely on steeper slopes and cannot be smoothed by normal tillage practices.

Causes of Soil Erosion

Erosion is caused by many different factors:
1. Wind.
2. Water.
3. Glacial movement.
4. Less protective covering of land.
5. Human activities.

Soil Conservation Measures

Agronomical measures	Mechanical measures
Cropping systems	Contour bunds
Crop geometry	Graded bunds
Contour cultivation	Bench terraces
Tillage	Half-moon terraces
	Grassed waterways
	Water harvesting ponds

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Ecological Weed Management: A Novel Approach for Sustainable Agriculture

Article ID: 30416

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Abstract

Ecological Weed Management a combination of methods aimed to achieve long term weed suppression through the use of ecological interactions between crop, weed, soil and other taxa fostered by appropriate agro ecosystem management with the least possible use of direct weed control methods, e.g. chemicals (According to FAO). Ecological weed management differs from traditional weed management in several ways. In this context, the challenge is to develop integrated weed management systems which reduces herbicide use and maintain sustainable crop production without compromising farmers' income and health of natural resources. The basic principles in Ecological Weed Management are enhancement in crop competitiveness to minimize competitive pressure of weeds on the crop. It emphasizes on integration of agronomic, genetic, mechanical, biological and chemical means of weed management that promote crop growth and development with less weed interference in an environmentally safe agro-ecosystem. "A good crop is the best weed killer (Fryer, 1983)."

Merits of Ecological Weed Management

1. Low cost for weed control
2. Easy to adopt
3. No residual problem
4. Technical skill is not much involved
5. No damage to crops
6. Effective weed control
7. Crop-weed ecosystem is maintained.

Demerits of Ecological Weed Management

1. Immediate and quick weed control is not possible.
2. Weeds are kept under suppressed condition.
3. Perennial and problematic weeds cannot be controlled.

Ecological Weed Management Strategies

1. Competitive crop and crop's cultivars
2. Time, method, rate of sowing and row spacing
3. Crop rotation, trap, catch & cover crops
4. Sole, inter- and mixed cropping
5. Time and method of irrigation
6. Kind, rate time and method of fertilization
7. Summer fallowing/ Ploughing
8. Soil Solarization
9. Stale seedbed technique
10. Flooding and drainage
11. Resistant crops and crop's cultivars for parasitic weeds
12. Residue incorporation into soil.

Competitive Crop and Crop's Cultivars

1. Crop species: Crop species differ in their germination pattern, tillering, branching, nature and orientation or inclination of leaf, root growth, relative growth rate, plant stature/height, total growing duration etc. and therefore, variation in their competitive and weeds smothering ability is quite apparent (Delorit and Ahlgren, 1967).

2. Crop variety / cultivar: the better competitive ability of WH-291 and HD-2285 than HD-2009 and S-308 against wild oat (*Avena ludoviciana* Dur.) under late- sown condition (Balyan and Malik (1990).

Sowing of Crop (Time, Method, Rate of Sowing and Row Spacing)

1. Time of sowing: A little earlier or later than its normal time of sowing, the crop may germinate and have initial growth under almost weed-free or less weedy environment. For example, weeds pose more competition when wheat is sown on October than on November or December (Kolar and Mehar, 1992).

2. Method of sowing: Line sowing usually encounters less weed infestation and provides more ease of controlling them than broad-casting method. In wheat, FIRBS is of recent introduction from CIMMYT, Mexico and has been found useful in reducing overall weed including Phalaris minor competition in wheat mainly on the raised bed, but the furrows remain highly populated with weeds.

3. Rate of sowing: Greater the initial seedling vigour of a crop, greater is the chance of having a healthy and competitive crop, which itself would be able to smother weeds. Seeding rate and per cent viability and germination of seeds usually determine crop density.

4. Row spacing: Suitable row spacing close enough, which does not invite intra-species/intra-specific completion among crop plants needs to be searched out.

5. Crop Rotation: Crop rotation is defined as the practice of growing different crops in sequence on the same piece of land year after year. Crop rotation is highly effective against parasitic weeds such as Striga hermonthica/ asiatica mainly in sorghum and maize, Orobanche ramose in Brassicas & solanaceous crops (Parker, 1979).

6. Change crop ecology: shallow/deep roots, cold/warm season, row/drilled crops, foliage density and heavy/light feeders. Change cultural practices: cultivation, mowing, fertilization and planting/harvest dates.

Cropping Practice

It is fact that suitable inter-cropping or mixed cropping is more remunerative than sole cropping under rainfed and unirrigated conditions, but under assured irrigation, sole cropping may prove superior towards maximization of sole crop yield.

1. Live mulch / cover crop: Live mulch is nothing but a living cover maintained by growing a cover crop. A food crop is directly planted in it without destroying the established cover by tillage or chemical ploughing (using herbicide).

2. Trap and Catch Crops: This crop should be included in crop rotation particularly for controlling parasitic weeds Striga and Orobanche, but not for Cuscuta. Trap crop are nothing but false hosts, which exude striga germination stimulants and induce striga seed germination.

Scheduling of Irrigation

Time and method of irrigation affect weed emergence and growth, submergence controls many weeds, drip irrigation reduces weed proliferation leaving less soil area wetted near the tree crops and alternate furrow lessens weeds in dry furrows.

Soil Solarization

A stale seedbed is one where initial one or two flushes of weeds are destroyed before planting of a crop. This is achieved by soaking a well-prepared field with either irrigation or rain and allowing the weeds to germinate and then they are destroyed by ploughing or by non-residual herbicides.

Summer Fallowing / Ploughing

The purpose of fallowing should be to expose weed seeds, under-ground vegetative structures of the deep-rooted perennial weeds like *Cyperus species*, Cynadon dactylon, Digitaria abyssinica etc, insects, pathogens, nematodes to the hot sun by deep tillage and kill them by means of solarization.

Residue Incorporation Into soil

Crop residues of lentil are phytotoxic to wheat and of sunflower and mustard to several crops. Weed research may be prioritized in this direction too, since now-a-days enough crop residues are piled up and the farmers face the problem of residue disposal, mainly in rice in southern states of India (Putnam, 1983).

Conclusion

Increasing use of chemicals in agriculture resulted into many environmental and health issues. Therefore, it is high time and challenge before all the agriculturists to work on the aspects using least chemicals in agriculture and ecological weed management is one of them. This aspect enhances crop competitiveness to minimize the competitive pressure of weeds on the crop.

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Nutraceuticals: A Novel Way for Health Promoting Phytochemicals in Vegetables

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Introduction

Vegetables are important components of Indian agriculture in view of their productivity, diversification, nutritive and medicinal values, value addition and export. India is the 2nd largest producer of vegetables across the globe, but still we are getting only 210g RDA against 300g per capita per day as determined by ICMR. In developing countries like India, 13.5% people are chronically undernourished with Western-Asia and Africa, the most severely affected regions. The spectrum of life in terms of income, lifestyle and spending is changing rapidly with economic development. However, it has also thrown up a major challenge in the form of lifestyle diseases due to manifold increase in consumption of junk food leading to a number of diseases related to nutritional deficiencies. But simultaneously people are becoming more and more health conscious and taking vegetables rich in vitamins, minerals, antioxidants etc. So, there is increased global interest in nutraceuticals and edible colour rich vegetables because of their role in protection against cancers and heart disease and boosting of immune system etc. The importance of functional food was first realized by Dr. Stephen DeFelice and coined the term 'Nutraceutical' which is any substance that may be considered as food or part of food providing medical or health benefits, encompassing, preventing and treating diseases.

Why Do Consumers Choose Alternative Over Conventional Remedies?

Many people are not satisfied with the treatment they are given by their doctors due to adverse effects or because it has been ineffective. Another reason for choosing alternative over conventional remedies is that people may feel that conventional medicine is impersonal or technologically orientated.

Demerits of Ecological Weed Management

1. Immediate and quick weed control is not possible.
2. Weeds are kept under suppressed condition.
3. Perennial and problematic weeds cannot be controlled.

Why Nutraceuticals?

Nutraceuticals play a significant role in modifying and maintaining normal physiological functions that maintain health of human beings. Nutraceuticals have the potential to play a role in healthy eating and to contribute towards the prevention and treatments of diseases. The purpose of nutraceuticals is to maintain or improve key functional aspects of the human body like digestive system, Immune system, Cardivascular system and Dental health.

What is Nutraceutical?

Nutraceutical can be defined as-Any substance that is a food or a part of food that provide medical or health benefits, including the prevention and treatment of diseases. Another definition from the USDA is diet supplement that delivers a concentrated form of a presumed bioactive agent from a food, presented in a non-food matrix and used to enhance health in dosages that exceed those that could be obtained from normal food. On the other hand, Health Canada defines nutraceutical as-a product prepared from foods, but sold in the form of pills or powder in other medicinal forms, not usually associated with foods.

Nutraceutical Properties in Vegetables

Vegetables	Nutraceuticals	Health benefits
Allium vegetables (Garlic, Onion, Chives and Leeks)	Allyl sulfides, Aliin, Alicin, Querecetin	Protect against cancers and heart disease, boost immune system
Cruciferous vegetables	Indoles/glucosinolates, Sulfaphoraphone, Isothiocyanates/thiocyanate, Thiols	Protection against cancer, heart disease and stroke, Jaundice, Liver infection, Piles

(Broccoli,Cauliflower,Cabbage, Brussels sprout, kale, Radish, Turnip, Chinese Cabbage)		
Solanaceous vegetables (Tomato, Peppers)	Lycopene and beta carotene	Protect against arterial disease and cancer
Cucurbits (Cantaloupe and Pumpkin, Bittergoud)	Vitamin A, momordicin and charantin	Anticancerous, diabetes, blood purifier, hypertension,dysentery
Green leafy vegetables	Vitamin E, vitamin C	Antioxidant, inhibition of platelet aggregation
Umbelliferous vegetables (carrot, celery, parsley)	Caotenoids, polyacetylenes and oligosaccharides	Antioxidant and artery protection
Compositae plants (Artichoke)	Silymarin	Hepatoprotective, anticarcinogenic, hypocholesterolemic
Beans	Flavonoids (isoflavones)	Anticancerous, lower cholesterol
Chilli	Capsaicin, oleoresin	Anti-diarrhoeal, anti-rheumatic
Brinjal	Chlorogenic acid	Anti-carcinogenic, anti-obesity and anti-diabetic properties

Nutraceuticals are recently being explored as sustainable alternative for the control and prevention of large number of ailments because of safe, efficacious and nutritional value as well as therapeutic effects. It has well been conceptualized that presence of colour pigments in vegetables is an indicator for the availability of various nutraceutical compounds like lycopene, β-carotene, anthocyanin, lutein etc. So, inclusion of biological active nutraceuticals in the form of vegetables as such or formulations in our various daily diet ailments can be instrumental in getting rid of malnutrition in children. Although basic research work on human health in relation to consumption of secondary metabolites remains unclear; many new scientific discoveries provide hope for health benefits through increased consumption of nutraceutical cultivars. There is a need to identify mechanism and biosynthesis pathway for each nutraceutical compound in vegetables. An Integrated approach of system biology involving conventional as well as genomics and metabolomics can be coupled to study and describe networks of biological regulations. The collaborations between public and private crop breeding institutions, with human health research centres would play a key role in the success of this endeavour.

Phytochemicals and their Health Benefits

Epidemiological studies provide convincing evidence that diet rich in antioxidants is associated with a lower incidence of degenerative diseases. The major sources of dietary polyphenols are cereals, legumes, oilseeds, fruits, vegetables and beverages. Fruits such as apple, grape, pear, cherry and various berries are rich sources of polyphenols. Red wine or a cup of coffee or tea contains about 100 mg polyphenols. Their total dietary intake may be about 1g per day, which is about 10 times higher than that of vitamin C and 100 times higher than those of vitamin E and carotenoids. The chief constituent of tea polyphenols are flavonols, flavanols, flavones and phenolic acids. They constitute up to 30% of the dry weight of green leaves and 9-10% of the dry weight of black tea leaves. Ferulic acid is associated with dietary fiber linked with hemi cellulose of the cell wall by means of ester bonds. Caffeic acid in the form of caffeoyl esters and coumaric acids are common in apples, pears, and grapes. Additionally, apples and pears are rich in chlorogenic acid and grapes in gallic acid. Apples contain high levels of quercetin among fruits. Grain-derived products are especially significant in human diet as they have higher concentration of phenolic acids in the outer layers of kernel that constitute the bran. Most of the phenolic acid derivatives are hydrolysable tannins and are usually esterified with glucose. Citrus fruits are major sources of flavonones and hesperidin is found in abundance (120-250 mg/lit) in orange juice. Quercetin occurs in its glycosylated form as rutin in fruits, vegetables and particularly onions are its rich source. Anthocyanins are pigments of fruits such as cherries, plums, strawberries, raspberries, black berries and red currant and their content varies from 0.15 to 4.5 mg/g in fresh berries.

Classification of Vegetables on the Basis of Colour and Corresponding Phytochemical

Colour	Contents	Benefits	Examples

Green Vegetables	Chlorophyll, fiber, lutein, zeaxanthin, calcium, folate, vitamin C, calcium and beta-carotene.	Reduce cancer risks, lower blood pressure and LDL cholesterol levels, normalize digestion time, support retinal health and vision, fight harmful free-radicals, boost immune system activity.	Asparagus, Broccoli, Brussel sprouts, Celery, Chinese cabbage, Cucumber, Green beans, Green cabbage, Green onion, Green peppers, Lettuce, Okra, Peas, Spinach.
White Vegetables	Beta-glucans, EGCG, SDG and lignans.	Provide powerful immune boosting activity. These nutrients also activate natural killer B and T cells, reduce the risk of colon, breast, and prostate cancers and balance hormone levels thus reducing the risk of hormone-related cancers.	Cauliflower, Garlic, Ginger, Mushrooms, Onions, Potato, Shallots, Turnip, Radish.
Red Vegetables	Lycopene, ellagic acid, quercetin and hesperidin.	Reduce the risk of prostate cancer, lower blood pressure, reduce tumor growth, lower LDL cholesterol levels, scavenge harmful free-radicals, and support joint tissue in arthritis cases.	Beets, Red apple, Red bell peppers, Red chilli peppers, Red onion, Red potato, Tomato, Red Carrot.
Yellow/ Orange Vegetables	Beta-carotene, zeaxanthin, flavonoids, lycopene, potassium and vitamin C.	Reduce age-related degeneration and the risk of prostate cancer, lower LDL cholesterol and blood pressure, promote collagen formation and healthy joints, fight harmful free radicals, encourage alkaline balance.	Carrot, Papaya, Pumpkin, Sweet potato, Yellow peppers, Yellow potato, Yellow summer squash, Yellow bell peppers, Yellow tomato, Yellow winter squash.
Blue/ Purple Vegetables	Lutein, zeaxanthin, resveratrol, vitamin C, fiber, flavonoids, ellagic acid and quercetin.	Support retinal health, lower LDL cholesterol, boost immune system activity, fight inflammation, reduce tumor growth, act as an anti-carcinogen in the digestive tract, and limit the activity of cancer cells.	Egg plant, Purple Belgian endive, Purple Potato, Purple asparagus, Purple cabbage, Purple carrot, Purple bell peppers, Purple onion, Purple broccoli, Purple cauliflower, Purple kollrabi, Purple broad beans.

Conclusion

Foods containing these functional ingredients offer great potential to improve health and/or help to prevent certain diseases when taken as part of a balanced diet and healthy lifestyle. Health-conscious consumers are increasingly seeking for the phytochemicals in form of nutraceuticals and functional foods to control their own health and well-being. There are exciting opportunities for the food industry to create such novel food products as presently there is a huge gap in market demand and supply of such food products. The `novel' nutraceuticals of plant origin may evolve to be considered a vital aspect of dietary disease-preventive food components. Careful studies are necessary on the various phytochemicals for their roles in the prevention of chronic degenerative diseases. The ever-widening choice of food ingredients makes it possible for food designers to provide food choices that meet the public's expressed desire for healthy food. Other aspects of determining the role of phytochemicals in functional foods include consumer attitudes, any competitive advantage for manufacturers producing functional foods and identification of those areas of research needed to produce foods with the desired health effects.

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Best Practices for Lac Production in Times of COVID-19: Challenges and Way Forward

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Introduction

Lac, an important versatile commercial resin of wide utility, is the natural heritage of India. It is secreted by tiny gregarious scale insects as a protective covering around their body. Thriving on succulent shoots of a number of plant species, these insects form a thick encrustation around the twigs, which are collected, scrapped for obtaining raw lac or sticklac. Lac insects reared on shoots of several tree species. It is subsidiary source of income mainly for tribals over a large area. India is the leading lac producing country in the world followed by Thailand & Indonesia. Minor quantities are also produced in China, Myanmar and Cambodia. Jharkhand state ranks 1st followed by Chhattisgarh, Madhya Pradesh, West Bengal Maharashtra and Odisha (Fig. 1). Commercially exploited lac insects are *Kerria lacca, K. chinensis* and *K. sharda.*

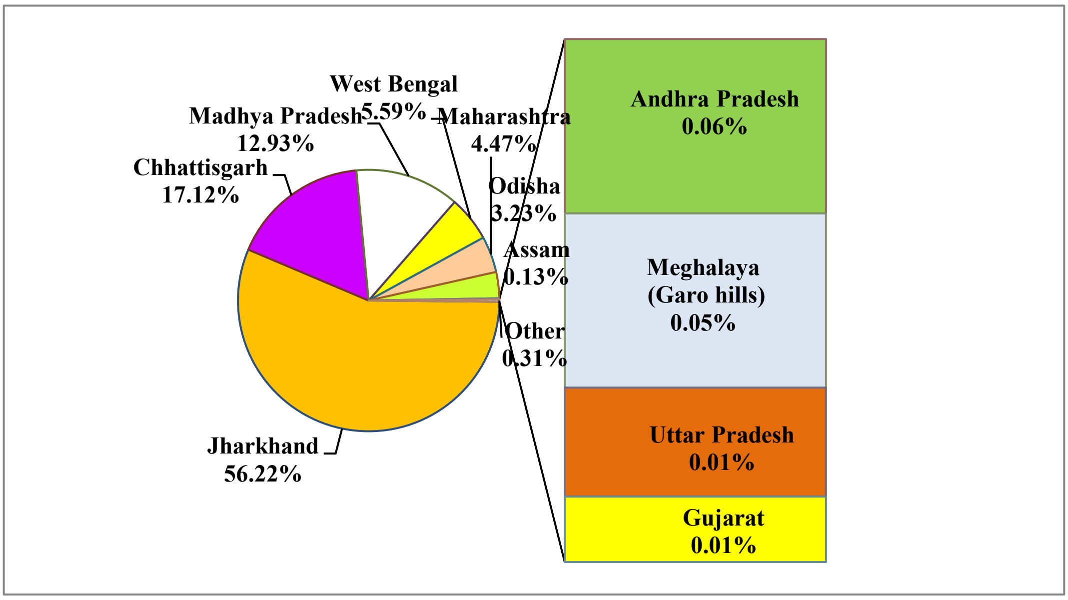

Fig. 1. State wise contribution in lac production during 2018-19

Lac Insect Stages and Its Development

Lac insect, *Kerria lacca* are placed under the order Hemiptera, superfamily Coccoidea, family Tachardiidae. They are characterized by the presence of a special type of mouth-parts, called the sucking type, intended for sucking plant juices- this is the sole mode of their feeding. The voyage of life of lac insects begins with completion of embryonic development within the body of the mother when eggs change their position in the ovariole. Eggs then travel through oviducts and come out of the vagina into the specially build "incubation chamber" formed by making sufficient gap between the body and resinous cell.

The insect moults thrice before reaching maturity, the duration of each instar being dependent on several environmental factors such as temperature, humidity, host plants etc. The lac cell of the male assumes a slipper like appearance at the final stage. However, during the last stage, the male insect stops feeding and the mouthparts become atrophied. The male emerges with the hind end of the body first by pushing the operculum. They copulate with the females, which remain enclosed in the lac cell and by the time of the emergence of males, generally become pear-shaped. The female insect, thus, assumes generally the appearance of a roundish bag completely occupying the space inside the lac cell. The males die within few days of their emergence and copulation. From this time onwards lac is secreted at a fast rate and the size of the female insects and of the enveloping lac cells increase at a faster rate than in the case during the earlier stage and reaches a size several times more than that of the male lac cell (Fig. 2). This state of activity lasts for a varying number of weeks depending upon the season, place and host plants (Mohanasundaram and Sharma, 2018).

		
Lac insect crawlers	**Sexual differentiation (Male and female lac insect)**	**Mature lac insect (Broodlac)**

Fig. 2. Different stages of lac insect development

Major Lac Host Plants

Trees and bushy plants are used for lac cultivation is called as lac-hosts. Lac insects draw nutrients by sucking the phloem sap of host plants, these are the nearest biotic associates of lac insects and stand at the first trophic level. Major lac host plants *viz., Palas (Butea monosperma), kusum (Schleichera oleosa)* and *ber (Zizyphus mauritiana), Semialata* (*Flemingia semialata*), *Albizia saman* (*Rain tree*) and *Ficus religiosa (Peepal*) are used for lac cultivation (Fig. 3).

		
Schleichera oleosa (Kusum)	**Butea monosperma (Palas)**	**Zizyphus mauritiana (Ber)**
		
Flemingia semialata (Semialata)	**Albizia saman (Rain tree)**	**Ficus religiosa (Peepal)**

Fig. 3. Major lac host plants

Lac Crop Cycle

Lac is a natural resin secreted by the tiny insects, mainly *K. lacca*. The insects are cultured on tender shoots of several plants called hosts. It derives its nutrition by sucking the saps from the host plants. Lac insect strains have been commonly related with the life-cycles of the insects and with their respective host plants. There are two strains of the lac insect *viz., rangeeni* and *kusmi*. Each strain completes the life-cycle twice a year, thus producing two crops in a year. However, in coastal region of West Bengal and Odisha, a tri-voltine insect, *Kerria sharda* is found which produce three crops in a year. But in each case the duration of the life-cycle and the seasons of maturity differ, as will be seen from the Table 1. *Kusmi* insect grows well mainly on *Kusum (S. oleosa)* and also on a few other trees but not *(B. monosperma)*, whereas *rangeeni* strain grows well mainly on *palas* and also on a few other trees but not on *kusum*.

Covid 19 periods affect/coincide the summer crops of both *rangeeni* and *kusmi* lac crops (March, April and May 2020).

Table 1. Different Crops and their Life Period

Name of strain	Name of crop	Season	Period		Approx. duration (Months)
			Month of inoculation	Month of harvesting	
Rangeeni	*Baisakhi*	Summer	Oct.-Nov.	June- July	8
	Katki	Rainy	June- July	Oct.-Nov.	4
Kusmi	*Aghani*	Winter	June- July	Jan. - Feb.	6
	Jethwi	Summer	Jan. - Feb.	June –July	6
Trivoltine	-	Winter	Oct.-Nov.	March-April	5
		Summer	March-April	July-August	4
		Rainy	July-August	Oct.-Nov.	3

Major Lac Production / Culture Operations at Farmer's Level

1. Pruning: Pruning is a removing/cutting undesirable shoots of host plants. Pruning of lac hosts is an important operation to provide suitable space for the lac insects to feed and thrive upon them. Appearance of maximum number of shoots of suitable age for lac inoculation depends upon proper pruning. Pruning should be done with sharp instruments such as dauli / tree pruner / secateur in such a manner that branches or twigs remain free from splitting or deep scratching.

2. Inoculation: Inoculation is a tying of broodlac bundles (lac stick with mature female insect) on host twigs for release of young lac larvae (crawlers). The lac crop management begins from inoculation or infestation of host plants with broodlac. Inoculation is of two types i.e. Artificial inoculation and self-inoculation.

3. Removing of used-up broodlac (phunki) sticks: Phunki is a used-up broodlac sticks after complete emergence of lac larvae from female cells. It should be removed to prevent access of enemy insect to new crop and avoid wastage of lac soon after emergence of lac larvae is over and within 3 weeks of inoculation by using pole mounted dauli or hook to cut plastic string.

4. Crop protection measures: Pesticides used to kill or control pests eg. Indaxacarb (0.5ml/lit of water) or Fibronil (1.5ml/lit of water) or Spinosad (2ml/lit of water) or Ethofenprox (2ml/lit of water) used for management of lac insect pest

5. Harvesting: It is a cutting of mature (broodlac) or immature (ari) lac crop from the host along with host sticks. (Sharma and Jaiswal, 2011).

Major Lac Production Issues During COVID-19 Periods

1. Removing of used-up broodlac (phunki) sticks: Farmers are unable to remove phunki during covid period (March 2020). Most of the farmers to purchase pesticides after selling scrapped lac from phunki. So, they are unable to buy pesticides and spraying lac crops leads to more pest infestation.

2. Crop protection measures: Kusmi summer crop (Jethwi) 2020– a minimum three sprays are required in the month of March, April and May, 2020. Similarly, Rangeeni summer crop (Baisakhi) 2020- Third spray is required during March, 2020 (Jaiswal and Singh, 2013). But farmers unable to spray due to lack of money, availability of pesticide and lack of manpower etc leads to more pest infestation and less production

3. Pruning of host trees: April month is a right time for pruning for next year rangeeni summer crop on Palas. But farmers may not prune the palas trees. It may hamper the succeeding summer crop lac production.

4. Broodlac availability and its quality: Shortage of broodlac (40 to 50 per cent) and less quality of broodlac may be occurred due to pest and disease problems. Lac production needs live seed materials (Broodlac) if lac insect dies due to covid 19 or any other reasons. Farmers could not continue its life cycle/ production. It leads to; farmers should depend upon other organizations, Broodlac producers for purchasing broodlac.

5. Broodlac price and sale: Price of broodlac may be increased. Sale and marketing of broodlac are also major issue due to restriction of transportation and easy movement of farmers.

Conclusion: Way Forward to Rectify Lac Production Issues During COVID-19

1. Farmers may be supplied with pesticides for minimum a spray to control the pest population below Economic Threshold Level (ETL).

2. State government functionaries may identify the cooperative societies to supply the recommended pesticides as given below,

   a. Lac pest management : Fibronil 5 EC/SC 0.007% 1.5ml per lit of water (or), Indaxacarb 15.8 EC 0.007% 0.5ml per lit of water (or) and Ethofenprox 10EC 0.02% 2ml per lit of water

   b. Sooty mould management - Carbendazim 0.01% (1g per lit water) or Chlorotholonil 75% WP - (1g per lit water) or Hexaconazole 5% EC (1ml per lit water)

3. Farmers involved in lac culture operations viz., removal of phunki, pruning, spraying and harvesting should maintain their social distancing, wear masks and follow hygiene properly.

4. Ensure it availability of broodlac/ seed materials with reasonable price for succeeding lac crop as well to continue its life cycle at village level through forest/Agricultural departments / local Broodlac suppliers etc.

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Anestrus in Cattle and Buffalo: Causes, Treatment and Management

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Introduction

It is the most important cause of infertility in animals. Anestrus means the absence of the heat cycle. The animal does not show any sign of oestrus or weak sign of oestrus. If animals do not come in heat within 90 days from parturition then it is considered as anestrus animals. Anestrus categorized by non-functional ovaries. Due to anestrous, the calving interval of the animal will increase so the costs of their feeding and management, etc. are also increasing and thus the profit of dairy farm reduces.

Causes of Anestrus

1. Animals have under bodyweight
2. Excessive parasitic load
3. Reproductive diseases or infection e.g. RP, dystocia, metritis and endometritis
4. Hypoplastic ovary or small size of genitalia
5. Nutritional deficiency
6. Genetic factors
7. Hormone imbalance.

Clinical Signs and Symptoms

1. Absence of oestrus
2. The smaller size of ovaries
3. No follicle or corpus luteum on the ovary
4. Persistent corpus luteum
5. The pathological condition of the uterus.

Treatment and Management

1. For a normal oestrus cycle, an animal should have proper body weight so give the good quality of feed and fodder with vitamin and mineral containing mineral mixture. Give 80-100 gram of mineral mixture daily. Provide an adequate amount of green fodder to animals. Vitamin A, E, Zinc and Phosphorus have affected the reproduction of animals.
2. Deworming is necessary for the animals as parasite competes with nutrient. High parasitic load reduces the bodyweight of animals. Deworming in the rainy season and grazing animals is necessary at 3 months of interval.
3. Give intra uterine antibiotics treatment for any uterine infection like pyometra. metritis etc.

Hormonal Treatments

1. Injection Receptol (Burselin-acetate), fertigyl (Gonadorelin)-5ml I.M
2. In case of the small size of the ovary with no corpus luteum, injection of folligon (PMSG) @750-1000 IU given along with the mineral mixture.
3. In the case of persistent corpus luteum, treatment of prostaglandins (Dinoprost,5mg/ml; Luprositol,7.5mg/ml) given to the animal.
4. Oestrogen preparation like Progynon depot @1ml I.M
5. In of silent oestrus, cases use a combination of prostaglandin and GnRH. In the treatment prostaglandin given on Monday repeat next Monday while GnRH is given on Wednesday and the artificial insemination can be planned on Thursday.

Major Lac Production Issues During COVID-19 Periods

Sejani capsule (2 capsules for 2 days), Estona or Prajana (2 capsules for 3 days).

Conclusion

Anestrus cause great economic loss to dairy farmers but with the help of good nutrition, treatment and management we can reduce the cases of anoestrus and improve the economics of dairy farms.

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Green Manuring an Option for Sustainable Agriculture

Article ID: 30420

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Introduction

Presently, India has achieved food sufficiency level by increased chemical fertilizer use but inorganic fertilizers are becoming more expensive and also observed the secondary and micronutrient deficient in India. Hence, alternate sources to supplement inorganic fertilizers are thought. The use of green manure crops in traditional agriculture for thousands of years are more common but conventional farming systems largely rejected them. Importance of this soil ameliorating practice is increasing in recent years because of high cost of chemical fertilizers, increased risk of environmental pollution and need of sustainable cropping systems. Maintaining such soils and increase crop production is a huge task for farmers. Application of green manuring helped to advance the physical and biochemical anatomy of the soil, prevented leaching losses of nutrients and enhanced the water holding capacity of soil (Pandey et al., 2008) and also stimulated soil microbial advance activities with consecutive mineralization of plant nutrients (Eriksen, 2005). Green manure crop absorbs the nutrient from lower layer of the soil and leave them in surface when ploughed.

Advantages of Green Manuring

1. Improves the soil fertility.
2. Add nutrients and organic matters.
3. Improves the soil structure and increase water holding property.
4. It also Maintain soil temperature.
5. Improves the soil physical, chemical and biological properties.
6. Helps control insect/mite pests, nematodes, and diseases.
7. Helps to control weeds.
8. Promotes habitat for natural enemies.
9. Increases soil's biodiversity by stimulating the growth of beneficial microbes and other soil Organisms.

Details of Common Green Manure Crops

Green manuring crops	Seed rate (kg/ha)	Green biomass (t/ha)	Dry biomass (t/ha)	Nitrogen content (%)	Nitrogen (kg/ha)	When to incorporate into the soil (DAP)
Azolla	50 – 90	8 – 10	1.8 – 3		52	35
Cowpea	40	9 – 10	3 – 4	1.4 – 1.5	140 – 150	40 – 65
Sesbania	20 – 90	1.4 – 4	4.3	250 – 360		45 – 50
Soybean	30 – 56	5.7 – 4				45 – 60
Sun hemp	35 – 40	5 – 19	5.5 – 6	1.7	108	50 – 60
Sweet clover	30 – 40	12	6	2		40 - 50

Nutrient Content of Green Manure Crops

Plant	Nutrient content (%) on air dry basis		
	N	P_2O_5	K_2O
Sun hemp	2.30	0.50	1.80
Dhaincha	3.50	0.60	1.20
Sesbania	2.71	0.53	2.21

Criteria for the Selection of Green Manure Crops

1. Fast growing nature
2. Produce abundant and succulent tops
3. Photoperiod insensitivity
4. Well adapted to the local condition
5. High seed production
6. They should have high biomass production
7. Can fix nitrogen in the soil.

Conclusion

Green manures can play a cardinal role as it has improve the physical, chemical and biological property of the soil and also it checks soil erosion and nutrient loss. Green manuring not only improves soil quality, but also fixes atmospheric nitrogen in the soil if legumes are considered. Thus, it may be declared that green manuring increases the agriculture sustainability.

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Revisiting Indian Food Policy Scenario

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Introduction

Despite being one of the major food grain producer ,hunger and malnutrition continues to remain chronic issues in India which is home to 195.9 million undernourished people (FAO,2017).According to 2017 Global Burden of Disease study, malnutrition was the top cause of death and disability in India in 2017 followed by poor diet choices. As per the FAO estimates, about 195.9 million in India are undernourished that is roughly about 15% of the entire population and almost 51.4% of women between 15-49 years are reported anemic. About 38.4% of children under the age of five are stunted while 21% suffer from wasting. Another emerging challenge is burgeoning obesity which grew from 12.6 percent in 2005- 06 to 20.7 percent in 2015-16 among women and from 9.3 to 18.9 percent among men (NFHS, 2015) which in the long run leads to severe health conditions like cardio-vascular diseases etc.

Although there are several large-scale social development programmes which has been in operation for many decades like Public Distribution System(PDS) for supplying food to poor at highly subsidized rates, Integrated Child development services(ICDS), National food security mission, National Mid-day Meal Scheme(MDMS) with special emphasis on nutrition enhancement. However, the effectiveness of these programmes at mitigating the challenges of malnutrition remains debatable. The economic inefficiencies and the losses incurred in the system due to several leakages, corruption, untrained staff have been known to outweigh the welfare gains(Gulati et al. 2012).Financial requirement of these programmes constitute a major part of the Union budget putting enormous burden on the fiscal. PDS alone constitute 1% of GDP(Government of India ,2017).

Evolution of Food Policy in India – Historical Background

Famines were a usual phenomenon in pre-independent era. Rising population, declining area under cultivation, great depression of 1929 aggravated the problem of food production. Gross Mismanagement of food supplies during Second World War, lead to the most horrifying Bengal famine in 1943 which shook the conscience of every nation in the world. Almost 1.5 million died due to shortage of food supply. Absence of proper institutional arrangement for food procurement emerged as the major loophole in the system. During 1950s and 60s in the aftermath of Bengal famine, policy thrust was mainly on making food grains available to masses. The approach adopted by Indian food policy makers was mainly two-pronged; to support producers by stabilizing farm prices through MSP and provide subsidized food to poor consumers through PDS procured from MSP supported producers. The idea was to ensure food security.

First Food Grain Policy of India

Pushed by the one of the worst famines in world history, first Food grain Policy Committee was constituted under the Chairmanship of Sir George Gregory. Major recommendation came as follows:
1. Procurement of food grains from the surplus areas.
2. Rationing for equitable distribution and
3. Statutory price control for checking the price rise.

Over the course of next few years, several other food grain policy committees were set up. During 1950s to 1966- 67 food economy of India was completely dominated by imports under PL480 programme to meet the domestic needs. As the share of imports in total food grain availability increased, emphasis of food policy of the country shifted towards:
1. Food self-sufficiency
2. Food grain price stability.
3. An equitable distribution of food grains at reasonable prices.

Policies to Ensure Food Availability and Self-Sufficiency – Era of Green Revolution

Food grain production in India increased manifold from 50 million tonnes in 1950-51 to an estimated 281.37 million tonnes in 2017-18. Achievement of self-sufficiency from being a food deficit nation in post-independence era has been a great achievement for India. This success was largely attributed to the Green Revolution during mid-1960s to 1970s which brought about technological innovation in the form of high yielding, disease resistant varieties mainly in staple grains like wheat and rice requiring intensive input application. Easy availability of highly subsidized seeds and other inputs, led to the dominance of cereal grains in most fertile tracts of the country, other food groups like pulses and coarse cereals were pushed to marginal dry tracts.

Green revolution propelled huge investments in development of high yield varieties, irrigation structures, chemical fertilizer and pesticides which required favourable price policy environment to ensure remunerative price to producer as well as maintain the affordability for the consumer. Keeping in View, K Jha Committee (1964) recommended the constitution of a body to advice the Government on agricultural prices to raise agricultural production. This led to emergence of Commission for Agricultural Cost and Prices (CACP) erstwhile Agriculture Price Commission (APC) in 1965 mainly to recommend the minimum support prices(MSP) and the procurement prices (higher than minimum support price but below the market prices). Further establishment of Food Corporation of India (FCI) in 1964, was another important policy measure to facilitate easy transmission of remunerative price to farmers through an arrangement of food grain procurement by Government.

National Food Security Act (NFSA)

National Food Security Act introduced in 2013 with an objective to alleviate hunger by extending the access to food as a legal right and providing highly subsidized food grain to roughly 70 percent of the Indian population. The state governments were allowed the flexibility to establish their own criteria for identifying eligible beneficiaries at the local level, but states were mandatorily required to cover 75 percent of all rural and 50 percent of all urban population. NFSA allowed states to expand coverage and introduce fortification of food grain at their own expense.

Of late it has been realized that concern of food security is not merely restricted to provision of food rather there are several multidimensional aspects attached to it. Keeping in view ,National nutrition mission was launched by Prime Minister Modi in 2018 also known as Poshan Abhiyan which aims to free India of malnutrition by 2022 but there is no clear laid out pathway on how it is going to be achieved.

Concept of Nutritional security was first popularized during 1970s through UNICEF's conceptual framework on malnutrition. Broadly nutritional security involves food intake & health status. Health status is further determined by underlying factors such as environmental determinants and access to health care services. In India, three major social safety net programmes namely Public distribution system (PDS), Integrated Child Development Services (ICDS) and Mid-Day Meal scheme (MDMS) mainly deployed as the main pillars of food-based assistance programme have been in operation for over decades now. However, nothing concrete can be said about the effectiveness of these programmes.

Problems with Major Food Safety Net Programmes in India

Under the PDS, rice, wheat, sugar and kerosene are provided to the consumers through a chain of Fair Price Shops (FPS) in the country. The PDS cards essentially entitle the identified beneficiaries in the AAY, Annapurna, BPL and APL categories to purchase food grains (rice, wheat, coarse cereals), sugar, kerosene and a few other items at highly subsidized prices .In most states, Targeted Public Distribution system(TPDS) has been merged under NFSM, however some states like Karnataka have their own state run PDS. Impact of PDS system in meeting nutritional security of households has been ambiguous. Studies show that in the poorest regions of Odisha, households receiving PDS supplemented food have shown improvement in macronutrient consumption and dietary quality compared to non-PDS households but substitution towards more proteinaceous food items like pulses, eggs, vegetables is negligible. Performance of states where PDS is reviving has shown improvement in short term nutritional indicators and long-term nutritional gains are observed in states where PDS is well-functioning. However not all reviving states show such improvement especially states like Bihar continue to perform poor.

Another major programme namely ICDS was launched on October 2, 1975 with a multi-sectoral approach to child well-being, incorporating health, education and nutrition interventions, implemented through a network of Anganwadi centres (AWCs) at the community level mainly targeting children between 0-6 years and lactating & pregnant women. Various studies reported that supplementary feeds provided through ICDS are lacking in major nutrients and no change in nutritional indicators among ICDS beneficiaries. Although in some cases, the knowledge availed by pregnant women on infant feeding services and early breast-feeding, did help in better infant care practices after child birth.

While MDMS was introduced in 1995 as a "National Program for Nutritional Support for Primary Education" mainly to address the problem of classroom hunger by provision of cooked meals of 300 calories, 8-12 grams of protein to all children studying in class 1 to V in government and government-aided schools. Later it was expanded to cover children of upper primary (classes VI to VII) providing 700 calories and 20 grams of protein. Reports regarding the meals provided under MDMS being deficient in all major nutrients against recommended dietary allowance (RDA) levels and often poor in quality are ubiquitous. Poor health indicators both in terms of weight and height are also observed in children enrolled in MDMS across states.

Conclusion

These age-old policies have mainly been thriving around the concept of food security and have been extracting a hefty sum from union budget every year, marred by several implementation lacunas have failed to address the challenges of large-scale nutritional deprivation. Instead of running several programmes parallel with similar agenda, amalgamation of these into one holistic programme may help reduce the implementation glitches, leakages etc. Excessive reliance on subsidized food grains like wheat, rice has made the agricultural production system quite skewed, favouring largely cereal grains while other nutritionally rich crops such as coarse grains, pulses remains ignored. To tackle the problem of malnutrition, we need to look beyond cereal grains. It requires a multi-faceted approach, improving dietary diversification along with improved access to health & hygiene such as clean drinking water and sanitation facility needs to be prioritized. Since strong correlation has been observed between agricultural performance and nutritional indicators among children and adults (Gulati, Kumar, Sridhar & Nandkumar,2012), formulating nutrition sensitive agricultural policies can go along way into this. Lack of awareness regarding right kind of child care practices and nutritional knowledge is another crucial factor which through effective educational intervention might prove effective in filling this knowledge gap.

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A Training Methodology for Effective Training Programme

Article ID: 30422

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Introduction

With the advance of technology in today's world from our day to day use appliances, say in health care sector, manufacturing sector to agriculture technology, an upgradation of the human force in the knowledge, skill and attitude aspects is of utmost need to cope out with the different new advanced technologies and similarly from urbanization, new government policy etc. The upgradation is possible through training, capacity building programmes with the help of the various training institutions in the country like NAARM, MANAGE, ICAR,SAUs, CAUs, EEIs, State Agriculture Department, KVKs etc. Training institutions have been giving their services since its inception till date with their own capacities and mandates. The approaches and methodologies more or less may vary from one organisation to the other. Training referred to educational activity imparted to persons so as to be fit, qualified, and proficient in doing some job (Dahama and Bhatnagar, 1980). With this background information; we would like to share the training methodology commonly used in Krishi Vigyan Kendra while imparting training for the extension personnel.

Stages of Training Methodology

There are four stages of training methodology useful for imparting training to the extension personnel/trainers. These are:

1. Training Need Assessment.
2. Development of Training Module.
3. Conducting Trainings.
4. Follow up.

Steps / Stages in Training

1. Pre-training phase:

a. Training Need Assessment: It is a study used for identifying the training needs as per the work interest, needs and problems faced in their organisation to fulfill the goals, objectives of the organisation. It works on the bottom up approach where the actual performance of an individual based on the knowledge, skill and attitude possessed is compared with the required ones. The exercise could be done through structured interview, questionnaire.

b. Development of Training Module: A training module is an instructional training guide on how to impart training consisting of detailed information on training objectives, content, training methods, training support materials, lesson plan and other resources needed to conduct the training programmes.

i. Development of training content: A training content must include the topics needed by the trainees as per the objectives covering knowledge, skill and attitude aspects. A content must include first the very essential information, skill which must be known by the trainees about the subject.

ii. Setting Objectives: An objective must be SMART (Specific, Measurable, Attainable and Time bound) which must be based upon the needs and problems, feasibility of the trainees to complete the task.

iii. Preparation of session plan: A session plan is a plan arrangement for delivering a lecture viz., timing, resource person, objective, training methods needed by a trainer as per the situation of the trainees useful to conduct and evaluate the training.

iv. Training methods: It must be as per the capacities/feasibility of the trainees like lecture, power point presentation, film show, discussion group, simulation games, field visit to demonstration unit, farmers' field etc. so as to improve the knowledge, skill and attitude aspects.

v. Other arrangement: Resource like flex banner, Audio Visual aids, camera, PA system, hall arrangement, field visit to farmers' field, sight-seeing to tourist place could be arranged for the trainees.

2. Training phase: Conducting Training refers to organizing training as per the plan using all the resources meant for the training viz., arrangement for logistics, fooding and lodging, providing suitable resource person, use of different training methods, supply of study reference material, pre and post-test.

a. Pre-test evaluation is the assessment of the actual knowledge, skill and attitude possessed by the trainees. The assessment is done by the trainer to get the response from the trainees before start of the training through questionnaire/schedule, discussions, exercises, quiz etc.

b. Use of suitable resource persons refers to the capacity of the resource person to conduct training with the help of appropriate tools, techniques and methods using communication skills, participatory approaches for an effective training.

c. Appropriate logistics refers to arrangement of transportation within the training campus, fooding as per the choice of the trainees and a comfortable lodging.

d. Organising training as per plan is the delivering of the training programme as per the schedule, arrangement with the suitable subject expert, training tools, techniques, methods to achieve the training task.

e. Training approach refers to the approach needed to impart training to the trainees and the most effective is the participatory approach. It is the approach where both the trainees and trainer used to participate in an interactive session, discussion, understands each other.

f. Supply of study reference materials: Training materials is very much essential for further learning reference. They may be in the form of manual, booklet, PowerPoint or soft copy.

g. Monitoring is a task to be carried out by the training institution to make the trainees comfortable in terms of fooding, lodging, training session so that they could concentrate fully on the training programme. This could be done with the help of a training coordinator/course director.

h. Post-test evaluation is the assessment of the actual knowledge, skill and attitude acquired by the trainees usually after the training programme to get the training feedback through questionnaire/schedule, discussions, exercises, quiz etc.

i. Preparation of training completion report: A report is prepared by the training institution on the overall training programmes conducted, the impact of the training on the participants to be submitted to the host institute.

3. Post training phase: Follow up training includes the contact of the training institution with the trainees through email, mobile phone to get the feedback on the utility of training in workplace, extent of usage of the lessons learnt, training effect and overall impact of training.

a. Post training contacts with the trainees through email, mobile phone, postal correspondence is very important to sensitize the trainees to implement the technologies learnt in the training institutes.

b. Feedback on utility of training and extent of application of lessons learnt at the field level is done through structured questionnaire to find out the usefulness and application of training content in the work place.

c. Impact assessment strategies: A study is needed to know the effect of training on the performance of the trainees towards the clients, their convincing power in such a way that the end user could adopt the technology easily.

Conclusion

Training methodology is therefore acting as the blue print for the training programme where the training design, plan and overall outline of the training programme is prepared beforehand. Thus, we can conclude that an effective training methodology acts as the main catalyst to an individual to improve their knowledge, skill and attitude and ultimately improve the work performance in the workplace, increase work relations with the client's farmers leading to agricultural growth/productivity.

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Bio-Methanation as an Alternative for Stubble Burning

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Introduction

In agrarian countries like India, biomass can be considered as a promising source of renewable energy, as its ample availability and low cost present a healthy case for people, planet and progress. Rice straw is one such biomass that is abundantly produced in India—about 160 million tonnes per year and is widely available. Stubble burning is a common practice followed by farmers to get rid of straw as well as to prepare fields for sowing wheat in November as there is little time left between the harvesting of paddy and sowing of wheat.

This process causes release of toxic pollutants and greenhouse gases in the environment. Anaerobic digestion of rice straw to produce biogas may offer a promising approach to rice straw utilisation and mitigation of air pollution. The anaerobic digestion of crop residues has been posed as an option towards the utilization of these lignocellulosic residues. At present, the farmer feels that the most practical way of using this resource is to return them to the soil.

Why Bio-Methanation?

Production of methane-rich biogas through anaerobic digestion can provide a versatile source of renewable energy, as methane can be used as replacement for fossil fuels in both heat and power generation and as a vehicle fuel, thus, significantly reducing greenhouse gas emissions and slowing down the climate change. Biogas has various applications, right from electricity generation, lighting and cooking fuel to biomethane, a potential fuel for vehicles and natural gas grid. Furthermore, the process generates nutrient-rich digestate that can be used as an organic fertiliser. In this way, nutrients originating from plants can be recycled and returned to nature.

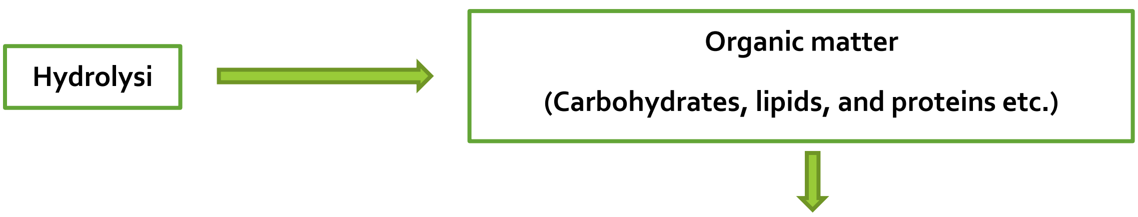
Extraction of energy from rice straw is limited due to the presence of lignin mesh around the cellulose and hemicellulose structure, making it recalcitrant to microbial attack. Thermochemical pre-treatment such as acid or alkali pre-treatment at high temperature is required to break open the complex structure and make it amenable to bio-methanation. However, such pre-treatment methods are expensive, highly polluting and laborious, making the options economically unviable.

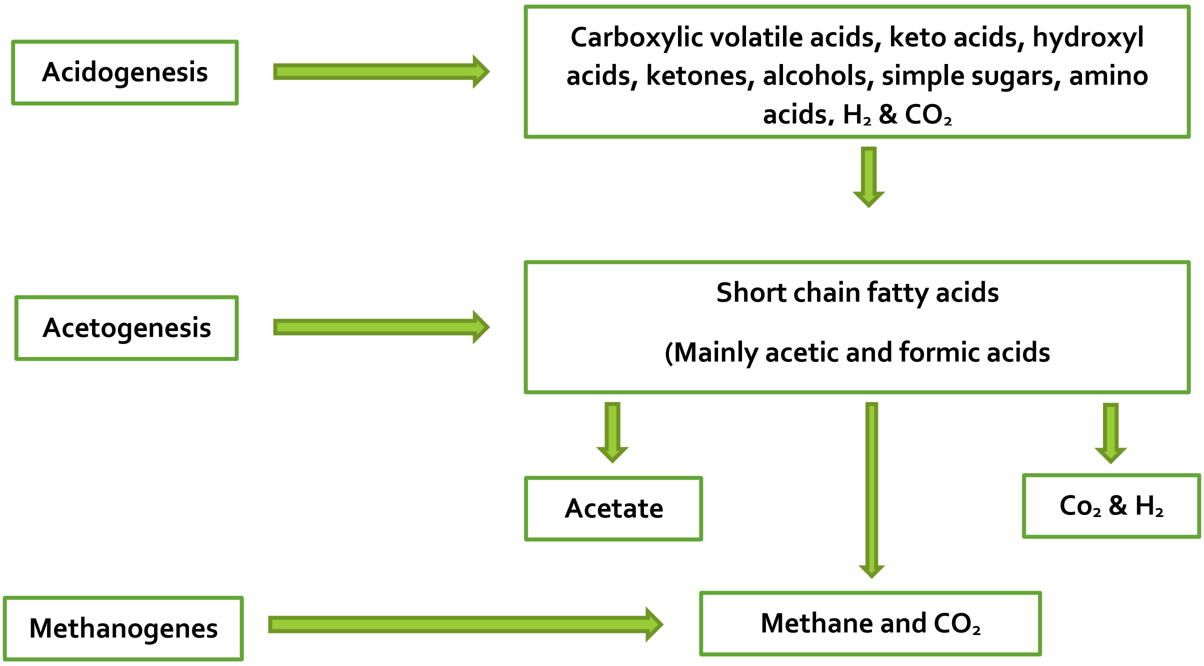
The nature of cellulose, in association with lignin, pectins, tannins, etc. makes it difficult for microorganisms to degrade. Gaden (1975) suggested that the degree of crystallinity and the extent of lignification of cellulosic materials determine their accessibility to hydrolytic action. The presence of silica as another encrusting substance further increases the indigestibility of the cellulosic material (Han, 1975). Rice straw has an extremely high silica content of up to 16.5%·of its dry matter (Han, 1975).

Process

Rice straw is a fibrous, lignocellulosic biomass that remains in the field once the grain is harvested. The straw can be collected and baled once it contains a moisture content below 25%, which can be as soon as 3–4 days following harvest depending on climatic conditions. Upon baling, the straw appears as flat fibres with approximate dimensions of 0.5 cm in width and 20–60 cm in length.

Flow Chart





Physiological Groups of Microorganisms Involved

1. Fermenting bacteria
2. Organic acid oxidizing bacteria
3. Methanogenic bacteria

The lignin portion of the rice straw was effectively removed by the bases. The cellulose fraction seems to be the least susceptible to loss during chemical treatment. The silica content could be lowered by about 75% using the bases. It has been shown that after 70 days of fermentation, only 50% of the volatile solids has been converted to biogas.
Two process involved for pre-treatment :

1. Biological: Biological processes utilize bacteria to convert the biomass into fuel either through anaerobic digestion of organic matter generating methane or through saccharification and fermentation of sugars producing ethanol. Utilizing rice straw for ethanol production has been investigated and the global production potential was estimated to be 205 gigalitres (GL), which could replace approximately 147 GL of gasoline. Aerobic composting of rice straw has been evaluated with various other substrates for its use as a fertilizer.

2. Thermochemical processes: Thermochemical processes such as pyrolysis, combustion and gasification have also been evaluated as treatment methods of rice straw. However, the production of biogas through anaerobic digestion, also known as methanization, is considered to be one of the most environmentally friendly processes for converting biomass into renewable energy. Much less energy input is required when compared with thermochemical processes and this technology can accommodate either wet or dry feedstocks economically on both small and large scales.

The recent interest in rice straw digestion stems from a global focus on efficiently using renewable energy sources and reducing greenhouse gas emissions contributing to climate change. Common practices such as open-field burning of rice fields or tilling the straw back into the fields contribute significantly to the release of methane into the atmosphere.

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Watershed – Hidden Potential for Achieving Food Security

Article ID: 30424

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Introduction

A watershed is a geo-hydrological unit that captures rainfall and funnels it to a lake or basins or wetland or streams. It can also be defined as an area of land, such as a mountain or valley, which collects rainwater into a common outlet. Watershed development is identified as an excellent approach for developing all rain-fed regions (arid, semi-arid and sub-humid tropics). It is recommended that watersheds be developed in clusters so that those micro-watersheds larger than 1200 ha could be developed. For prioritization of watersheds, emphasis should be on high proportion of rain-fed areas, low GDP (more poverty), prime constraint of water scarcity (drinking and agriculture), low crop yields and proneness to severe land degradation. Appropriate strengthening of community-based institutions with proper training and hand-holding through quality capacity building efforts would go a long way to enhance the impact and sustainability of watershed programs to address the issues of equity, construction of low-cost rainwater harvesting structures throughout the topo-sequence along with in-situ conservation measures including productivity enhancement, to benefit small-scale land holders. Components of watershed includes Land (Slope, terrain, soil depth, soil texture and structure, WHC and infiltration rate), water (Inflow, use and outflow), biomass (human, plants and animals), agro-climate of that area, Others (Govt. schemes, political influences etc.) etc.

Benefits of Watershed Management

Watershed does matter because; we all live in watershed and there are certain other benefits i.e. Recharge water supply, protect oceans, mitigate flood, provides suitable habitat for plants and animals, serve as recreational and educational places, protect public health, support the economy, mitigate the effect of climate change etc.

Principles of Watershed Management

Watershed works with certain principles i.e. provision of adequate amount of drinking water, maintenance of quality of drinking water, participation of local community, harmonizing economic development and environmental requirement, increasing of productivity of resource use in sustainable manner, stabilizing and protection of natural resources etc.

Evolution of Watershed

The rain-fed agriculture shares 58 per cent to world's food requirement from 80 per cent agriculture lands. In India, 60 per cent of 142 M ha arable land is rain-fed. The rain-fed areas are the hotspots of poverty, malnutrition, food insecurity, prone to severe land degradation, water scarcity and poor social and institutional infrastructure (Rockström et al., 2007; and Wani et al., 2007). National Commission on Farmers recommended consortium approach to implement watersheds with holistic livelihood approach and release of money from national coordination cell to the district watershed coordinating agency (GoI, 2005). The NRAA was established in 2007 and new common guidelines for watershed development were released by the Government of India (GoI, 2008).

Chronological Events of Watershed Development Programmes and Guidelines

Over the decades, the concerned authorities in India have been drawing up a series of guidelines from time to time–each time revising them to suit the changing situation, objectives and to make them more flexible, specific to regional variations and to the demands of new developments in the science and art of natural resource management.

In addition, there are different sets of guidelines formulated during the evolution by various donor agencies and the NGOs, based on their own understanding of the ground situation and norms of planning and implementation of the watershed development projects. Till 1st April 2008, Department implemented three watershed programmes viz. Integrated Wastelands Development Programme (IWDP), Desert Development Programme (DDP), Drought Prone Areas Programme (DPAP); then, amalgamated to a comprehensive programme under the guidelines of watershed development (2008) named Integrated Watershed Management Programme (IWMP).

Changes in Watershed Approaches

There were different approaches were introduced for watershed in the beginning, watershed program went through the structure-driven approach for soil conservation and rainwater harvesting, aiming at only some productivity enhancements. This was a top-down contractual approach led to less transparency and inequitable benefits among the community members. Now a day the projects implemented are operated as demand driven project not as supply driven. Different guidelines were made for better and efficient watershed i.e. the Hanumantha Rao Committee Guidelines, guidelines for Haryali and WARSA-JAN SAHABHAGITA guidelines (Nov, 2000).

Analytical Framework for Implementation of Watershed

The aspects of the watershed development that call for a careful planning in advance, as suggested in the available literature, are the i.e. identification and selection of watersheds and villages, identification and mobilization of the stakeholders, resolution of outstanding disputes over land and other assets, if any, ensuring participatory planning and implementation, Working out common pool resource management and protection, building-up a watershed fund, planning for regeneration of vegetation and rehabilitation of the poor particularly, the landless who are not benefited by the project, following through and exit strategies of the government, NGOs and donor agencies and leaving the project to be managed by the stakeholders, creation of institutions for planning, implementing and managing the project.

Implementation Options

The Indian experience has thus thrown up the following implementation options for a WSDP; through the line departments of the government, through non-government initiatives, with community participation at different levels, through panchayats, watershed development teams and user groups and through any of the above PIAs adopting consortium approach (including PPPs).

Forwarded Guidelines for Watershed Implementation Includes

Village selection, community participation, planning process, fund disbursement, sustainability of the project, implementation process, equity questions, institutions and watershed development programme, capacity building, monitoring and implementation options, watershed development programme objectives and guidelines and exit protocol.

Delineation of Watershed

Various stages of delineation are as under:
Stage-I: Water Resources Regions (WRR) are segregated and numeric codes 1 - 6 have been assigned to them There are 6 WRR in the country.

Stage-II: Each WRR is then divided into basins. There are 37 basins in the country.

Stage-III: These 37 basins are further subdivided into catchments, which mostly pertain to main tributaries or a group of contiguous small tributaries or individual streams. There are 117 catchments in the country.

Stage-IV: These 117 catchments are further sub-divided into 588 smaller streamlets or tributaries called sub-catchments.

Stage-V: Each sub catchment has been subjected to further divisions into number of watersheds. There are 3851 watersheds in the country and these are considered as the smallest hydrologic entity on the 1:1000K scale.

Case Studies in Chhattisgarh

1. In Jangir-champa implementation of IWDP-I (Borai nadi) during 2006-07 Kharif paddy grown up to 42ha and horticulture product increased to 12ha.
2. In Bilaspur dist. Implementation of IWDP-III during 2006-07 plantation crops grown up to 14ha.

Conclusion

Initially the focus of productivity enhancement was on HYVs and agrochemicals which is now shifted to watershed management and farming system approach. There are different institutions and programmes involved in development of guidelines for watershed implementation. For effective watershed implementation there should be demand driven, transparent approaches which must specially focused to resource limited areas, socially and economically backward communities. Sustainability, equity and participation are the three basic elements of participatory watershed management. People's participation and collective actions are the prime ingredient for successful implementation of watershed.

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Water Productivity Enhancement Strategies Under Rainfed Agriculture

Article ID: 30425

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Introduction

Water scarcity and insufficient freshwater resources to meet the human and environmental demands of a given area are serious problems worldwide and water will become more critical input in many countries within one or two decades. According to the International Water Management Institute (IWMI), agriculture accounts for about 70% of global water withdrawals and is constantly competing with domestic and industrial uses for a scarce water resource along with environmental uses. In agriculture, water of suitable quality and quantity is essential for the crop production, livestock and fisheries in addition to its requirement of processing and preparation of their food products. At present sustainability of livelihoods dependent on water and agriculture are under severe threat due to poor agricultural practices of water use.

Rainfed agriculture plays predominant role in providing food and livelihood for ever increasing world population as majority of area is under rainfed condition. Under rainfed agriculture, rainfall is the prominent parameter beyond the control and it is a primary source of risk and uncertainty for agricultural production. In addition, alarmingly depleting ground water resources and climate change in terms of rainfall intensity and its distribution raised concern on water availability and its accessibility to agriculture. Hence, a target of more crops per drop of water is essential in attaining food security by adopting effective methods of water management all over the world.

Strategies to Improve Water Productivity

Water productivity is generally defined as crop yield per cubic metre of water consumption, including 'green' water (effective rainfall) for rain-fed areas and both 'green' water and 'blue' water (diverted water from water systems) for irrigated areas.

Effective utilization of water in agriculture is mainly influenced by the climatic factors, soil factors, management factors and plant factors. Improving water productivity in agriculture requires an increase in the crop productivity in terms of marketable yield and a reduction in water loss from the rhizosphere or water application. Methods to improve water productivity includes:

1. Rain water management to secure water availability.
2. Selection of crops and varieties.
3. Crop management approaches.

Rain Water Management

Improving soil surface conditions to increase infiltration rate of water and improving water holding capacity are two basic requirements in rainfed agriculture. It includes In-situ conservation of soil and water along with drainage improvement in low rainfall areas while Ex-situ water conservation and groundwater recharge in high rainfall areas.
The purpose of In-situ conservation of water is to increase the soil water availability and minimize the drought stress to crops. These practices include:

1. Land surface management by adopting broad-bed and furrow (BBF), ridges and furrows, micro-basins, dead furrows, staggered trenches, contour farming, contour bunds, conservation furrows and terraces etc., to improve opportunity time for infiltrating water.
2. Summer or fall ploughing to create micro-undulations to harvest subsequent rains.
3. Deep tillage once in 2-3 years to create gradient for infiltration by disturbing sub-surface compaction.
4. Vegetative barriers for bund stabilization and screening runoff.
5. Soil health improvement through addition of organic manures, tank silt, reclamation of soil problems to improve infiltration and water holding capacity.
6. Mulching to reduce evaporation losses and obstruct runoff for better infiltration.

The purpose of Ex-situ conservation of surplus water is to mitigate dry spells, recharge groundwater, enable supplemental irrigation, extend the cropping season and permit other multiple uses of water etc. These practices include:
1. Water harvesting through surface ponds like check dams in channels or gullies, farm ponds at lower field reach, surface micro-dams, nala bunds with sand filled bags or bricks or brush woods across the nalas, percolation ponds, check-dams etc.
2. Groundwater recharge through gully plugs, subsurface ponds, bore well recharge pits and other groundwater recharging structures.

Selection of Crops and Varieties

Crops and their genotypes differ in their ability to absorb, use and transpire water. The important strategies are:
1. Selection of short duration crops and varieties to reduce crop duration during hot weather conditions.
2. Breeding high-yielding and drought tolerant varieties to increase water productivity.
3. Adoption of crops or varieties having deep root system, cuticular coatings, pubescence etc., which are less sensitive to higher soil moisture depletion.
4. More emphasis on C_4 plants.

Crop Management Approaches

These include practices which enhance crop yield with minimum water loss. The important agronomic practices like:
1. Early sowing / dry sowing
2. Maintenance of optimum plant population
3. Timely weeding
4. Repeated inter-cultivations
5. Potassium spray
6. Use of anti-transpirants and mulches to minimize evaporation
7. Balanced plant nutrition with integrated nutrient management
8. Protective irrigation during critical stages of crop
9. Timely plant protection with integrated pest/disease management practices
10. Timely harvest and proper post-harvest management
11. Practice of intercropping, crop rotations and crop diversification
12. Crop intensification in rice fallows and rainy season fallows
13. Practice of Contingency cropping.

Conclusion

Upgrading rainfed agriculture at global level is required as it plays a prime role to meet the demanding food security with ever increasing population. But the productivity of the rainfed agriculture mainly depends on effective utilization of rainfall through In-situ and Ex-situ conservation of water, proper selection of crops and varieties along with other crop management practices which enhances the water productivity. Hence there is a need of keen attention on water productivity enhancement under rainfed conditions for increasing total productivity per unit of land and also to cope up with prevailing climate related risks and uncertainties in agriculture.

Permaculture

Article ID: 30426

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Permaculture is a philosophy of working with, rather than against nature; of protracted and thoughtful observation rather than protracted and thoughtless labour; and of looking at plants and animals in all their functions, rather than treating any area as a single product system. The term permaculture was coined by David Holmgren. Bill Mollison, "father of permaculture.

The twelve principles of permaculture most commonly referred to were first described by David Holmgren in his book *Permaculture: Principles and Pathways Beyond Sustainability* (2002). They include:

1. Observe and interact: By taking time to engage with nature we can design solutions that suit our particular situation.

2. Catch and store energy: By developing systems that collect resources at peak abundance, we can use them in times of need.

3. Obtain a yield: Ensure that you are getting truly useful rewards as part of the work that you are doing.

4. Apply self-regulation and accept feedback: We need to discourage inappropriate activity to ensure that systems can continue to function well.

5. Use and value renewable resources and services: Make the best use of nature's abundance to reduce our consumptive behaviour and dependence on non-renewable resources.

6. Produce no waste: By valuing and making use of all the resources that are available to us, nothing goes to waste.

7. Design from patterns to details: By stepping back, we can observe patterns in nature and society. These can form the backbone of our designs, with the details filled in as we go.

8. Integrate rather than segregate: By putting the right things in the right place, relationships develop between those things and they work together to support each other.

9. Use small and slow solutions: Small and slow systems are easier to maintain than big ones, making better use of local resources and producing more sustainable outcomes.

10. Use and value diversity: Diversity reduces vulnerability to a variety of threats and takes advantage of the unique nature of the environment in which it resides.

11. Use edges and value the marginal: The interface between things is where the most interesting events take place. These are often the most valuable, diverse and productive elements in the system.

12. Creatively use and respond to change: We can have a positive impact on inevitable change by carefully observing, and then intervening at the right time.

Ethics Involved in Permaculture

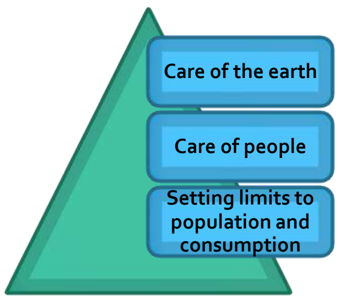

Figure: The three ethics on which the whole of permaculture builds is articulated in Mollison's A Designers' Manual.

1. Care of the Earth: Provision for all life systems to continue and multiply.

2. Care of people: Provision for people to access those resources necessary for their existence

3. Setting limits to population and consumption: By governing our own needs, we can set resources aside to further the above principles.

The third ethic is often referred to as "Fair Share" which rhymes pleasantly with 'Care', but it is not equivalent to 'setting limits to population and consumption'. The ethic of 'setting limits to population and consumption' is independent of sharing fairly. Either can be done with or without the other. Sharing fairly is, however, a necessary consequence of the three ethics taken together.

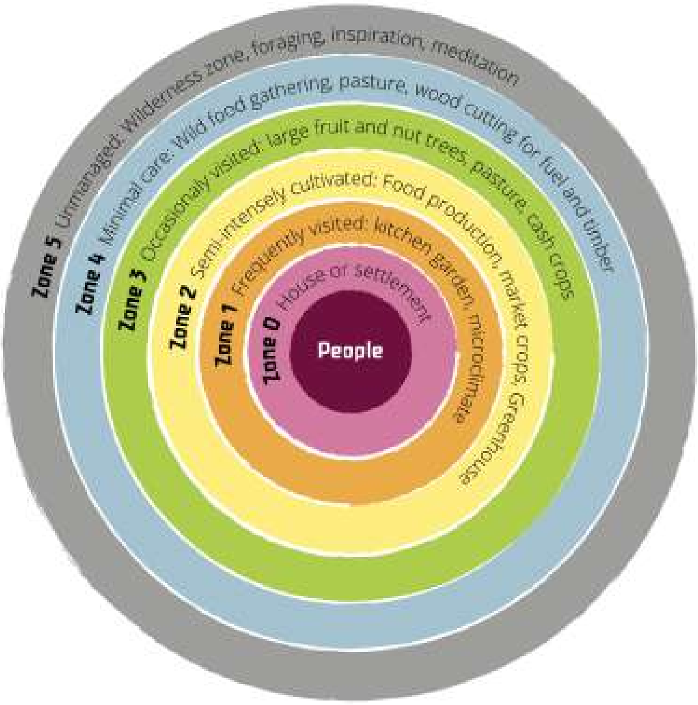

Figure: Permaculture Zone 0-5

Permaculture design emphasizes patterns of landscape, function, and species assemblies. It determines where these elements should be placed so they can provide maximum benefit to the local environment. Permaculture maximizes useful connections between components and synergy of the final design. The focus of permaculture, therefore, is not on each separate element, but rather on the relationships created among elements by the way they are placed together; the whole becomes greater than the sum of its parts.

Vegan Permaculture

Vegan permaculture (also known as veganic permaculture, vegan culture, or Vega culture) avoids the use of domesticated animals. Vegan permaculture recognizes the importance of free-living animals, not domesticated animals, to create a balanced ecosystem. Soil fertility is maintained by the use of green manures, cover crops, green wastes, composted vegetable matter in place of manure.

Hugelkultur

Hugelkultur is the practice of burying large volumes of wood to increase soil water retention. The porous structure of wood acts as a sponge when decomposing underground. During the rainy season, masses of buried wood can absorb enough water to sustain crops through the dry season.

Rainwater Harvesting

Rainwater harvesting is the accumulating and storing of rainwater for reuse before it reaches the aquifer. It has been used to provide drinking water, water for livestock, water for irrigation, as well as other typical uses.

Conclusion

There has been a growing awareness though that firstly, there is the need to pay more attention to the people care ethic, as it is often the dynamics of people that can interfere with projects, and secondly that the principles of permaculture can be used as effectively to create vibrant, healthy and productive people and communities as they have been in landscapes.

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Viral and Fungal Diseases of Pineapple

Article ID: 30427

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Ethics Involved in Permaculture

Pineapple is initiated in South America, where native people nominated a seedless mutation from wild sps. It belongs to Bromeliaceae, various members of which are ephiphytes living on trees and rocks. Pineapple roots are adventitious and will not stimulate if damaged.

Bacteria Associated Diseases

1. Marbling
2. Pink disease

Marbling

Casual organism: *Pantoea ananatis* and *Acetobacter* sps.

Disease symptoms: Externally, infected fruits do not show any symptoms. Flesh is red-brown and granular internally and has a woody consistency.

Survival and spread: The bacteria enter through the open flower and cracks on the fruit surface by natural growth. Infected fruit are low in acid and sugars.

Favourable conditions: When flowers are initiated and fruit matured under warm, wet conditions, the diseases occur.

Management:
1. A practical way of managing marbling is not known. Internal symptoms are clearly observable in infected fruit, and fruit can be rejected certainly during processing.
2. Smooth Cayenne is moderately resistant.

Pink Disease

Pathogen: *Pantoea citrea, Gluconobacter oxydans* or *Acetobacter aceti*

Disease symptoms:
1. Externally, infected fruits do not show any symptoms, even when fully ripe. Internally, the flesh may be water-soaked or light pink and have an aromatic odour, although these symptoms may not be clear immediately. During canning, when sterilized by heat, infected tissue darkens to colours ranging from pink to dark brown.
2. Only one or a few fruitlets may be infected in some fruits. Low- brix fruit, the entire cylinder can be invaded in highly translucent.

Survival and spread: Pathogen survives in decaying fruit near flowering fields.

Favourable conditions: Disease incidence increases in dry conditions before flowering, followed by rainfall during flowering.

Management:
1. This disease occurs only periodically when fruits develop under cool, wet conditions.
2. Since the bacteria are destroyed by high temperatures, pink disease occurs mainly in spring (September– October).
3. The occurrence of infected fruit is very low. Management is not usually justified.
4. Smooth Cayenne is relatively resistant.

Virus associated diseases:
1. Mealy bug wilt disease
2. Yellow spot

Mealybug Wilt Disease

Pathogen: Ampelovirus transmitted by Mealy bug

Disease symptoms:
1. The early symptoms are a slight reddening of leaves about halfway up the plant. The colour of the leaf changes from red to pink and lose rigidity, roll downwards at the margin and the tip of the leaf dies.
2. The root tissue also collapses and plant appears wilted. Plants can be recovered to reduce symptomless leaves.
3. It is affected by age of the plant at the onset of mealy bug infestation, with younger plants showing symptoms two to three months subsequent feeding and older plants may take up to 12 months to develop symptoms

Survival and spread: The disease are caused by viruses transmitted by mealybugs with the pink mealy bug *(Dysmicoccus brevipes)* being the mainvector. The viruses are transmitted when the mealy bugs feed on young leaves once they established.

Mealybugs are sedentary insects that are moved from plant to plant by attendant ants or by wind. Ants actively tend mealybugs. The removal of spiders from fields by ants often allows large populations of mealy bugs to develop, increasing the risk of severe mealy bug wilt outbreaks. The incidence is variable and sometimes high. The amount of wilt in a field is related to the number of mealy bugs present, the length of time they feed and the activity of ants.

Management:

1. If the plants show wilt symptoms, eradicate infected plants by hand and destroy them.
 Spray the insecticide to control the mealy bug namely
2. Chlorpyriphos, Imidacloprid, Quinolphos.

Yellow Spot

Casual organism: Tomato spotted wilt virus, *Capsicum chorosis* virus (Tospoviruses)

Disease symptoms:

1. Infection occurs on young crowns during the first few months after planting. Small (2–5mm), round, yellow spots appear on the upper surface of the leaves of young plants. These spots fuse and form yellow streaks in the leaf tissue, become brown and die.
2. The virus spreads to the leaves in the plant heart that causes to bend sideways. Infection eventually kills the plant so that the virus is not transmitted to subsequent plantings. If the crown is infected, the fruit dies from the top downwards. Infections occur through open blossoms causing the development of large, blackened cavities in the side of the fruit.

Transmission and favourable conditions:

1. The viruses are transmitted to pineapple plants by thrips. Infection occurs mostly on plants during early growth, and developing fruit are occasionally infected on crowns.
2. Tospo viruses have many hosts among weed and crop plants.

Management:

1. Keep the plantation free from weeds.
2. Spray the suitable insecticide to control the thrips.

Conclusion

The diseases can be prevented by applying suitable pesticides, fungicides and insecticides for the growth of the plants. Thus, the plants will grow healthy in the suitable environmental surroundings.

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Important Diseases of Okra and their Management Practices

Article ID: 30428

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Okra (*Abelmoschus esculentus* L.) of the family Malvaceae, is a tropical, subtropical and warm temperate vegetable crop, cultivated for its immature edible green fruits, which are used as vegetable both in green and dried state. The crop is attacked by number of diseases of which *Cercospora* leaf spots, Powdery mildew, Damping Off, Fusarium wilt, Yellow vein mosaic virus, Enation leaf curl virus and root-knot nematode are most serious causing substantial reduction in crop growth and yield. In the present document the causal organism, symptoms, survival and spread, environmental factors, disease management and various IDM practices have been discussed to save the crop from diseases.

Cercospora Leaf Spots

1. Causal organism: *Cercospora abelmoschi*, *C. malayensis* and *C. hibisci*

2. Disease Symptoms: All the stages of the crop are susceptible to this disease and it is one of the notable diseases in okra. In India C. abelmoschi is the most prevalent species and it produces gray colour spores on the lower surface of the leaves which later become sooty black patches and corresponding upper surface yellowish to dark green colour or purplish red irregular spots are produced. The other two species C. malayensis and C. hibisci produces small, round, necrotic spots surrounded by purple halo and later the centre portion become grey colour and in advance stages, it may produce shot hole symptoms.

3. Survival and spread:

- **a. Primary:** The fungi survive through conidia and stromata on crop debris/refuse in soil.
- **b. Secondary:** The conidia are dispersed by wind from one plant to other.

4. Environmental Factors: High temperature (25-29oC) coupled with high level humidity (80%) favours fast spread of the disease. The disease is more serious, when the mean minimum and maximum temperature are 18 and 25oC, respectively, along with high level humidity and heavy rainfall (330 mm).

5. Integrated Disease Management:

a. The fungus survives on the diseased plant material, removal and destruction and of diseased plant material helps to check the spread of the disease.
b. Apply crop rotation and destruction of wild host.
c. Okra sowing should be completed latest by first week of July.
d. Use of resistant varieties like Round selection, Walgaon, Long green, Sonepat strain etc.
e. Spray should be started immediately after disease initiation; delay in spray schedule will not give proper control due to very fast secondary infection rate.
f. Spray various systemic and non-systemic fungicides like copper oxychloride, Benomyl, Bordeaux mixture for effective in controlling the disease.
g. Apply Topsin M-70 WP and lemongrass oil as foliar spray to control the disease.

Powdery Mildew

1. Casual organism: *Erysiphe cichoracearum*, *Sphaerotheca fuliginea*

2. Disease symptoms: The disease caused by the former is most common in okra growing areas. The disease affects mainly the older leaves, petioles and stems of plants. The disease symptom appear as blotches of white powdery coating are mainly on the lower surface of the leaves but may appear on the upper leaf surface also young leaves are almost immune. A large part of the leaf surface is covered by the talc-like powder composed of spores. These spores are easily blown by winds to nearby susceptible plants. Heavily infected leaves become yellow, then become dry and brown. Extensive premature defoliation of the older leaves occurs if the disease is not controlled.

3. Survival and spread:

a. Primary: Dormant mycelium and cleistothecia in crop residue.

b. Secondary: Wind dispersed conidia.

4. Favourable conditions: Powdery mildew is generally favoured by moderate temperature, reduced light, fertile dry soil and succulent plant growth. Low humidity (60-80%) and moderate temperature are found favourable for the development of the disease.

5. Integrated Disease Management:

a. Grow healthy, vigorous plants by applying standard doses of manure fertilizer.

b. Grow moderately resistant varieties like AE-37, BH-102, Early green, Green, Long green and Red bhindi.

c. Spray neem oil and neem seed kernel extract alone and in combination with *Pseudomonas flurescens* resulting a lower incidence of powdery mildew.

d. Apply fungicides like wettable sulphur, Dinocap and Binomyl for effective control of disease.

e. Spray inorganic sulphur 0.25% or Dinocap 0.1% 3 or 4 times at 15 days interval.

f. Spraying with 0.01% Topas recorded no incidence of powdery mildew.

Fusarium Wilt

1. Causal organism: *Fusarium oxysporum* f. sp. *vasinfectum*

2. Disease symptoms: Fursarium wilt, a serious disease, found wherever okra is grown intensively. The fungi persist in the soil for a very long time through chlamydospore formation. Initially the plants show temporary wilting symptoms, which become permanent and progressive, affecting more plants. The leaves of the affected plants show yellowing, loose turgidity and show drooping symptoms. Eventually, the plant dies. In older plants, leaves wilt suddenly and vascular bundles in the collar region become yellow or brown. The fungus invades the roots, colonizes the vascular system and thereby restricts water translocation. Cutting the base of the stem reveals a dark woody portion along with dark brown streak underside of bark.

3. Survival and spread:

a. Primary: It survives for some time as a saprophyte on colonized roots and then as chlamydospores in the soil.

b. Secondary: Intercultural operation.

4. Environmental Factors: The fungal disease develops during hot weather and is most destructive when soil temperatures approach 80°F. Dry weather and low soil moisture encourage this plant disease.

5. Integrated Disease Management:

a. Continuous cultivation of okra on the same piece of land should be avoided.

b. In case of fields severely infected by the wilt pathogen practicing long crop rotations is useful in reducing the pathogen population.

c. Apply increased doses of potash with a balanced dose of nitrogenous and phosphatic fertilizers.

d. Treat the seeds with Mancozeb @ 3g/kg seed.

e. Three sprays of Karathane (6g in 10 litres of water) or Bavistin (1g/litre of water) immediately on appearance of initial symptoms at 5-6 days interval checks the spread of the disease. Leaves of fully grown plants should be thoroughly drenched during spraying.

Damping Off

1. Causal organism: *Pythium* spp., *Rhizoctonia* spp.

2. Disease symptoms: Damping off disease may kill seedlings before or soon after they emerge. Infection before seedling emergence results in poor germination due to decay of seeds in soil. If the decay of the seedlings starts at emergence they fall over the ground and die which is referred to as "damp-off". The severity of the disease depends on the amount of pathogen in the soil and on environmental conditions. When seedlings on emergence develop a lesion near the collar region, the tissue beneath the lesion soaks water and becomes soft due to which the seedlings topple down on the ground and collapse. Cool, cloudy weather, high humidity, wet soils, compacted soil, and overcrowding especially favour development of damping-off.

3. Survival and spread:

a. Primary: Soil, Seed, Water

b. Secondary: Conidia through rain splash or wind.

4. Environmental Factors: High humidity, high soil moisture, cloudiness and low temperatures below 24° C for few days are ideal for infection and development of disease. Crowded seedlings, dampness due to high rainfall, poor drainage and excess of soil solutes hamper plant growth and increase the pathogenic damping-off.

5. Integrated Disease Management:

a. Over irrigation should be avoided to reduce humidity around the plants.

b. The field should be regularly inspected for the disease-affected seedlings. Such seedlings should be removed and destroyed.

c. The efficacy of clean fallow and rotational crop reduces population densities of *Pythium aphanidermatum* , *P. myriotylum*, and *Rhizoctonia solani* in soil

d. Seed treatment with antagonist fungal culture of *Trichoderma viride* (3–4 g/kg of seed) or thiram (2–3 g /kg of seed) will be used against the disease.

e. Seed treatment with carbendazim followed by soil application of *Trichoderma viride* was proved effective controlling the seedling diseases of okra caused by *Rhizoctonia solani* and *Pythium aphanidermatum.*

f. Soil drenching with Dithane M 45 (0.2%) or Bavistin (0.1%) affords protection against the disease.

Root-Knot Nematodes

1. Casual organism: *Meloidogyne incognita*

2. Disease symptoms: Okra is highly susceptible to root-knot nematodes, Meloidogyne species. The above ground symptoms are similar to root rot and wilt diseases. Only the difference is appearance of root galls/knots of different sizes, instead of root rotting. The infected roots also become enlarged and distorted. Root-knot nematode has wide host range.

3. Survival and spread:

a. Primary: Infective J_2 stage

b. Secondary: trough irrigation and agriculture operation

4. Environmental Factors: Nematode is easily found in every temperate like tropical, subtropical and temperate region and it is possibly the single most damaging crop pathogen in the world.

5. Integrated Disease Management:

a. Summer ploughing for desiccation of nematode.

b. Crop rotation with *Chrysanthemum* spp., *Sesbania* spp., *Crotalaria* spp., *Gaillardia* spp., castor bean, *Desmodium* spp., cereals and low land paddy for at least 2 years.

c. Intercropping of marigold with okra is very effective for reduction in larval and nematode population

d. Apply neem cake @ 25 q/ha or saw dust @ 28 q/ha along with 120 kg nitrogen before transplanting.

e. Use of biocontrol agents like *Paecilomyces lilacinus, Pochonia chlamydosporia, Pasteuria penetrans,* Verticillium and Bacillus spp.

d. Phorate or Aldicarb @ 25 kg/ha should be applied before crop sowing.

Yellow Vein Mosaic Virus (YVMV)

1. Causal organism: *Bhendi yellow vein mosaic virus* (BYVMV)

2. Disease Symptoms: This is the most important and destructive viral disease in okra that infects crops at all the stages growth. The characteristic symptoms of the disease are a homogenous interwoven network of yellow veins enclosing islands of green tissues. Initially infected leaves exhibit only yellow coloured veins but in the later stages, the entire leaf turns completely yellow. In extreme cases, the infected leaf becomes totally light yellow or cream coloured and there is no trace of green colour. At times, enations (raised structures) are observed on the under surface of infected leaf. Plants infected in the early stages remain stunted. The fruits of the infected plants become pale yellow to white in color, deformed, small and tough in texture. The disease causes 50-100% loss in yield and quality if the plants get infected within 20 days after germination.

3. Survival and spread:

a. Primary: Virus particles in infected plants and collateral hosts like *Hibiscus tetraphyllus*, *Croton sparsiflora* and *Ageratum* spp.

b. Secondary: Virus particles transmitted by whitefly (*Bemisia tabaci*).

4. Environmental Factors: during rainy season, the temperature and relative humidity might have been high enough to support white fly multiplication for disease development.

5. Integrated Disease Management:

a. Early sowing in last month of June to first week of July.

b. Use resistant/tolerant variety Pusa Sawani, Pusa A 4, Arka Abhay, Arka Anamika, Varsha Uphar, Hisar Unnat, Hisar Naveen, Gujarat Anand Okra-5, Azad Bhindi -1, Azad Bhindi-3 the incidence of the disease can be minimized.

c. Removal and destruction of virus affected plants and planting of disease resistance varieties reduces the disease incidence.

d. Seed treatment with Imidacloprid @ 5 ml per kg of seed.

e. Removal of malvaceous hosts around the field.

f. Spraying monocrotophos 1.5 ml/litre of water can restrict the disease spread.

g. Two spray of Acetamiprid 20SP @40g a.i/ha was effective in reducing the incidence of YVMV, subsequently increase the yield of okra.

h. He finally concluded that most effective one was admiring spray on okra followed by neem oil and mustard oil. Imidachloprid 17.8% SL applied twice and one seed treatment significantly reduce the pest population up to 90.2%.

i. Controlling the whitefly population minimizes the incidence of YVMV. Soil application of Carbofuran (1kg a.i./ha) at the time of sowing and 4-5 foliar sprays of Dimethoate (0.05%) or Metasystox (0.02%) or Nuvacron (0.05%) at an interval of 10 days effectively controls the whitefly population.

Enation Leaf Curl

1. Causal organism: *Enation Leaf Curl Virus* (ELCV)

2. Disease Symptoms: The important symptoms of this disease are curling of leaves in an adaxial direction, and mild or bold enations on the under surface of the leaves (become thick and deformed). The most characteristic symptom of this disease is twisting of the main stem and lateral branches Twisting of leaf petiole is conspicuous. The leaves become thick and leathery in structure. In case of heavy infection, the newly emerged leaves also exhibit bold enations, thickening and curling. The infected leaves become thick and leathery. The plant growth is retarded. Fruits from infected plants are small and deformed and unfit for marketing.

3. Survival and spread:

a. Primary: Virus particles in infected plants and collateral hosts like *Amaranthus retroflexous, Malva parviflora, Gossypium barbadense, Lycopersicon esculentum* and *Nicotiana tabacum.*

b. Secondary: through the insect vector, whitefly (*Bemisia tabaci*).

4. Environmental Factors: The disease is now wide-spread in sub-tropical regions during rainy season from June to September and in tropical region during spring summer from February to June.

5. Integrated Disease Management:

a. Removal and destruction of virus affected plants reduces the disease incidence.

b. Use tolerant cultivars.
c. Seed treatment with Imidacloprid @ 5 ml per kg of seed.
d. One to two sprays of Abamectin @ 0.05% upto flowering stage.
e. Controlling the whitefly population minimizes the incidence of YVMV. 4-5 foliar sprays of Dimethoate (0.05%) or Monocrotophos (0.02%) at an interval of 10 days effectively controls the whitefly population.

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Use of Ultrasonography Diagnostic Techniques in Animals

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Introduction

High-frequency sound waves are used in to produce the images of soft tissues and internal organs in ultrasonography. It is a non-invasive technique, safe for both animals as well as the operator. The findings of ultrasonography are rapid, accurate and documentable during the examination. This technique is easy to handle, portable from one place to another place. So, it is a revolutionary technique for diagnosis different ailments, diseases, and normal physiological function of the body in small as well as large animals.

Principle of Ultrasonography

The ultrasound beam is generated from Pizzo-electric crystal travel and strike the organ/tissues and gets reflected or reabsorbed by the tissue and organ. The reflected beams are received by the transducer and displayed on the monitor of ultrasound. If the sound beams strike to the solid organ-like bone, the major parts of the beam reflected and it appears as bright white on the screen. If the beams strike to fluid, these beams get absorbed and not reflected therefore appears as black on the screen.

Term Related to Ultrasonography

1. Echoic: Which reflect ultrasound beam without absorbing it e.g. A solid structure like a bone. The structure appears bright white on the screen.

2. Anechoic: Those structures which absorb almost all ultrasound beams fluid. This structure appears black on the screen.

3. Hypoechoic: These are soft tissue which reflects some portion of the beam.

4. Hyperechoic: These are body organ that reflects the majority of the ultrasound beam.

Use of Ultrasonography in Animal

1. USG is used in the diagnosis of cystitis, enlargement of the prostate gland, urethritis and diagnosis of urinary stones in animals.

2. In USG, ovarian stroma appears as more echogenic as compared to the ovarian structure like follicles and corpus luteum. Ovarian stroma is difficult to visualize in buffalo as luteal tissues occupy the almost entire ovary. The follicle is the 2-3mm diameter. Maximum diameter of the preovulatory dominant follicle at oestrus is 10-14 mm in buffaloes.

3. The sudden disappearance of the large preovulatory follicle on subsequent USG examination indicates the ovulation process. It is also possible to detect the corpus haemorrhagicum on the first day after ovulation.

4. In USG, a developing corpus luteum appears an irregular mildly echoic structure, while mature corpus luteum is more echoic and appears well-defined granular oval structure with the line of demarcation from the ovarian stroma. In buffalo, the size of mature corpus luteum is 18-25 mm in diameter. The cysts appear large (25-55 mm), nonechoic round structure black in colour that is single or multiple. The thickness of the wall of the cyst is less than 3 mm in the follicular cyst and more than 3 mm in the luteal cyst.

5. Various pathological and other physiological condition of the uterus can be identified using ultrasonography in large animals. Uterine pathological condition like endometritis, pyometra, mummified/macerated condition characterised by the thickened uterine wall and a distended lumen, filled in varying degree with partially echogenic snowy patches.

6. With the help of USG, it is possible to diagnose the early pregnancy between 16-21 days after insemination. The stage of gestation is also known by measuring a variety of parameters.

7. Diagnosis of fetal sex is based on the presence of scrotal swelling and mammary gland or location of genital tubercle which leads to the formation of the penis or clitoris. It is also recognized as a prominent bilobular structure in the vicinity of the umbilical cord in the male and the tail in females. Correct diagnosis can be done in between 55-100 day after breeding.

8. In embryo transfer program ultrasound can be used to evaluate the response and suitable strategies which could enhance ovulation rate in the donor. The USG examination of recipient animal for the presence of corpus luteum on the day of embryo transfer is very useful for its correct diagnosis.

9. Transrectal ultrasonic scanning helps predict the day of estrus and ovulation, studying follicular dynamics during estrus cycle, postpartum period, superovulation and concerning the hormonal treatment and differentiating true anestrus from silent estrus condition.

10. Anovulation in an animal can be accurately determined by sequential Ultrasonographic examinations.

Conclusion

Ultrasonography is a better alternative to diagnose the disease or pathological condition in animals. It is a suitable strategy to optimise the reproduction and thus fertility of a female animal.

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Agro-Ecological Farming Systems

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A major challenge of the 21st century is to cope with the increasing demand for agricultural products from a growing world population with changing consumption patterns while maintaining biodiversity and securing ecosystem services in agroecosystems (Godfray et al., 2010) Agro-ecological Farming Systems defines itself as a network of partners aiming to gather format and disseminate useful and operational information in order to meet the needs for information of practitioners in natural resources management and agricultural development. This working group's field is described by the term "Agro-ecological Farming Systems". This term covers the concepts of "agro-ecology" and "farming systems". A short definition of both concepts is useful in order to lay down the foundation for common understanding of the theme.

Agroecology

The term agro-ecology refers to ecosystems. Ecosystems are characterised by aspects such as nutrient cycling, population regulation, energy flows and a dynamic equilibrium. These characteristics apply to natural ecosystems, and, in a much-altered form, also to manmade or agricultural ecosystems. The magnitude of the differences between natural and agricultural ecosystems depends mainly on the human manipulations, generally characterised by the intensity of management or intervention, and the level of disturbance vies- versa the (natural) equilibrium. Both the intensity of management and the level of disturbance have to be considered as a result of social and economic pressures on the human actors in the agricultural ecosystem. This increasing intensity of management is clearly visible in technical innovations in agriculture, often invented under the economic pressure to become more efficient. Production increases through agricultural intensification are characterized by high rates of fossil fuel energy consumption and high levels of agrochemical use. This intensification often causes environmental problems (Pittelkow et al., 2015), such as degradation of soil and water resources and loss of biodiversity and associated ecosystem services. Thus, modern agricultural management faces the challenge to deliver constant high-quality yield without harming the environment (Reganold and Wachter, 2016). The innovations often require a uniformity (in crops, in soil management) by which the agro-ecosystem moves further and further away from the natural system.

This interdependence of natural and social dynamics explains why an information system concentrating on Agro-ecology has to be based on local information for a large part: it has to represent the local combination of social, technological and natural conditions

Farming Systems

A farming system can be defined by:
1. Boundaries: What belongs to the farm, what is the environment in which it operates?
2. Components: Crops or cropping systems, livestock system, trees, buildings etc.
3. Interactions: The relationships between the components.
4. Inputs: Materials, information and energy originating outside the system but utilised within.
5. Internal Resources: Materials, information and energy originating within the system.
6. Products and By-Products.

As Interdev focuses on innovations, it is important to get a clear view of the location of the modifications in a farming system and where they fit in the whole. In order to judge the relevance of agricultural innovations, questions can be raised such as, "What are the key elements describing the bio-physical and socio-economic context?" and "What are the criteria a farmer uses in the decision to adopt a certain change? In farming systems research farmers are often grouped together in so-called recommendation domains, and it is assumed that these farmers have a similar demand for innovations. However, for this working group, the focus is more on the farm-family level, and the changes in agricultural (forestry, fisheries) practices that these individual households could adopt. Innovations on a higher level of aggregation, especially the institutional innovations required for management and control of common resources and ecosystems (such as community forestry or land management) are another important related topic, which will be dealt with in a separate table in the database, called "Institutional Innovation". The concept of Agro-ecological Farming Systems includes the idea that the agricultural practices are both site-specific and specific to the socio-economic position of the (type of) farmer or farm family applying them.

Priorities for Agro-ecological Farming Systems

In terms of priority, the emphasis will be on small scale agriculture, without at this moment in time defining the upper limit clearly. Both agro-ecology and the farming systems concepts are quite holistic approaches to the functioning of farms. Agro-ecology may have the connotation of a well-developed, completed innovation process attaining high standards of "agriculture in partnership with nature" etc. However, at this stage, the idea is not to fill the database with cases of such a completed innovation process only, though these may be very interesting. For now, we use the concepts of agro-ecology and farming systems to describe the orientation of the technologies and innovations that should be described. Any change that is oriented towards the general aims of agro-ecology and where the context and the system are sufficiently described, could be entered in the database.

Database Information

The information to be entered in the information system includes methodologies and technologies, practical experiences, directories with contact persons, multimedia documents and selected bibliography.

Type of Experiences in the Development of Agro Ecological Farming System

1. Techniques and Principles: Describes recommended farming practices/techniques or practices of natural resource management with observations/feed-back from farmers on how they have adapted the practice.

2. Farmers' Experiences: Describes farmers' practices and innovations. Includes traditional/ indigenous practices and those that have been developed under or adapted to local conditions

3. Institutional Innovations and Scaling-Up: Describes methodological approaches to working with farmers or groups/communities of farmer's involved in the development of agro-ecological farming systems. Would include Participatory technology development (PTD) and Sustainable Livelihood approaches, capacity-building of Community based organizations (CBO's), scaling-up strategies, etc. Note: The technical out-puts of such approaches should be described under "Farmer Experiences "developed/adapted to local conditions.

Conclusion

The agro-ecological sustainability analysis showed that the studied organic horticultural farms had a good level of sustainability. By analyzing individual components of the environmental systems, farms had satisfactory crop rotation with very positive effects on the landscape and biodiversity. Family farming is a strategic framework for promoting conservation and the sustainable use of resources. It is therefore important to determine the feasibility and benefits of practices oriented toward these objectives. Maintaining and improving fertility and soil stability, increasing diversification of crops and of income and reducing inputs, are actions of interest in agro-ecological transition systems.

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Food Ingestion Behaviour of Sap Feeding Insects - Its Implications in their Management

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Introduction

Feeding is the important process by which all insects obtain their food in adequate quantity. In search of evolution of insect feeding, it is varied with different strategies evolved at several times in independent lineages (Sahney et al., 2010). Insects and also mites that feed on plants have different feeding behaviours, include biting and chewing (e.g. grasshoppers), piercing and sucking (e.g. sap feeders), rasping and sucking (e.g. thrips), Chewing and lapping (e.g. honey bees), siphoning (e.g. moths and butterflies) etc.

Thereby they cause variety of symptoms on plants such as formation of galls (Fig.1), leaf twisting (Fig. 2), leaf cupping (Fig.3), leaf mines (Fig.4), leaf skeletonization (Fig. 5), wilting and rotting. Differently, biting and chewing insects, physically remove portions of any of plant tissues either directly or consume entire plant parts and ingest macerated tissues. All insects that possess other methods of food ingestion are known to be evolved from these two types. Common examples for insects with piercing and sucking and related types of mouthparts include plant bugs, aphids, whiteflies, mealybugs, scales, hoppers and thrips cause severe defoliation and significant yield loss (Fig. 6 to 8).

They thrust their flexible stylet or proboscis into the vascular tissues of plants either in xylem or phloem and acquire sufficient quantity of plant sap. This resulted in variety of malfunctions and deviations in phenology and physiology of plant system. Majority of sap feeders concentrate on phloem (main transport channel of food materials) to obtain their nutrition and whereas, certain leafhoppers and spittlebugs feed within the water-conducting tissues called xylem.

Feeding Mechanism

Basically, any insect possesses following parts such as, upper lip (labrum), lower lip (labium), cutting parts (pair of mandibles), holding and mastigating structures (pair of labia) and a middle hypopharynx in their mouth either with or without modifications. In due course of evolution, sap feeders evolved with some essential modified adaptations to ingest food. Majority of sap feeding insects passively uptake their food from vascular tissues via high pressure exist within sieve elements.

Their mouth parts such as maxillae and mandibles are elongated into thrusting stylets which pierce the plant tissues. Whereas, the distal end of labium act as feeding guide for stylet. While feeding, these insects known to produce saliva contain digestive enzymes of plant tissues (Miles 1999, Felton and Eichenseer 1999). This feeding habit cause only little damage to plant cells when compared to that of chewing Insects. In order to recognize ideal host plants, the sap feeders normally make multiple feeding probes through their stylet (Alvarez et al., 2006; Schwarzkopf et al., 2013).

Host Plants and Insect Feeding

Majority of sap feeders' harbours on green tissues of plants and also devastate reproductive portions during certain conditions. It is mainly attributed to the presence of relatively high levels of protein. Nitrogen is the primary plant nutrient influence on host plant nutrition.

It also contributed to the production of certain defensive secondary metabolites which may interfere with acceptability. In general phloem vessels are chief transport source of all plant nutrients and xylem take care of movement of water. Insects those feed on phloem vessels (e.g. aphids, mealybugs, scales, whiteflies) are found to be predominant than on xylem feeders such as cicada, spittle bugs, leaf hoppers (Wiegart, 1964, Bayers and Wells, 1966, White, 1976, David and Robert, 1987).

Xylem feeding insects tends to be adjusted with more negative water tension and very low concentrations of essential nutrients available in xylem vessels resulted in extraction of large quantities of plant fluids than phloem-feeders. But this is not easy process as sap feeders need to exhibit many physical and chemical reactions to overcome plant defences exerted though their secondary metabolites (Guerrieri and Digilio, 2008).

Similarly, plant nutrients are highly accumulated in reproductive portions than the vegetative arts such as leaves and stems and this varied depend on plant type, age and nutritional status of the soil. Excessively fertilized plants produce succulent growth and thinner cuticles which causes their more susceptibility to sap feeders through easy penetration of stylets and rapid food ingestion.

Insects such as aphids, mealybugs, whiteflies, scales and certain hoppers feed on phloem excrete larger quantities of honeydew rich in sugar and amino acids and this could be achieved by consumption of large quantities of plant sap. On the other way, this helps them for good development and reproduction. As a chain of reaction, black sooty mould often grows on honeydew deposited by sap feeders. Phloem feeders possess appreciable number of enzymes like amylase, protease and lipases which help to break down the plant tissues. In addition, their host preference and suitability are decided by plant-specific chemical compounds. Sap feeders known to harbour many intracellular symbiotic microorganisms for efficient digestion and utilization of food (Douglas, 2006). Apart from direct feeding and causing quality deterioration their infestation is associated with the transmission of phytopathogenic viruses
(Fig. 9).

Thrips often referred as an important sap feeder, known to lacerate the plant tissue instead of cutting due to absence of right mandible. This was achieved by the aberration action of their left mandible against the plant and sucking part helps them to take the liquefied plant tissue. Mites especially red spider mites and yellow mites do not feed in the vascular tissues instead feed on under surface of leaves and obtain food by removing chlorophyll with their stylet like structure called as chelicerae (Fig.10). Due to this kind of feeding nature they are not much susceptible to systemic insecticides.

Fig. 1 Galls

Fig. 2 Leaf rolling

Fig. 3 Leaf cupping by Jassids

Fig. 4 Leaf mines

Fig. 5 Leaf skeletonization

Fig. 6 Mealybug infestation

Fig. 7 Infestation of Aphids

Fig. 8 Scales attack

Fig. 9 Mosaic disease transmitted by whiteflies

Fig. 10 Mite infestation

Suitability of Insecticides

As sap feeders directly ingest the plant sap, insecticides possessing systemic action are found to be more promisive to manage them. Basically, systemic insecticides are classified as plant systemic (systematically moved in plants alone), insect systemic (systematically translocated in insect alone) and plant and insect systemic (translocated in both plants and insects). Majority of the commercial plant systemic insecticides upon absorption through leaves in turn translocated in xylem vessels followed by acropetally (upward) moved along with water and nutrients and hence they are referred as one-way systemic.

Insects with piercing-sucking mouthparts that derive nutrients from food conducting vessels are susceptible to systemic insecticides. Plants do not readily metabolize these systemic insecticides. They possess greater water solubility which allows them to be distributed throughout plant system. Generally, the active ingredient (A.I.) is taken up and moved throughout the plant via xylem, phloem or both and as a result the whole plant sap becomes insecticidal. As an insect feeds, it takes up a lethal dose of A.I. and cause killing of insects. Insects with piercing-sucking mouthparts that feed primarily on the underside of leaves are susceptible to insecticides with translaminar properties or local systemic activity viz., abamectin, acephate and spinosad. Howbeit, phytophagous mites are susceptible to insecticides or acaricides with translaminar properties such as abamectin and etoxazole. In order to achieve desirable level of management, while targeting insects feed on xylem, the systemic insecticide should be xylem translocative and similar concept has to be adopted for phloem feeders also.

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Modern Techniques of Molecular Cytogenetics

Article ID: 30432

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Introduction

Cytogenetics is a branch of genetics that is concerned with the study of the structure and function of the cell, especially the chromosomes. It includes routine analysis of G-banded chromosomes, other cytogenetic banding techniques, as well as molecular cytogenetics such as Fluorescent In situ Hybridization (FISH) and Genomic In situ Hybridization (GISH). Molecular cytogenetics involves the combination of molecular biology and cytogenetic with inclusions of series of techniques in which DNA probes are labeled with different colored fluorescent tags to visualize one or more specific regions of the genome.

Brief History of Molecular Cytogenetics

History	Inventor
Images of human chromosomes	Arnold 1879; Flemming 1881
Down syndrome	Lejeune et al., 1958
Klinefelter syndrome	Jacobs and strong 1959
Turner syndrome	Ford et al., 1959
Chromosomal banding Pattern (Q Band)	Caspersson et al., 1968
Philadelphia chromosome	Rowley 1973
in situ hybridization analysis	Gall and Pardue 1969; John et al., 1969
FISH	Bauman et al., 1980
GISH term coined by	Schwarzacher et al., 1989

Modern Techniques of Molecular Cytogenetics

1. In situ Hybridization (ISH): ISH is a type of hybridization that utilises a labelled complementary DNA, RNA or modified nucleic acids strand (i.e. probe) to localize a specific DNA or RNA sequence in a portion or section of cells, tissue and provides physical map of the sequences. This technique also provides abundance and distribution of repetitive sequences. It used isotopes to label probes to detect the DNA or RNA sequences in cytological preparations. Radiolabelled probes, including 3H, 35S, 32P, are still widely used, on the other hand, non-radioactive successfully used with in situ hybridization include digoxigenin (DIG) and biotin.

a. Procedure:

i. Slide Preparation: For chromosome spreads, alcohol/ether (1:1) cleaned slides are sufficient.

ii. Sample Collection and Fixation: To preserve morphology, fresh tissue should be rapidly removed and fixed as soon as possible. For metaphase chromosome spreads, methanol/acetic acid fixation is usually sufficient.

iii. Embedding and Section: After fixation, the sample is embedded in paraffin for long-term storage and sectioning for subsequent procedure.

iv. Permeabilization: It is known that the target DNA or RNA sequences are surrounded by proteins and the extensive cross-linking of these proteins mask the target nucleic acid, which present obstacles to good infiltration of the probe. Three main reagents used to permeabilize tissue are proteinase(1 µg/ml), HCl and detergents (Triton X-100, SDS).

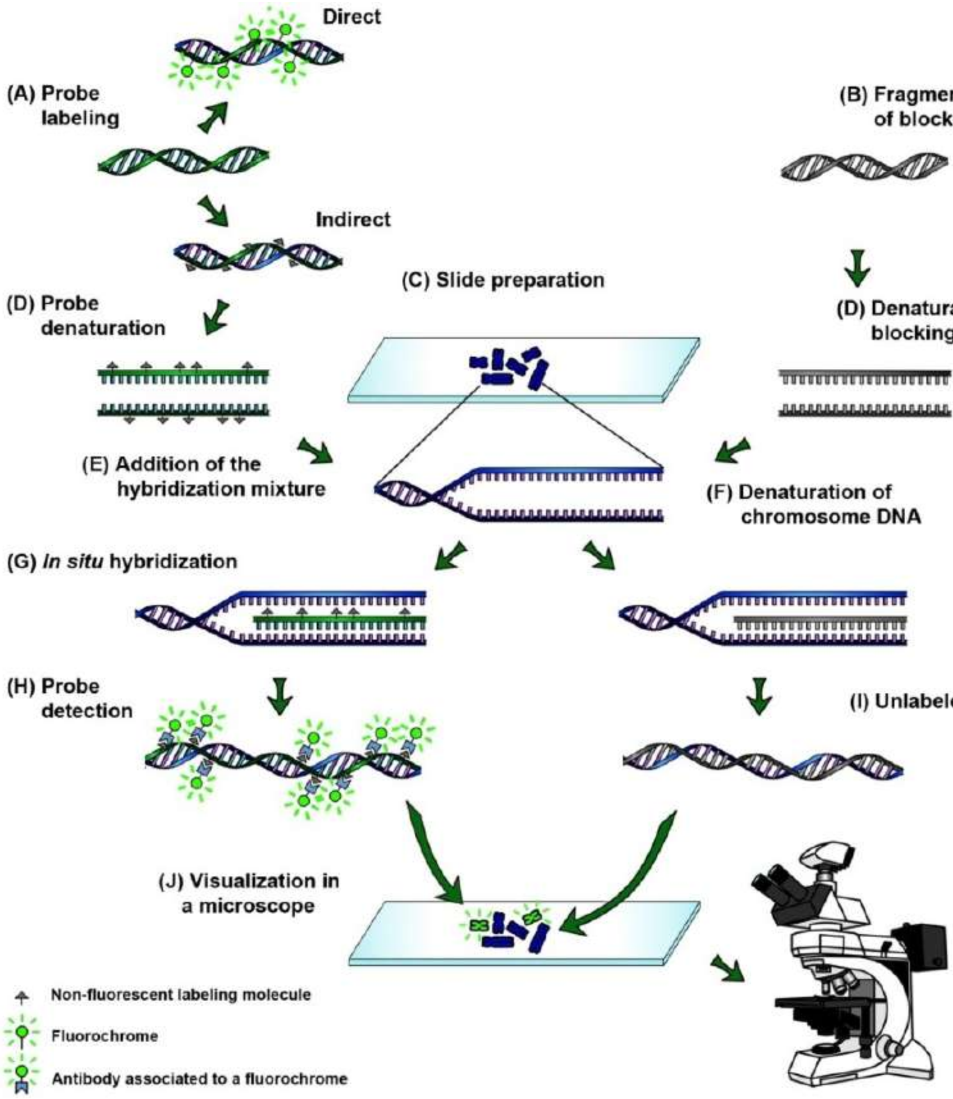
v. Prehybridization: Prehybridization is generally carried out to low the background noise.

vi. Endogenous enzyme inactivation: When an enzyme (such as peroxidases or alkaline phosphatases) is used visualize the label, the endogenous enzymes which could result in high background have to be inactivated.

vi. RNase treatment (optional): RNase treatment serves to remove endogenous RNA and decrease background in hybridization reaction.

vii. Hybridization: It depends on the ability of the probe to anneal with a complementary target strand just below its melting point (Tm). Additionally, the composition of the hybridization solution is important to control the efficiency of hybridization process.

viii. Washes: Unbound or loosely bound probes are removed by performing washes.



The process of In-situ hybridization (Bauman et al. 1980)

b. Detection: As mentioned above, radiolabelled probes are detected by either photographic film or photographic emulsion. For non-radiolabelled probes, there are two methods:

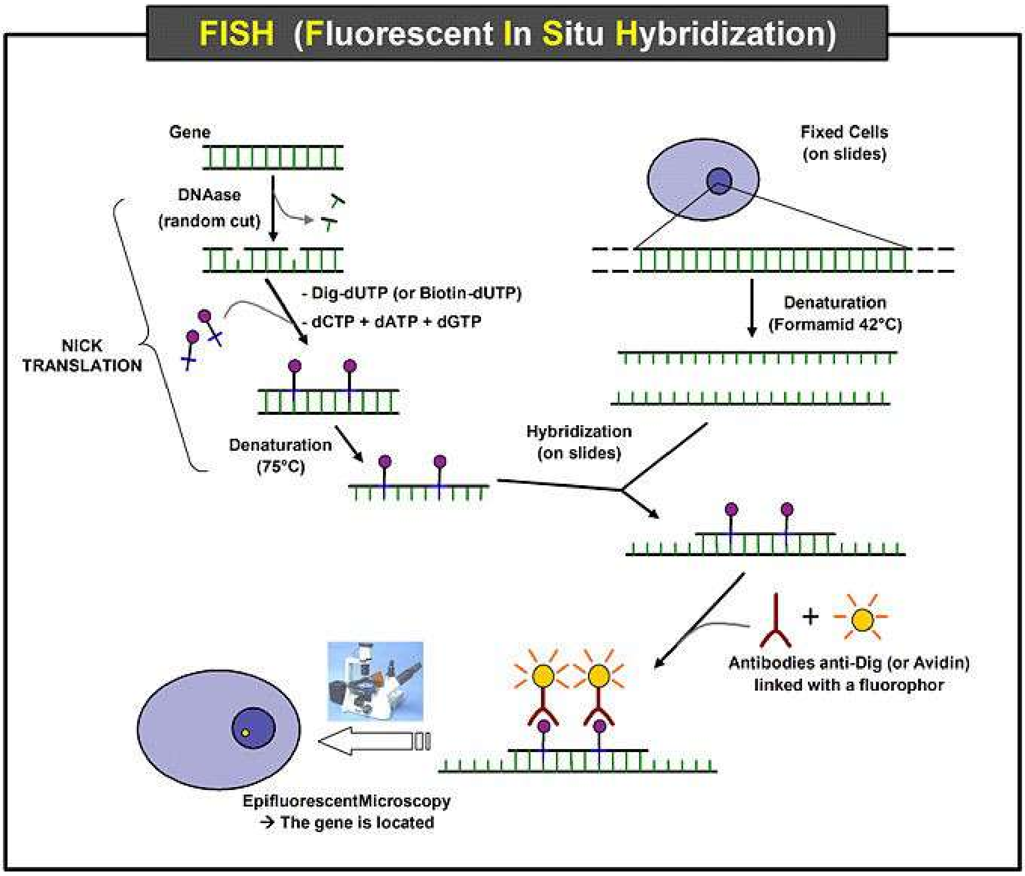
i. Direct methods: The detectable reporter is bound to the probe directly so that the probe-target hybrids can be detected under a microscope immediately post-hybridization wash.

ii. Indirect methods: If antibodies against the reporter molecules are available, indirect procedures are recommended. Probes labelled with biotin, DIG or FITC are usually detected by specific antibodies.

2. Fluorescent In-Situ Hybridization (FISH): is a cytogenetic technique uses fluorescent probes that bind only to those parts of the chromosome with which they show a high degree of sequence similarity. It can be used to detect and localize the presence or absence of specific DNA sequences on chromosomes. These features can be used in genetic counseling, medicine, and species identification.

a. Variations of FISH:

i. Stellaris FISH: Formerly known as Single Molecule RNA FISH. It is a method of detecting and quantifying mRNA and other long RNA molecules in a thin layer of tissue sample. Targets can be reliably imaged through the application of multiple short singly labeled oligonucleotide probes. The binding of up to 48 fluorescent labeled oligos to a single molecule of mRNA provides sufficient fluorescence to accurately detect and localize each target mRNA in a wide-field fluorescent microscopy image. Probes not binding to the intended sequence do not achieve sufficient localized fluorescence to be distinguished from background.



The process of Fluorescent In situ hybridization

ii. Fibre FISH: The highest resolution target for FISH analysis on microscope slides is provided by the preparation of released chromatin fibres. These consist of chromatin from which proteins such as histones are removed, allowing it to unfold and extend. This method, known as fibre FISH, provides a resolution of 1–500 kb.

iii. Q-FISH: In Q-FISH, the technique uses labelled (Cy3 or FITC) synthetic DNA mimics called peptide nucleic acid (PNA) oligonucleotides to quantify target sequences in chromosomal DNA using fluorescent microscopy and analysis software. Commonly used to study telomere length.

iv. Flow-FISH: Flow-FISH is a cytogenetic technique to quantify the copy number of specific repetitive elements in genomic DNA of whole cell populations via the combination of flow cytometry with cytogenetic fluorescent in situ hybridization staining protocols.

v. Multicolour FISH: Painting of the entire chromosome complement such that each chromosome is labelled with a different combination of fluorophores. Simultaneous discrimination of different genomes in allopolyploids and visualize all the pairs of chromosomes in an organism in different colours.

3. GISH (Genomic In-Situ Hybridization): One of the important modifications of the FISH technique is GISH, where in the total DNA from the genome of one parent of a polyploid species or a hybrid is labelled as a probe. GISH is used to estimate the amount of alien chromatin within chromosomes in interspecific hybrids. GISH was first used for plants at Plant Breeding Institute, Cambridge by Schwarzacher et al.1989 using the biotinylated probe of total genomic DNA from *Secale africanum*.

Applications of GISH and FISH:

i. Analysing genome architecture.
ii. Chromosome identification.
iii. Genome analysis.
iv. Analysis of meiotic behaviour through GISH.

v. Phylogenetic Analysis
vi. FISH-based karyotyping
vii. Analysis of somaclonal variations
ix. Detection of Alien Chromatin
x. Detection of Chromosomal aberration
xi. For chromosome mapping
xii. Detection of chromosome elimination.

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Application of Minimal Processing Technologies in Food Industry

Article ID: 30433

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Introduction

Minimal processing is defined as the least possible treatment to achieve a purpose which minimally influences the quality characteristics of a food, giving the food sufficient shelf-life during storage and distribution. Or we can say that minimum processing includes techniques which preserve foods but also retain to a greater extent their nutritional quality and sensory characteristics. Minimal processing techniques often face challenge of replacing traditional methods of preservation retaining nutritional and sensory quality.

Importance

Minimal processing techniques are fast techniques which make them most suitable for heat sensitive foods. These also have the capacity to manufacture a wider range of products. This also results in uniform processing of food products therefore reduces the risk of contamination and spoilage. Also, the quality of food is improved, so the marketing of food is also increased.

Minimal Processing of Foods with Thermal Methods

Thermal methods are extensively used for the preservation and preparation of foods. Thermal treatment leads to desirable changes such as protein coagulation, starch swelling, textural softening and formation of aroma components. The common thermal methods are:

1. Aseptic processing: In aseptic processing, or ultra-high temperature (UHT) processing the product is sterilized before it is filled into pre-sterilized containers in a sterile atmosphere.

2. Semi-aseptic processes: In this heat treatment is done in direct contact between heating medium and food.

3. Infrared heating: When Infrared (IR) waves are absorbed they are transformed into heat and the temperature of the food material increases. This is used for drying fish, pasta, rice, vegetables, frying meat, roasting cereals and coffee, baking pizza, biscuits and bread.

4. Sous-vide processing: In this the actual cooking of raw foods is done under vacuum in the package which produces high quality cooked foods of limited refrigerated shelf-life. A wide range of vegetables, meat and fish products are being processed by this technique,

5. Electric volume heating: This heating method directly transfer energy from the electromagnetic source to the food, without heating up heat transfer surfaces in the heat processing equipment itself.

6. Electric resistance/ohmic heating: In electric resistance heating, the food itself acts as a conductor of electricity taken from the mains supply. In ohmic heating processes, foods are made part of an electric circuit through which alternating current flows, causing heat to be generated within the foods due to the electrical resistance of the foods.

7. High frequency or radio frequency heating: in High frequency (HF) heating food is heated by transmitting electromagnetic energy through the food placed between an electrode and the ground. The most accepted and widely used applications of RF heating in the food processing industry is the post-baking of biscuits and bulk defrosting of meats and fish

8. Microwave heating: Microwaves are used for heating. The majority of foods contain a substantial amount of water. When a microwave or RF electric field is applied to a food, dipoles in the water and in some ionic components such as salt attempt to orient themselves to the field resulting in oscillation which create frictional heat. The various industrial applications of microwave heating are:

a. Baking and cooking.
b. Tempering.
c. Drying.
d. Pasteurization and sterilization.

9. Inductive electrical heating: In this process, the food is pumped through coils of plastic tubing wound around the magnetic core of a strong electromagnet. This raises the temperature of food very quickly to sterilization temperatures.

Minimal Processing of Foods with Non-Thermal Methods

To check the undesirable changes which occur from thermal methods such as loss of vitamins and minerals, formation of thermal reaction components of biopolymers and, in minimal processing terms, loss of fresh appearance, flavor and texture, non-thermal methods are used. The most common non-thermal methods are:
1. Ionizing radiation: Ionizing radiation is widely used for packaging material for aseptic processing of foods. The most common irradiated foods are – Spices, fruits and vegetables, rice, potatoes, onions, sausages, dried fish, herbs.

2. High pressure processing: By subjecting foods to high pressures, microorganisms and enzymes are inactivated without the degradation of flavour and nutrients. Vegetative cells are inactivated at about 3,000 bars, while spore inactivation requires much higher pressures (6,000 bars or more) in combination with a temperature rise to 60–70ºC.

3. Ultraviolet light: UV rays are absorbed by the DNA/RNA of the microbes. This leads to sterilization by killing of the microbes.

4. Laser light: Laser lights rapidly inactivate microbes on surfaces or in clear liquids.

5. Pulsed white light: The pulsed white light is used for the continuous sterilisation of packaging film in aseptic processes. The UV content in combination with the extremely high intensity inactivate microorganisms by a combination of photochemical and photothermal effects.

6. Oscillating magnetic fields: Magnetic fields damage microorganisms. For effective growth inhibition magnetic field strengths in the order of 5–50 Tesla and oscillating frequencies between 5 kHz and 500 kHz have to be used. This permits treatment of liquid and solid foods in sealed packages.

7. Ultrasound: Ultrasound consists of vibrations like sound waves. These disrupt cell structure and inactivate microorganisms. High intensity ultrasound is used for cleaning surfaces and for changing the properties of foods, such as emulsification and meat tenderisation. This can assist in drying and diffusion. In some foods the rates of drying are increased by two to three times.

8. Plasma sterilisation at atmospheric pressure: This is a method of non-thermal sterilisation, using OH-radicals produced by pulsed discharge plasma at atmospheric pressure. This is applied for high-speed continuous sterilisation at room temperature of dry food materials and surfaces. The cold ionised gases kill bacterial cells rapidly.

Modified Atmosphere Packaging (MAP)

MAP refers to replacement of air in the package with a fixed gas mixture. Once the gas mixture is introduced, no further control of the gas composition is exercised, and the composition will inevitably change. MAP gives the following benefits:
1. Increase shelf-life by possibly 50–400%
2. Reduce economic losses due to longer shelf-life
3. Provides a high-quality product
4. Improved presentation – clear view of product and all-around visibility
5. Little or no need for chemical preservatives.

Active and Intelligent Packaging

Active packaging and smart packaging enhance food safety and quality in as natural way as possible. This technology is used for a wide range of shelf-stable and ready-to-eat chilled foods.

1. Active packaging: packaging technique that actively and constantly changes package permeation properties or the concentration of different volatiles and gases in the package head-space during storage; or actively adds anti-microbial, anti-oxidative or other quality improving agents, e.g. flavour enhancing substances via packaging materials into the packed food in small amounts during storage.

Examples of active packaging methods are as follows:

a. Oxygen scavengers or absorbers
b. Carbon dioxide absorbers or generators
c. Ethanol emitters
d. Ethylene absorbers
e. Moisture absorbers.

2. Intelligent, smart or clever packaging: packaging technique containing an external or internal indicator for the active product history and quality determination.

Examples:

1. Time–temperature indicators intended to be fixed onto a package surface
2. O_2 indicators
3. CO_2 indicators
4. Spoilage or quality indicators.

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Legumes Vegetable for Better Soil and Human Health

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Abstract

Legumes vegetables like Beans and peas are typically low in fat, contain no cholesterol, and are high in folate, potassium, iron and magnesium. Legumes Vegetable plays an important role for sustainability in many ways. Encouraging awareness of the nutritional value of legumes can help consumers adopt healthier diets. It can fix atmospheric nitrogen through their root nodules and also increase soil fertility that will in turn increase the yield of regular crops by a range of 10 to 15 per cent. They are an important component of crop rotations; they require less fertilizer than other crops and they are a low carbon source of protein. They have a direct positive impact on soil quality because they help feed soil microbes, which benefits soil health.

Leguminous vegetables have been cultivated for more than 6,000 years in different parts of the world. Legumes for human consumption constitute about 5% of the cultivated crops. Legumes Vegetable includes beans (cluster bean, cowpea, French bean, dolichols bean, broad bean and winged bean) and garden peas are the most versatile and nutritious foods available. Legumes are typically low in fat, contain no cholesterol, and are high in folate, potassium, iron and magnesium. They also contain beneficial fats and soluble and insoluble fibre. A good source of protein, legumes can be a healthy substitute for meat, which has fatter and cholesterol. The World Health Organization estimates that up to 80% of heart disease, stroke, and type 2 diabetes and over a third of cancers could be prevented by eliminating risk factors, such as unhealthy diets and promoting better eating habits, of which pulses are an essential component. Legumes are included in all 'food baskets' and dietary guidelines. The World Food Programme (WFP) for instance includes 60 grams of pulses in its typical food basket, alongside cereals, oils and sugar and salt. Encouraging awareness of the nutritional value of legumes can help consumers adopt healthier diets. In developing countries, where the trend in dietary choices tends to go towards more animal-based protein and cereals, retaining pulses is an important way to ensure diets remain balanced and to avoid the increase in non-communicable disease often associated with diet transitions and rising incomes.

In countries like India where majority of the population are vegetarians, leguminous vegetables serve as the major source of protein in the diet. In developing third world countries, especially for the' poor, the major protein source in the diet are vegetable legumes. Most leguminous vegetables are rich in phosphorus, calcium, iron, and a number of essential vitamins. Although leguminous vegetables are deficient in some of the sulphur-containing amino acids, they are well compensated when consumed with cereals. In some instances, the leaves, tender shoots, and roots are harvested and used as vegetables. The whole seed of some of the legumes are called grain. Seeds of legumes without seed coat and cotyledons split into half are commonly called as pulses in India.

Legumes play an important role for sustainability in many ways. They are an important component of crop rotations; they require less fertilizer than other crops and they are a low carbon source of protein. Legumes are part of the rotational crop's farmers can use to maintain soil fertility. They have a direct positive impact on soil quality because they help feed soil microbes, which benefits soil health. They have also been shown to produce greater amounts and different types of amino acids than non-legumes and the plant residues left after harvesting pulse crops have a different bio-chemical composition than other crop residues. By fixing nitrogen in the soil, pulses also help reduce the footprint of other crops so the benefits extend much further into the food production cycle. There are many legumes traditionally used as dal and many of them now being utilized as vegetables. Legumes crop respond better to loam soil and it can maintain optimum moisture for longer period, which is essential for the normal activities of Rhizobium bacteria.

Legumes Vegetable crops can fix atmospheric nitrogen through their root nodules. This reduces the use of chemical fertilizers like urea and ammonium nitrate. At a time when decreasing soil fertility especially due to indiscriminate use of chemical fertilizers and prolonged cultivation of commercial crops has become a cause for concern among farmers, legume vegetables have turned out to be a boon for addressing this issue. Scientists feel that growing the legume vegetables at least once in a season will help in increasing soil fertility as they have the capacity to fix atmospheric nitrogen through their root nodules. This reduces the use of chemical fertilizers like urea and ammonium nitrate. Of course, growing legume crops for the natural fixation of atmospheric nitrogen was an age-old practice of traditional farmers. But the process has now been discontinued mostly by those growing commercial crops due to lack of awareness.

Leguminous Vegetable Plants Reduce Greenhouse Gas Emissions

1. Reduction of the emission of the greenhouse gases carbon dioxide and nitrous oxide (CO_2 and N_2O) in comparison to emissions from nitrogen-fertilized crops.
2. Reduction of fossil energy use in the production of food and feed.
3. Sequestration of carbon in the soil.
4. Biomass for biofuel production.

Studies at the Indian Institute of Horticultural Research, Hessarghatta (Bengaluru) have shown that growing legume vegetables can increase soil fertility that will in turn increase the yield of regular crops by a range of 10 to 15 per cent. Similarly, separate studies by various institutes and organisations too have indicated an increase in paddy yield by over 10 per cent when legume vegetables are grown as a rotational crop and an increase of 10 to 12 per cent in sugarcane yield when legume vegetables are grown as an intercrop. Cultivation of all the crops including cereals and regular vegetables will get benefitted if the legume vegetables are grown once a season. Apart from fixing atmospheric nitrogen, the legume vegetables also help in increasing the organic content of the soil as they produce huge quantum of foliage that gets added into the soil. In addition to this, they also enhance the water-holding capacity of soil. They have a positive impact on human health too as these protein-rich legume vegetables can help fight protein and energy-deficiency induced malnutrition. The advantage of legume vegetables is that they are all short-duration crops whose life cycle will get completed within 70 to 75 days. Hence, they can be grown either as a rotational crop or as an inter-crop between the regular commercial crops depending upon the requirements. In fact, the legume vegetables start yielding within 45 to 50 days of sowing and fit into any cropping systems, so focuses on developing high-yielding and disease resistant varieties which can fetch good incomes to farmers. These short-duration varieties help enhance the incomes of farmers not just because of increase in their yield, but also due to the fact that they reduce the spending in terms of application of fungicides and pesticides.

Table: Important Varieties of the Leguminous Vegetable Crops

Pea	Cowpea	French Bean	Dolichos Bean	Cluster Bean	Broad Bean
Pusa Shree	Arka Garima	Kashi Param	Kashi Haritima	Goma Manjari	Pusa Udit
Arkel	Kashi Shyamal	Arka sharath	Arka Amogh	Pusa Navabahar	
Arka Ajit	Kashi Gowri	Arka Komal	Arka Jay	Pusa Mausami	
Kashi Kanak	Kashi Unnati	Arka Suman	Arka Sambhram	Pusa Sadabahar	
Kashi Aarati	Kashi Kanchan	Arka Suvidha	Arka Soumya	Durga Bahar	
Kashi Nandini	Kashi Sudha	Arka Anoop	Arka Vijay		
Kashi Udhay	VRCP-06	Arka Bold	Pusa Early Prolific		
Kashi Shakti	Pusa barsati	Bountiful	Pusa Sem-1		
Kashi Mukti	Pusa Dofsali	Pant Anupama	Pusa Sem-2		
Kashi Samridhi	Pusa Phalguni	Pusa Parvathi	Rajni		
Rachna	Pusa Komal				
Azad Matar-3	Pusa Ritu Raj				

The IARI, IIHR and IIVR has released different improved varieties of legume vegetables in the crops of French bean, garden pea, dolichos bean, and cow pea while various other research institutes and agricultural universities too have come out with their own varieties. In fact, some of the legume vegetable varieties go beyond the conventional concept that they are meant for the consumption of common people residing mostly in rural areas as they are gaining popularity in niche urban markets.

Such popular varieties include the 'whole pod edible' variety of garden pea. The pods of Arka Apoorva can be eaten either as fresh salad or after cooking and frying. The agricultural scientists feel that these whole pod edible peas present an opportunity for Indian farmers to explore their potential in the country's niche urban markets.

Similarly, there are garden pea varieties which have resistance to rust and powdery mildew diseases. Also, there are yard long beans varieties like Arka Mangala which is a climber that produces pods with a length of 75 to 80 cms that are extremely popular in niche market. The package and practices of some important leguminous vegetable crops are given in the table-2.

Thus, planting a leguminous vegetable will result in nitrogen rich soil and when a non-leguminous vegetable is grown in this soil there is increase in vegetable production as well as provides minerals and vitamins for healthy life.

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Fertilizer use and Fertilizer Use Efficiency- An overview

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Introduction to Fertilizer Use in India

Fertilizer consumption has increased considerably from 60's (~ 0.69-2.94 Lakh tones) to 2010-11 (~ 281.22 Lakh tones). This increase in fertilizer consumption was due to introduction of fertilizer responsive HYV's and hybrids (FAI, 2015). Despite use of ideal ratio 4:2:1 current NPK use ratio is 8:2.7:1 which leads to imbalance nutrition and lower productivity (2.5 tha-1) than world average (3.5 tha-1) in Rice. Fertilizer consumption during 1967-68 to 2013-14 increased 24 times but food grain production was only 3.5 times. Nearly 50% of total fertilizer consumption is used in rice and wheat production, but the response declining gradually leading to decreasing rate of partial factor productivity.

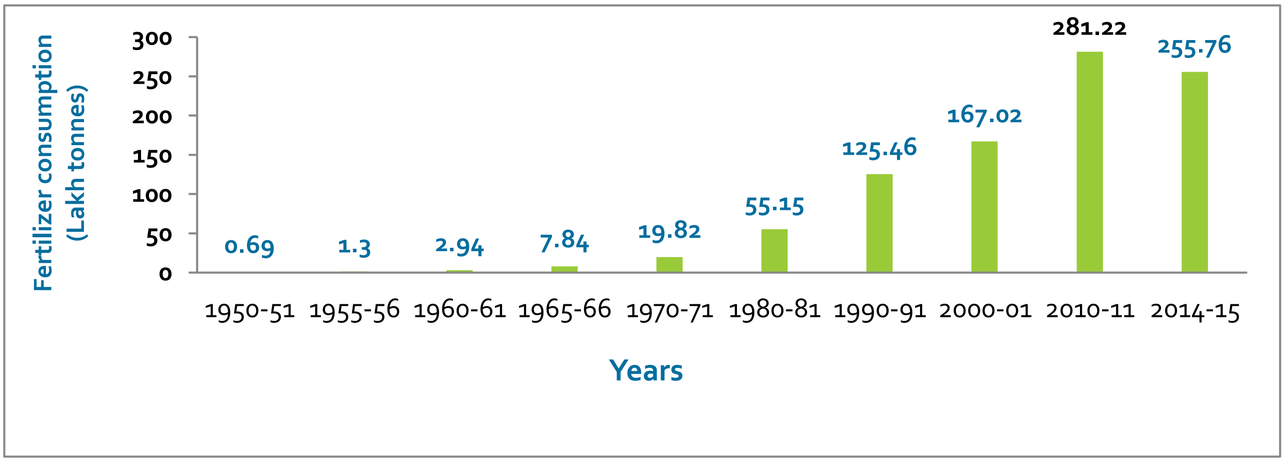

Fig. 1 Fertilizer consumption in India (Lakh tonnes)

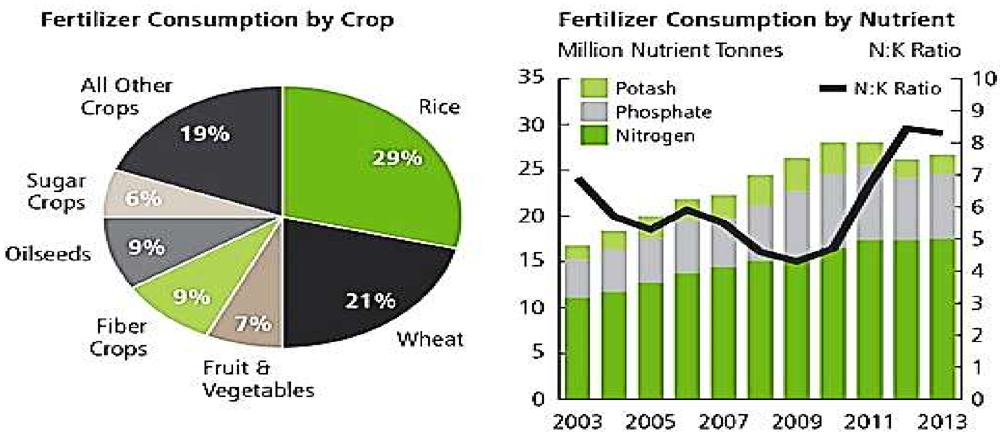

Fig. 2 Fertilizer consumption by crop and fertilizer ratio

Above pi-chart shows about 50% fertilizer used in rice and wheat production, however other sectors consume limited fertilizers. The 2nd graph shows the imbalanced fertilizer use which leads to reduced fertilizer use efficiency. A brief fertilizer consumption report is given below:

1. Increase in fertilizer consumption: Total fertilizer nutrient consumption increased by 5.6% in 2015-16 over 2014-15. The consumption of N, and P2O5 increased by 3.8% and 15.9%, respectively, during 2015-16 over 2014-15. However, the consumption of K2O declined by 7.9% during the period.

2. NPK use ratio changed: NPK use ratio changed from 6.7:2.4:1 during 2014-15 to 7.5:3.0:1 during 2015-16.

3. Per hectare use increased: Total nutrient consumption per hectare of gross cropped area increased from 131.6 kg in 2014- 15 to 138.9 kg in 2015-16.

4. Ten states account for 78% consumption: Uttar Pradesh had the largest share (17.7%), followed by Maharashtra (10.1%), Madhya Pradesh (7.3%), Karnataka (6.6%), Punjab, Andhra Pradesh and Bihar (6.3% each), West Bengal (6%), Rajasthan and Gujarat (5.6% each). These 10 states accounted for 78% of the total consumption in the country.

Fertilizer Use Efficiency (FUE) and Causes of Low Fertilizer Use Efficiency and Losses

FUE is the fraction of fertilizer nutrient removed from the field with the crop harvest. There are different efficiency indicators used, viz; Partial factor productivity (PFP), Agronomic efficiency (AE), Physiological efficiency (PE) and Apparent recovery efficiency (ARE).

$$PFP = \frac{Yield\ (kg\ ha^{-1})}{Nutrient\ applied\ (kg\ ha^{-1})}\ x\ 100$$

$$AE = \frac{\{Yield\ (kg\ ha^{-1}) in\ fertilized\ treatment - Yield\ (kg\ ha^{-1})\ in\ unfertilized\ treatment\}}{Nutrient\ applied\ (kg\ ha^{-1})}\ x\ 100$$

$$PE = \frac{\{Yield\ (kg\ ha^{-1}) in\ fertilized\ treatment - Yield\ (kg\ ha^{-1})\ in\ unfertilized\ treatment\}}{Nutrient\ uptake\ (kg\ ha^{-1})\ in\ fertilized\ treatment - Nutrient\ uptake\ (kg\ ha^{-1})\ in\ unfertilized\ treatment}\ x\ 100$$

$$ARE = \frac{\{Nutrient\ uptake\ (kg\ ha^{-1})\ in\ fertilized\ treatment - Nutrient\ uptake\ (kg\ ha^{-1})\ in\ unfertilized\ treatment\}}{Nutrient\ applied\ (kg\ ha^{-1})}\ x\ 100$$

Among different applied fertilizer nutrient sources Nitrogenous fertilizers are more prone to losses due to different mechanisms like leaching, denitrification, volatilization and sometimes immobilization. Fixation is the major problem in Phosphatic fertilizers. Soil pH is the major determining factor for available soil phosphorous. In acidic soil P fixation with Al- & Fe- and in saline soil as Calcium phosphate.

Fixation in clay lattice and leaching in sandy soils are the major problem in K losses. Immobilization and leaching are major problems in sulphur and in case of micronutrients fixation is the major problem for un-availability.

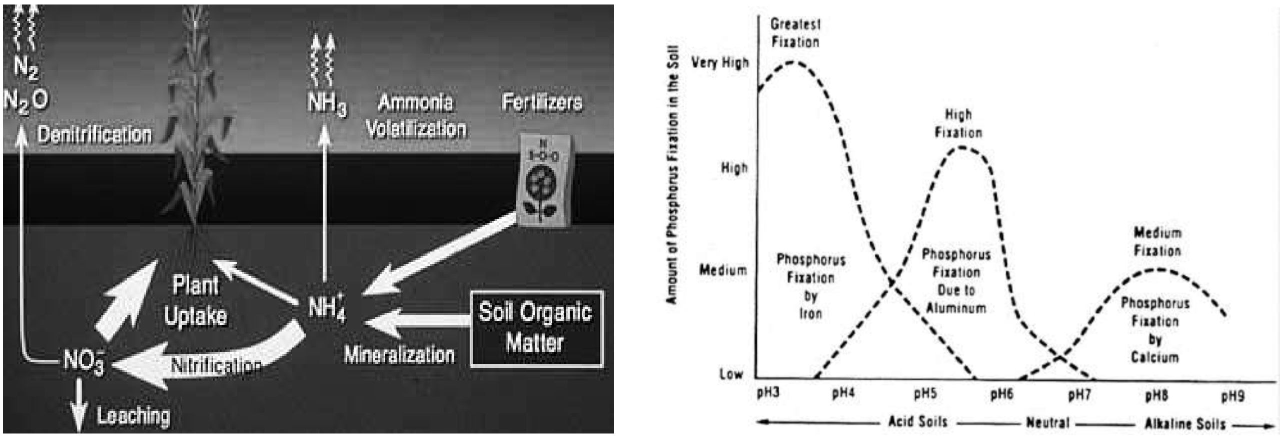

Fig. 3 Different losses in N fertilizers and P fixation related to soil pH

Table- NUE of different nutrients in India and causes of low NUE		
Nutrient	NUE (%)	Causes of loss
N	30-50	Immobilization, Leaching, volatilization, de-nitrification
P	15-20	Fixation in soil as Al-P, Fe-P, Ca-P
K	70-80	Fixation in clay lattices
S	8-10	Immobilization, leaching
Micronutrients	1-2	Fixation in soil

Ways to Improve NUE

To cope up with low NUE and reduce losses 4-R principles followed as; Right source, Right rate, Right time and Right place.

1. Right source of fertilizer application is an important factor attributing to how efficient the fertilizer is for a specific edaphic climate and crop species. For example, acidic fertilizers are used in basic soils and vice versa. Ammoniacal source of fertilizers are well suited for low land paddy not for other crops. In case of phosphatic fertilizers, water soluble fertilizers are used for annuals and water and citrate insoluble fertilizers used for perennial trees.

2. Right rate of fertilizer application is always recommended for higher fertilizer use efficiency minimizing the losses and over and under application.

3. Right time of application should be synchronous to optimal period of crop nutrient demand so that crop can be able to uptake the nutrient as per need.

4. Right place of application is more specific to phosphatic fertilizers because they are immobile in soil and their fixation in soil leads to crop nutrient unavailability. Somehow, in case of ammoniacal N fertilizers it is recommended to use in reduced zone to avoid volatilization losses and increase fertilizer use efficiencies.

Nutrient management strategies in plant should be well focused on profitability, productivity, sustainability and environment. Fertilizer application should be based on the nutrient balance of soil i.e. if soil shows negative balance of nutrient it is recommended to apply balanced recommended fertilizers with some organic manure to maintain the soil alive increasing the soil microbe population.

Conclusion

Indiscriminate use of fertilizers by Indian farmers not only limiting the FUE but also make the system unsustainable due to rhizosphere and phylosphere contamination. Modern principles of fertilizer application mainly focus on understanding the soil and plant nutrient balance and real time fertilizer application to minimize the losses and increase FUE. Recent advancement in LCC and SPAD based N-management in rice, wheat and vegetables has a considerable impact on modern resource conservation strategy in respect of fertilizer management. 4R principles i.e. right time, right source, right rate and right place of fertilizer application must be followed for increasing.

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Phosphorus Dynamics in Soils

Article ID: 30436

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Introduction

Phosphorus is a vital component of the substances that are building blocks of genes and chromosomes. Its reserves in soil are found mostly as sedimentary formations and unrefined ores known as phosphate rock. Recently great strides have been made in understanding the cycling of elementals, particularly N, S, and P, within ecosystems (McGill and Cole, 1981). Ecological studies have generally emphasized flux of P within organic compartments (flora, fauna, litter, microorganisms, and soil organic matter), pedologic and fertility studies have traditionally examined transformations of inorganic P within soils. The purpose of this paper is to review and integrate these two approaches in order to develop a more comprehensive understanding of P dynamics in soil ecosystems. It is assumed that such perturbations will not alter the direction of paedogenic processes; only the time required to attain steady state will be affected.

Forms of Phosphorus

Different forms of phosphorous like soluble, labile, primary minerals, secondary minerals, organic, and occluded will be used exclusively. Soluble P is extractable with water or a dilute salt. Labile P will be used for isotopically exchangeable or anion resin-extractable phosphorus which can be determined by the method of Olsen and Dean (1965) and Olsen and Sommers (1982), respectively. Although Mattingly (1975) indicates that the labile pool can be partitioned into several fractions with different bonding energies, labile P will be used herein to refer to soil P which is in equilibrium with P in soil solution.

Primary minerals refer to appetites, which are acid-extractable. Secondary P minerals include minerals with P chemisorbed to their surfaces (most commonly Fe and Al oxides and carbonates) as well as minerals formed by low temperature crystallization, which contain P as a structural component. The latter include variscite, an A1 phosphate, strengite, Fe phosphate and Ca phosphates, brushite, monetite, and octocalcium phosphate. Because this group includes both crystalline P and non-labile adsorbed P, reactivity of secondary P minerals, as defined, is variable; but secondary P minerals can generally be perceived as dictating long-term, sluggish movement toward equilibria. Variscite is generally believed to be extractable with NH_4F, strengite with NaOH, and calcium phosphates with HCl. Organic P occurs primarily as ester linkages on inositols with lesser amounts in phospholipids and nucleic acids (Cosgrove, 1977).

Organic P can be converted to inorganic P by ignition or wet oxidation. Occluded P refers to phosphorus physically encapsulated by minerals which are structurally devoid of phosphorus. Thus, occluded P is physically sheltered from interaction with more reactive P forms. Usually, P becomes occluded in the iron oxides, hematite and goethite; such P is often referred to as reductant-soluble phosphorus because it can be released by a reducing agent such as citrate-bicarbonate- dithionite. Phosphorus occluded in gibbsite can be released by NaOH, whereas P encapsulated by primary or secondary silicate minerals, referred to as residual inorganic, can only be released by very strong treatments such as HF dissolution or Na_2CO_3 fusion.

Phosphorus Transformations in Soil

Phosphorus transformations in soil Microorganisms bring about a no. of transformations of this element:
1. Altering its solubility
2. Mineralization of organic phosphate compounds into inorganic phosphates
3. Oxidation and reduction of phosphorus compounds.

The ultimate source of all soil P is primary appetites. Because of weathering, primary phosphates release soluble P, which may be leached, be utilized by plants and microorganisms, enter the labile pool, or be transformed into secondary P minerals. Apatite weathering is enhanced by soil acidity. Size of the potential labile P pool is a function of soil properties which determine the anion exchange capacity; the actual quantity of labile P may be limited by the solubility-product and dissolution kinetics of secondary P minerals. Reactive secondary P forms such as dicalcium phosphate dihydrate or octo- calcium phosphate rapidly equilibrate with labile and soluble P but others such as hydroxyapatite equilibrate so slowly that equilibrium is seldom attained (Murrman and Peech, 1969). Because soil is a dynamic system in a constant state of flux and secondary P mineral reactions are slow, equilibrium is rarely established between soluble P and secondary P minerals but equilibrium between labile and soluble P pools is rapidly established (Olsen and Khasawneh, 1980). Thus, as soluble P is removed by leaching, plant uptake, or conversion to secondary P minerals, the labile pool is initially depleted as it replenishes P in solution (Murrmann and Peech, 1969). With time, soluble and labile P pools may be replenished by dissolution of primary or secondary P minerals if the soil solution becomes undersaturated with respect to these minerals. As soils weather with the concurrence of decreasing soil pH, formation of secondary Fe- and A1-P minerals is favoured as their solubility decreases which results in decreasing pools of soluble and labile P. Secondary phosphorus minerals may be, in turn, encapsulated by secondary Fe and A1 oxides or other soil minerals which comprise the occluded P sink.

Thus, transformations of inorganic P accompanying soil weathering are analogous to a one-way street with primary P minerals being ultimately converted to occluded P via intermediate soluble, labile, and secondary mineral forms. In most soils, complete transformation from primary to occluded P requires a geologic timeframe; hundreds to thousands of years may be necessary. Within a pedologic timeframe, however, partial transformations are evident and significant. The C/P ratio of the decomposing residues regulates the predominance of P mineralization over immobilization. - Net immobilization of soluble phosphorus is most likely to occur if residues added to the soil have a C/P ratio greater than 300:1. - While net mineralization is likely if the ratio is below 200:1.

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Biofertilizers and their Roles in Soil Fertility

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Introduction

Biofertilizers are the preparations containing live or latent cells of efficient strains of microorganisms used for seed or soil applications with the objective of increasing the number of such microorganisms in soil or rhizosphere and consequently improving the extent of microbiologically fixed nitrogen and other nutrients for the plant growth and development. A bio-fertilizer is simply a substance, which contains living microorganisms which when applied to the soil, a seed or plant surface colonizes the rhizosphere and promotes growth by increasing the supply or availability of nutrients to the host plant. A bio-fertilizer is a modernized form of organic fertilizer into which beneficial microorganisms have been incorporated.

Soil Fertility

Soil refers to the part of the earth on which plant grow. It consists of three layers: top soil, sub- soil and parent material. However, we are more concerned with the top soil since it is the part that favors plant growth. It contains minerals, air, water, living organism and inorganic and organic matter all of which have to be in a particular ratio with at least a medium pH to constitute a fertile soil. According to Purves et al., 2000, a good quality soil is one that is 45% minerals (sand, silt, and clay), 25% water, 25% air, and 5% organic and living matter. The mineral portion of a soil which makes up half of the volume contains about 93% silica, aluminum and iron oxides; 4% calcium, potassium and magnesium oxides and 3% titanium, sodium and very small amount of nitrogen, Sulphur, phosphorous, boron, manganese, zinc, copper, chlorine, molybdenum and many other elements. However, of all minerals only fourteen are essential to plant and these are called essential elements.

Why Biofertilizer?

1. Environmentally friendly
2. No nitrogen losses through denitrification, volatilization and leaching
3. No need of big fertilizer producing factories causing pollution
4. Saving of forex reserves
5. Cheap source
6. Increase nitrogen fixation and nutrient availability.
7. Some biofertilizers may work as biopesticide. Example: Azotobacterin.
8. Production of plant growth promoting rhizobacteria.

Classification of Biofertilizers

1. Nitrogen fixing bio-fertilizers (NFB): Examples include *Rhizobium* Spp., *Azospirillum* Spp. and blue-green algae; these work by fixing atmospheric nitrogen and converting them to organic (plant usable) forms in the soil and root nodules of legumes, thereby making them available to plants. Nitrogen fixing bio-fertilizers are crop specific bio-fertlilizers.

2. Phosphate solubilizing bio-fertilizer (PSB): Examples include *Bacillus* Spp., *Pseudomoona* Spp. and *Aspergillus* Spp. These work by solubilizing the insoluble forms of phosphate in the soil, so that plants can use them. Phosphorus in the soil occurs mostly as insoluble phosphate which cannot be absorbed by plants. However, several soil bacteria and fungi possess the ability to convert these insoluble phosphates to their soluble forms (Chaudhary and Kennedy 2004). These organisms accomplish this by secreting organic acids which lower the pH of the soil and cause the dissolution of bound forms of phosphate making them available to plants (Gupta 2004).

3. Phosphate mobilizing bio-fertilizers (PMB): Examples are Mycorrhiza. They work by scavenging phosphates from soil layers and mobilizing the insoluble phosphorus in the soil to which they are applied. Chang and Yang 2009 stated that phosphorus solubilizing biofertilizer (PSB) sometimes act as phosphate mobilizers. Phosphate mobilizing bio-fertilizers are broad spectrum bio-fertilizers.

4. Plant growth promoting bio-fertilizer (PGPB): Examples of plant growth rhizobacteria are Pseudomonas Spp. etc: these work by producing hormones and anti-metabolites which promotes root growth, decomposition of organic matter which help in mineralization of the soil thereby increasing availability of nutrients and improving crop yield. PGPB are crop specific bio-fertilizers.

5. Potassium solubilizing bio-fertilizer (KSB): Examples include *Bacillus* Spp. and *Aspergillus niger*. Potassium in the soil occurs mostly as silicate minerals which are inaccessible to plants. These minerals are made available only when they are slowly weathered or solubilized. Potassium solubilizing microorganisms solubilize silicates by producing organic acids that cause the decomposition of silicates and helps in the removal of metal ions thereby making them available to plants. Potassium solubilizing bio-fertilizers are broad spectrum bio-fertilizers.

6. Potassium mobilizing bio-fertilizer (KMB): Example of potassium mobilizing bio-fertilizer is *Bacillus* Spp. These work by mobilizing the inaccessible forms of potassium (silicates) in the soil. Some phosphate solubilizing bio-fertilizers such as *Bacillus* Spp. and *Aspergillus* Spp. have been found to mobilize potassium and solubilize phosphorus.

7. Sulfur oxidizing bio-fertilizer (SOB): Example of sulphur oxidizing microorganism is *Thiobacillus* Spp. These work by oxidizing sulphur to sulphates, which are usable by plants.

Importance of Bio-Fertilizers

Bio-fertilizers play an important role in improving fertility of the soil. In addition, their application to soil improves the structure of the soil and minimizes the sole use of chemical fertilizers. Under low land conditions, the application of blue green algae (BGA) plus *Azospirillum* proved significantly beneficial in improving yield of grain. Bio-fertilizers inoculation with *Azotobacter* and *Rhizobium* and Vesicular Arbuscular Mycorrhiza gave the highest increase in straw and grain yield of wheat plants with rock phosphate as phosphate fertilizer. Azolla is inexpensive, economical, eco-friendly, which provides benefit in terms of carbon and nitrogen enrichment of soil. It was recorded microorganisms such as *Bacillus subtilis*, *Thiobacillus thioxidans* and *Saccharomyces* species can fix atmospheric nitrogen symbiotically and about 80–90% nitrogen demand could be supplied by soya bean through symbiosis.

Bio-control, a modern approach of disease management can be a significant role of bio-fertilizer in agriculture. *Trichoderma* based bio-fungicides has been found promising to control root rot of mung bean. Growth, yield and quality parameters of certain plants significantly increased with bio-fertilizers containing bacterial nitrogen fixers, phosphate and potassium solubilizing bacteria and microbial strains of some bacteria.

1. Secretion of plant growth hormones, which help in plant growth,
2. Protection of the plant against attack by pathogens,
3. Improvement soil fertility,
4. No special care is necessary while using bio-fertilizer,
5. Reduction in the use of chemical fertilizers,
6. Bio-fertilizers are cost effective compared to synthetic fertilizer,
7. Promotes growth of plants,
8. Bio-fertilizers restore the soil's natural, nutrient cycle.
9. Build soil organic matter and Bio-fertilizer provides protection against drought.

Conclusion

Our dependence on chemical fertilizers and pesticides has encouraged the thriving of industries that are producing life-threatening chemicals that are not only hazardous for human consumption but can also disturb the ecological balance. In fact, attention is now shifting from consuming food grown with chemical fertilizers to food grown with organic fertilizers because of the harmful effects that these foods have in the body when consumed. Biofertilizers can help solve the problem of food need of the ever-increasing global population. It is important to realize the useful aspects of bio-fertilizers so as to apply it in modern agricultural practice. The application of bio-fertilizers containing beneficial microbes promote to a large extent, crop productivity. These potential biological fertilizers would play a key role in productivity and sustainability of soil, protect the environment as eco-friendly, and cost-effective inputs for the farmers. Using the biological and organic fertilizers, a low input system can help to achieve sustainability of farming.

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Plant Growth Regulators and their Mode of Action

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Introduction

Plant growth regulators are defined as the natural or synthetic biological substances which influence the overall growth and development of plants. There are five groups of plant growth regulators recognised i.e. auxins, gibberellins, cytokinin, ethylene and abscisic acid. Here, the mode of action of plant growth regulators are discussed in the context of the genes and transcription factors involved in this process.

Auxin

Auxins are a class of plant growth regulators having a main role in apical dominance in plants. Indole-3-acetic acid (IAA) is the basic and most abundant auxin present in plants. Auxins are chemical compounds with aromatic ring and a carboxylic acid group. Tryptophan is the precursor of auxin biosynthesis in plants. Auxin triggers the signal responses directly through stimulation or inhibition of the expression of genes. It activates different families of primary response genes like glutathione S-transferases, auxin homeostasis proteins like GH3 and the Aux/IAA repressors transcriptionally.

Auxin signaling pathway: ARE mediated transcription of auxin genes are initiated by auxin responsive factors (ARF). This transcription is then inhibited by binding of AUX/IAA protein complex. In absence of auxin, AUX/IAA protein complex binds and suppress transcriptional activity of ARFs. When auxin is present it forms a molecular complex between T1R1 protein and AUX/IAA, which results ubiquitone mediated proteolysis of AUX/IAA. ARF are then free to bind to promoter and carry out transcription.

Cytokinin

Cytokinin are the PGRs generally derived from adenine. It promotes cell division in plants roots system and shoots system. The most common form of naturally occurring cytokinin is zeatin. Some examples of synthetic cytokinin are 6-Benzyl amino purine, 6-phenyl amino purine. 5′-AMP is the precursor of cytokinin biosynthesis. Lowering the signals of cytokinin causes pleiotropic developmental changes and increasing endogenous cytokinin level causes expression of cytokinin biosynthesis gene isopentyl transferase (ipt) which reduces apical dominance and root development. A cytokinin signalling and response regulator protein is a plant protein that is associated with two-step cytokinin signalling and response regulation pathway.

Cytokinin signalling pathway: In the presence of cytokinin, Cytokinin sensor kinases (CRE1/AHK4, AHK2, and AHK3) are activated and then auto-phosphorylates itself by transferring a phosphate from the kinase domain to receiver domain. This phosphate is then transferred to a histidine phosphotransfer protein (AHPs). Histidine phosphotransfer protein then phosphorylates a response regulator or transcription factors. Response regulators serve as positive or negative regulators of gene expression.

Gibberellins

Gibberellins (GAs) are a large family of tetracyclic diterpenoid plant growth substances. It is involved in seed germination and cell elongation. Ent-kaurene is a tetracyclic hydrocarbon which is the precursor of GAs. GA induced signal transduction involves 3 main types of transcriptional factors i.e. Gibberellin insensitive dwarf mutants (GAI), Gibberellin deficiency reversion mutants (RGA) and Spindly or slender mutants (SPY).

Gibberellin signalling pathway: GAI and RGA (DELLA repressors) both have conserved region for DELLA proteins. GAI and RGA act as repressors of those genes that lead to growth. SPY is also a repressor which act as upstream of GAI and RGA which play inhibitory role directly or by enhancing effect of GAI and RGA. In presence of GA these repressors are degraded, so transcription of genes occurs that lead stem elongation.

Ethylene

Ethylene is a PGR produced by plants which aids in ripening and aging process of plants. The amino acid methionine is precursor of ethylene. Ethylene after its biosynthesis is perceived by a family of receptors located in endoplasmic membrane, then ethylene signaling pathway starts. Signaling involves protein kinases, GTP binding proteins and transcription factors (EIN2, EIN3).

Ethylene signaling pathway: Ethylene signal perception and transduction is mediated by copper cofactor receptor. Then the receptors interact with protein kinases like CTR1. Binding of ethylene to receptors results in inactivation of both receptors and CTR1 which causes depression of positive regulatory molecule EIN2. It is then transmitted from EIN2 to EIN3/EIL1 resulting in accumulation of EIN3 factors in nucleus. There it induces transcription of ethylene regulated genes like ERF1, EBF1, 2, 3, and 4 resulting in ethylene gene expression.

Abscisic Acid (ABA)

Abscisic acid is a plant growth regulator which involves in developmental processes including seed and bud dormancy, control of organ size and stomatal closure. It is an inhibitory hormone in plants that help in adaptation to stress. Xanthoxin is an advanced biosynthetic precursor of ABA. ABA plays a critical role in response to various stress signals like drought, cold, and salinity. ABA induced gene expressions relies on presence of cis acting elements called ABRE (ABA responsive element). These are regulated by various transcriptional factors like AREB, DREB2A, DREB2B, MYC/MYB, RD22BP1, and AtMyB2 which are responsible for the ABA gene expression in plants during the environmental stress.

Abscisic acid signalling pathway: The ABA dependent stress signalling activates AREB which binds to ABRE element and induces stress responsive gene. The stress responsive gene (RD29B) encodes a LEA like protein (Late Embryogenesis Abundant Protein). Transcription factors like DREB2A, DREB2B, DRE cis-element and help in maintaining osmotic equilibrium in plant cells during stress. The MYC/MYB transcription factors bind its respective cis-elements MYBRS and MYCRS and helps in activation of RD22 gene. Overall, these transcription factors cross talk with each other for their maximal response to stress tolerance.

Conclusion

The plant growth regulators influence the growth and development processes in plants. The role play of these regulators could be individualistic or synergistic in plants which may conclude as a promoting or inhibiting response. Factors like temperature and light affect plant growth events (vernalisation) via plant growth regulators. So, the study of the signalling behaviour of the plant growth regulators in plants is highly essential to understand the molecular processes operated in the plants.

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Mycoherbicides: Fungal Plant Pathogens for Biological Control of Weeds

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Plant pathogenic fungi are commonly viewed through a negative lens as the major causal organisms for widespread economic losses they cause on commercial crops. However, they have an alternatively important role in biological control of weeds. Till date, 36 fungal pathogens have been authorized for introduction across 18 countries for this purpose. Although these are arguably safe, the risk of their transferability to other plants prevails. Even in the affluent countries, the development and commercialization of bioherbicides are still plagued by technological hurdles and limited market potential.

Introduction

Plant pathogenic fungi have been known to cause significant economic losses pertaining to their adverse impact on crop yields, quality and overall plant health. They are, however, beneficial in some situations, such as in antibiosis and biological control of undesirable weeds. Weeds are defined as "the native or alien plants that usually have detectable detrimental effects on the economy, environment, or human health and well-being". These are majorly problematic across multiple ecosystems, as they compete against crops and native plants for water, light, and nutrients; and/or affect human health. Over 30 % of crop losses worldwide have been attributed to weeds, making them the most notorious of all crop pests. To alleviate this burden, farmers rely on a suite of integrated control methods, including physical removal, grazing management, synthetic herbicide use, and biocontrol.

Any living organisms that can suppress the growth of weeds are broadly considered biocontrol agents, especially including arthropods (insects, mites) and plant pathogens for targeted weed control. Weed biocontrol comprises two main approaches: classical and bioherbicide. The classical approach has been most frequently employed and consists of managing a problematic weed in a specific region by deliberately introducing specialist natural enemies from the weed's native habitat. It is based on the enemy release hypothesis and is considered the only cost-effective approach to manage abundant and widespread weeds across different land uses. Once an introduced biocontrol agent is established and its population has built up, it can, in conjunction with other control methods, cause severe damage to the weed that leads to a decline in its biomass, reproduction, and/or population density.

The bioherbicide approach is based on living microorganisms (mycoherbicide when a fungus is involved) already existing where the target weeds are present and has been in use since the 1970s. This approach entails the application of massive doses of inoculum of a pathogen onto the target weed or the soil it grows in a localized field, to create a rapid disease epidemic that hampers the weed population. It generally involves the production, formulation, and packaging of the pathogen as well as the registration of the product by relevant authorities for commercialization.

Instances of Classical Biocontrol

1. The rust fungus *Puccinia chondrillina* was introduced for control of the narrow-leaf form of *Chondrilla juncea*; Australia (1971).
2. *Puccinia spegazzinii*, for classical weed biocontrol of *Mikania micrantha*, has been introduced in 12 countries to date.
3. *Puccinia komarovii* var. glanduliferae on *Impatiens glandulifera* is the first pathogen to be introduced in Europe.
4. *Puccinia psidii* on *Melaleuca quinquenervia* in Florida and *Melampsora hypericorum* on *Hypericum androsaemum* in New Zealand and Australia (Not authorized for introduction but recognized as contributing to the biocontrol of their weed hosts).
5. *Puccinia jaceae* var. *solstitialis* on *Centaurea solstitialis*; USA (2003).
6. *Puccinia myrsiphylli* for the biocontrol of *Asparagus asparagoides*; Australia (2000).

Suitable Candidate Pathogen

Identifying and introducing suitable agents that can inflict the type and level of damage required to achieve the defined goal increase the chances of a successful outcome. The decision on which candidate pathogen agents should undergo comprehensive host-specificity testing relies on early information and prediction of the impact they could have on the target weed in the new environment.

Foliar fungal pathogens are preferred because they are generally more specific and readily dispersed by wind or rain splash. The high specificity-level displayed by some rust fungi, and their detrimental effect on the metabolism of their host plant, has made them the pathogens of choice for weed biocontrol. They rapidly colonize plant tissue, divert plant nutrients to support their own growth and thus reduce plant productivity. Pathogens that only cause discrete necrotic leaf spots are less preferred because of the low impact on weed growth.

The intraspecific variation in the pathosystem and genotypic specificity for a precise genetic match between the pathogen and the weed is another aspect required for biocontrol to succeed. Conversely, the host range of candidate pathogen agents may be too wide, making them unsuitable for classical biocontrol. A restricted host range is a prerequisite for any pathogen proposed for introduction into a new country as a classical weed biocontrol agent.

Release in a New Range

Regulatory approval for the release of a pathogen for classical weed biocontrol is contingent on demonstrating that the pathogen poses negligible risks to species in the recipient country. The objective of the release phase of a biocontrol program is for the pathogen to establish rapidly throughout the range of the weed. The optimal number and distance between release sites depend on the natural dispersal of the agent. Pathogens with windborne spores require fewer releases because they can naturally spread quickly from initial disease foci to other infestations of the weed. Another simple technique widely utilized to release a pathogen agent in the field involves spraying the target weed with a spore suspension or misting the inoculated foliage with water and covering it with plastic bags or sheets for the first night or day after inoculation. Regular visual inspections of the weed at release sites for characteristic disease symptoms caused by the pathogen are performed to confirm establishment and gather initial data on the spread. Bioclimatic modeling can assist in identifying release sites that have similar climates to the source location of the agent in the native range and in monitoring the subsequent establishment, spread, and initial impact of the pathogen in the target area.

Commercial Bioherbicides

Despite the availability of a voluminous literature on possible candidate pathogens for bioherbicide development, only 15 bioherbicides have ever been registered for use globally since the first one, DeVineTM, in 1981 (Table 1). And still, very few are commercially available.

Table 1 Current status Mycoherbicides

Product name	Year of registration and current status	Country of registration	Active ingredient	Target weed(s)
Di-Bak® Parkinsonia	2018 Registered, commercially available	Australia	*Lasiodiplodia pseudotheobromae*, *Neoscytalidium novaehollandiae*, *Macrophomina phaseolina*	*Parkinsonia aculeate*
Bio-PhomaTM	2016 Registered	Canada	*Phoma macrostoma*	Numerous broad-leaved weeds
Sarritor®	2009 Registered	Canada	*Sclerotinia minor*	*Taraxacum officinale* and other broad-leaved weeds
SmolderTM	2005 Registration lapsed in 2009	USA	*Alternaria destruens*	*Cuscuta* spp
BioMalTM	1992 Registration lapsed in 2006	Canada	*Colletotrichum gloeosporioides* f.sp. *malvae*	*Malva pusilla*
Dr. BioSedgeTM	1987 Registration lapsed in 1999	USA	*Puccinia canaliculata*	*Cyperus esculentus*

CollegoTM	1982 Registration lapsed in 2003	USA	*C. gloeosporioides* f.sp. *aeschynomene*	*Aeschynomene virginica*
DeVineTM	1981 Reregistered in 2006	USA	Chlamydospores of *Phytophthora palmivora*	*Morrenia odorata* (milkweed vine)

Challenges and Constraints

1. Risk of transfer to a new host after the introduction
2. Successfully demonstrating the safety of introduced pathogens is paramount.
3. Extensive host-specificity testing for accurate host-range predictions
4. Vulnerability to slight fluctuations in ambient temperature and moisture conditions in the field make them less reliable.
5. To be commercially successful, a bioherbicide needs to be as easy to handle and as efficacious and have as few limitations as competing products.
6. Reduction of production cost and bridging technical barriers
7. The development and commercialization of bioherbicides are plagued by technological hurdles encountered during production and formulation. It is essential in ensuring that a bioherbicide has an acceptable shelf-life, is easy to apply, and is tolerant of variable environmental conditions at the time of application.
8. The formulation is also a major challenge for mycoherbicides that are sprayed onto the weed's foliage because they require moisture for several hours after application for infections to occur.

Conclusion

The present situation of phasing out of several older synthetic herbicides and the high cost of developing and registering new ones, the emergence of herbicide-resistant weeds, and use of government policies to reduce or ban synthetic pesticide usage pertaining to the environmental and health hazards have been the key reasons for the growing interest in bioherbicides. The classical biocontrol approach has aided in bringing down target weed populations to manageable levels and has emerged profitable for low-income countries. A close collaboration between plant pathologists, entomologists, and weed ecologists from both governmental research institutions and universities is critical to harness this approach to its full potential.

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Quality Test Methods for Foods

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Quality is defined as the combination of attributes or characteristics of a product that will help in determination of acceptability of the product to a user. Determination of quality is important for control over raw materials by setting up specifications and improve product quality and improve the processing methods by reducing cost of production and increase the profits. Quality will meet greater consumer confidence towards product quality due to maintenance of sanitary conditions and standardization of finished products according to label specifications. For processed products, determination of physico chemical attributes of raw materials like soluble solids, development of uniform colour, flavour, juiciness, uniform maturity, tenderness in some vegetables etc are necessary. This is necessary for marketing and to increase the profit to the manufacturers. Hence, determination of quality becomes very important and this determination can be done by the following methods.

Objective Methods

These methods are based on the observation from which the attitude of investor is entirely excluded. These are based on recognized standards, scientific tests and are applicable to any product sample without regard to its previous history or ultimate aim. These methods consist of the following three types:

1. Physical methods: Observations will be done regarding visual appearance, color, texture, consistency, size, shape while the color measurement is done by using tintometer or Hunter color difference meter, texture by texture analyzer, firmness of fruit by penetrometer etc.

2. Chemical methods: Observation on quantitative chemical evaluation of nutritive value and quality level are done. For routine test, analysis of pH, acidity, TSS, jellification etc. are carried out.

3. Microscopic methods: This is done to check adulteration and contamination of product with mound, yeast, bacteria, insect excreta etc.

Subjective Methods

Quality evaluation is based on the investigator opinion. In this method, an individual is required to give his opinion based on their sense for sight, touch, smell, taste, hearing for quantitative and qualitative value of characteristics. E.g. snap of chips, breakfast cereal, apple or celery crunch.

The common test/method followed for determination of quality is given in the table below:

Characteristic	Method/equipment for determination
A. Physical test	
1. Size	Vernier calliper
2. Weight	Weighing balance
3. Volume	Water displacement method
4. Specific gravity	Specific gravity bottle, pycnometer
5. Gross weight	Net weight+ Tare weight
6. Net weight	Gross weight – Tare weight
7. Drain weight	Net weight – weight of syrup/brine
8. Colour	Visual/colour chart
9. Texture	Texture analyser
10. Firmness	Penetrometer, pressure tester
11. Consistency	Oswald viscometer
12. Viscosity	Brookfield viscometer
13. Head space	Vacuum/pressure gauge
14. Seam measurement	Seam checking guage/ seam micrometer

15. Can testing	Can tester
B. Chemical Test	
1. TSS	Hand refractrometer, Abbe refractrometer
2. Brine strength	Salometer
3. Moisture	Oven dry method, infra-red moisture meter
4. pH	pH meter
5. Titratable acidity	Lane and Eynon method
6. Sugars(reducing, non-reducing and total sugar)	2,6-dichloro-phenol-indophenol dye titration method
7. Ascorbic acid	Silver nitrate titration using Mohr's method
8. Salt	Modified Ripper titration method
9. Sulphur dioxide	Muffle furnance
10. Ash	Benzoic acid is converted to water soluble sodium benzoate.
11. Benzoic acid	Acidification of sodium benzoate to form water isoluble benzoic acid and chloroform. Removal of chloroform with evaporation. Dissolving residue containing benzoic acid in alcohol and titrate with standard
C. Microbiological tests	
1. Total plate count/viable count	Inoculation chamber, incubator
2. Yeast and mould count	Howard's mould counting method
3. Coliform test	Macroscopic/microscopic examination
4. Extraneous contamination	Wildman trap flask
D. Sensory evaluation	
1. Colour	Hedonic rating test
2. Flavour	Numerical scoring test
3. Body	Ranking test
4. Overall acceptability	Paired comparison test; Single sample test; Multiple sample test

Conclusion

Quality parameters are determined by trained personnel using different test/methods for improvement of quality of a food product to increasing acceptability as well as return to the manufacturer. Hence, determination of the quality of food is essential for food safety and to increase confidence of consumer for hygiene and adulteration to food which might be harmful to consumers may also be prevented.

Decision Support Systems in Agriculture

Article ID: 30441

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Introduction

A Decision Support System is an information system that supports decision making activities in all the fields. DSS are software-based systems that gather and analyze data from a variety of sources. In the agricultural sector, it helps farmers to solve complex issues related to crop production, management and marketing. DSS is a tool for diagnosis, risk assessment and reasoning assistance.

Decision Support Systems in Agriculture

Decision Support Systems in Agriculture are used in various areas in the field of agriculture. DSS are used in various are such as crop management, crop protection, farm management, marketing etc., DSS framework helps to structure the complex system and allow to understand easily with additional information. For effective agricultural management decision support system is very much essential. There are many DSS for agriculture listed in Table 1

Table 1 DSS for Agriculture

S.No	Name of DSS	Application
1.	DSSAT	DSS tool to decide the type of seed to grow, when and how much to irrigate, rate of application of fertilizer and crop yield prediction
2.	CROPWAT	DSS tool for Land and water management
3.	SWASALT	DSS tool for Soil and Water Resource Management
4.	CROPMAN	DSS tool for Crop Production Management
5.	DSS-ET	DSS tool for soil evapotranspiration estimation
6.	DSS-FS	DSS tool for fertigation simulator for application of fertilizers
7.	IPM	DSS for Integrated Pest Management.

DSSAT

The first simulation based DSS is Decision Support System for Agro-technological Transfer (DSSAT). DSSAT is used in different regions and crops to decide the type of seed to grow, when and how much to irrigate, rate of application of fertilizer and crop yield prediction. DSSAT was modified according to the type of crop and agricultural environment.

DSSAT was developed to simulate crop yield, near surface soil water contents, and cumulative nitrate-N losses associated with regular free tile drainage (TD) and controlled tile drainage with optional subsurface irrigation (CDS). The developed model gives better results to increase crop yield in uneven rainfall areas.

DSS in Crop Productivity Improvement

Cropping System Simulation Model (CropSyst) is a simulation based DSS model linked with Geographical Information System (GIS). The developed model simulates the growth and development of all herbaceous crops using periodic biomass and Leaf Area Index (LAI). The model helps to decide water saving and water productivity policy for rice crop in Punjab by integrating crop management practices such as transplanting date, type of seed and irrigation.

CROPGRO - Soybean model is also a part of DSSAT which is used to simulate climatic change, growth and yield of soybean for four major states as Madhya Pradesh, Maharashtra, Rajasthan and Karnataka. The model is used to estimate the potential yields in water limiting and water non-limiting areas and to estimate yield gaps for major soybean regions of India.

DSS in Irrigation Scheduling

DSS tool for Simulation of WAter and SALT (SWASALT) was used in the region of Haryana. The model is used to calculate Water Management Response Indicators (WMRI) which helps to optimize the on-farm irrigation schedule by minimizing the percolation losses to ground water for different soil types. It helps to increase the crop production for different cropping pattern as per the groundwater availability for Godavari Delta Central Canal Irrigation Project in Andhra Pradesh.

DSS Based on Climatic Data

DSSAT Cropping System Model (DSSAT-CSM) is used to study impact of climatic parameters in rice-wheat system productivity over the Indo-Gangetic plains of India. To study the effects of different dates of transplanting and weather parameters on yield, evapotranspiration and water productivity, a simulation based multi-year, multi-crop and daily time step cropping based model called as Crop Production and Management (CROPMAN), used in Punjab. The model was also simulated to study grain yield of cheakpea crop for semi-texture soil of Punjab for rice-cheakpea cropping pattern. It is also successfully concluded that irrigation water requirement is more in the environments of low rainfall and coarse-textured soils compared to medium textured soil and high rainfall areas.

DSS in Advisory System

Advisory DSS is plays an important role in Indian agriculture. e-Sagu is a farm specific DSS. Media Lab Asia helped to improve farm productivity by delivering high-quality farm specific agro-expert decisions in a timely manner to each farm at the farmer's doorsteps. The advice was provided in many stages of cultivation of crops from sowing to harvesting, which reduces the cost of cultivation and increases farm productivity as well as quality of Agricultural commodities.

Insect and Pest Management

Insect and Pest Management Plant protection is definable as the reasoned application of different methods, products as well as chemicals to allow optimal productive factors, with the objective to satisfy farm worker, consumer and safeguard environment. Reported 67 different DSSs for plant protection. Out of these, 30 deal with insect pest problems, 20 with plant disease and 17 with weeds.

Conclusion

DSS is very much useful for farmers, researcher and used as teaching tool. DSS helps the farmers in tackling huge problems in the area of crop improvement, crop protection and for extension activities. DSS incorporate the input factors such as water, climate, human and an economic resource plays an important role to influence the productivity of crop.

Need and Importance of Crop Insurance in Agriculture

Article ID: 30442

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Abstract
Present article is addressed to need and importance of crop insurance in agriculture sector. Production risk, market or price risk, institutional risk, financial risk, etc. are the different risks occurred in agriculture. To overcome such risks and uncertainty, crop insurance is a specialized version of insurance. So, there is a need of crop insurance to provide insurance coverage and financial support to the farmers in the event of prevented sowing & failure of any of the notified crop as a result of natural calamities, pests & diseases. It encourages the farmers to adopt progressive farming practices, high value in-puts and higher technology in Agriculture. It helps to stabilize farm incomes, particularly in disaster years. There is a need for some subsidization by government.

Keywords: Agriculture, Crop, Insurance.

Introduction
Agriculture is imperious business in India. Risk is crucial factor in all business activities. Risks in agriculture business are production risk, market or price risk, institutional risk, financial risk, etc. Agricultural Insurance is a special insurance which covers risk in farming industry. Crop insurance is a specialized version of insurance which has exclusively been designed for agriculturists for protecting them from financial loss arising out of any unforeseen risks or perils which are generally beyond the control of farmers (AIC 2008). There are many risk causing factors in agriculture responsible for causing insecurity in mind of farmer and instability in his income. So, there is need of crop insurance as part of risk management tool in agriculture. Agriculture in India is not just dependent on weather conditions, but also suffers the brunt of natural disasters. Government can facilitate agricultural insurance in several ways. In case farmers are asked to pay full premium themselves then chances of adoption of insurance are bleak.

Need of Crop Insurance
There is a need of crop insurance to provide insurance coverage and financial support to the farmers. It can provide information, on weather patterns, locations of farms and crops, incidence and history of perils and crop yields. It can help to meet the costs of the research to be undertaken before starting an agricultural insurance program. It can also provide reinsurance. Substituting existing crop insurances with weather insurance in India will not only introduce a more efficient and low-cost insurance scheme for the Government, but it will also provide a more transparent and actuary fair insurance product to the farmer. Crop insurance make farmer confident that in the event of any loss from risks and uncertainties in their operations, they will be indemnified by the insurer.

Agricultural insurance is considered an important mechanism to overcome the risk to output and income resulting from various natural and manmade events. Unfortunately, agricultural insurance in the country has not made much headway even though the need to protect Indian farmers from agriculture variability has been a continuing concern of agriculture policy. According to the National Agriculture Policy 2000, "Despite technological and economic advancements, the condition of farmers continues to be unstable due to natural calamities and price fluctuations". In some extreme cases, these unfavourable events become one of the factors leading to farmers" suicides which are now assuming serious proportions (Raju and Chand, 2007). Crop insurance is a means of "protecting the farmers against uncertainties of crop yields, arising out of practically all-natural factors beyond their control". Crop insurance may be of different types according to different criteria.

DSS in Crop Productivity Improvement
A number of crop insurance schemes launched in India from period to period, though, the first existing attempt was made in the 1970s. The details of various insurance schemes progressed till date, is as follows.

Name of Insurance Scheme	Period	Approach	Crops Covered
Crop Insurance Scheme (CIS)	1972-78	Individual	H-4 Cotton, groundnut, wheat, potato
Pilot Crop Insurance Scheme (PCIS)	1979-85	Area	Cereals, millets, oilseeds, cotton, potato and Chick pea
Comprehensive Crop Insurance Scheme (CCIS)	1985-99	Area	Food grains and oil seeds
Experimental Crop Insurance Scheme (ECIS)	1997-98	Area	Cereals, pulses and oil seeds
National Agricultural Insurance Scheme (NAIS)	1999- 2010-11	Area and Individual	Food grains, oilseeds, annual commercial and horticultural crops
Farm Income Insurance Scheme (FIIS)	2003-04	Area	Wheat and rice
Weather Based Crop Insurance Scheme (WBCIS)	2003-04-Continuing	Individual	Food grains, oilseeds annual commercial and horticultural crops.
Modified National Agricultural Insurance Scheme (MNAIS)	2010-11 Continuing	Area and Individual	Food grains, oilseeds, annual commercial and horticultural crops
Pradhan Mantri Fasal Bima Yojana (PMFBY)	2017	Area	All Cereals, millets, & oilseeds, pulses and Annual Commercial / Annual Horticultural crops.

Conclusion

Even though various insurance schemes launched from period to period in India but our country has accomplished restricted purposes. Expanse of insurance schemes in terms of area and number of farmers is infinitesimal, payment of indemnity based on area approach miss affected farmers outside the compensated area and most of the schemes are not practicable. Mounting the acquaintance of crop insurance would therefore increase government costs extensively. Apart from this, the programme is reorganized judiciously to make it practicable, the strategies of its future development to comprise and impact more farmers is remote. This need developed efforts by Government in terms of planning suitable schemes and providing economic backing for agricultural insurance.

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Introduction to Flavonoids and its Role in Promoting Health

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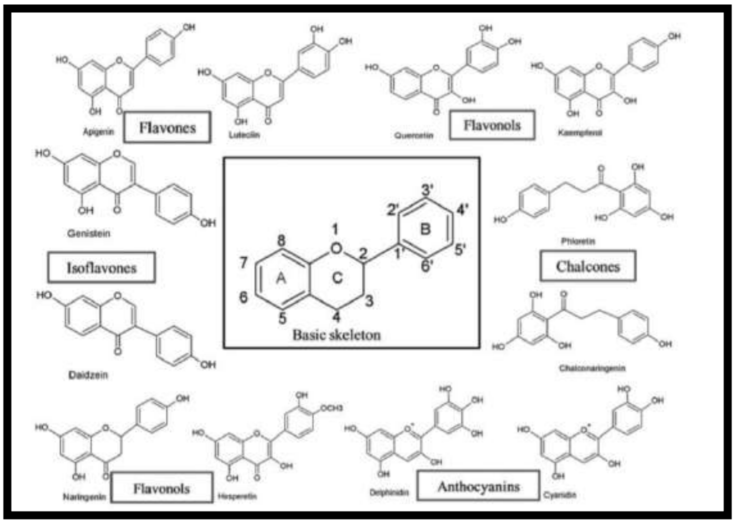
Flavonoids may be defined as the phenolic substances, isolated from a wide range of vascular plants, vascular means plants having lignified tissues used for conduction of water and minerals throughout. Flavonoids are formed in the plants from the aromatic amino acids- phenylalanine and tyrosine. According to IUPAC Recommendations 2017 for Nomenclature of flavonoids, the term flavonoid may be applied to compounds structurally based on derivatives of a phenyl-substituted propyl benzene having a C15 skeleton, compounds with a C16 skeleton that are phenyl-substituted propyl benzene derivatives (rotenoids) and flavonolignans based on derivatives of phenyl-substituted propyl benzene condensed with C6-C3 lignan precursors (Rauter et al., 2018).

Flavonoids have been studied to have a positive role in a broad spectrum of health effects. Some of the studied effects of flavonoids on human health are their ability to prevent Cardiovascular diseases, their anti-inflammatory effects, anti-carcinogenic effect and many more. Flavonoids are easily available to our body through consumption of a diet rich in fruits and vegetables. They have no toxic effect on body.



Structure of Flavonoids

Dealing with the structure of the flavonoids it could be said that the basic flavonoid skeleton consists of a flavan nucleus with two benzene rings A and B combined by an oxygen containing pyran ring C. The various classes of flavonoids depend on the level of oxidation and the pattern of substitution of the C ring.

Classification of Flavonoids

Flavonoids are divided into six major subgroups depending on the Carbon atom of the Cring on which B ring is attached and the degree of oxidation and saturation of the C ring. These subgroups are as follows:

1. Anthocyanins
2. Chalcones
3. Flavanones
4. Flavones
5. Flavonols
6. Isoflavonoids.

Brief Description of Flavonoids Subgroups

1. Anthocyanins: These are the pigments responsible for colour in plants, flowers and fruits. Cyanidin, delphinidin and malvidin are commonly studied anthocyanins. The colour of the anthocyanin depends on the pH and also by methylation or acylation at the hydroxyl groups on the A and Bring.

2. Chalcones: These pigments are characterized by the absence of C ring from the basic flavonoid skeleton structure. Hence, they are also referred to as open chain flavonoids. They occur in significant amounts in tomatoes, pears and berries, etc. Examples of these pigments are phoretin, phloridzin, arbutin, chalconaringenin.

3. Flavanones: These are generally present in citrus fruits such as oranges, tomatoes, rapes, lemons, etc. Examples include hesperitin, naringenin and eriodictyol. They have significant free radical scavenging properties. They are also called as dihydroflavones as they have their C ring saturated.

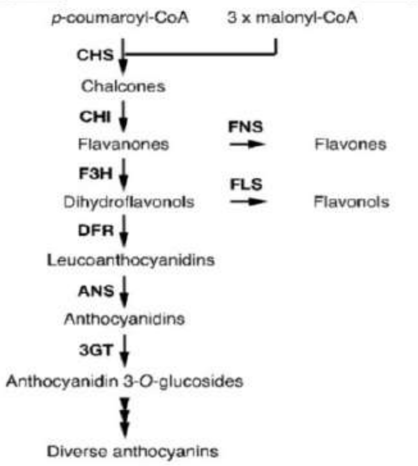
4. Flavones: They are widely present in leaves, fruits and flowers of plants as glucosides. Luteolin, apigenin, tangeritin belong to this subclass. They are present in celery, parsley, red pepper, etc.

5. Flavonols: These are flavonois with a ketone group. They are the building blocks of proanthocyanins. Examples are Kaempferol, quercetin, myricetin and fistein.

6. Isoflavonoids: They are also regarded as phytoestrogens because of their proved estrogenic effects in certain animal models. Two widely consumed isoflavones are genistein and diadzein found in soya beans.

Digestion and Absorption of Flavonoids

About 0.2-0.9% of ingested flavonoids are absorbed. Flavonoids are believed to be absorbed by passive diffusion after their glycosylated forms are converted into aglycones. This is achieved by the action of gut microflora. After absorption, the flavonoids are conjugated in the liver by glucuronidation, sulfation or methylation or are metabolized to smaller phenolic compounds.



Simplified flavonoid biosynthesis pathway. The enzymes in the pathway are: CHS, chalcone synthase; CHI, chalcone isomerase; F3H, flavanone 3-hydroxylase; DFR, dihydroflavonol 4-reductase; ANS, anthocyanidin synthase; 3GT, UDP-glucose:flavonoid 3-Oglucosyltransferase; FNS, flavone synthase; FLS, flavonol synthase. The arrowheads indicate modification steps of anthocyanins, which are mediated by glycosyltransferases, acyltransferases, and methyltransferases. Hypothesis 1 of EFP function: EFP enhances CHS activity. Hypothesis 2 of EFP function: EFP interacts with biosynthesis enzymes and forms a metabolon complex.

Biosynthesis of Flavonoids

Flavonoids are synthesized via phenylpropanoid pathway by transforming phenylalanine into p-coumaroyl CoA which is acted upon by the enzyme chalcone synthase that produces chalcone scaffolds which subsequently gets isomerized by the chalcone isomerase to produce flavanone and from this central intermediate the pathway diverges into several side chains each yielding a different class of flavonoids.

Excretion

Flavonoids are excreted either in the unchanged form or the colonic bacteria splits and degrades these hetrocyclic molecules into phenyl acids.

Requirement of Flavonoids

Official doses of flavonoid intake have not been established. However, it is estimated that an average daily intake of flavonoids ranges from about 50mg/day to 800mg/day. Excess intake even as high as 1000mg/day has not been found to show any toxicological effects due to their easy excretion via urine.

Health Promoting Roles of Flavonoids

Flavonoids are associated with a broad spectrum of health enhancing effects. They form an inevitable part of variety of nutraceutical, pharmaceutical, medicinal and cosmetic applications. This is attributed to their anti-oxidative, anti-inflammatory, anti-mutagenic and anti-carcinogenic properties coupled with their capacity to modulate key cellular enzyme functions.

Flavonoids act as ***Xanthine oxidase*** modulators. XO catalyses the conversion of hypoxanthine to xanthine and subsequently to uric acid. The increase of uric acid levels in blood serum results in a condition known as hyperuricaemia that can lead to further health complications such as gout and kidney stones. The various types of flavonoids were studied and it was found that the presence of benzo-pyran ring in their basic nucleus would have contributed to its XO-inhibitory activity.

Similarly, flavonoids also possess ***anti-acetylcholine esterase*** activity. AChE is a key enzyme in the central nervous system and inhibition of it may lead to an increase in the level of ***acetylcholine,*** which is a neurotransmitter. It is one of the therapies used in the treatment of asymptomatic dementia. Flavonoids have been labelled as high-level natural antioxidants on the basis of their ability to scavenge free radicals. They do this either by free radical chain breaking, metal chelating or by singlet oxygen quenching.

Flavonoids have been shown to promote the development of COX inhibitors that inhibits the response induced by COX2 i.e. of pain and fever against inflammation. A flavonoid known as baicalin was recently shown to possess anti-inflammatory and anti-HIV-1 activities, by interfering with the interaction of HIV-1 envelope proteins with chemokine coreceptors, hence blocking the HIV-1 entry to target cells. This application of flavonoids may be valuable in developing anti-HIV agents in labs.

Owing to their significant antioxidant ability, flavonoids prevent lipid peroxidation and thus its conversion to the subsequent athero-pogenic form. This consequently leads to the prevention of various cardiovascular ailments. Researchers have studied various anticarcinogenic effects of flavonoids. It has been found that flavonoids exert their effect on cytochrome P450 to inhibit the activities of certain ***P450*** enzymes which are responsible for the production of a number procarcinogens. Another mechanism of action is that flavonoids help in the production of metabolizing enzymes as ***gluthione-S-transferase, quinone reductase*** and ***uridine 5-diphospho-glucuronyl transferase*** by which carcinogens are detoxified and thus eliminated from the body.

Due to the ability of the flavonoids to affect the infectivity and replication of DNA and RNA viruses, they also act as anti-microbial compounds.

Conclusion

Flavonoids, being potent antioxidants, confer numerous health benefits. However, due to the fact that the study of flavonoids is quite complex because of the heterogeneity of different molecular structures, much research is needed in this area so that the usefulness of flavonoids in diet could be improved for better human health.

Abbreviations

XO-Xanthine Oxidase, AChE-Acetylcholine Esterase, COX-Cyclooxygenase, HIV-Human Immuno deficiency Virus.

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Hydroponic Techniques- A Method of Soil Less Technology

Article ID: 30444

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Introduction

Urbanization, climate change and indiscriminate use of chemicals, making soil-based agriculture to face various challenges which is further depleting the land fertility. A good alternative for producing healthy crops and vegetables, free from soil borne pathogens is hydroponic cultivation. Hydroponics is a method of growing plants by providing all of the nutrients, in their inorganic form, in a liquid solution with or without solid media. The term Hydroponics was derived from the Greek word "hydro" means water and "ponos" means labour and literally means water work (Beibel, J.P, 1960). Now-a-days hydroponic cultivation is gaining popularity all over the world because of efficient resources management and quality food production.

The nutrients used in hydroponic systems can come from different sources, including fish excrement, duck manure, chemical fertilisers, or artificial nutrient solutions (Jones, Jr., J.B, 2004). By giving continuous and readily available nutrition, plants grow up to 50% faster in hydroponics compared to they would in soil. And the produce can be harvested round the year from a hydroponic farming. Plants which are grown commonly using hydroponics includes tomatoes, peppers, cucumbers, lettuces, marijuana, and model plants like Arabidopsis thaliana.

Hydroponics offers many advantages, one of them being a decrease in water usage for agriculture and also any water that is used in hydroponic gardening stays in the system and can be utilized, lowering the constant need for a fresh water supply. For example, for growing 1kilogram of tomatoes requires 400 litres of water using intensive farming methods and 7 litres using hydroponic farming.

Hydroponic Structures and their Operation

Large numbers of hydroponic techniques are available. Most commonly used systems are wick, drip, ebb-flow, deep water culture, Aeroponics and nutrient film technique (NFT). For selecting a suitable technique, the following factors must be considered:
1. Space and other available resources
2. Expected productivity
3. Availability of suitable growing medium
4. Expected quality of the produce.

Wick System

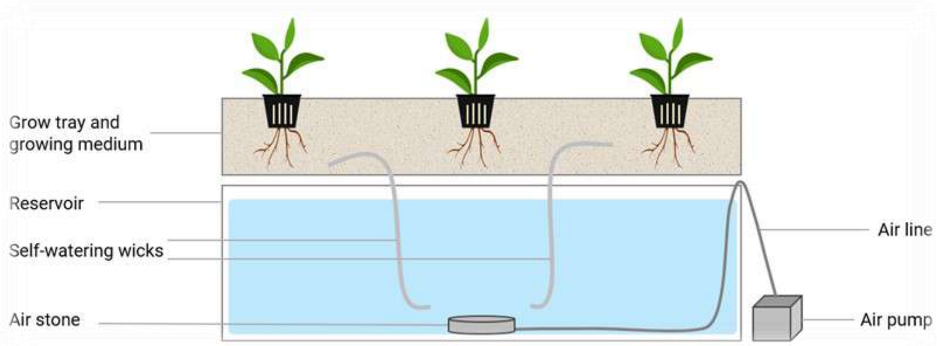

Fig1: Diagram of wick hydroponic system

Wicking is one of the simplest and lowest costing methods of hydroponics requiring no electricity, pump and aerators (Shrestha and Dunn, 2013). The concept behind wicking is that there will be a material that is surrounded by a growing medium with one end of the material placed within the nutrient solution. Generally, plants are placed in an absorbent medium with a nylon wick running from plant roots into a reservoir of solution. By using capillary action water and nutrient solution are supplied to plants. This system works well for small plants, herbs and spice and doesn't work effectively that needs lot of water.

Ebb and Flow System

An ebb & flow hydroponics system, also called as a flood and drain system, is a great system for growing plants using hydroponics technique. This type of system functions by overflowing the growing area with the nutrient solution at specific intervals. Then the nutrient solution drains into the reservoir. An ebb & flow hydroponics system is idyllic for plants that are familiar to periods of dryness. As the root system grows larger the plant grows faster as it can absorb more nutrients. By using this system, it is possible to grow different kinds of crops but the problem of root rot, algae and mould is very common therefore, some modified system with filtration unit is required (Nielsen et al., 2006).

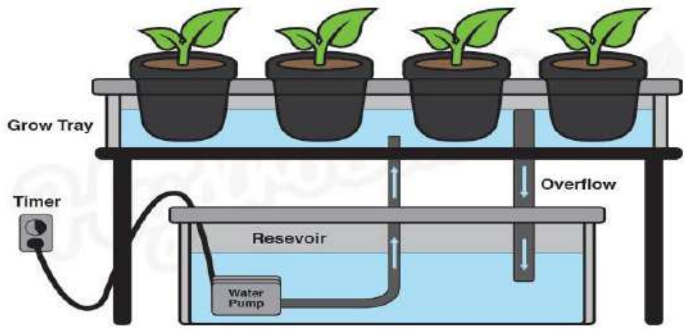

Fig 2: Diagram of Ebb and flow system

Drip System

The drip system method in hydroponics is widely used method among both home-gardener and commercial hydroponic growers. Plants are usually placed in moderately absorbent growing medium and water or nutrient solution from the reservoir is provided to individual plant roots in appropriate proportion with the assistance of pump. Various crops can be grown steadily with more conservation of water.

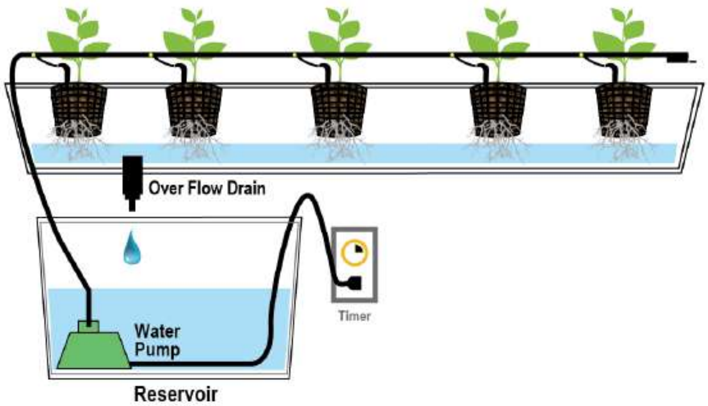

Fig 3: Diagram of drip system

Deep Water Culture System

Deepwater Culture (DWC) also referred to as the reservoir method is out and away the best method for growing plants with hydroponics. The roots are suspended in the nutrient solution and an air pump oxygenates the nutrient solution; this keeps the roots of the plants from drowning. The prime benefit of using a Deepwater Culture system over drip system is that there aren't any drip or spray emitters to clog. This makes DWC a very good choice for organic hydroponics, as hydroponics systems that use organic nutrients are more subjected to clogs. The foremost thing with the system is mandatory to observe the oxygen and nutrient concentrations, salinity and Ph as algae and moulds can grow rapidly within the reservoir (Domingues et al., 2012). This method works well for larger plants that produce fruits especially cucumber and tomato, grow well with this system.

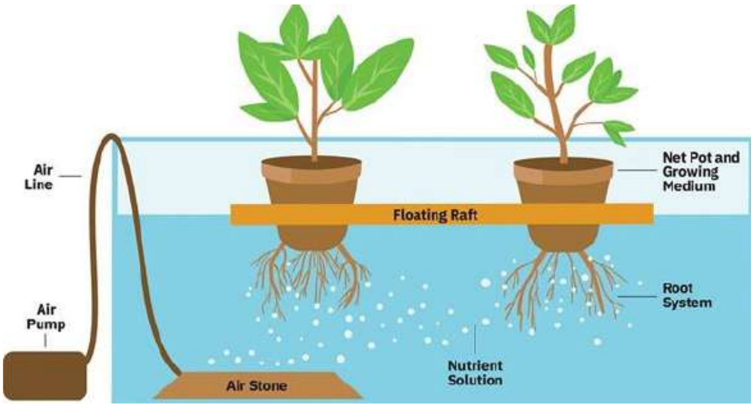

Fig 4: Diagram of deep-water culture system

Aeroponics

Aeroponics is a hydroponics method by which the roots are misted with a nutrient solution while suspended within the air. There are two primary methods to obtain the solution to the exposed roots. The foremost method involves a fine spraying nozzle to mist the roots and the other method uses a pond fogger.

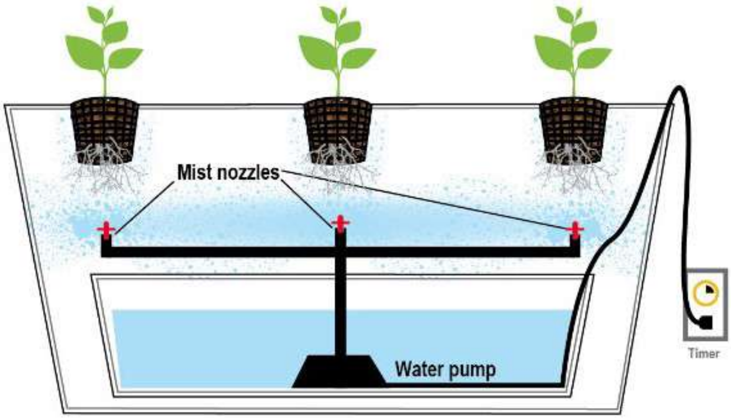

Fig 5: Diagram of aeroponics

Nutrient Film Technique (NFT) System

NFT is a type of hydroponic system where a continual flow of nutrient solution runs over the plants roots. This kind of solution is on a small tilt in order that the nutrient solution will flow with the force of gravity. NFT system works extremely well because the roots of a plant absorb more oxygen from the air than from the nutrient solution, which promotes a faster rate of growth. Because they're constantly immersed in water or nutrient roots are sensitive to fungal infection. In this system, many leafy greens can easily be grown and commercially most widely used for lettuce production.

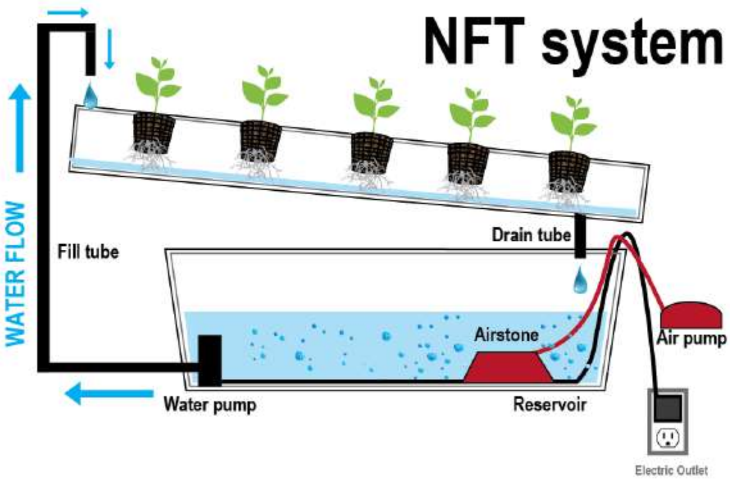

Fig1: Diagram of wick hydroponic system

Benefits and Limitations

1. Crops in hydroponic system are not influenced by any climate change therefore, can be cultivated year-round and considered as off season (Manzocco et al., 2011).
2. Further, commercial hydroponic systems are automatically operated, reduces labour and several other traditional agricultural practices may be eliminated.
3. Hydroponics saves large amount of water as irrigation and other type of sprays are not needed and the water logging never occurs.
4. The difficulty of pest and disease is controlled easily while weed is non-existent.
5. Higher yields may be obtained since the amount of plants per unit is higher compared to traditional agriculture.

Although soil-less cultivation is an advantageous technique but it has some limitations which are significant.
1. Technical knowledge and higher initial cost are fundamental requirement for commercial scale cultivation (Resh, 2013).
2. Plant during a hydroponics system is the exact same nutrient, and water borne diseases can easily spread from plant to a different. (Ikeda et al., 2002).
3. Hot weather and limited oxygenation may limit production and may lead to loss of crops.
4. Maintenance of pH, EC and concentration of the nutrient solution is of leading importance.
5. Finally, light and energy supply are required to run the system.

Conclusions

In recent years hydroponics is a promising strategy for growing different crops. The advantage of hydroponic systems is they can be grown in any weather conditions and anywhere whether it is indoors, outdoors or in a greenhouse. Due to soil not being used, plants can be placed close together which reduces the space needed to grow the same amount of the crops. In India hydroponics industry is expected to grow in future, hence it is necessary to develop a low-cost technology with fully sustainable growing system having minimal waste, and to reduce labour and lower the start-up and operational costs.

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The Potentiality of Zeolite Minerals for Sustaining Soil Fertility and Quality in Agriculture

Article ID: 30445

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Introduction

The world's population is expected to reach 9.6 billion by 2050. So, by then four major global challenges for Earth's soils will arise to meet up rising human demands (i.e. double food supply, double fuel supply, increased water supply by > 50% and mitigate / adapt to climate change). The global soil resource is under serious degradation which has ultimately negative impact on sustained crop yield and environmental quality.

Inadequate water resources coupled with increasing demand for freshwater has been a challenging issue for countries located in arid and semi-arid regions. Among different solutions, zeolites have been extensively employed in agricultural activities which have potential to improve both water use efficiency (WUE) and nutrient use efficiency (NUE) in agricultural.

What is Zeolite?

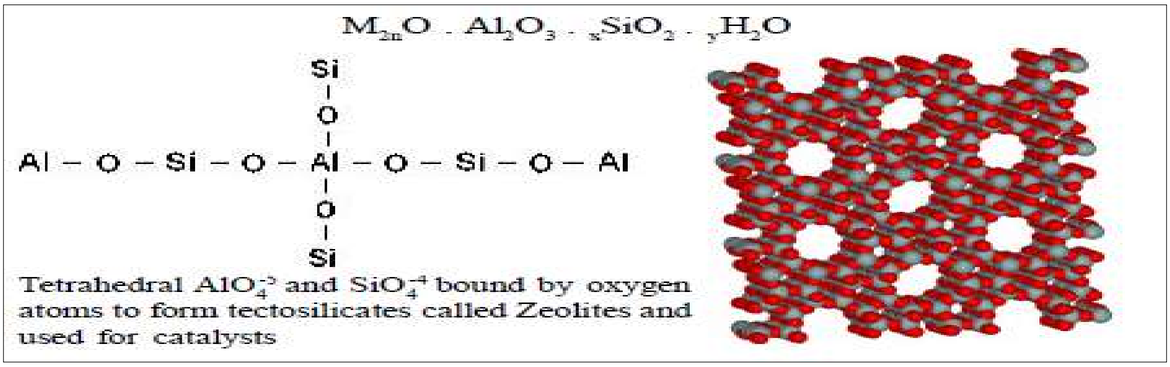
Zeolite is a cation exchanger which serves both as a sink for dissolved cations and as a source of nutrients such as NH4 + (Allen et al. 1993). It is able to lose and gain water reversibly and to exchange extra framework cations without change of crystal structure. While organic matter may have similar effects on soil quality improvement, zeolites are very stable materials with long residence life in the soil.

Hence, their application will result a long-term solution to moisture and nutrient retention limitations. Due to their alkaline characteristics, use of zeolites in combination with fertilizers can help buffer soil reaction thereby reduce the need for lime. Zeolites are one of the widely used natural inorganic soil conditioners to improve physical and chemical properties of soil, such as water holding capacity, infiltration rate, saturated hydraulic conductivity, and cation exchange capacity.

Structure of Zeolite

Zeolites are naturally occurring minerals formed in the reaction of volcanic ash with surface water or groundwater. They can be formed in the non-volcanic environment due to interaction between the saline soil particles with strong basic solutions (Kumpiene et al. 2007). They are crystalline, hydrated aluminosilicates of metals, including calcium, magnesium, sodium, potassium, strontium and barium. The primary building unit of zeolite framework is tetrahedron, the centre of which is occupied by a silicon or aluminum atoms, with four oxygen atoms at the vertices.

The negative charge of the framework is developed by Substitution of Si4+ by Al3+, which is balanced by monovalent or divalentcations located at the surface. It has porous structure which is characterized by cages approximately 12Å in diameter, interlinked through channels about 8Å in diameter, composed of rings of 12 linked tetrahedrons (Kaduk and Faber, 1995). The general empirical formula, which represents a zeolite chemical structure, is shown below:



Origin

The term "Zeolite" is derived from two Greek words meaning "boiling stones", due to the ability of the mineral to froth when heated to about 200°C. Thereafter, zeolites were considered as a mineral found in volcanic rocks for a period of 200 years. Identification of zeolites as a mineral goes back to 1756, when a Swedish mineralogist, Alex Fredrik Cronstedt, collected some crystals from a copper mine in Sweden. The commercial production and use started in the 1960s (Polat et al. 2004).

Nature and Properties of Zeolites

1. In zeolites, different combinations of SiO_4^{4-} and Al $(OH)_3$ $^{6-}$ tetrahedral lead to the formation of a three-dimensional framework with pores and voids of molecular dimension.

2. Shape, dimensions and linkage of zeolite pores and voids are the key characteristics of zeolite materials. The pores and interconnected voids are occupied by cations and water molecules.

3. Zeolites have low bulk density due to the large internal channels in their structure created by three-dimensional framework of silica and alumina tetrahedron. The crystal structure is highly stable, with uniform molecular-sized channels which do not lose their structure when dehydrated.

4. Zeolites having complex structure with large open 'channels' in the crystal structure that provide a large void space for the adsorption and exchange of cations, making zeolite an extremely effective ion exchanger.

5. Cations can be changed by ion exchange and water can be removed reversibly by application of heat. The mineral has a three-dimensional crystal lattice, with loosely bound cations, capable of hydrating and dehydrating without altering the crystal structure.

Role of Zeolites in Increasing Nutrient Use Efficiency

1. Nitrogen: Though nitrogen is considered as king of agriculture and widely used in all crops and cropping system, its use efficiency is just 30-40% only. Zeolites having the potential to increase nitrogen use efficiency by various ways like reduction in soil urease activity with zeolite , used in partial liquidation of fast and liquid wastes from animal production in agriculture and can be utilized for removing unpleasant smell in stables, ensured good retention of soil-exchangeable cations, good sorbent for nitrate besides retaining large quantities of ammonium ion which interfere with the process of nitrification, reduced nitrate and ammonium. The application of Zeolites with urea can reduced the ammonia volatilization by 8 per cent.

2. Phosphorus: Zeolite rock phosphate combination acted as an exchange fertilizer, with Ca^{2+} exchanging onto the zeolite in response to plant uptake of nutrient cations i.e. NH^4 + or K, enhancing the dissolution of rock phosphate. Ammonium-charged zeolites have ability to increase the solubilization of phosphate minerals and promoted the rock-phosphate dissolution in all soil types as well as reduced fixation in soils.

Remediation of Contaminated Soil

Natural and synthetic zeolites are being used among other additives for reduction of bioavailability of heavy metals in the soil. The use of zeolites in acidic soils results an increase in pH that significantly affects reduction in heavy metals solubility and bioavailability for plants. Zeolites application to soil contaminated with heavy metals or radionuclides can be effective in lowering their concentrations. Zeolites can exchange or adsorb different cations such as Cesium (Cs) and Strontium (Sr) as well as heavy metals such as Cadmium (Cd), Lead (Pb), Nickel (Ni), Manganese (Mn), Zinc (Zn), Chrome (Cr), Iron (Fe), and Copper (Cu) ,anions such as Chromate (CrO_4^{2-}) and Arsenate (AsO_4^{-3}) and organic pollutants such as volatile organic compounds including benzene, toluene, ethyl benzene, and xylene.

As Soil Amendment

Zeolites remain in the soil for long time which improves nutrient retention. Therefore, addition of zeolites to the soil may significantly reduce water and fertilizer costs by retaining beneficial nutrients in the root zone. Many of the beneficial effects are due to a significant change in CEC and an improvement in the physical characteristics of soils. Sandy soils have low water and nutrient retention capacities. Thus, zeolite amendments result in remarkable influence on the reduction of NH^{4+} leaching. It is reported that the addition of 0.2 per cent by weight of a clinoptilolite zeolite to a loamy soil is enough to absorb the applied NH^{4+} and prevent its leaching by the inflow water in sandy and loamy soils.

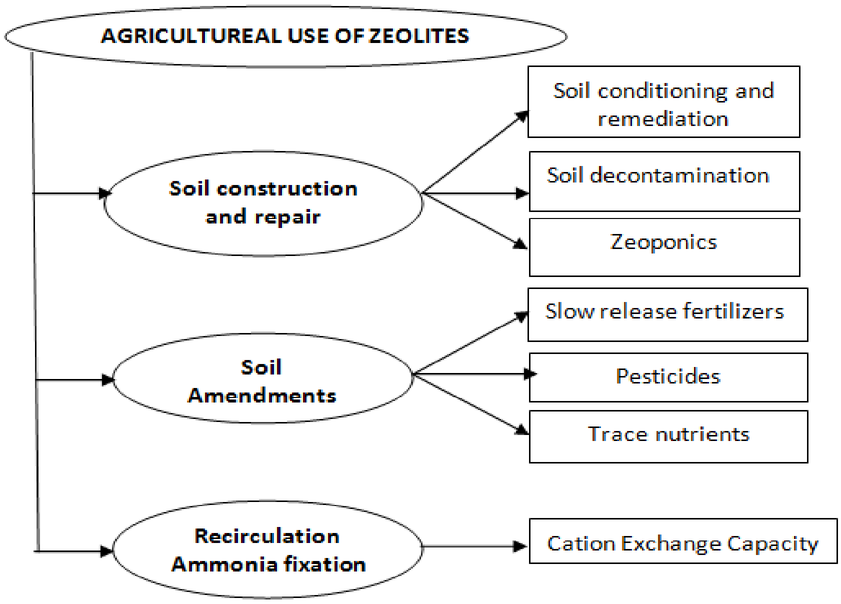


Fig: Use of Zeolites in different Agricultural purposes

Future Perspective

Under the present scenario of intensification of agriculture there are wide areas of use for a natural, inert and non-toxic material such as the natural zeolite. Although almost all of naturally occurring zeolites and most of the artificial zeolites do not have high affinity for anionic fertilizers such as NO^{3-},PO_4^{3-}, and $SO4^{2-}$, they can be effectively use as cationic surfactant, multifunctional adsorbents with capability to trap anions and non-polar organics with surface modification. The ion exchange properties of natural, synthetic, and modified zeolites can be exploited in the preparation of slow-release fertilizers for nitrogen, potassium, and sulphur. However, it is necessary to do further study prior to any commercial applications to evaluate the risk of leaching toxic surfactants that are loosely attached to the zeolite surface for environmental safety.

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Awareness About Management in Citrus Orchards

Article ID: 30446

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Introduction

The area under citrus in Madhya Pradesh is estimated to be 74,815 ha of which 55,640 ha is under oranges (*Citrus reticulata* Blanco), 11,116 ha under acid lime (*Citrus aurantifolia* Swingle), and 8,698 ha under sweet oranges (*Citrus sinensis* Osbeck), as per official record of Directorate of Horticulture and Farm Forestry of the state. The area under citrus cultivation is increasing gradually. In Madhya Pradesh orange cultivation was restricted to Chhindwara district which has now extended in Betul, Hoshangabad, Mandsaur, Neemach, Ujjain, Bhopal, Vidisha, Harda Shajapur, Agar Malwa, Khandwa, Khargone, Dhar and Ratlam districts. Out of 55,640 ha under orange cultivation Chhindwara commands approximately 25,000 ha only indicating a good potential for orange cultivation in other districts of the state. Pandhurna and Sausar block of Chhindwara district adjoining to Vidarbha region of Maharashtra are famous for quality Nagpur mandarin .Orange cultivation is also becoming popular in two more blocks viz., Mohkhed and Bichhua of the district commanding approx. 1,000 ha each. The main citrus fruits in Madhya Pradesh are orange, acid lime and sweet orange. Fruits are grown in 49 out of 51 districts of Madhya Pradesh. The basic objective of this study was to establish the relationship between the socio-economic characteristics of respondents and awareness and adoption of technologies. Furthermore, the process adopted is influenced by the socio-economic aspects such as age, education, land holding size etc. So, the present study was carried out focusing on analysing the impacts of socio-economic attributes on awareness and the adoption of improved production practices.

Discussion

Survey research design due to availability of sampling frame, probability (random sampling) was applied for sample selection. Through random sampling, 120 citrus growers were selected as sample. Structured questionnaire administered through interview was used as a research instrument. Analysis of the data collected from the targeted citrus growers revealed a highly significant influence of education on awareness and adoption. Moreover, significant association was found between citrus cultivation area and awareness and adoption of improved practices. Age also showed significant association with awareness and adoption. Moreover, dominancy of middle-aged farmers and illiteracy in the study area strongly point the need of provision of formal and non-formal education and training program for farmers. Young generation needs to be focused and reorientation of youth clubs may help in better way to gain the utmost outcome.

Relationship between age of the respondents and awareness and adoption

Age	Awareness (percentage)			Adoption (percentage)		
	Low	Medium	High	Low	Medium	High
Young (up to 25 years)	23.3	17.5	0.83	4.16	11.66	74.16
Middle (26-50)	20.0	24.16	0.83	0.83	3	6.66
Old (above 50)	6.66	6.66	0	0	0	0

Relationship between Education of the respondents and awareness and adoption

Education	Awareness (percentage)			Adoption (percentage)		
	Low	Medium	High	Low	Medium	High
Illiterate	10.0	14.16	0	0	3.33	5.0
Up to middle	15.0	8.33	0	5.0	10.83	75.83
Above matric	11.66	10.0	3.33	-	-	-

Land is anticipated aural assets and pride of farmers in society. Farmers' response showed non-significant association with land holding size. However, it is fortunate to say that with large land holding size farmers may gain extended interest in seeking new information. Land under citrus cultivation was also proven to have non-significant association.

Relationship between size of citrus orchard of the respondents, awareness and adoption						
Size of citrus orchard	Awareness (percentage)			Adoption (percentage)		
	Low	Medium	High	Low	Medium	High
5 acres	25.0	21.66	0.83	0	3.33	5.0
5-10	12.5	19.16	-	5.0	10.83	75.83
Above 10	12.5	7.5	0.83	-	-	-

Regression analysis indicated that such factors such as age had negative relationship with the adoption of improved citrus production practices. In addition, significantly positive relation of factors such as education was found which implies that the education will increase the adoption and the same case can be observed regarding holding a large land holding size. Relationship of adoption with land holding size was also positive.

Conclusions

The passage of time promotes technologies for enhanced productivity. However, adoption process is slow and growers' interest varies according to the feasibilities of technology. Awareness and adoption depend upon several elements like socio-economic one was given to each adopted recommendation and 2 to non-adopted recommendation. An adoption index was then developed by adding the adopted recommendations.

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Application of ICT in Agriculture: Opportunities in Developing Countries

Article ID: 30447

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In the context of agriculture, the potential of information & communication technology (IT) can be studied under broadly two outcomes viz. direct contribution to farm productivity and indirect contribution. The Precision farming is the result of direct contribution of agriculture technology for farm productivity. The indirect tools help farmers to take informed and quality decisions which will have positive impact on the way agriculture and allied activities are conducted. Indian farmer urgently requires timely and reliable sources of information inputs for taking decisions. At present, the farmer depends on trickling down of decision inputs from conventional sources which are slow and unreliable. The changing environment faced by Indian farmers makes information not merely useful, but necessary to remain competitive.

The major ICT tools for agricultural sector include personal computers, mobile telephones and other telecommunication devices. ICT has many potential applications in delivering agricultural extension and can bring new information services to rural areas. ICT tools can help in meeting the challenges in agricultural development in the following ways:
1. Agriculture Information, Awareness and Education using ICT.
2. Advanced information about adverse weather condition, so that farmers can take precautionary measures.
3. Real time and near real times pricing and market information.
4. Information dissemination about various government schemes.
5. Information regarding Agri finance, Agri clinicals and agribusiness.
6. Online Farmer Communities.

Let's look at the top agriculture apps that are revolutionizing Indian farming.

New & Old Tractors- KhetiGaadi

The KhetiGaadi app provides a platform for farmer awareness about the benefits of farm mechanization for Indian farmers. One of the best agriculture apps in India and one of the best apps for Indian farmer education, its user-friendly interface details farming tractors, tractor agricultural implements, and other farm equipment. The Kisan farmer can easily find the best tractor in India via this app as well as others like the Myfarm app and the Kisan farmer app, In the New Tractors section, farmers discover new tractors from different tractor brands and, in the New Implements section, the latest in tractor implements technology. They can view Mahindra tractor models, Tafe tractors models, Massey Ferguson tractor models in India, and New Holland tractor models in India. They can find out the Massey Ferguson tractor models price as well as the Mahindra tractor price, the New Holland tractor price, the John Deere tractor price, and prices of other agriculture tractor brands. The latest Mahindra tractor, Mahindra Yuvo tractor, New Holland tractor, and John Deere tractors are expensive, but, fortunately, the Old Tractors section has affordable options. The Sell and Rent Tractor agriculture app sections have tractors for sale and rent. The Compare Tractors & Implements section offers agri-expert tractor reviews and tractor model comparisons to find the best tractor in India for agriculture. Farmers can learn about tractor financing. The Tractor Dealers & Service Centers and the Tractor News sections also offer an essential information.

IFFCO Kisan – Agriculture App

IFFCO Kisan agriculture app informs Indian farmers about local weather conditions, mandi prices, and crops that suit their agro-climatic zone. The Gyan Bhandar section has agriculture resources while Through the Ask Our Experts feature connects farmers with agri-experts. The agriculture app also has a platform for farmer marketplace sales. Using such apps for Indian farmer enlightenment will make a huge difference in Indian agriculture.

Farmer's Portal India

Through this platform for farmer interaction, the Kisan farmer can learn about dealers, types, and usage of seeds, fertilizers, pesticides, and other farm machinery. The Crop Management section covers organic farming and other farming practices. The Postharvest section covers storage, crop prices, and the state-wise market price for different commodities. The Risk Management agriculture app section informs about drought-affected areas, soil fertility maps, contingency plans, and more. Farmers can learn about markets in the Exports. Imports section, and contact nation-wide soil testing laboratories and download their local soil health card in the Soil Health Card section.

Kisan Suvidha

The Weather feature provides weather reports and extreme weather alerts. The Dealers feature covers dealers of seeds, fertilizers, pesticides, and farm machinery. Farmers can check current regional and crop-wise market prices with the Market Price feature. In Plant Protection, they can learn about crop diseases, weed management, crop protection, and crop maintenance. They can consult agri-expert via the Agro Advisories section, or call a toll-free number through the Kisan Call Centre (KCC). Farmers can learn about soil types and storage facilities via the Soil Health Card and the Cold Storages and Godowns features.

MyAgriGuru

This app for Indian farmers is an agro connect between the Indian Kisan and agricultural experts. In the theAgriBuzz section, farmers can swap farming information, success stories, and concerns. The Crop section covers organic farming, crop sowing, crop protection, pest management, weather conditions, and crop prices. The Kisan farmer can consult a MyAgriGuruagri-expert about crop issues. The Market Price section gives mandi bhav prices and the regional weather forecast. The Tip of the Day section and the More sections enrich the Indian Kisan with useful tips and information about government schemes and subsidies, organic farming, the latest agriculture news, and new technologies.

AgroStar Agri-Doctor

The Krishi Charcha agriculture app section connects Indian farmers and the AgroStar Agri-Doctoragri-experts. Farmers can upload content about their agricultural issues. The app provides localized weather reports and informs farmers on crop protection methods. The app's shop provides a platform for farmers necessary items like seeds, pesticides, tractors, and pumps. The Krishi Gyaan section informs farmers about growing crops, crop diseases, and crop nutrition. The app's offline mode allows farmers to access previously visited content without an Internet connection.

Kisan Abhimaan

One of many different apps for Indian farmer conveniences like the Myfarm app and the Kisan farmer app, the Kisan Abhimaan app serves as a marketplace to sell and buy vegetables, fruits, cereals, pulses, spices, and flowers across India. Farmers, retailers, and wholesale dealers can create selling lists for their produce and search for potential buyers. Individuals, organizations, hotels, and restaurants can create buying lists and buy directly from a farmer, a retailer, or a wholesale dealer. The search feature lets users find various produce and their sellers as well as transporters, agriculture experts, fertilizer suppliers, exporters, cold storage providers, agriculture equipment suppliers, and veterinarians.

My Farmer

Consumers, vendors, and wholesale dealers can buy farm produce directly from the Kisan farmer via this app. Farmers can list their produce and product details. Buyers can post ads about the produce they seek. The app lets farmers contact an agri-expert as well as government agriculture departments and other agencies to clarify their agriculture problems. The Farmer News Feed section has advisories about water supply shortage and the possibility of heavy rainfall in various areas.

Krushi Mitra

This agriculture app covers organic farming practices for various crops. Farmers can learn about seed varieties and prices, crop diseases, organic pesticides, soil testing, and soil fertility. They can get tips about agricultural techniques and check their land records and daily mandi rates. They can learn about crop insurance and government schemes and subsidies.

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Carbon Credits & their Trade

Article ID: 30448

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Introduction

The warming of earth is resultant of emissions of carbon dioxide and other Greenhouse Gases (GHG's) from human activities like industrial processes, fossil fuel combustion and deforestation, etc. The Global warming led to the threat of melting of ice bergs in the Sea, which further can raise the sea levels in dangerous proportions resulting in flooding & led to climate change. To protect our planet, the adverse effects of climate change must be checked by reducing emissions of greenhouse gases. In this direction concept of Clean Development Mechanism (CDM) came into force as a part of Kyoto Protocol. The objective of CDM is stabilization of greenhouse gas at a level that would prevent dangerous anthropogenic interference with the climate. The carbon credit came about in response to the Kyoto Protocol, signed by 180 countries in December 1997 in Kyoto, Japan. The Kyoto Protocol mentioned 38 industrialized countries to reduce their greenhouse gas emissions during the years 2008 to 2012 to levels that are 5.2% lower than those of 1990. Carbon is given economic value and allowed companies, agencies and governments to trade Carbon Credits called Certified Emission Reductions or CERs. Carbon markets are structures that allow companies or heavy industry to reduce their economic footprint with the help of series of incentives. The main theme behind this mechanism is to purchase the right to pollute more by most polluting countries from countries that have not reached their emissions limits.

How is the Concept Evolved?

1. The concept of carbon credit started with 'clean development mechanism' (CDM) after the Kyoto Protocol agreement of 1997.
2. This new concept include afforestation which helped in reducing carbon dioxide emissions and earn 'credits' that could be sold in the market.
3. These carbon credits bought by the developed countries that had committed to emissions cuts under the Protocol.

Working of Carbon Credits

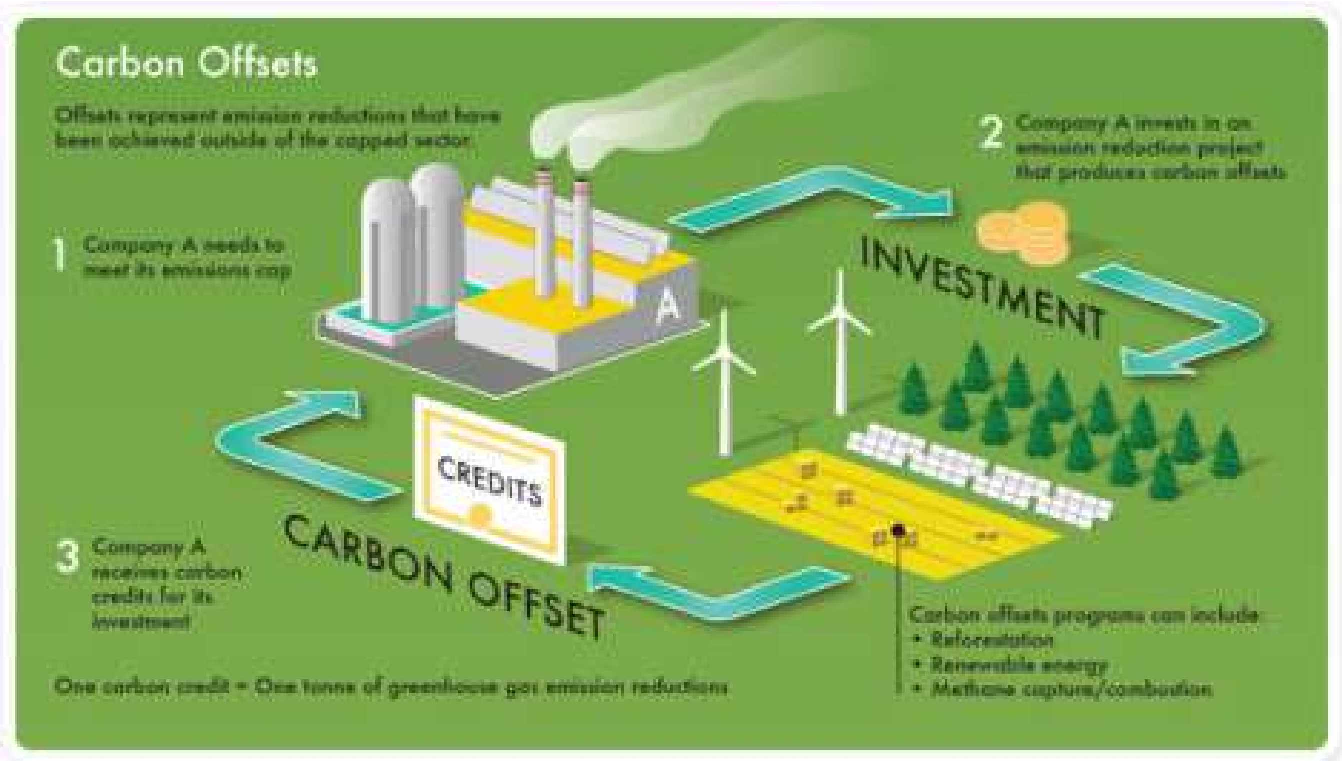

Figure 1: Working of Carbon Credits

Under this mechanism, a company or country that exceeds certain carbon reduction targets could buy credits from another company or country that does not exceeded their carbon emission limits. In other words, companies can 'offset' carbon emissions through pre-determined contributions to low-carbon projects or it can purchase of green bonds.

Types of Carbon Credits

There are basically two types of Carbon credits:
1. Voluntary emissions reduction (VER): A carbon offset that is exchanged in voluntary market for credits.
2. Certified emissions reduction (CER): Carbon credits created through a regulatory framework with the purpose of offsetting a project's emission of greenhouse gases.

The main difference between the two is that CER involved a third party which certifies and regulates emissions as opposed to the VER.

India's Scenario

In India, companies have registered 1669 projects under Clean Development Mechanism and earned 246.6 million credits. Apart from that 526 projects were registered under the 'voluntary' market and these have earned 89 million credits. Therefore, in total Indian companies got roughly 350 million credits. These credits were given different names under different dispensations. Under CDM, they are called CER (certified emission reductions). Like shares, the worth of carbon credits depends on the market price.

E.g.: the carbon credits were sold for $25 a CER. Also, Indo Wind (Chennai-based wind energy company) sold some for $15 apiece. Ironically, if the market crash happens during the tenure when carbon ought to be priced far higher than its historical peak then IMF took the decision to limit price up to $75 as it would be consistent with climate action ambitions.

Which Countries are Interested in them and Why?

1. The countries which are facing problem of decarbonisation and which committed to keep the global average temperature increase below 1.5ºC, carbon markets served as very attractive opportunity for such countries such as Brazil, India and China.

2. Interestingly, when US is in the process of withdrawing from the Paris accords, it also showed significant interest in an international carbon market.

Conclusion

Carbon Credit greatly contributes in the fight against Global warming as it improves the return on investments in projects, boosts the economic feasibility of projects, accelerates project implementation and thus provides an additional source of revenue. As several countries are responsible for a large proportion of global emissions (notably USA, Australia, China and India) have avoided mandatory caps and Governments of capped countries may seek to unilaterally weaken their commitments. The carbon credit business is a rapidly changing project implementation and business therefore, people should be aware about market rates, protocols, and registration programs under carbon credits.

Influence of Organic Nutrient Management on Soil Properties and Crop Performance

Article ID: 30449

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Introduction

Agriculture sector is the principal source of livelihood for more than 58% of the population and its contribution to the national GDP is 14.2% (DOA, 2019). India has only 2.3% share in world's total land area and has to ensure food security of about 17.5% of world population. Rapidly increasing population, shrinking land resources for crop production are putting tremendous pressure on land resource due to intensive cultivation (Verma et al., 2012). To meet the challenge, the farmers are forced to apply agrochemicals to adopted high yielding varieties. Fertilizers play an important role to meet nutrient requirement of the crop but their continuous use on lands will have deleterious effects on physical, chemical and biological properties of soil, which in turn reflects on yield.

Before the introduction of chemical fertilizers, the manure was the primary source of soil nutrients used in crop production. The long-term use of imbalanced chemical fertilizers and other agrochemical resulted in the stagnation of crop yield and deterioration of soil health. The cost of fertilizers has also increased limiting their use by the farmers. Considering the scenario, farmers wish to revisit the earlier nutrient management practices, but the limited nutrient supply capacity and bulk nature of organic inputs restricts them. The recent developments in organic nutrient supply packages either sole or integration there has been a renewed interest in use of organic nutrition. The interest is attributed to concerns for maintaining sustainable agricultural production while preserving the environment. The judicious use of nutrient especially organic manures not only improves the productivity and quality but also make cultivation sustainable because it is the basic source of soil organic matter. Soil organic matter plays pivotal roles in various processes of the soil ecosystem including nutrient cycling, soil structure formation, carbon sequestration, water retention and energy supply to microorganisms (Lakaria et al., 2012).

Soil Properties Under Organic Nutrient Management

1. Soil physico-chemical properties: Organic crop production rely on the sustainable management of soil organic matter which influence the soil fertility, soil biological, physical and chemical properties of soil to a great extent which in turn reflects in to crop yield and sustainability of system. Over-exploitation of soils over the decades has resulted in the exhaustion of the agricultural production systems and steadily decline in the productivity (Manna et al., 2005).Therefore, sustainability and productivity of cropping systems are directly related to the maintenance of soil organic matter. Organic manures are the best source of soil organic matter that influences the soil properties and health. Ramesh et al., (2008)has reported that the application of organic manures improved the soil organic carbon content over the chemical fertilizers. The increase in soil organic carbon can be attributed to the addition of higher biomass to the soil as of crop stubbles and residues. The soil nutrient availability is governed by soil adsorption and mineralization behaviour. Rama Lakshmi et al., (2011) observed the accumulation of organic carbon was higher in the plot where the FYM was applied. The enhanced organic carbon increases the soil aggregation and physical properties (Aher et al., 2019). Singh et al., (1999) reported that the continuous application of chemical fertilizer, decrease the organic carbon content in soil, where addition of 5 t FYM ha-1 along with fertilizer N helped in maintaining the original organic matter status in soil. The application of manure plays important role in improving soil organic matter (Mugweet al., 2009). Bayuet al., (2006) also concluded that farm yard manure application increased soil organic carbon content by up to 67% over the control treatment.

Long-term application of organic manures improved the soil organic carbon, available N, P and K in soil, thereby sustaining the soil health (Ramesh et al., 2009). The nitrogen dynamics in soil is also governed by the soil organic matter. The application of farm yard manure reported for higher plant available nitrogen fraction in soil (Khandagle et al., 2019). Nagar et al., (2016) reported that pH and EC reduced slightly with application of FYM and crop residues while significantly higher organic carbon, available nitrogen and potassium were recorded in FYM + phosphocompost and pigeonpea stalk + phosphocompost over RDF alone. Long-term manuring and fertilization registered significant increase in available soil organic carbon, total N P, K and S in the plots under 100% NPK + farmyard manure at 10 ton/ha (Katkaret al., 2011). Singh et al.(2005) concluded that the favourable soil condition with the treatments which received organic manures helped in the mineralization of soil N leading to increased available N content. Mann et al. (2006) reported that available phosphorus content increased due to addition of FYM over initial and control. Influence of FYM in improving the soil available P has been observed and well established. The increase in available P resulting from the organic manures may be due to the mineralization of organic P, the production of organic acids which have a solubilizing effect on soil P and the organic amino acids which retard the fixation of phosphorus (Gupta et al., 1992). Sienkiewicz et al. (2009) reported that the application of manure for several years resulted in a three-fold increase in the available potassium in soil as compared to the content determined after the application of chemical fertilization.

Chaudhary and Narwal (2005) reported that the application of FYM significantly increased the DTPA extractable Zn, Mn, Fe and Cu. Application of farm yard manure significantly increased the concentration of Zn, B and Fe in the soil solution. Organic farming is capable of sustaining the higher crop productivity and improving the soil quality and productivity by manipulating the soil properties on long term basis. It was reported that organic and low-input farming practices after four years led to an increase in the organic carbon, soluble phosphorus, exchangeable potassium, and pH and also the reserve pool of stored nutrients and maintained relativity stable EC.

2. Soil biological properties: In soil, the organic matter acts as food and shelter for microorganisms. The microbial population can survive on different carrier material in the soil. Nakhro and Dkhar (2010) reported maximum counts of fungi and bacteria and microbial biomass carbon in organically treated plot over the inorganically treated plot and control. Mandicet al. (2011) recorded highest count of soil microorganisms in solid manure treatment, the control and other fertilizer treatments.

Dubey et al. (2014) reported significant increase in population of fungi, bacteria, azotobacter, PSB and actinomycetes under 100% organics over the 100% inorganic nutrient management. Aher et al. (2018) recorded 27-102% and 30-45% higher enzymatic activities and soil microbial biomass carbon, respectively under organic soil management over the inorganic management.

Chang et al. (2007) reported that the soil microbial biomass, populations of bacteria, fungi and actinomycetes, as well as soil enzyme activities (dehydrogenase, acid and alkaline phosphatase) increased in the compost-treated soils as compared to the chemical fertilizer treated soil. Soil enzyme activities commonly correlate with microbial parameters and are to be a sensitive index of long-term management influences such as crop rotations, animal and green manures and tillage. The application of vermicompost resulted in very good growth of microbial population compared to inorganics (Das and Dkhar, 2011). A higher level of dehydrogenase activity was observed in soil treated with vermicompost and manure compost over the fertilizer has been reported. Datt et al. (2013) stated that the activity of dehydrogenase was significantly higher under organic and integrated treatments than the chemicals.

High dehydrogenase and phosphatase activity with application of FYM is attributed to higher content of organic matter. It increases the activity because of its high biodegradability and micro-organisms addition. Application of organics viz. chicken manure, sheep manure and filter mud cake are emphasized by their beneficial effects on soil characteristics, macro and micronutrients availability and plant growth. Application of organics along with effective microorganisms positively affected growth and yield of wheat plant (Brennan and Acosta-Martinez, 2019).

Crop Performance Under Organic Nutrient Management

Organic manure plays an important role in the improvement of soil permeability and water stable aggregates in the soil. Thus, the application of organics improves the soil physical properties and nutrient uptake resulting in higher growth, yield and yield components of crops (Satyanarayana et al., 2002).Organic nutrient management not only maintain soil health but also ensure the sustainable crop production. Devi et al. (2013) reported that the crop management through organic inputs produced significantly higher number of pods per plant and seed yield of soybean than inorganic and integrated practice. The soybean showed 9.95% higher yield under organic sources of nutrients as compared to the application of inorganics. The increase in yield might be due to increased biological nitrogen fixation and solubilization of more amount of Phosphorus by phosphate solubilizing bacteria and organic manure also acts as a substrate for the soil microorganisms and makes soil condition favourable for the availability of nutrients to the crop throughout the growth period (Dotaniya et al., 2014).

Ramesh et al., (2008) conducted a field experiment on Vertisols of Bhopal and reported that, the organic manure treatment recorded significantly higher seed yields, which were 10.6 and 11.2% higher than the chemical fertilizers. Significant increase in the yield of maize was recorded with the application of organic nutrients (Ali et al., 2014). Yashona et al.,(2018) stated that there was significant increase in the yield of Pigeon pea under the organic treatment. It has already been reported that wheat yield was significantly higher with the application of organic nutrients (Aher, 2018).Nutrient management plays a key role in improving crop yield with maintenance of soil fertility for sustainable production in intensive cropping system.

Summary and Conclusion

A comprehensive review of organic nutrient application either alone or integrated enhances the soil organic carbon. The soil organic carbon acts as a source of food and shelter for microorganisms. The increased microbial population and enzyme activities results in higher nutrient availability which reflected in terms of better crop performance. The agricultural production in sufficient quantities in a sustainable way is the today's greatest challenge. The sustainable way here means without deteriorating the soil health. In current scenario, the cultivation of high yielding varieties with synthetic fertilizer and agrochemicals helping to produce required food demand of growing population but indiscriminate and imbalanced use of agrochemicals imparting negative effect on soil productivity, environmental health and food quality. It is therefore, important to use appropriate production system that produces good quality food in sufficient quantities without degrading the soil and polluting environment. The organic nutrient management favours soil health sustenance and environmental protection. However, the system has always been criticized for limitations with respect to crop performance in terms of yield. The subsequent modification and integration in organic nutrient management system increased its efficiency. The studies indicating the importance and benefits of organic nutrient management towards agricultural production and soil health sustenance has been reviewed in present work. The comprehensive review revealed that the organic nutrient management either sole or integrated is essential for optimum crop production and improving soil properties.

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What Happens to the Natural World if All the Insects Disappear?

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There are an awful lot of insects. It's hard to say exactly how many because 80% haven't yet been described by taxonomists, but there are probably about 5.5m species. Put that number together with other kinds of animals with exoskeletons and jointed legs, known collectively as arthropods – this includes mites, spiders and woodlice – and there are probably about 7m species in all.

Despite their ubiquity in the animal kingdom, a recent report warned of a "bugpocalypse", as surveys indicated that insects everywhere are declining at an alarming rate. This could mean the extinction of 40% of the world's insect species over the next few decades.

What is particularly worrying is that we don't know exactly why populations are declining. Agricultural intensification and pesticides are likely a big part of the problem, but it's certainly more complicated than that, and habitat loss and climate change could also play a part.

Although some newspaper reports have suggested that insects could "vanish within a century" total loss is unlikely – it's probable that if some species die out, others will move in and take their place. Nevertheless, this loss of diversity could have catastrophic consequences of its own. Insects are ecologically important and if they were to disappear, the consequences for agriculture and wildlife would be dire.

The Sprawling Kingdom of Bugs

It's difficult to overstate how many species there are. Indeed, the 7m estimate above is likely a major underestimate. Lots of insects that look alike – so-called "cryptic species" – are distinguishable only by their DNA. There are an average of six cryptic species for every easily recognisable kind, so if we apply this to the original figure, the potential total number of arthropods balloons to 41m.

Even then, each species has multiple kinds of parasites which are mostly specific to just one host species. Many of these parasites are mites which are themselves arthropods. Conservatively allowing just one kind of parasitic mite per host species brings us to a potential total of 82m arthropods. Compared with only around 600,000 vertebrates – animals with backbones – that's 137 species of arthropod for every vertebrate species.

Astronomical numbers like these caused the physicist-turned-biologist Sir Robert May to observe that "To a good approximation, all [animal] species are insects." May was good at guessing big numbers – he became the UK Government's chief scientist – and his quip in 1986 now seems pretty close to the mark.

That's just diversity though. How many individual insects would be lost in a mass extinction? And how much might they weigh? Their ecological importance will likely depend on both measures. It turns out that insects are so numerous that even though they are small, collectively their weight far outstrips that of the vertebrates.

Perhaps the most celebrated ecologist of his generation, the Harvard ant enthusiast E.O. Wilson estimated that each hectare (2.5 acres) of Amazonian rainforest is inhabited by only a few dozen birds and mammals but well over one billion invertebrates, almost all of which are arthropods.

That hectare would contain about 200kg dry weight of animal tissue, 93% of which would be made up of invertebrate bodies, and a third of that being just ants and termites. This is uncomfortable news for our vertebrate-centric view of the natural world

The Wriggling Foundations of Life

The role allotted to all these tiny creatures in the grand scheme of nature is to eat and be eaten. Insects are the key components of essentially every terrestrial food web. Herbivorous insects, which make up the majority, eat plants, using the chemical energy plants derive from sunlight to synthesise animal tissues and organs. The job is a big one, and is split into many different callings.

Caterpillars and grasshoppers chew plant leaves, aphids and plant hoppers suck their juices, bees steal their pollen and drink their nectar, while beetles and flies eat their fruits and devastate their roots. Even the wood of huge trees is eaten by wood-boring insect larvae.

In turn, these plant-eating insects are themselves eaten, being captured, killed or parasitised by yet more insects. All of these are, in their turn, consumed by still larger creatures. Even when plants die and are turned to mush by fungi and bacteria, there are insects that specialise in eating them.

Going up the food chain, each animal is less and less fussy about what kind of food it will eat. While a typical herbivorous insect might consume only one species of plant, insectivorous animals (mostly arthropods, but also many birds and mammals) don't much care about what kind of insect they catch. This is why there are so many more kinds of insect than birds or mammals. Because only a small fraction of the material of one kind of organism is transformed into that of its predators, each successive stage in the food chain contains less and less living matter. Even though efficiency in this process is known to be greater higher up the food chain, the animals "at the top" represent only a few percent of the total biomass. This is why big, fierce animals are rare.

And so, it's obvious that when insect numbers decrease everything higher up in the food web will suffer. This is already happening – falling insect abundance in Central American tropical forest has been accompanied by parallel declines in the numbers of insect-eating frogs, lizards and birds. We humans ought to be more careful about our relationship with the little creatures that run the world. As Wilson commented:

The truth is that we need invertebrates, but they don't need us.

Onion-Worth the Tears!

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Introduction

Onion (*Allium cepa* L.) is an important and indispensable item of every Indian cuisine. It belongs to the family Alliaceae and is one of the oldest vegetables in the world. Even though onion has its origin in the temperate regions of Central Asia, has established well under tropical and short-day conditions of India. India ranks second both in area and production of onion in world after China and is the third exporter after Netherlands and Spain. During 2015-16, total area under onion cultivation in India was 13.20 lakh hectares with a total production of 209.31 lakh tons and productivity 15.86 t ha-1 (NHRDF, 2017). Kerala is not a traditional growing area for onion, but as a part of tropicalization of cool season vegetables, cultivation of cool season vegetables including onion is gradually picking up during winter season.

Onion is a commodity of masses and commands an extensive internal market in the form of vegetable, spice and condiment. It provides layers of flavour, colour, and texture to a wide variety of dishes and cuisines. But their appeal goes beyond flavour when you consider their role in putative nutritional and health benefits for centuries.

Nutraceutical and Dietary Uses

Onions are multipurpose foods which can be baked, boiled, braised, grilled, fried, roasted, sautéed, or eaten raw as in salads. They form major ingredient in various dishes, salads, soups or chutney or used in pickles for flavor. Onions are also being used as a thickener for curries and gravies. Spring onions are most likely used in making vegetable flavor and of a different taste. Yellow and red onions are considered best for preparing soup because of its sweet flavor, while pink and red onions are preserved in vinegar as a long-lasting relish. Eating of green raw onions is quite beneficial because cooked onions in vegetable may loss many active ingredients. White onions are the traditional onions that are used in classic Mexican cuisine.

Onion contains many beneficial phytochemicals and is rich in water, sugar, protein, fiber, vitamins, and fats. Most onion cultivars are about 89% water, 4% sugar, 1% protein, 2% fiber, and 0.1% fat. They are also a good source of vitamin C, vitamin B6 and folic acid (Upadhyay, 2016).

Table 1. Nutritional Value of Raw Onion in Each 100 G.

Energy	166kJ (40 kcal)
Carbohydrate Sugars Dietary fiber	9.34 g 4240 mg 1700 mg
Fat	100 mg
Protein	1100 mg

Vitamins	
Thiamine (B1)	(4%) 0.046 mg
Riboflavin (B2)	(2%) 0.027 mg
Niacin (B3)	(1%) 0.116 mg
Pantothenic acid (B5)	(2%) 0.123 mg
Vitamin B6	(9%) 0.12 mg
Folate (B9)	(5%) 19 g
Vitamin C	(9%) 7.4 mg
Trace Metals	
Calcium	(2%) 23 mg
Iron	(2%) 21 mg
Magnesium	(3%) 10 mg
Manganese	(6%) 0.129 mg
Phorphorus	(4%) 29 mg
Potassium	(3%) 146 mg
Zinc	(2%) 0.17 mg
Other constituents	
Water	89110 mg
Fluoride	1100 mg

Alliums are rich in favoring phytochemicals which are suitable for health and hygiene, and they can contribute their flavor to savory dishes without raising caloric content appreciably. These are low in fats and in sodium, possess an energy value of 166kJ (40 kcal) per 100 g serving. Onions contain phenolics and flavonoids (quercetin) that have potential anti-inflammatory, anti-cholesterol, anticancer, and antioxidant properties. Organosulfur compounds present in onion are linked to lowering of blood pressure and cholesterol levels. Regular dietary use of raw alliums can lower down the toxigenicity of oils, and reduce the risk of gastric cancer. Allium cepa L. shows inhibitory effects on even the proliferation of cancer cells and adipocytes by inhibiting fatty acid synthase. Use of onions in hot summer check fast dehydration of body and assist in release of excessive heat. It is known as a forgotten source of nutrients, since it contains minerals and trace elements (zinc) of high nutritive value (Ribeiroet al., 2014). Daily use of onion in diet restore zinc deficiency. It is antimicrobial in nature and kills entero-toxigenic bacteria.

Therapeutic Uses

Therapeutically onion has anti-disease potential against a number of diseases. They are good to relieve headaches, coughs, gastric problems and hair loss (Park *et al*., 2007). The pungent juice of onions is used to repel insects mainly moths and houseflies. These are also used to make into syrups, to form poultices, and rubbed on the skin to prevent insect bites. Onions are traditionally used in preparation of Ayurvedic formulations for wound healing and in treating cardiovascular diseases, hyperglycemia, and stomach cancer. Its topical preparations have been used for prevention of surgical scars. On an average daily dose of 50 g of fresh onion, 50 g of fresh onion juice, or 20 g of dried onion have been suggested good for health.

Onion (Allium cepa L.) is widely used in the food industry for its nutritional and aromatic properties. Onion contains active components, which possess antioxidant, cytotoxic and pro-apoptotic properties. Food-derived flavonoid quercetin, widely distributed in onions is able to inhibit growth of various cancer cells. It can be considered as a good candidate for anticancer therapy. It behaves as an antioxidant and/or pro-oxidant as well as modulating different intracellular signaling cascades may all play a certain role. *Allium cepa* Linn is commonly used as supplementary folk remedy for cancer therapy. Polyphenols extracted from lyophilized onion were found effective in human leukemia cells (Upadhyay, 2017).

Table 2. Chemical Constituents in Onion and their Biological Activity / Pharmaceutical Effects

Chemical component	Characteristics	Biological activity
Acetic acid (bulb)	Major contributors to the characteristic odor of onion, chemo-preventive	Acidulant, antibacterial, antiotitic, antisalmonella, antivaginitic, expectorant, fungicide, keratitigenic, mucolytic, osteolytic, perfumery, protisticide, spermicide, ulcerogenic and verrucolytic.
Allicin (bulb)	A sulfur-containing compound found in Allium generates hot sensation	Allergenic, anthelmintic, antiatherosclerotic, antibacterial, antibiotic, anticholinesterase, antidiabetic, antiflu, antiglaucomic, antihypertensive, anti-inflammatory, antioxidant, antiplatelet, anticeptic, anti-triglyceride, antitumor, antiviral, candidicide, fungicide, hypoglycemic, and immunostimulant
Allyl propyl-disulfide (bulb)	A sulfur-containing compound	Hypoglycemic, insulin-sparing and occuloirritant.
Catechol (bulb)	Chemopreventive	Allergenic, antioxidant, cancer-preventive, antiseptic
Allyl methyl sulfide	After food intake onion strong-smelling sulfur compounds are metabolized, forming allyl methyl sulfide	Act as mosquito repellent
Diallyl sulfide	A onion derived OSC	Prevents tumor progression and promotes apoptosis in ectopic glioblastoma xenograft, prevent growth of pancreatic cancer cells
Dillyl-disulfide	A onion derived OSC	Anti-HIV, antibacterial, antioxidant, antitumor cancer-preventive, fungicide, hypocholesterolemic, hypoglycemic, immunostimulant

Dimethyl-disulfide (bulb)	A onion derived OSC	Antithyroid and perfumery activities
DATS	Cytotoxic to prostate cancer cells	Highly cytotoxic to prostate cancer cells, inhibits cell proliferation by triggering either cell cycle arrest or apoptosis, shows pro-apoptotic activity regulated by a caspase-dependent cascade through the activation of both intrinsic and extrinsic signaling pathways, or mediated through the blocking of PI3K/Akt and the activation of the JNK pathway
Diallylpolysulfides	OSC	Diallylpolysulfides induce growth arrest and apoptosis in cells
DATTS	OSC	Induce mitotic arrest to apoptosis
Gamma-glutamylcysteines, allylcysteine sulfoxide (alliin)	OSC	Generate hot odor
Allyl sulfides	OSC	Inhibit cell growth of skin cancer cells through induction of DNA damage mediated G2/M arrest and apoptosis
S-allylcysteine	OSC	Anticancer
S-allylmercaptocysteine	OSC	Induce cell cycle arrest and reduce the risk of various types of human cancer
S-alkenylmercaptocysteine	OSC	Induce apoptosis in pancreatic cells
S-allylmercaptocysteine	active OSCs	Highly toxic to cancer cells
Polysulfanes	Sulfur-containing compounds	Possess antimicrobial, chemopreventive and anticancer properties
Glycolic acid (bulb)	Chemopreventive	Cholesterolic, diuretic, hepatonic and irritant
Oleanoic acid (bulb)	Chemopreventive	Anti-HIV, antiallergic, antiatherosclerotioc, antibacterial, antigingivitic, anti-inflammatory, antioxidant, antiviral, antitumor and cardioprotective
Pyrocatechol (bulb)	Chemopreventive	Anticancer (breast), antihepatotoxic, antioxidant, antiseptic, CNS-stimulant, cardiovascular, dermatitigenic, dye, insectifuge, nematicide and quinone-reductase-reducer
Quercitin (bulb)	Chemopreventive	Analgesic, anti-Crohn's, anti-GTF, anti-HIV, anti-PMS, antiaggregant, antiaging, antiallergic, antialzheimeran, antiarthritic, antiasthmatic, antiatherosclerotic, antibacterial, anticataract, anticystitic, antidepressant, antidermatic, antiflu, antigastric, antihistaminic, anti-inflammatory, antimalarial, antioxidant, antipancreatic, antiplaque, antipolio, antispasmodic, antitumor, antiulcer
S-methyl-cysteine-sulfoxide (bulb)	Chemopreventive	Antidiabetic and antihypercholesterolemic activities

DATS: Diallyl trisulfide, OSC: Organosulfur compounds, DATTS: Diallyl tetrasulfide, GTF: Glucosyltransferase, CNS: Central nervous system, PMS: Premenstrual syndrome.

Conclusion

Onion is a well-known traditional plant that has been consumed for centuries. This is used throughout the world and is the most popular vegetable in India. They are rich source of vitamins, minerals, and have many nutraceutical and therapeutic values. Onions contain phenolics and falvonoids that have potential anti-inflammatory, anti-cholesterol activity, anticancer and antioxidant properties. So, inclusion of onion in our regular diet should be encouraged.

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Water Requirement of Different Crops - Irrigation Water Management

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Introduction

Selection of crop depends on water requirement of the crop, soil, environment and crop growing pattern. Knowledge on good water management, depth of roots in soil, critical stages for water requirement, duration of the crop, crops that tolerate water stress is required.

Water Requirement of Different Crops (mm):

Crop	Season	Water requirement (mm)
Paddy	*Kharif*	1000-1200
	Rabi	1200-1800
Aerobic rice	*Kharif*	800-1000
Maize	*Rabi*	500-800
Jowar/Sorghum	*Rabi*	450-600
Fingermillet, Soybean	*Rabi*	400-450
Bajra	*Rabi*	400-550
Cotton	*Kharif/Rabi*	600-850
Sugarcane		1950-2750
Groundnut	*Rabi*	500-700
Sunflower	*Rabi*	350-500
Sesame	*Summer*	300-350
Castor	*Rabi*	300-350
Cabbage	*Rabi*	500
Redgram	*Rabi*	350-450
Greengram/Blackgram	*Rabi/Summer*	200-400
Chickpea	*Rabi*	350
Onion	*Rabi*	450-550
Bhendi, Brinjal	*Rabi*	500-600
Radish, Beans	*Rabi*	300
Carrot	*Rabi*	400
Chillies	*Kharif, Rabi*	550-650
Banana	-	1600-2200
Mango	-	1100-1200
Citrus, Grapes	-	900-1200
Pineapple	-	700-1000

Supply of required water to crops through drip irrigation not only improves water use efficiency but also saves 50-60% water and also increase cultivable land by 2-4 times.

Crop Selection Based on Availability of Water

Available water (mm)	Suitable crops
Low (200-400)	Sunflower, safflower, greengram, blackgram, minor millets, sesame, cluster bean

Medium (400-600)	maize, jowar, groundnut, redgram, soybean
High (600-800)	Cotton, chillies
Very high (> 1000)	Paddy, Sugarcane. Banana

Crop should not be subjected to water stress during critical stages. If crop subjects to water stress during critical stages major yield losses will occur.

Critical Stages for Irrigation for Different Crops

Crop	Critical stages
Paddy	Tillering stage, flowering, grain milking stage
Maize/Jowar	Flowering, head initiation stage, grain milking stage
Groundnut	Flowering, peg insertion, seed formation
Sesame	Flowering and seed filling stage
Sunflower/Castor	Bud, flowering and seed filling stage
Chickpea	Flowering and seed formation stage
Soybean	Flowering and seed formation stage
Redgram	Flowering and seed formation stage
Greengram	Flowering and seed formation stage
Blackgram	Flowering and seed formation stage
Cotton/Chillies/Bhendi/Brinjal/Beans	Flowering and fruit formation stage
Sugarcane	Crop establishment stage (First 4 months)
Onion	Bulb formation stage
Carrot	Root growth stage
Tomato	Flowering, fruit ripening stage

Irrigation Water Management

Irrigation should be given to crops before depletion of 50% moisture in root zone of crop. Crop will subject to moisture stress when there is 75% depletion of moisture. This leads to major yield losses in crops. If irrigation is given when there is sufficient moisture in soil crop growth will be retarded because of insufficient oxygen. Irrigation time will be decided by observing top 15-20 cm soil. For this soil has to be taken in hand and can observe water status in soil.

Conclusion

Selection of crops based on available water and supply of water at critical stages will give assured yields and income to farmers.

Effect of Biochar on Soil Health and Productivity

Article ID: 30453

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Introduction

Biochar is the product of burning biomass such as hardwood, rice hulls, bamboo, or even chicken litter, in a low to no oxygen environment. Biochar is a stable carbon compound created when biomass is heated to temperatures between 300 and 1000 ˚C under low oxygen concentration. Biochar is highly porous, black carbon skeletal-like structure containing amounts of extractable humic -like and fluvic -like substances (Lin et al. 2012). A wide range of common raw materials are used as the feedstock including wood chip, organic wastes, plant residues and poultry manure (Sohi et al .2010).The elemental composition of biochar generally include carbon, nitrogen, hydrogen, and some lower nutrient elements such as K, Ca, Na and Mg (Zhang et al.2015). Biochar has a high specific surface area and a number of polar or non-polar substances which has a strong affinity to inorganic ions such as heavy metal ions, phosphate, and nitrate (Kammann et al.2015). Application of biochar is very imperative to increase soil fertility, enhance nutrient uptake, ameliorate polluted soils and reduce the amount of carbon produced due to biomass burning and its application can decrease the need for additional chemical fertilizer (nitrogen) and water inputs. Several studies indicate that amending poor or depleted soils with biochar can have a positive impact on soil health and crop yield. Keeping these things in view an experiment was conducted at Birsa Agricultural University, Kanke, Ranchi (Jharkhand) with the main objective to find out the effect of biochar on soil health and crop productivity.

Materials and Methods

After the pyrolysis process, all samples were ground and sieved to less than 0.5mm in diameter. The biochar yield was calculated as the proportion of the weight of pyrolysis product to the original material. The volatile matter was thus determined by measuring the weight loss that follows the combustion of about 1g of charcoal in a crucible at 600°C. pH of Biochar was measured in 1:20 (biochar :water ratio) .The CEC of biochar is estimated by using ammonium acetate (NH 4OAc)OAc) method (pH 7).

Results and Discussion

It was found that soil pH was increased as a result of biochar application in the soil which was also supported by the findings of Lehman and Rondon,2006 that may be due to the nature of biochar having pH from neutral to alkaline. It was also observed that cation exchange capacity of the treated soil with biochar increased. Similar findings were reported by Glaser et al.,2002. Fertilizer use efficiency also increased significantly in biochar treated plots that was reflected in increased yields of several crops. Gaunt and Cowie, 2009 studied the effect of biochar application on fertilizer use efficiency and observed that biochar application improved 10-30% fertilizer use efficiency. Soil moisture retention and biological nitrogen fixation were also increased after the application of biochar was recorded as evidenced by Tryon,1948 and Lehman and Rondon,2006 which may be due to enhanced biomass production that might have promoted biological nitrogen fixation in leguminous crops and the same finding may also be supported by Warnock et al., 2007 who indicated that mycorrhizal population increases about 40% after application of biochar.

Yield variations of different crops were also observed after applying biochar. Corn yield improved after addition of different varieties of biochar. The increased amount crop yield depended on the quantity and types of additional biochar. Different biochar had different influence on different crops (Table 2).

Table 1: Effect of Biochar on Different Soil Properties

Some selected soil properties	Findings	Reference
Soil Chemical properties		

pH (Initial 4.5)	4-5-unit increase	Chan et al., 2007
C (%)(Initial18)	50 -54% increase	Chan et al., 2007
Cation exchange capacity	50% increase	Glaser et al., 2002
Fertilizer use efficiency	10-30 % increase	Gaunt and Cowie, 2009
Soil Physical properties		
Soil moisture retention	Up to 18 % increase	Tryon, 1948
Bulk density	Soil dependent	Laird, 2008
Soil Biological properties		
Biological nitrogen fixation	50-72 % increase	Lehman and Rondon , 2006,
Mycorrhizal population	40 % increase	Warnock et al., 2007

Table 2. Crop Yield Variations When Applying Biochar

Soybean crop	Biochar addition amount	Crop species	Effects
SFWB	11 g/kg soil	Rice	A lone with biochar has no evident influence, but rate production improved by 80% with mineral fertilizer.
BB	0.5 g/kg soil	Soybean	Feedstock of unit area improved by 51%.
RHB	10 g/kg soil	Soybean Corn	rate production improved by 10% -40%
CCB	0.45g/kg soil	Corn	Yield improved by 10.98%
BBC	20 g/kg soil	Corn	Yield improved by 22.77%.
BBC	40 g/kg soil	Corn	Yield improved by 49.80%
PMSB	10 g/kg soil	Wheat	Acid soil yield improved by 30% -40%
CSB	10 g/kg soil	Wheat	Yield improved by 21.89%.

Source : Shareef, T. M. E. and Zhao, B. (2017).

SFWB = Secondary Forest Wood Biochar, BB = Branch biochar, RHB= Rice husks biochar,
CCB = Corn Cob Biochar, BBC= Biological Black Carbon, PMSB = Paper Mill Sludge Biochar, CSB= Corn Stover Biochar.

Conclusion

As a result of biochar application in the soil, huge surface area and well-developed pore structure may increase the water holding capacity and microbial abundance. The cation exchange capacity and availability of nutrients could be increased due to the amounts of exchangeable cations and nutrient elements.

Therefore, improvements in soil physical, chemical and biological properties may promote the productivity of plant through increasing the amount of nutrient elements, enhancing availability of nutrient elements, reducing nutrient leaching and mitigating gaseous nutrients losses and hence, addition of biochar might be a partial solution for improinge soil fertility, promoting plant growth, increasing crop yield and for minimising contaminations.

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Winged Bean - A God Sent Vegetable

Article ID: 30454

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Introduction

Beans are globally important leguminous vegetables. Beans contain high amounts of protein and vitamins. In addition to the nutrient content, legumes have evolved the ability to fix atmospheric nitrogen, meaning that fertilizer input can be lower, legumes can often tolerate poor soils, and they can improve the soil for subsequent crops (kles et al., 1995). One of the underutilized legumes is the winged bean (*Psophocarpus tetragonolobus* L.). The important feature of the winged bean is the potential for almost all parts of the plant to be eaten, from the seeds, pods and flowers, to the leaves and tuberous roots (Haq, 1982; Khan, 1976) with the stems and leaves used as fodder. Due to nitrogen fixation capability it also serves well in crop rotation (Rahman et al., 2014). It is one of the underutilize legume vegetable, which has been ignored by us since many years. It is also known as Goa bean, Asparagus pea, Manila bean, four angled bean, Princess pea and becoming popular as tropical legume vegetable. It is a multivitamin and multimineral packed legume.

Origin

Madagascar in Africa in known as centre of origin for winged bean. Now a days this crop is grown in South-East Asia and in some other countries in the world, but Burma is the only country where it is cultivated as a field crop. In India, Malaysia, China, Sri Lanka, Thailand and Vietnam this crop is grown as very limited scale.

Varieties

The varieties available in india are IIHR selections, 20,60,71 and WBC 2.

Soil and Climate

Winged bean needs 250-300 C temperature for better cultivation. Flowering starts in 8-10 weeks due to planting it in Short days. For tuber initiation short day is necessary. It needs well drained sandy loam soil for development of better tuber. The soil pH range should be in between 5.0-5.5. Annual rain fall 1500-2000mm is required for this crop. It can be cultivated from sea level up to 2000m, but generally prefers humid tropical climate. It cannot withstand prolonged drought. Seeds are sown by the beginning of rainy season.

Land Preparation

Field should be properly ploughed, pulverized and should be fine tilth with weed free. The reason of land preparation is to allow the necessary soil conditions which helps the plant and root growth.

Spacing

The spacing depends on the cultivar and locations. Normally seeds are sown at the spacing of 120 × 60cm. and seed rate varies from 10-35kg/ha.

Manures and Fertilizers

Apply 10-15 tonnes of FYM /ha and Fertilizers of N:P:K:50:100:50 kg/ha. Cut the top portion of the main vine when it developed 10-12 leaves to encourage side shoots. Grow them on a trellis (2m height) oriented north-south for best sun exposure. For first 3-5 weeks weed control is required.

Irrigation

Due to drought tolerant crop it needs an irrigation of once in 7-10 days.

Post-Harvest Care

After harvesting store, the pod in a plastic bag with tight neck. Put it in to the refrigerator for best results at a temperature of 10°C, Relative humidity of 90% and shelf life is extended up to 4 weeks.

Disease and Pest

Several bacterial, fungal, viral and nematode diseases and a disease of viral and/or aphid origin were recorded in surveys of winged bean in Sri Lanka. Three fungal diseases, pulvinus rot *(Fusarium pallidoroseum)* pod rot (*Botryodiploidea theobromae)* and leaf scorch *(Phoma sorgina)* have not been recorded elsewhere.(Shantichandra *et al*., 2008).

Harvesting and Yield

The tender green pods used as vegetable are ready for harvest in ten weeks after sowing and extends up to 2-3 years. The seeds mature in about 5 months and tubers are harvested after 8 months of sowing. Yield varies from 15-25 tonnes/ha depending on varieties. (Kranthirekha and Srikanth 2009).

Nutrition Facts

Analysis of nutrients in Winged bean.

Principle	Nutrients value	% RDA
Energy	49 Kcal	2.5%
Carbohydrate	4.31 mg	3%
Proteins	6.95 mg	12%
Fat	0.87 mg	3%
Cholesterol	0 mg	0%
Vitamins		
Folates	66 µg	16.5%
Niacin	0.900 mg	6%
Pantothenic acid	0.059 mg	1%
Pyridoxine	0.113 mg	9%
Riboflavin	0.100 mg	8%
Thiamin	0.140 mg	12%
Vitamin A	128 IU	4%
Vitamin C	18.3 mg	30%
Electrolytes		
Sodium	4 mg	<1%
Potassium	240 mg	5%
Minerals		
Calcium	84 mg	8%
Copper	0.051 µg	5.5%
Iron	1.5 mg	19%
Magnesium	34 mg	8%
Manganese	0.218 mg	9%
Phosphorus	37 mg	5%
Selenium	1.5 µg	3%
Zinc	0.39 mg	3%

Winged beans *(Psophocarpus tetragonolobus)*, Raw, immature seeds, Nutritive value per 100 g. (Source: USDA National Nutrient data base).

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Bioactive Peptides: A New Trend and Opportunity for Future Foods

Article ID: 30455

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Introduction

Proteins are one of the major nutrients required by human being for the growth and development of the body. It is present in many forms and structure in the environment, such as fibrous, globular and membrane proteins. The occurrence of proteins in different sources may be present as primary, secondary, tertiary and quaternary. There are numerous sources of protein present in the environment, protein obtained from animal sources like egg, milk, fish and meat have better quality due to presence of majority of the essential amino acids as compare to plant sources. Protein is made up of numerous of amino acids linked by peptides bonds.

1. Peptides: A peptide is a short chain of amino acids. The amino acids in a peptide are connected to one another in a sequence by peptide bonds. Typically, peptides are distinguished from proteins by their shorter length.

2. Bioactive peptides: specific protein fragments endow with functions further than basic nutrition that have a positive impact on body functions or conditions and may influence health.

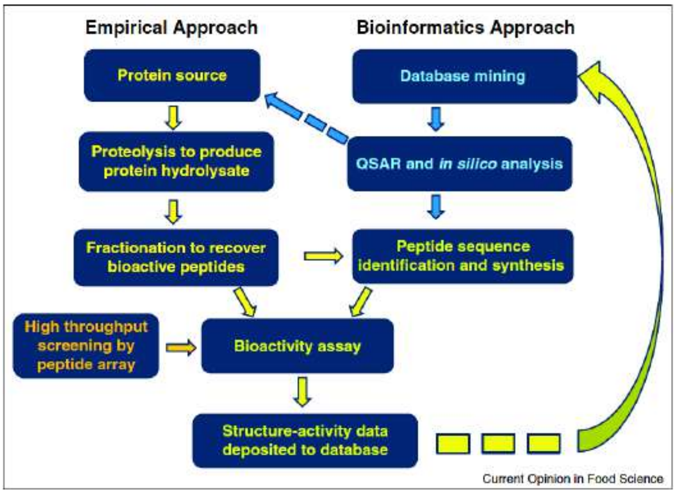

Fig 1: Discovery of bioactive peptides by an empirical approach

Nowadays, lifestyle of people is accountable for many diseases or conditions and has unfortunate consequences on their health. So, there is obligation to take such products in their diet that improve and maintain the robustness, good physical and mental condition. Bioactive peptides are special elements possess many positive effects like antimicrobial, antioxidative, antithrombotic, antihypertensive, antimicrobial and many more. These fragments also affect the major body systems i.e. the cardiovascular, digestive, immune and nervous systems. The behaviour of such bio functional peptides is dependent on its structure and sequence of endogenous amino acids. The size of active sequences may vary from two to twenty residues of amino acids. There are many peptides shows multifunctional properties, so these kinds of sequences are identified as strategic zone (Meisel and FitzGerald 2003; Migliore-Samour and Jolles 1988; Meisel 1998).

Sources of Bioactive Peptides

Bioactive peptides are principally inscribed within the proteins present in different sources. There are many sources of bioactive peptides as listed in table 1. Milk is high in protein. Casein and whey proteins are the two main protein classes in milk, around 80 percent of total protein in bovine milk is casein, which is classified into α-, ß- and π-caseins. Whey protein comprises of ß-lactoglobulin, α-lactalbumin, immunoglobulins (IgGs), glycomacropeptides, serum bovine albumin, and minor proteins such as lactoperoxidase, lysozyme, and lactoferrin. Every subfraction present in casein or whey has their own special biological characteristics. Milk proteins may be degraded by enzymatic proteolysis to numerous peptide fragments and serve as a source of bioactive peptides. Because of the availability of high-quality proteins, meat is the most studied method for the isolation of novel bioactive peptides. Different mechanisms apply to the generation of bioactive peptides from meat and meat products. Eggs are also a good source of novel peptides. Cereal grains such as wheat, barley, rice, rye, oat, millet, sorghum, and corn, are a rich source of bioactive peptides. Cucurbitaceae seeds also seem to be a valuable source of good quality proteins in terms of their amino acid composition; they could potentially be used as functional food ingredients.

Table 1: Sources and obtained bioactive peptides.

S.No.	Sources	Bioactive peptides
1	Milk	VPP, IPP, YP, KVLPVPQ, α-lactorphin (YGLF) and β-lactorphin
2	Egg	RVPSLM, TPSPR, DLQGK, AGLAPY and DHPFLF
3	Meat	RPR , KAPVA and PTPVP
4	Oats	FLQPNLDEH, DLELQNNVFPH TPNAGVSGAAAGAGAGGKH
5	Soybean	IAVPGEVA, IAVPTGVA and LPYP
6	Fish	MY, LKP, IKP and LRP
7	Wheat	IAP, GYYPT and YPISL
8	Broccoli	YPK
9	Rice	GYPMYPLR
10	Bitter melon	VSGAGRY, ITLPYSGNYER, IAAGKPREKIP
11	Pumpkin	PQRGEGGRAGNLLREEQEI
12	Cheese	Bovine -CN f(13–28), S2-CN f(5–21)
14	Others	Casopiastrin, Casoplatelins, Lactoferricin B, OTAP-92, Opioid

Production of Bioactive Peptides

Bioactive peptides are inactive within the sequence of the parent protein and can be released in following ways:
1. Enzymatic hydrolysis by digestive enzymes.
2. Microbial fermentation.

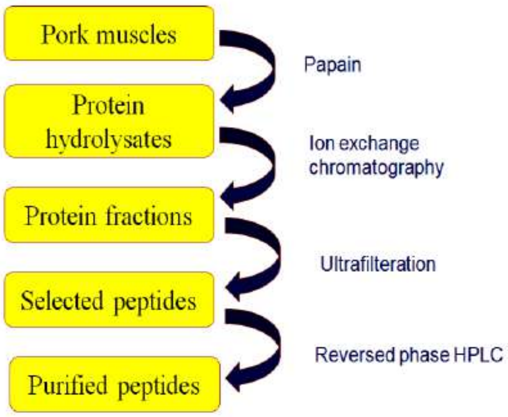

Fig 2(a): enzymatic hydrolysis (Saiga et al., 2003)

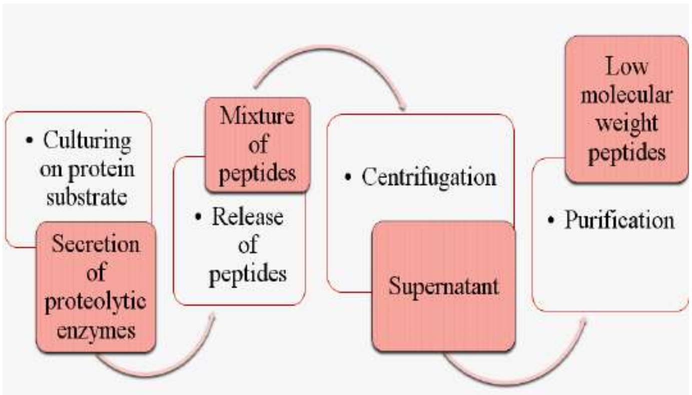

Fig 2(b): microbial fermentation (Mohanty et al., 2016)

Physiological Effects of Bioactive Peptides

1. Effects on the cardiovascular system: peptides and proteins are implicated in the overall antioxidative status of cells and contribute towards maintaining the health of biological tissue. Previous studies show that peptides released from human milk after digestion with pepsin and pancreatin could be beneficial with respect to antioxidant activity. Peptides, known as κ-caseinoglycopeptides, exert their biological function by reducing platelet aggregation and enhancing fibrinolysis, which results in the prevention of thrombosis development.

2. Effects on the nervous system: Peptides are known as opioid peptides in dairy products that play an active role in the nervous system.

3. Effects on immune system: Several casein and whey protein derived peptides display an immunomodulatory role. Immunomodulating peptides have been found to stimulate the proliferation of human lymphocytes, the phagocytic activities of macrophages and antibody synthesis.

4. Effects on nutritional status and dental health: Casein-derived phosphorylated peptides, CPPs, can form soluble organophosphate salts and lead to enhanced mineral uptake. Calcium absorption is enhanced by limiting the precipitation of calcium in the distal ileum. Since CPPs can bind and solubilise minerals, they may have value in the prevention of osteoporosis, dental caries, hypertension and anaemia.

5. Other health effects: Anti-aging, anti-cancer, anti-cariogenic, anti-diabetic, anti-hypertensive, anti-microbial, anti-oxidative stress, anti-inflammatory, cholesterol lowering, growth enhancing immunomodulatory, mineral binding, antithrombotic, regulation of glucose and insulin homeostasis, satiety regulating etc.

Applications in Food Processing and Industry

Due to their ability to provide a positive impact on body functions or conditions, bioactive peptides and their application are of relevance for the food industry. These peptides are used in different ways by food industry such as, by direct addition in food matrix, by inoculation of food with the bacteriocin producer strain, in packaging film, by immobilization, by peptide coating, in the form of functional food and nutraceuticals.

Challenges for Commercialization of Food-Derived Bioactive Peptides as Nutraceuticals and Functional Foods

1. Complications in methodology for quality assurance.
2. Sparse data on bioavailability and metabolic fate.
3. Inadequate clinical evidence of bio efficacy.
4. The bitter taste of peptides.
5. High cost of production.
6. Selection of enzyme(s) and conditions for hydrolysis to achieve best activity and yield.
7. Analysis of bioactive peptides in product.
8. Consumer acceptance.

Scientific Approach and Research Requirements

1. Use economical materials such as by-products and underutilized resources.
2. Debittering, encapsulation or masking.
3. Human sensory evaluation.
4. High-throughput screening using instrumental taste sensors and cell-based assays.
5. Research on stability, bioavailability, absorption, distribution, metabolism, excretion.
6. Systematic design of experiments approach to optimize process parameters for best quality attributes.

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Locust Species of India and their Migratory Pattern

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Fig 1: Locust swarm in India (source: https://www.businesstoday.in/)

Introduction

Locust are any of a group of insects (Acrididae; Orthoptera) that are dispersed globally, the common name mostly mentions the assembly of short-horned grasshoppers that every so often increase significantly in numbers and migrate distances in devastating swarms. In North America the names locust and grasshopper are used for acridid. Cicadas (order: Homoptera) too could be called locusts, the 17-year "locust" being the 17-year periodic cicada. The grouse (or pygmy) locust is a member of the family Tetrigidae (see pygmy grasshopper).

A phase theory is developed to explain the sporadic appearance and disappearance of locust swarms. According to the theory, a plague species has two phases: one solitary and the gregarious. A solitary-phase nymph, for example, adjusts its coloration to match that of its surroundings, does not collect in groups, has low metabolic and oxygen-intake rates, and is sluggish.

A gregarious-phase nymph, on the other hand, has black and yellow or orange coloration in a fixed pattern, gathers in large groups, has high metabolic and oxygen intake rates, and is active and nervous. When a nymph of a solitary-phase locust matures in the presence of many other locusts, it undergoes a physiological change and produces offspring of the gregarious type. If crowding is sufficiently dense and of long enough duration, the majority of a local population will shift to the gregarious migratory phase. When unfavourable environmental conditions occur in the marginal regions, individuals are forced to return to smaller, permanently habitable areas, resulting in crowding and triggering the physiological shift to the gregarious form. There are 3 important locust species in India.

Desert Locust *(Schistocerca gregaria)*

In the desert locust, adults with a life span limited to a single season emigrate from their breeding site, deposit their eggs, and die. Such migratory flights can be very short or very long but, because they are always one-way journeys, cannot be regarded as migration in its strictest sense. The migratory, gregarious form arises from the solitary form as a result of various conditions such as lack of food, crowding.

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The desert locusts breed when seasonal rains permit; as a consequence of climatic conditions, therefore, the insects migrate from one breeding area to another. If the available food declines and the numbers of insects rise too severely in a specific area, migratory forms develop. They differ from non-migratory forms in colour, structure, behaviour, and physiology. Swarms numbering up to 10,000,000,000 individuals periodically invade territories in Africa, southwestern Asia, and southern Europe, covering areas as large as 1,000 square kilometres (400 square miles) (Dorst, 2019). Swarms may appear in the Punjab, the United Provinces and Rajputana, and are known to have been derived from outbreak areas in Baluchistan, Iran and Arabia. Similarly, locusts from Rajputana and the Punjab may migrate as far afield as Assam and Madras. It will be clear that, in such cases, the provincial entomologist would be severely handicapped if he had to attempt the control of an insect the origin of which was in a distant province of India (Imms, 1943).

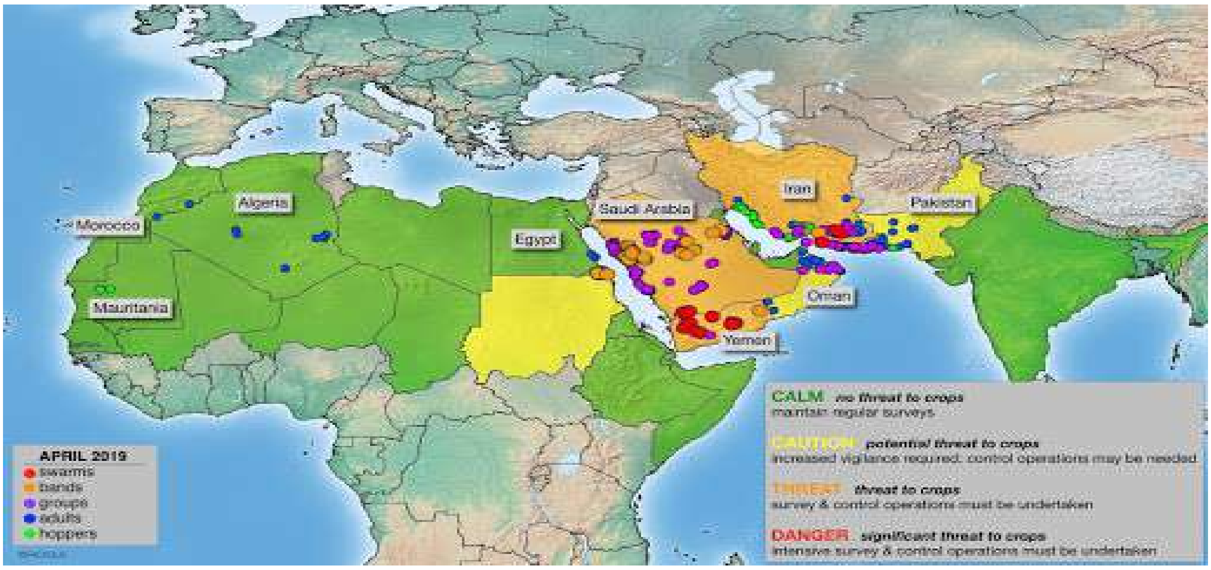

Fig 2: Desert Locust Migratory Pattern (source: http://www.fao.org)

Migratory Locust *(Locusta migratoria)*

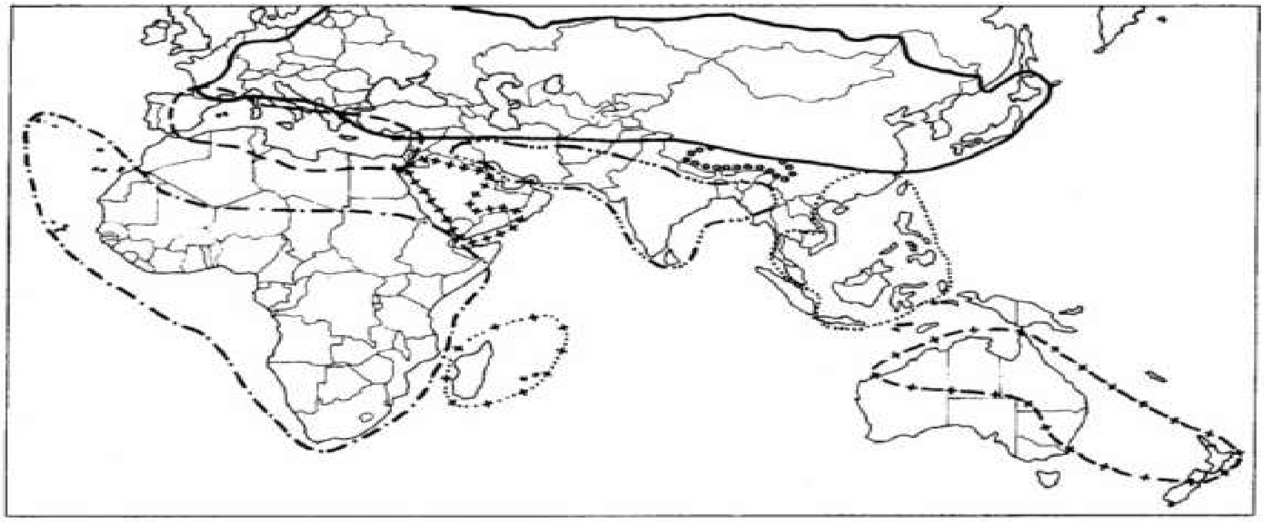

Fig 3: Distribution pattern of Migratory Locust (source: Latchininsky and Sivanpillai, 2010)

The range of the migratory locust is wider than that of any other acridid. It is found in grasslands throughout Africa, most of Eurasia south of the taiga, the East Indies, tropical Australia, and New Zealand. Within their immense geographic range, the populations of the migratory locust display morphological and biological variety, and the existence of nine subspecies is widely accepted; some are economic pests. Populations of locusts that are endemic to temperate climates (some classified as subspecies), undergo embryonic diapause, establishing 1-2 annual generations. However, this does not occur in the subtropical Middle East. A non-swarming subspecies *Locusta migratoria cinerascens* (Fabricius), exists in some of the other countries surrounding the Mediterranean.

As a rule, the migration of *L. migratoria* is more limited than that of *Schistocerca gregaria* (Forskal). Isolated migratory locusts fly at night, whereas crowded adults fly mainly by day. Isolated locusts have 1-2 more larval instars than individuals in crowded populations, but this does not prolong their development, which is more rapid than when crowded. In consequence locusts in crowded populations raise fewer generations. The Israeli migratory locust population is alike another population that is established in irrigated localities in central Arabia. Solitariform *L. migratoria* may occur in low numbers on field crops and grasses during summer and autumn in Israel, disappearing in winter.

Bombay Locust (*Nomadacris succincta* Formerly Known as *Patanga succincta*)

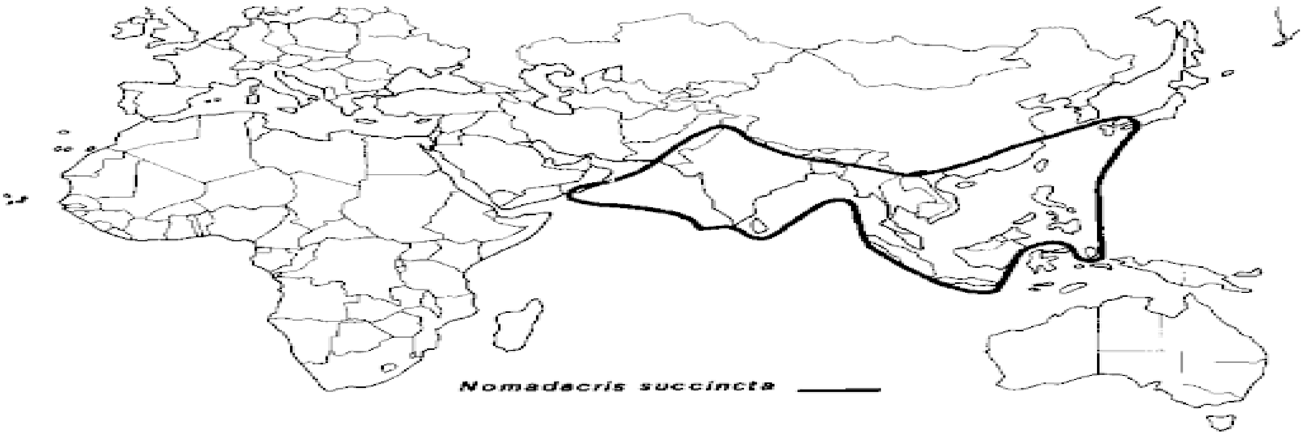

Fig 3: Distribution pattern of Bombay Locust (source: http://www.nzdl.org/)

The Bombay locust is found in India, Southwest Asia and Southeast Asia. Its range extends from India and Pakistan to Thailand, Malaysia, Vietnam, Japan, the Philippines and Indonesia. The Bombay locust has only exhibited swarming behaviour in India. The most recent plague lasted from 1901 to 1908 and the last recorded swarm was in 1927, since when the patterns of agriculture in the region have changed. When swarming, the insects spent the cool period from November to March in forested areas in the Western Ghats. In May, when the monsoon winds had started to blow, they moved north-east into Gujarat, Indore, Nagpur, Hyderabad and the Eastern Ghats, by then covering an area of 500,000 square kilometres (190,000 sq. miles). If the rains failed to arrive in June, the plague continued to move with the wind, sometimes as far as Orissa, Bihar and Bengal. On the arrival of the rains, the swarms split up, the females laid their eggs and the insects died.

Conclusion

The locust plague has caused great losses to agriculture in Africa, the Middle East and South West Asia. India experienced serious locust outbreaks in 1812, 1821, 1843-44, 1863, 1869, 1878, 1889-92, 1896-97, 1927-29 and 2020. One of the key methods of control was to destroy the breeding grounds and locust larvae before they could fly. The study of migratory pattern of the locust is of vital importance in application of proper management of the locust swarms and in issue of necessary forewarning in the critical areas.

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Revisiting Indian Food Policy Scenario

Article ID: 30457

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Introduction

Despite being one of the major food grain producer ,hunger and malnutrition continues to remain chronic issues in India which is home to 195.9 million undernourished people (FAO,2017).According to 2017 Global Burden of Disease study, malnutrition was the top cause of death and disability in India in 2017 followed by poor diet choices. As per the FAO estimates, about 195.9 million in India are undernourished that is roughly about 15% of the entire population and almost 51.4% of women between 15-49 years are reported anaemic. About 38.4% of children under the age of five are stunted while 21% suffer from wasting. Another emerging challenge is burgeoning obesity which grew from 12.6 percent in 2005- 06 to 20.7 percent in 2015-16 among women and from 9.3 to 18.9 percent among men (NFHS, 2015) which in the long run leads to severe health conditions like cardio-vascular diseases etc.

Although there are several large-scale social development programmes which has been in operation for many decades like Public Distribution System(PDS) for supplying food to poor at highly subsidized rates, Integrated Child development services(ICDS), National food security mission, National Mid-day Meal Scheme(MDMS) with special emphasis on nutrition enhancement. However, the effectiveness of these programmes at mitigating the challenges of malnutrition remains debatable. The economic inefficiencies and the losses incurred in the system due to several leakages, corruption, untrained staff have been known to outweigh the welfare gains(Gulati et al. 2012). Financial requirement of these programmes constitutes a major part of the Union budget putting enormous burden on the fiscal. PDS alone constitute 1% of GDP(Government of India ,2017).

Evolution of Food Policy in India – Historical Background

Famines were a usual phenomenon in pre-independent era. Rising population, declining area under cultivation, great depression of 1929 aggravated the problem of food production. Gross Mismanagement of food supplies during Second World War, lead to the most horrifying Bengal famine in 1943 which shook the conscience of every nation in the world. Almost 1.5 million died due to shortage of food supply. Absence of proper institutional arrangement for food procurement emerged as the major loophole in the system. During 1950s and 60s in the aftermath of Bengal famine, policy thrust was mainly on making food grains available to masses. The approach adopted by Indian food policy makers was mainly two-pronged; to support producers by stabilizing farm prices through MSP and provide subsidized food to poor consumers through PDS procured from MSP supported producers. The idea was to ensure food security.

First Food Grain Policy of India

Pushed by the one of the worst famines in world history, first Food grain Policy Committee was constituted under the Chairmanship of Sir George Gregory. Major recommendation came as follows:
1. Procurement of food grains from the surplus areas.
2. Rationing for equitable distribution and
3. Statutory price control for checking the price rise.

Over the course of next few years, several other food grain policy committees were set up. During 1950s to 1966- 67 food economy of India was completely dominated by imports under PL480 programme to meet the domestic needs. As the share of imports in total food grain availability increased, emphasis of food policy of the country shifted towards:
1. Food self-sufficiency.
2. Food grain price stability.
3. An equitable distribution of food grains at reasonable prices.

Policies to Ensure Food Availability and Self-Sufficiency – Era of Green Revolution

Food grain production in India increased manifold from 50 million tonnes in 1950-51 to an estimated 281.37 million tonnes in 2017-18. Achievement of self-sufficiency from being a food deficit nation in post-independence era has been a great achievement for India. This success was largely attributed to the Green Revolution during mid-1960s to 1970s which brought about technological innovation in the form of high yielding, disease resistant varieties mainly in staple grains like wheat and rice requiring intensive input application. Easy availability of highly subsidized seeds and other inputs, led to the dominance of cereal grains in most fertile tracts of the country, other food groups like pulses and coarse cereals were pushed to marginal dry tracts.

Green revolution propelled huge investments in development of high yield varieties, irrigation structures, chemical fertilizer and pesticides which required favourable price policy environment to ensure remunerative price to producer as well as maintain the affordability for the consumer. Keeping in View, K Jha Committee (1964) recommended the constitution of a body to advice the Government on agricultural prices to raise agricultural production. This led to emergence of Commission for Agricultural Cost and Prices (CACP) erstwhile Agriculture Price Commission (APC) in 1965 mainly to recommend the minimum support prices(MSP) and the procurement prices (higher than minimum support price but below the market prices). Further establishment of Food Corporation of India (FCI) in 1964, was another important policy measure to facilitate easy transmission of remunerative price to farmers through an arrangement of food grain procurement by Government.

National Food Security Act (NFSA)

National Food Security Act introduced in 2013 with an objective to alleviate hunger by extending the access to food as a legal right and providing highly subsidized food grain to roughly 70 percent of the Indian population. The state governments were allowed the flexibility to establish their own criteria for identifying eligible beneficiaries at the local level, but states were mandatorily required to cover 75 percent of all rural and 50 percent of all urban population. NFSA allowed states to expand coverage and introduce fortification of food grain at their own expense.

Of late it has been realized that concern of food security is not merely restricted to provision of food rather there are several multidimensional aspects attached to it. Keeping in view ,National nutrition mission was launched by Prime Minister Modi in 2018 also known as Poshan Abhiyan which aims to free India of malnutrition by 2022 but there is no clear laid out pathway on how it is going to be achieved.

Concept of Nutritional security was first popularized during 1970s through UNICEF's conceptual framework on malnutrition. Broadly nutritional security involves food intake & health status. Health status is further determined by underlying factors such as environmental determinants and access to health care services. In India, three major social safety net programmes namely Public distribution system (PDS), Integrated Child Development Services (ICDS) and Mid-Day Meal scheme (MDMS) mainly deployed as the main pillars of food-based assistance programme have been in operation for over decades now. However, nothing concrete can be said about the effectiveness of these programmes.

Problems with Major Food Safety Net Programmes in India

Under the PDS, rice, wheat, sugar and kerosene are provided to the consumers through a chain of Fair Price Shops (FPS) in the country. The PDS cards essentially entitle the identified beneficiaries in the AAY, Annapurna, BPL and APL categories to purchase food grains (rice, wheat, coarse cereals), sugar, kerosene and a few other items at highly subsidized prices .In most states, Targeted Public Distribution system(TPDS) has been merged under NFSM, however some states like Karnataka have their own state run PDS. Impact of PDS system in meeting nutritional security of households has been ambiguous. Studies show that in the poorest regions of Odisha, households receiving PDS supplemented food have shown improvement in macronutrient consumption and dietary quality compared to non-PDS households but substitution towards more proteinaceous food items like pulses, eggs, vegetables is negligible. Performance of states where PDS is reviving has shown improvement in short term nutritional indicators and long-term nutritional gains are observed in states where PDS is well-functioning. However not all reviving states show such improvement especially states like Bihar continue to perform poor.

Another major programme namely ICDS was launched on October 2, 1975 with a multi-sectoral approach to child well-being, incorporating health, education and nutrition interventions, implemented through a network of Anganwadi centres (AWCs) at the community level mainly targeting children between 0-6 years and lactating & pregnant women. Various studies reported that supplementary feeds provided through ICDS are lacking in major nutrients and no change in nutritional indicators among ICDS beneficiaries. Although in some cases, the knowledge availed by pregnant women on infant feeding services and early breast-feeding, did help in better infant care practices after child birth.

While MDMS was introduced in 1995 as a "National Program for Nutritional Support for Primary Education" mainly to address the problem of classroom hunger by provision of cooked meals of 300 calories, 8-12 grams of protein to all children studying in class 1 to V in government and government-aided schools. Later it was expanded to cover children of upper primary (classes VI to VII) providing 700 calories and 20 grams of protein. Reports regarding the meals provided under MDMS being deficient in all major nutrients against recommended dietary allowance (RDA) levels and often poor in quality are ubiquitous. Poor health indicators both in terms of weight and height are also observed in children enrolled in MDMS across states.

Conclusion

These age-old policies have mainly been thriving around the concept of food security and have been extracting a hefty sum from union budget every year, marred by several implementation lacunas have failed to address the challenges of large-scale nutritional deprivation. Instead of running several programmes parallel with similar agenda, amalgamation of these into one holistic programme may help reduce the implementation glitches, leakages etc. Excessive reliance on subsidized food grains like wheat, rice has made the agricultural production system quite skewed, favouring largely cereal grains while other nutritionally rich crops such as coarse grains, pulses remains ignored. To tackle the problem of malnutrition, we need to look beyond cereal grains. It requires a multi-faceted approach, improving dietary diversification along with improved access to health & hygiene such as clean drinking water and sanitation facility needs to be prioritized. Since strong correlation has been observed between agricultural performance and nutritional indicators among children and adults (Gulati, Kumar, Sridhar & Nandkumar,2012),formulating nutrition sensitive agricultural policies can go along way into this. Lack of awareness regarding right kind of child care practices and nutritional knowledge is another crucial factor which through effective educational intervention might prove effective in filling this knowledge gap.

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Heat Stress Condition for Agricultural Workers and it's Management

Article ID: 30458

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Summary
Ergonomics is very important part of agriculture. Most of the agricultural operation has been performed under heat stress condition. This condition may create heat stroke, heat exhaustion, heat cramp, heat rashes etc. Heat stress condition can be measured by measuring dry bulb temperature, relative humidity, wet bulb temperature, Globe temperature and air movement. Heat stress monitor provide combined measurements of temperature known as heat stress indexes. Some personal factors are there which affect the heat tolerance like age, sex, physical fitness, body fat. Heat stress management became very important to enhance the working efficiency of agricultural labour.

Introduction
Ergonomics aims to ensure that human needs for safe and efficient working are met in the design of work systems. Ergonomics is concerned with the design of systems in which people carry out work. its name comes from Greek words ergon which means "work" and nomos which means "law". Lots of agricultural operations has been performing under heat stress condition, which reduces the working efficiency of agricultural workers. Heat stress may be defined as the combination of all those factors both climatic and non-climatic which lead to convective or radiant heat gains by the body or prevent heat dissipation from the body (Leithead and Lind, 1964).

Measurement of Thermal Environment
1. Dry bulb temperature: Dry bulb temperature indicates the thermal state of the air, other factors have an equally important effect on the heat gained or lost by a worker.

2. Relative humidity: Relative is a term used to describe the water vapour pressure of the air at a given temperature. It is the water vapour pressure at a given temperature expressed as a percentage of the saturated water vapour pressure at that temperature.

3. Wet bulb temperature: Wet bulb temperature is traditionally measured with mercury in glass thermometer. A wet cloth "sock" is placed over the bulb of the thermometer and the measurement is made after allowing the thermometer and sock to stabilized at the ambient temperature. The wet bulb and dry-bulb temperatures can be used to calculate the relative humidity. This calculation is normally done using psychometric charts (Kerslake,1982).

4. Globe temperature: The bulb of a mercury-in-glass thermometer is placed in a metal sphere which is painted matte black. Any radiant heat (from the sun or from hot objects) is absorbed by the sphere and heats up the thermometer. Measurement of globe temperature is essential if the true nature of the thermal environment is to be evaluated.

5. Air movement: In an evaluation of the effects of temperature on the workers, Air movement must consider. Air movement moderates the effects of high temperatures and exacerbates the problems of low temperatures. Air movement can be measured using mechanical anemometers or by electrical means such as the hot-wire anemometer, where air movement cools a heated wire.

Modern heat stress monitors make use of thermistors instead of mercury-in –glass thermometers. Typically, dry bulb, wet bulb and globe temperatures can be measured by the same instrument, and air movement can be taken into account.

These devices often provide combined measurements of temperature known as heat stress indexes. The wet bulb globe temperature (WBGT) is a commonly used heat stress index. It is a composite temperature used to estimate the effect of temperature, humidity, wind speed, and visible and infrared radiation on humans. The WBGT value can be calculated for indoor and outdoor conditions using the following formulae:

$$WBGT_{outdoors} = 0.7T_w + 0.2T_g + 0.1T_d$$

$$WBGT_{indoors} = 0.7T_w + 0.3T_g$$

Where,

T_w= Natural wet-bulb temperature, °C
T_g= Globe thermometer temperature, °C
T_d= Dry-bulb temperature, °C

WBGT is an indicator which is used as feel temperature and can be used as a standard for heat stress condition.

Most of the agricultural operations in the country are still being performed by human whether as manual labour or as operator. Farmer has to work under open sun from starting to the end of the cultivation. High drudgery and low income are the main hurdle in agricultural production. Ploughing, sowing, intercultural operations and harvesting are the main agricultural operations which are being performed in hot sunny days and some of them are performed by manual tools. The effect of heat stress can be shown by measuring oral temperature, mean skin temperature, heart rate, overall discomfort rate etc of farm workers.

Health Problems Caused by Heat Stress

1. Heat stroke: Heat stroke is a dangerous condition caused by exposure to excessive heat. Sweating stops and the skin become dry. Heat stroke occurs when the body’s temperature regulating system fails and body temperature rises to critical levels (greater than 104°F). If core temperature rises above 42°C, blood pressure may drop and insufficient blood is pumped to the vital organs including the heart, kidney and brain. This is a medical emergency that may result in death. The signs of heat stroke are confusion, loss of consciousness, and seizures.

2. Heat Exhaustion: Heat exhaustion is a heat-related illness caused due to exposure in high temperature which is accompanied by dehydration. There are two types of heat exhaustion: - 1.Water depletion. Signs include excessive thirst, weakness, headache, and loss of consciousness 2.Salt depletion. Signs include nausea and vomiting, muscle cramps, and dizziness. The signs and symptoms of heat exhaustion are headache, dark coloured urine (symbol of dehydration), dizziness, weakness, irritability, confusion, thirst, heavy sweating and a body temperature greater than 100.4°F.

3. Heat Cramps: Heat cramps generated due to high exposure in sunlight. Heat Cramps are muscle pains usually caused by the loss of body salts and fluid during sweating. Workers with heat cramps should replace fluid loss by drinking water and/or carbohydrate-electrolyte replacement liquids (e.g., sports drinks) every 15 to 20 minutes.

4. Heat Rash: Heat rash is a skin related problem. It is skin irritation caused by sweat that does not evaporate from the skin. It is the most common problem in hot work environments. Heat rash is caused by sweating and looks like a red cluster of pimples or small blisters. Heat rash may appear on the neck, upper chest, groin, under the breasts and elbow creases. The best treatment for heat rash is to provide a cooler, less humid work environment.

Personal Factors Affecting Heat Tolerance

1. Age: The very young and very old are less tolerant than other age groups. Young children have less sweating capacity than adults. Older men are less able to tolerate high heat stress partly because of their higher skin temperature threshold for the onset of sweating.

2. Sex: There are no qualitative differences between men and women in their response or acclimatization to heat. There is some evidence that women begin sweating at a higher skin temperature and sweat less than men.

3. Physical Fitness: Physically fit workers are less stressed by hot conditions even if they are accustomed to a temperature climate.

4. Body Fat: Excess body fat degrades heat tolerance by increasing the mass to surface area ratio of the body and reducing cardiovascular fitness.

The management of heat stress is very important for the drudgery reduction during agricultural operation. Agricultural workers must use various protective equipment to reduce the heat stress effect so that their working efficiency can be increased. Heat acclimatization is physiological process of adaptation rather than a psychological adjustment to life in a hot environment. It involves an increase in the capacity to produce sweat and a decrease in the core temperature threshold value for the initiation of sweating. The maximum rate of sweat production can double from 1 lit per hour in an unacclimated person to 2 lit per hour in an acclimatized person. A state of acclimatization is best achieved by exercising in the heat and drinking plenty of fluid. Furthermore, acclimatization reduces the skin's blood flow requirements, which reduces the cardiovascular load during work in heat.

Some Basic Steps in Heat Stress Management

1. Reduce high relative humidity by using dehumidifiers
2. Increase air movement by using fans or air conditioners
3. Workers must use loose fitting overalls and remove heavy clothing
4. Work rate should reduce
5. Work rest cycle must follow
6. Outdoor work must be done at cooler times the day like- early morning
7. Allow two weeks for acclimatization
8. Must use drinking water or other fluid during work time
9. Must use shade to reduce the effect of radiant heat load (e.g.- wide brimmed hats)
10. Workers must be trained to work in heat stress condition.

OSHA Recommended Threshold WBGT Temperatures for Heat Stress Management

	Air Velocity	
Work Rate	<1.5 m/s	≥1.5 m/s
Light	30.0	32.0

Moderate	27.8	30.5
Heavy	26.0	28.9

Conclusion

Heat stress condition is very dangerous condition for the farmers. It is a discomfort situation for the farmers which lead to convective or radiant heat gains by the body or prevent heat dissipation from the body. This condition reduces the working efficiency of agricultural workers. According to OSHA (Occupational Safety Health and Hazard) WBGT outdoor value 28̊ C or above is the indication of heat stress condition. Agricultural workers must use protective measures or modify the working space to reduce the effect of heat stress condition.

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Crop Modeling (DSSAT v4.6) - An Alternative Strategies for Crop Management

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Summary

The DSSAT v4.6 model package incorporates models of 42 different crops with new tools that facilitate the creation and management of experimental, soil, and weather data files. DSSAT v4.6 also includes improved application programs for seasonal, spatial, sequence and crop rotation analyses that assess the economic risks and environmental impacts associated with irrigation, fertilizer and nutrient management, climate variability, climate change, soil carbon sequestration, and precision management.

Introduction

Recently, crop modeling and system analysis have also been viewed as potential tool to quantify the agronomic management practices, effects of climate, seasonal weather condition, soil environment, management and genotype as well as their interaction on crop growth, yield, resource-use efficiency and environmental impacts (Shamim et al. 2012). These tools after validation and calibration for particular regions can be used to compute the gaps between potential and actual yields to evaluate management option and to determine likely environmental impact. They can also be used to forecast of yield. Evans and Sadler (2008) also suggested that decision support tools will be needed to assist growers and managers to optimize the allocation of limited water among crops, selection of crops by regions, and adoption of appropriate alternative crops in drought years. Over the years, where studies on crop production are traditionally carried out by using conventional experience-based agronomic research, in which crop production function were derived from statistical analysis without referring to the underlying biological or physical principles involved. The weakness and disadvantages of this approach and the need for greater in-depth analysis have long been recognized. So, application of the knowledge –based system approach to agriculture management has been gaining popularity because of our expanding knowledge of processes that are involved in the growth of plants, coupled with the availability of inexpensive and powerful computers. The system approach makes use of dynamic simulation models of crop growth and of cropping systems. In the most satisfactory crop growth models, current knowledge of plant growth and development from various disciplines such as crop physiology, agro meteorology, soil science and agronomy, is integrated in a consistent, quantitative and process-oriented manner. After proper validation, the models are used to predict crop responses to different environments that are either the result of global change or induced by agricultural management and to test alternative crop management options.

Brief Description of Crop Simulation Models

Crop simulation models have been used widely to describe systems and processes at the level of genotype, the crop, the farming systems, the region and the global environment (Matthews et al., 2002). These models were originally developed as research tools and probably had their greatest usefulness so far as part of the research process. Boote et al. (1996) saw that models providing structure to a research programme and as being particularly valuable for synthesizing research understanding and for integrating up from reductionist research process, but pointed out that if the efficiency of research is to increase, then the modelling process must become a truly integrated part of the research activities. Experimentation and model development need to proceed jointly, new knowledge is used to refine and improve models, and models used to identify gaps in our knowledge, thereby setting research priorities. The crop models, not only used as tools in research, but there have been many attempts in recent years to use them as tools to help in decision making processes of practitioners with the development of so-called decision support systems. The decision support system in a sophisticated form is an interactive computer system that utilizes simulation models, databases and decision algorithms in an integrative manner and typically has quantitative output and place emphasis on the end user for final problem solving and decision making . The Decision Support System for Agro technology Transfer (DSSAT), a microcomputer software package that contains crop-soil simulation models, database for weather, soil and crops, and strategy evaluation program integrated with a 'shell' programme which is the main user interface. The DSSAT provides a framework for scientific co-operation through research to enhance its capabilities and apply it to research questions. It also has considerable potential to help decision makers by reducing the time and human resources for analysing complex decision alternatives . The original DSSAT v2.1 was released in 1989 by IBSNAT. A second release of DSSAT v3.0 was made available late in 1994 (Tsuji et al., 1994). The DSSAT v3.5 was made available for use during the year 1998 (Hoogenboom et al., 1999). The Decision Support System for Agro technology Transfer version 3.5 (DSSAT v3.5) incorporates 16 crop growth simulation models for use in helping the decision makers (Hoogenboom et al., 1999), that includes CERES-model for maize (Zea mays L.), Wheat (Triticum aestivum L.), Rice (Oryza sativa L.), Sorghum (*Sorghum bicolor* (L) Moench), Millet (*Pennisetem typhoides* (Burm) Stap and Hubb), and Barley (*Hardeum vulgare* L.), CROPGRO models for bean (*Phaseolus vulgaris* L.), Peanut (*Arachis hypogeal* L.) Chickpea (*Cicer arientinum* L.), Tomato (*Lycopersicom lycopersicum* (L) Karsten) and pasture baniagrass (*Paspallum notatum* Fluegge), SUBSTOR-model for potato (*Solanum tuberosum* L.), OIL CROP-SUN-model for sunflower (*Helianthus annuus* L.), CANEGRO model for sugarcane (*Saccharum officinarum* L.), and CROPSIM – model for cassava.

Description DSSAT v4.6 Model to be Used in Study

The Decision Support System for Agro-technology Transfer (DSSAT) Version is a software application program that comprises crop simulation models for over 42 crops (as of Version 4.6). For DSSAT to be functional it is supported by data base management programs for soil, weather, and crop management and experimental data, and by utilities and application programs. The crop simulation models simulate growth, development and yield as a function of the soil-plant-atmosphere dynamics. DSSAT and its crop simulation models have been used for many applications ranging from on-farm and precision management to regional assessments of the impact of climate variability and climate change. It has been in use for more than 20 years by researchers, educators, consultants, extension agents, growers, and policy and decision makers in over 100 countries worldwide. The crop models require daily weather data, soil surface and profile information, and detailed crop management as input. Crop genetic information is defined in a crop species file that is provided by DSSAT and cultivar or variety information that should be provided by the user. Simulations are initiated either at planting or prior to planting through the simulation of a bare fallow period. These simulations are conducted at a daily step and, in some cases, at an hourly time step depending on the process and the crop model. At the end of the day the plant and soil water, nitrogen and carbon balances are updated, as well as the crop's vegetative and reproductive development stage. For applications, DSSAT combines crop, soil, and weather data bases with crop models and application programs to simulate multi-year outcomes of crop management strategies. DSSAT integrates the effects of soil, crop phenotype, weather and management options, and allows users to ask "what if" questions by conducting virtual simulation experiments on a desktop computer in minutes which would consume a significant part of an agronomist's career if conducted as real experiments. DSSAT also provides for evaluation of crop model outputs with experimental data, thus allowing users to compare simulated outcomes with observed results. This is critical prior to any application of a crop model, especially if real-world decisions or recommendations are based on modeled results. Crop model evaluation is accomplished by inputting the user's minimum data, running the model, and comparing outputs with observed data. By simulating probable outcomes of crop management strategies, DSSAT offers users information with which to rapidly appraise new crops, products, and practices for adoption. With the release of DSSAT v4.6, many changes have been incorporated - from both the structure of the crop models and the interface to the models and associated analysis and utility programs. The DSSAT package incorporates models of 42 different crops with new tools that facilitate the creation and management of experimental, soil, and weather data files. DSSAT v4.6 also includes improved application programs for seasonal, spatial, sequence and crop rotation analyses that assess the economic risks and environmental impacts associated with irrigation, fertilizer and nutrient management, climate variability, climate change, soil carbon sequestration, and precision management.

Crop model Validation and Test Criteria

Validation is the comparison of the results of model simulations with observations from crops that were not used for the calibration. Before any model can be used with confidence, adequate validation or assessment of the magnitude of the errors that may result from its use should be performed. Model validation, in its simplest form is a comparison between simulated and observed values. Several criteria were used to quantify the differences between observed and simulated data. Test criteria have been separated into two groups, called summary measures and difference measures. Summary measures include the mean of observed values (Obs) and simulated values (Sim), the standard deviation of observations (So) and the simulation (Ss), the slope (b) and intercept (a) of the least square regression (Simi = a + b + Obsi). The summary measures describe the quality of simulation while the difference measures try to locate and quantify errors.

Conclusion

The process-based dynamic simulation crop model based on soil, crop and weather factors could be effective research tools for planning alternative strategies for crop management, land use and water management and also a useful tool for planning and developing technological interventions in diverse areas like India. They can also be used to determine the potential impact of climate change on future crop productivity, Climate smart agriculture development, mitigation and adaptation strategies.

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Pest Risk Analysis

Article ID: 30460

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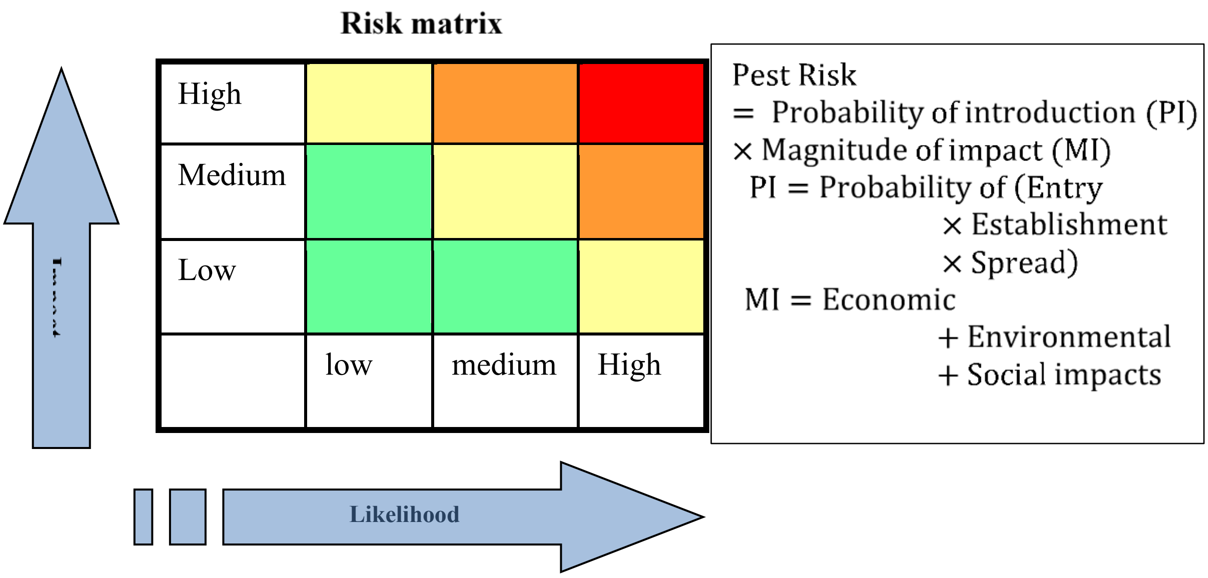
Pest Risk Analysis (PRA) is the process of evaluating biological or other scientific and economic evidence to determine whether a pest should be regulated and the strength of any phytosanitary measures to be taken against it (ISPM No. 5). It is a science-based process that provides the rationale for determining the appropriate phytosanitary measures for a specified area. It provides for a systematic approach to decide if a pest should be managed by legislation, so as to ensure minimal impact on trade. The approaches for managing the pest in quest ion are evaluated and the results of this review are shared with those involved.

A pest is defined as "any species, strain or biotype of plant, animal or pathogenic agent, injurious to plants or plant products" (IPPC 1997) and Risk is a product of likelihood (probability) and impact.



Why is a PRA Done?

1. To protect the country's agriculture from damages that can be caused by harmful (quarantine) pests that can be brought in along with imported commodities.
2. To evaluate and manage risk from specific pests and internationally traded commodities
3. Identify and assess risks to agricultural and horticultural crops and forestry plants.
4. To create lists of regulated pests
5. To produce lists of prohibited plants and plant products
6. To assist in identifying appropriate management options.

The process entails to evaluate the likelihood of the entry, establishment or spread of a pest and the associated potential biological and economic consequences. It aims to decide whether or not the organism is a pest; the likelihood of its entry and establishment; might the pest have an unacceptable impact (economic, environmental, social) or not and if so, what can be done to avoid / inhibit unacceptable impacts.

Organizations like National Plant Protection Organizations (NPPOs) and Regional Plant Protection Organizations (RPPOs) are authorized to conduct a PRA.

When is PRA Done?

PRA may be initiated by one of the three pathways:

1. Pest initiated pathways: In case of Detection of pest in consignments; Outbreaks inside or outside PRA area; Request for pest to be imported for research; overseas pest spread or Identification of an organism not previously known to be a pest.

2. Pathway initiated pathway: In case a new trade pathway operates or; Identification of a pathway that presents a potential pest risk

3. Policy initiated pathway: In case review or revision of existing phytosanitary policies and priorities is required.

Stages of PRA

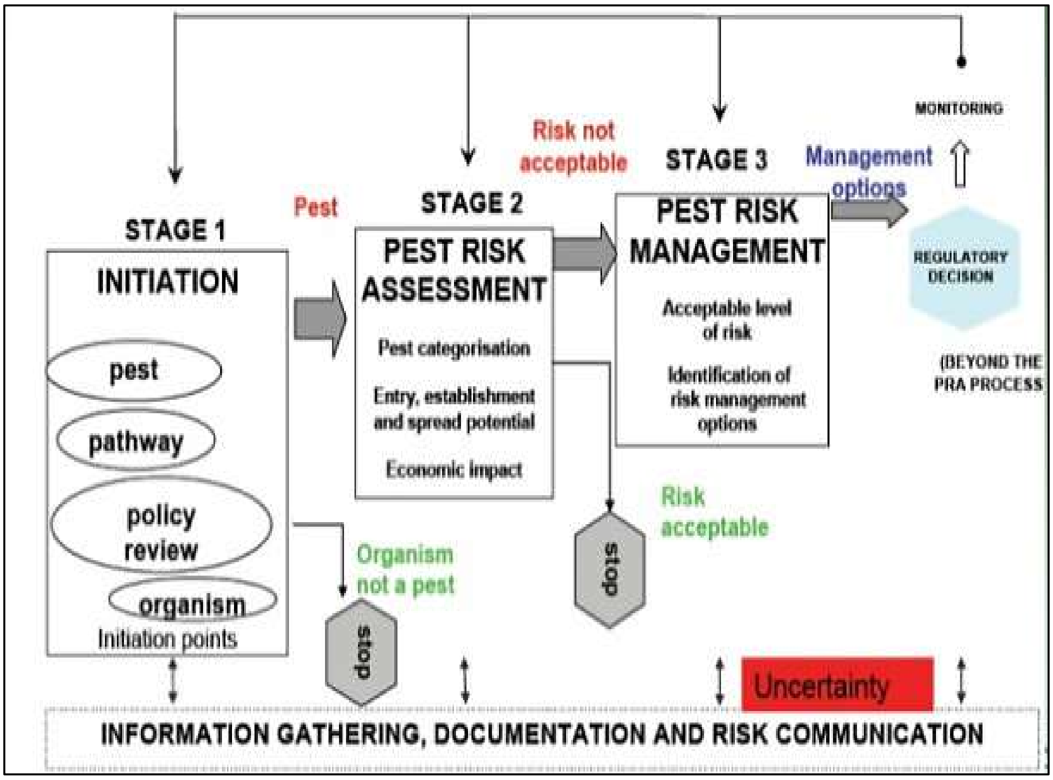


Figure: PRA flowchart (ISPM No. 2)

Stage 1: Initiation.
Stage 2: Pest Risk Assessment.

There are three steps to this stage:
Step 1: Pest categorization.

Step 2: Assessment of the probability of introduction (entry and establishment) and spread.

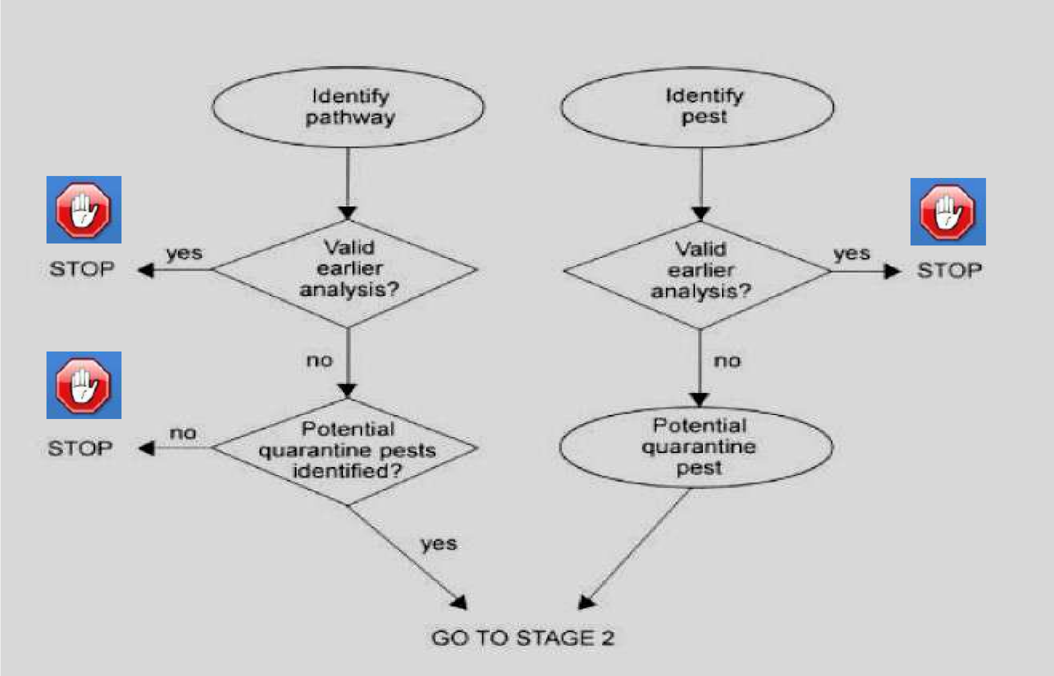
Step 3: Assessment of potential impacts of introduction and spread.

Stage 4: Pest Risk Management.

PRA Stage 1- Initiation

At the end of the stage 1, the pests, concerned pathways and the PRA area would have been identified.
Relevant information is gathered and organisms are identified as potential quarantine pests, either individually or may be in association with a pathway.

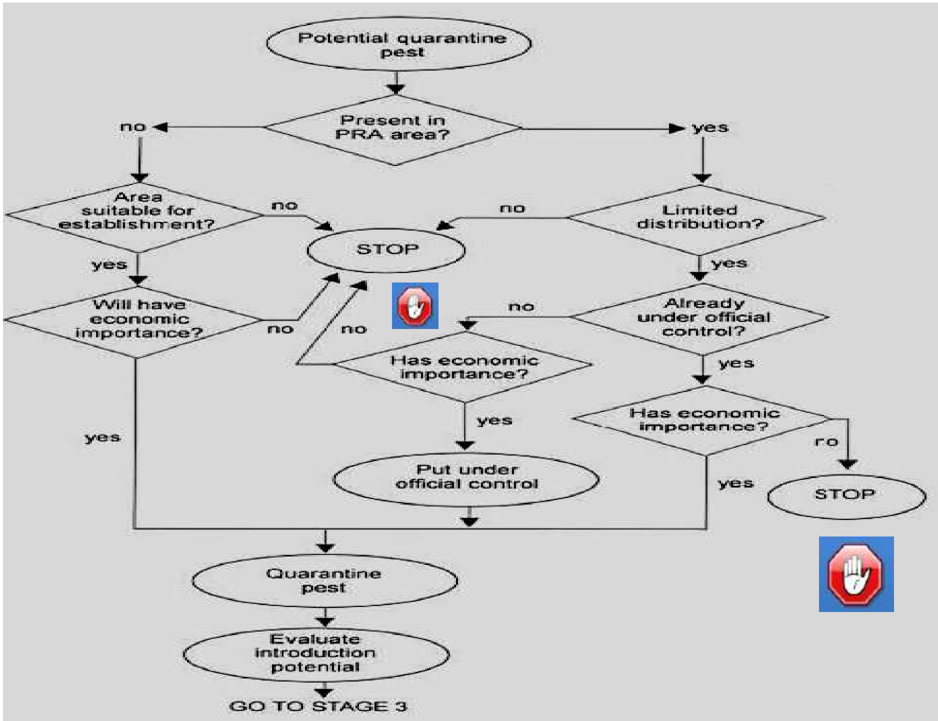
Organisms that have been determined not to be pests, and pathways not carrying pests, do not need to be assessed further. The decision and rationale to stop the PRA at this point should be recorded and communicated, as appropriate.



PRA Stage 2- Pest Risk Assessment

At the end of the stage 2, a list of potential quarantine pests is made and detailed assessment of the probability of introduction and spread of each species is completed.

Assessing the probability of introduction requires an analysis of each pathways associated with the pest, from its origin to its establishment in the PRA area. If a pest has the potential to be a quarantine pest, the PRA for that pest continues.

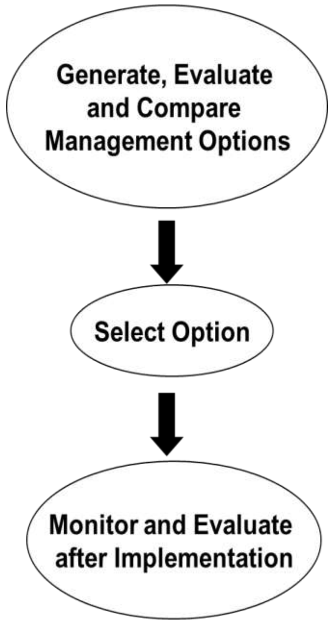


PRA Stage 3- Pest Risk Management

According to the ISPM No. 11 (2004), Pest Risk Management is the process of identifying ways to react to a perceived risk, evaluating the efficacy of these actions and determining the most appropriate mitigation options to achieve the desired level of protection. Management options can be existing or new measures that have been developed specially to address the risk from the pest or pathway under consideration.

Conclusion of Stage-3

At the end of the stage 3, appropriate phytosanitary measures for risk mitigation have been identified, evaluated and selected. These may consist of any combination of measures including; pre- or post-harvest treatments, inspection at various points between production and final distribution, surveillance, official control or certification.



Documentation of PRA

The whole process should be sufficiently documented stating the sources of information and rationales used in reaching the management decision.

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Soil Health Management an Important Strategy to Sustain the Crop Production with Higher Productivity

Article ID: 30461

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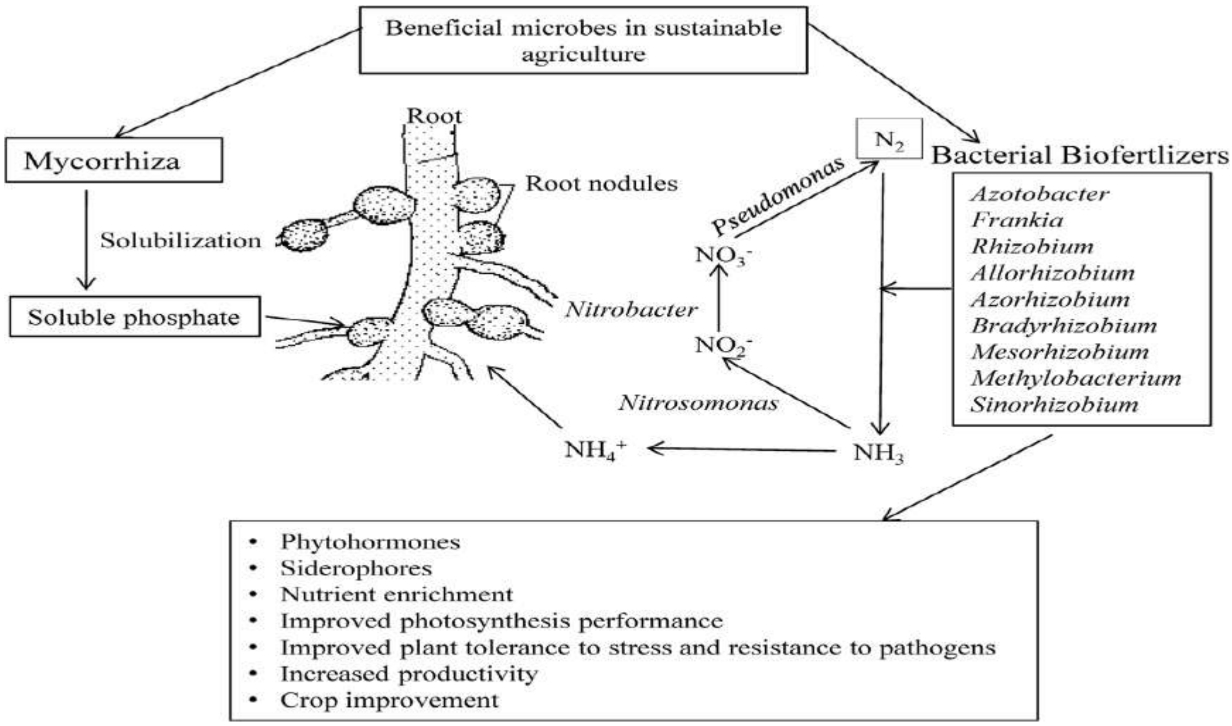
Introduction

Short-term consequences of intensification were highly positive and the world increased grain production massively whereas long-term consequences of intensified agriculture have not all been positive which include lack of sustainability, primarily through the loss of biodiversity and pollution via inefficient nutrient management presented the growing concern with specialized agricultural systems, because of increasingly negative responses from the environment that are manifested as water contamination with excessive nutrients, pesticides, and pathogens and decreasing groundwater levels due to high demand with competition from a variety of stakeholders that includes specialized crop production , rising greenhouse gas concentrations from soils depleted in organic matter functional soils that have become degraded from excessive tillage, salt accumulation, and pesticide inputs there for we have to choose such activity in such manner whereas the higher productivity of crop along with the sustainability of soil health is the crucial emerging factors or global concern for future generations. Soil health is a holistic approach that is soil physical, chemical and biological property which are also an inherent and dynamic properties where the Inherent soil qualities refers as natural ability to function and dynamic soil qualities that is how soil changes depending on how it is managed there for the goal of soil health research is emphasis on how to manage soil in such a way that could be improves soil function as well its towards sustainability with respond to differently to management depending on the inherent and dynamic properties of the soil around the surrounding landscape.

Approaches of Soil health Management

The micro biome: potential significance of beneficial microbes in maintain soil health.

The rhizosphere that is the narrow zone of soil surrounding plant roots which comprise up to 1011 microbial cells per gram of root and above 30,000 prokaryotic species in general. It improves the plant productivity of rhizosphere through the microbial community enveloping plant roots is larger compared to that of plants and is referred as microbiome where there interactions provide the crop health in natural agro ecosystem by providing numerous services to crop



plants that is organic matter decomposition, nutrient acquisition, water absorption, nutrient recycling, weed control and bio-control by towards maintain soil sustainability.

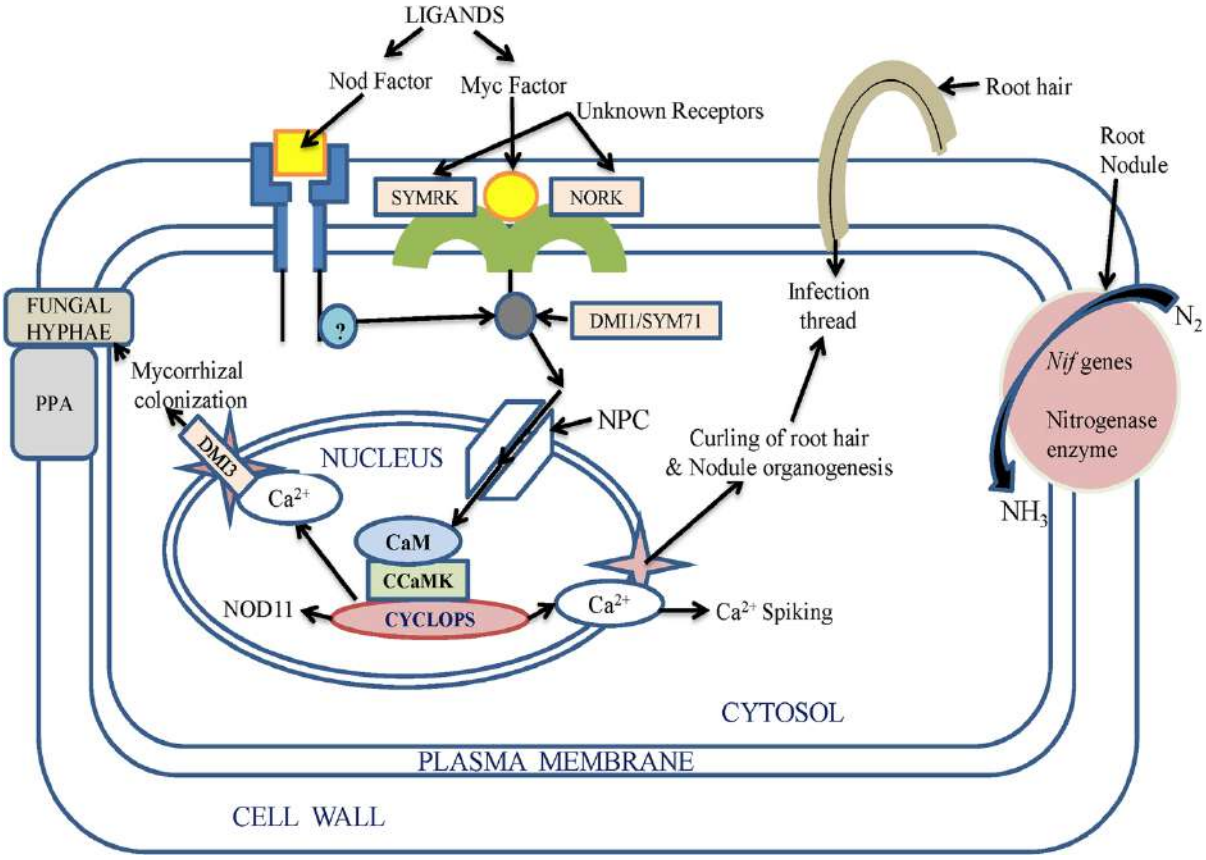
A major focus in the coming decades would be on safe and eco-friendly methods for exploiting the beneficial micro-organisms in sustainable crop production and maintaining the soil health like as Azotobacter, Azospirillum, Rhizobium, cyanobacteria, phosphorus and potassium solubilising microorganisms and mycorrhizae are some of the PGPRs are observe to increase in the soil under no tillage or minimum tillage treatment also playing role in nitrogen fixation and capacity to produce vitamins such as thiamine and riboflavin and plant hormones , indole acetic acid (IAA), gibberellins (GA) and cytokinin(CK).

Soil Properties Influence Microbial Diversity to Maintaining the Soil Heath

Soils are highly diverse for habitation by equally diverse communities of microorganisms that is as 10,000–50,000 species of microbes existing in 1 g of soil (Schloss and Handelsman2006). The bacterial and fungal communities have been associated with soils along with varying texture (Girvan et al. 2003),N content (Frey et al. 2004), P content (Faoro et al. 2010) and soil pH (Fierer and Jackson 2006; Lauber et al. 2008; Rousk et al. 2010). A strong correlation was observed between soil pH and the diversity and composition of bacterial communities seen across biomes of that the reason for connection between pH and soil bacterial community structure has to do with the sensitivity of bacterial cells to pH as bacterial taxa exhibit a relatively narrow pH growth tolerance(Rousk et al. 2010) Soil fungal Communities changed composition and decreased in total biomass after planting with a non-native model plant or applying the non-native plant's exudates (Broeckling et al. 2008there for it is conclude that plant root exudates plants themselves are able to affect the composition and total population of soil microflora.

Bio Fertilizers: Relevance and Plant Tolerance to Environmental Stress Towards Sustain the Soil Health

Biofertilizers keep the soil environment rich in all kinds of micro and macro-nutrients through the nitrogen fixation, phosphate and potassium solubilisation or mineralization by the release of plant growth regulating substances, production of antibiotics and biodegradation of organic matter in the soil. Abiotic and biotic stresses are the major constraints in the crop the productivity there for many tools of modern science have been extensively applied for crop improvement under stress such as PGPRs that has major rules in bioprotectants has become paramount importance in this regard like as Rhizobium trifolii inoculated with Trifolium alexandrinum showed increased number of nodulation



under salinity stress condition whereas Pseudomonas aeruginosa has been shown to withstand biotic and abiotic stresses . A synergistic

Interaction of PGPR and AMF was better suited to 70% fertilizer plus AMF and PGPR for P uptake whereas the Similar trend were also reflected in N uptake on a whole-tissue basis which shows that 75%, 80%, or 90% fertilizer plus inoculants were significantly comparable to 100% fertilizer. It was reported that rhizoremediation of petroleum contaminated soil can be removed by adding microbes in the form of effective microbial agent (EMA) to the different plant species such as cotton, ryegrass, tall fescue, and alfalfa that provide an effective result.

Integrated Crop-Livestock Systems Achieve Nutrient Cycling and Soil Improvement in No-Till Integrated Systems

The integration of crops and livestock is not a new technology or not new adoptive methods rather it is a re-emerging concept integrated crop-livestock systems have been conceived as a means for reclaiming of pastures degraded by overstocking and lack of fertility that improves productivity through land use intensification and mitigates the carbon sequestration, lowering energy consumption through reduce the carbon dioxide emission and decreasing the pollution of surface waters. It is also observe the positive aspects of no-tillage soil management particularly on tropical oxisols, that no tillage is not sufficient for maintaining soil quality and a positive carbon balance within a succession of annual crops but incorporating pastures and animals in rotation with crops cultivated in no-tillage systems optimizes even more the beneficial characteristics of conservation agriculture, particularly via the capacity of pastures to sequester carbon also by increasing biodiversity through improving nutrient cycling, and reducing economic risk. The integration of pastures in crop rotations several advantages, including maintenance of physical, chemical and biological soil characteristics and maintain the sustainability of soil heath.

Conclusion

It is here by conclude that for betterment of soil health towards the sustainability of crop production for future generation we have to emphasis on soil heath through the innovation approach with eco-friendly measure with natural ecosystem maintain balance with biodiversity with soil health maintains.

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Bionomics of Bagworm

Article ID: 30462

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Introduction

1.The larvae of Psychidae, popularly called bagworms belong to the order Lepidoptera.

2. Around 1000 known bagworm species are described in the world 40 are available in Indian territory.

3. These leaf eating caterpillars are commonly present in low number but they could increase to high number under continuously favorable environments leading to severe outbreaks, resulting in crop loss of 30-50% over two years.

4. Bagworms, *Pteroma pendula* is a polyphagous insect with a wide range of host plants (Yunus and Ho, 1980).

5. In Malaysia, bagworms are common on many orchard, landscape and ornamental trees. *Metisa plana, Pteroma pendula* and *Mahasena corbetii* are important leaf pest of oil palm in Malaysia (Loong and chong, 2012)

6. Ever green bagworm, *Thyridopteryx ephemeraeformis* Haworth feed on many kinds of plants such as arborvitae, southern white cedar, red cedar, juniper, spruce and pine (Caron, 2004).

Pteroma pendula **Joannis**

Metisa plana **walker**

Mahasena corbetti **Tams**

Thyridopteryx ephemeraeformis **Haworth**

Biology

1. Egg: Creamy to pale yellow in colour, soft, oblong to barrel shaped measuring less than 1mm long and are laid within the pupal exuviae of the adult female. Number varies between the species (Cheong et al., 2010).

Species of Bagworm	Number of eggs laid by single female bagworm.
Metisa plana	99-200
Pteroma pendula	59-81
Mahasena corbetii	2000-3000
Thyridopteryx ephemeraeformis	500-1000

2. Larvae: Eruciform larvae with head and thoracic legs well developed and sclerotized. Sixty-seven per cent plant materials is used for case construction (Basri et al., 1993).Accelerate development by creating favourable microclimate. Variable larval period (Chinkok et al., 2011). When the larvae move, the head and thoracic segments protrude from the anterior of the case, the larvae move with thoracic legs while abdominal segments remain inside the case, it grips tightly with its prolegs and carries the case upright. The cases are different in shape and size between different species, the size of the female cases is larger than the male cases.

a. Feeding behaviour of bagworm larva?

i. First instar larvae construct self-enclosing bag before they start to feed.
ii. Omnivorous, polyphagous
iii. High midgut pH

b. Does a bag worm clean their cases?

Larvae keep their cases clean and dry throughout the development. They eject the faeces through a posterior opening of case and their exuviae are ejected anteriorly or posteriorly after moulting.

c. Mode of dispersal of bagworm larvae?

The dispersal mechanism of bagworm species appeared to be related to the fecundity of the different species.

i. For *P. pendula* which has a lower reproductive rate, it has to ensure the neonates reach and feed on the vegetation within a short time in order to reduce the mortality risk. Thus, its primary mode of dispersal is by crawling out from the mother case to reach the vegetation attached to the case and start constructing its bag as soon as possible.
ii. The neonates of *M. plana* are usually dispersed via long silk thread through a process known as Balloning.

3. Pupae:

a. Female pupae:

i. Are larger and differ morphologically from male pupae,
ii. Worm like appearance with a simple sac
iii. Does not exhibit well defined appendages sheaths

b. Male pupae:

i. Elongated, obtect pupa, exhibiting enclosed structures readily identified as wings, legs, eye or antennae.
ii. The abdomen possesses an anterior row of tergal spines that aid the male in moving downward in its bag before emerging.
iii. Pupal stage is shorter for females than for males.

Pupal case of *P. pendula* with a hook shaped attachment on the leaf

Pupal case of *M. plana* has a long attachment thread on the leaf like pendulum

Pupal case of *M. corbetti* is composed of irregular piece of leaves, stalk and other material, with a very untidy appearance

c. Sexual Dimorphism: The determination of sex of the bagworm is based on the size and shape of the pupal case or the morph of the pupa. Generally, the size of the case of female pupa is longer than that of male pupa in the same species.

Pupal case of *P. pendula* (Left) and *M. plana* (Right)

4. Adult:

a. Male moth:

i. Shortly before emergence male pupa partly push itself out of bag often aided with row of recurved spines on abdominal tergites 2-8.

ii. The adult male emerges after rupturing the anterior segments of its pupal case and leave their pupal exuviate at the posterior of the cases.

iii. The male is a typical winged moth, with well-developed bipectinate antennae, relatively long legs, and reduced mouthparts.

The pupae of *P. pendula*: male pupa-obtect (left) and female pupa-worm like and apterous (right)

b. Female moth:

i. Apterous females with fully developed legs leave their pupal case upon emergence and spend their adult life clinging on the exterior surface of the bag.
ii. In many species, neotenic females lack functional appendages.
iii. Adults with vestigial appendages remain in their pupal case and protective bag until shortly before death.
iv. The longevity is longer for females (up to two weeks) than for males (usually one or two days).

Mating Behaviour

1. Female releases sex pheromones that consist of chiral esters.
2. Calling behaviour characterized by periodic pulsation of the abdomen.
3. In subfamily Oiketicinae, the pheromones are synthesized in glands located on thoracic segments and on the first abdominal segment.
4. In subfamily- Metisinae, female periodically protrude their thorax outside of the lower section of the bag, possibly to further dissemination of pheromone.

Mating Procedure

1. The male moth pneumatically inserts his extensible abdomen through the posterior opening of the females' bag all along her body inside her pupal case to reach the caudal genitalia.
2. Males of Oiketicinae typically possess paired sclerotized apophyses, arising from the male eighth sternum that assists in the considerable extension of the abdomen (upto three times its original length) during copulation.

Adult female of *P. pendula* showing its head outside of the case, a "calling for mating", pheromone is released to attracted male (left) and male mating with a female by intruding his abdomen into the lower section of the female's bag (right).

Ovipositional Behaviour

1. After mating, apterous females -insert their telescopic abdomen into the lower opening of the bag to oviposit in their pupal case.
2. Peristaltic contractions of the abdomen allow females to discharge their eggs intermixed with abdominal setae inside the upper section of their pupal case and then these vermiform female shrinks to a shapeless mass.

Eggs are normally laid within the pupal exuviae of the adult female after mating

An Unusual Lepidopteran Sex Pheromone System in the Bagworm Moth (Leonhardt Et Al., 1983)

1. The female sex pheromone of the bagworm moth is (R)-l-methylbutyl decanoate.
2. The cryptic female dispenses the chemical from morphologically specialized, deciduous hairs that are cast from the body.
3. Pheromone-laden hairs dislodged from a female's thorax are expelled through the anterior aperture in the pupal shell toward the bottom opening of the bag.

Conclusion

Knowledge on the unusual biology (possession of a larval bag and extreme forms of appendage reduction in females), behaviour and correct identification is essential for the sound management of the pest.

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False Smut: A Rice Disease Emerged as a Major Problem

Article ID: 30463

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Causal Organism

Ustilaginoidea virens.

Economic Importance

Most nations in Asia, Latin America and Africa have detailed the nearness of the malady. There was extreme pestilence in Burma in 1935. Its essence was accepted to demonstrate a decent harvest year. This conviction is as yet regular in South-east Asia.

Symptoms

The organism changes singular grains into yellow or greenish spore bundles of smooth appearance which are little from the start and 1 cm or longer at later stages.

At beginning times, the spore balls are secured by a layer which overflows with further development. Because of the improvement of the fructification of the pathogen, the ovaries are changed into enormous smooth green masses. Generally, just a couple of spirelets in a panicle are influenced.

Etiology

Chlamydospores are formed on the spore balls, they are spherical to elliptical, waxy and olivaceous.

Disease Cycle

In temperate regions, the growth endures the winter through sclerotia just as through chlamydospores. Ascospores delivered on the over wintered sclerotia obviously start essential disease. Chlamydospores are significant in optional contamination which is a significant piece of the malady cycle. Disease for the most part happens at the booting phase of rice plants. Chlamydospores are borne, however don't liberate them from spore ball effectively on account of the nearness of clingy material. Great conditions precipitation and overcast climate during the blossoming and development periods are good.

Management

1. Spray copper oxychloride@0.3% or carbendazim@0.1% at panicle emergence stage
2. Keep the field clean.
3. Remove infected seeds, panicles, and plant debris after harvest.
4. Reduce humidity levels through alternate wetting and drying (AWD) rather than permanently flooding the fields.
5. Where possible, perform conservation tillage and continuous rice cropping.
6. Use moderate rates of Nitrogen.
7. Use certified seeds.
8. Resistant varieties have been reported. Contact your local agriculture office for an up-to-date list of available varieties.
9. Treat seeds at 52°C for 10 min.

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Ecolabelling - An Environment Concern Labelling

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Definition

"Ecolabelling" is a voluntary method of environmental performance certification and labelling that is practiced around the world. An ecolabel identifies products or services proven environmentally preferable overall, within a specific product or service category.

In contrast to "green" symbols, or claim statements developed by manufacturers and service providers, the most credible labels are awarded by an impartial third party for specific products or services that have been independently determined to meet transparent environmental leadership criteria, based on life-cycle considerations.

History

The roots of ecolabelling are found in the growing global concern for environmental protection on the part of governments, businesses and the public. As businesses have come to recognize that environmental concerns may be translated into a market advantage for certain products and services, various environmental declarations, claims and labels have emerged, such as natural, recyclable, eco-friendly, low energy, recycled content, etc. These have attracted consumers looking for ways to reduce environmental impacts through their purchasing choices, but they have also led to some confusion and scepticism. Unproven or irrelevant claims have been branded "greenwash".

GEN member ecolabels provide clarity for consumers and prove authenticity. From its beginnings in 1994, GEN has grown, in two decades, to embrace more than 33 organisations circling the globe, and stretching from Norway to New Zealand.

Types

The International Organization for Standardisation (ISO) has identified three broad types of voluntary labels, with ecolabelling fitting under the strongest Type 1 designation.

TYPE I: A voluntary, multiple-criteria based, third party programme that awards a license that authorises the use of environmental labels on products indicating overall environmental preferability of a product within a particular product category based on life cycle considerations.

TYPE II: Informative environmental self-declaration claims.

TYPE III: Voluntary programmes that provide quantified environmental data of a product, under pre-set categories of parameters set by a qualified third party and based on life cycle assessment, and verified by that or another qualified third party.

Why Ecolabelling is Important?

A certification also means that the whole production process is under control. Each year, control bodies make sure companies have good waste management, minimise their energy consumption and provide recycled or reusable packaging. They even go as far as to control the origin and the organic quality of the products.

Finally, eco-labelling allows every actor committed to the making, processing and selling of certified products to be fairly treated. Wages are high enough to enable people to live, and employees experience absolutely no discrimination of any kind. When buying certified eco-products, you act in favour of the planet, but also of people.

Benefits of Ecolabelling

Eco-labelling has a number of major benefits:

1. Informing consumer choice: Eco-labelling is an effective way of informing customers about the environmental impacts of selected products, and the choices they can make. It empowers people to discriminate between products that are harmful to the environment and those more compatible with environmental objectives. An eco-label makes the customer more aware of the benefits of certain products, for example, recycled paper or toxic-free cleaning agents. It also promotes energy efficiency, waste minimization and product stewardship.

2. Promoting economic efficiency: Eco-labelling is generally cheaper than regulatory controls. By empowering customers and manufacturers to make environmentally supportive decisions, the need for regulation is kept to a minimum. This is beneficial to both government and industry.

3. Stimulating market development: When customers choose eco-labelled products, they have a direct impact on supply and demand in the marketplace. This is a signal which guides the market towards greater environmental awareness.

4. Encouraging continuous improvement: A dynamic market for eco-labelled products encourages a corporate commitment to continuous environmental improvement. Customers can expect to see the environmental impacts of products decline over time.

5. Promoting certification: An environmental certification program is a seal of approval which shows that a product meets a certain eco-label standard. It provides customers with visible evidence of the product's desirability from an environmental perspective. Certification therefore has an educational role for customers, and promotes competition among manufacturers. Since certified products have a prominent logo to help inform customer choices, the product stands out more readily on store shelves. Coveting the logo may induce manufacturers to re-engineer products so that they are less harmful to the environment.

6. Assisting in monitoring: Another benefit of an official eco-labelling program is that environmental claims can be more easily monitored. Competitors and customers are in a better position to judge the validity of a claim, and will have an incentive to do so should a claim appear dubious.

Conclusion

Eco-labelling is an effective way of informing customers about the environmental impacts of selected products, and the choices they can make. It empowers people to discriminate between products that are harmful to the environment and those more compatible with environmental objectives.

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Agri-Tourism - Rural Setting Experience

Article ID: 30465

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Agritourism - Definition

Agritourism refers to an enterprise at a working farm, ranch or agricultural plant conducted for the enjoyment of visitors that generates income for the owner. Agricultural tourism refers to the act of visiting a working farm or any horticultural or agricultural operation for the purpose of enjoyment, education, or active involvement in the activities of the farm or operation that also adds to the economic viability of the site.

Agri tourism or agro tourism, as it is defined most broadly, involves any agriculturally based operation or activity that brings visitors to a farm or ranch. Agri tourism has different definitions in different parts of the world and sometimes refers specifically to farm stays as in Italy. Elsewhere, agri tourism includes a wide variety of activities, including buying produce directly from a farm stand, navigating a corn maze, slopping hogs, picking fruit, feeding animals or staying at a bed and breakfast on a farm.

Scope of Agri Tourism in India

Agri Tourism is to experience the real rural life, taste the local genuine food and get familiar with the various farming tasks. Agriculture is the backbone of Indian Economy. Around 75% of the population is directly or indirectly dependent on Agriculture and almost 26 percent of India's GDP comes from Agriculture. 90 million farmers are dwelling in 6.25 lakh villages producing food grains for feeding the country. More than a profession or a business, agriculture is India's culture. Hence, adding additional income generating activities to existing agriculture would certainly increase contribution of agriculture in the national GDP. Serious efforts need to be made in this direction and Agri-Tourism is one such activity.

Why Agri Tourism?

Mother Nature is an open-door school without brick walls! If observed carefully one can learn something or the other, moreover India is Agriculturist's Country, it is expected that we should know the information related to agriculture.

Today urban children's world has become limited in the closed-door school, classes, cartoon programs on the television, video games, chocolates, soft drinks, spicy fast food, computer, internet and so on, they see mother nature only on television screen.

Now it has become very necessary that children know the traditional way of agricultural farming activities and other businesses dependent on agriculture. Here children come very close to Mother Nature and learn many new things in life for a sustainable living.

Importance of Agritourism

As commercialism and mass production become the standards by which we live, agri tourism has given people who work in the agricultural and horticultural sectors a chance to share their work with the masses. Some agri tourism experiences allow guests to buy food products grown on the farm or hand-crafted products made by the farmers' families; purchasing these goods helps provide farmers who rely on their land with another source of income.

Home and consumer education have given way to technology courses in middle and high schools and many children grow up without ever really knowing what the countryside is or what it's like to interact with live farm animals. Agri tourism, therefore gives parents the opportunity to introduce their children to something other than city life.

Agri Tourism Benefits

1. Benefits for Farmers: For farmers agri tourism is a potential way of:

a. Expanding farm operations;

b. Using farm-based products in new and innovative ways;
c. Improving farm revenue streams;
d. Developing new consumer market niches;
e. Increasing awareness of local agricultural products;
f. Increasing appreciation of the importance of maintaining agricultural land;
g. Channelling additional on-farm revenues directly to family members;
h. Improving farm living conditions, working areas & farm recreation opportunities;
i. Developing managerial skill and entrepreneurial spirit; and
j. Increasing the long-term sustainability for farm businesses.

2. Benefits for Communities: From a community perspective, agri tourism can be a vehicle for:
a. Generating additional revenue for local businesses and services from tourists;
b. Upgrading / revitalizing community facilities for residents and visitors;
c. Increasing protection of rural landscapes and natural environments for tourists and residents;
d. Helping preserve and revitalize local traditions, art and craft;
e. Increasing awareness of agricultural issues and values among the public;
f. Promoting the on-going use of local agricultural products and services;
g. Helping to diversify & strengthen rural economy via job & income creation; and
h. Providing a more energetic business environment for attracting other businesses and small industries.
i. Promoting inter-regional, inter-cultural communication and understanding;

3. Benefits for Tourism Operators: From a tourism industry view point, agri tourism can be a means of:
a. Diversifying the mix of tourism products and services available to visitors;
b. Increasing tourism flows into attractive rural regions;
c. Increasing season length during traditionally off-peak business periods;
d. Uniquely positioning rural regions in key tourism markets; and
e. Bringing more non-local currency to local businesses.

Conclusion

Agritourism gives producers an opportunity to generate additional income and an avenue for direct marketing to consumers. Additionally, agritourism provides educational opportunities to the public, helps to preserve agricultural lands, and allows states to develop business enterprises.

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Substrates Used for Greenhouse Cultivation

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Introduction

Substrate culture refers to soilless systems where a solid inorganic (sand, gravel, perlite, rockwool, volcanic stones etc.) or organic (peat, bark, coir, rice hulls etc.,.) medium offers support to the plants. Substrates retain nutrient solution reserves, thereby buffering interruptions in water and nutrient supply, and protect roots from temperature fluctuations. Cultivation on substrates is currently the primary soilless system used for the production of greenhouse peppers, cucumbers and tomatoes. Several substrates may be adopted as a growing medium in soilless cultivation and the choice is mainly based on water retention and water dynamics.

Various kinds of planting media can be used in greenhouse cultivation. The choice of selection depends on the application and cost effectiveness.

The Basic Features of Ideal Substrates

1. The medium should be firm and dense enough to hold the root system intact. There should be no shrinkage or expansion of the medium under dry or wet conditions.
2. It should have optimum water holding capacity, so that frequent watering may not be necessary.
3. There should be good drainage and aeration with in the medium.
4. The media composition should be such that it holds enough nutrients in reserve.
5. There should be no weeds, nematodes, fungus and insect eggs.
6. The medium should be amenable for pasteurization with steam or chemicals.
7. The pH should be in the range of 5.6 – 6.5.

A Substrate with All the Desirable Characteristics Can Be Composed by Mixing One Or More of the Following Components as Per the Need of the Plants

Soil	Pumice	Charcoal
Sand	Polystyrene flakes	Wood bark
Peat	Urea formaldehyde foam	Clay Pebbles
Sphagnum mass	Shredded bark	Vermicompost
Vermiculite	Compost	Rock wool
Perlite	Coco peat	

Soil

Soil as such is a good component. It consists of organic and inorganic matter. Soil from top layers in forests consists of leaf mould and humus, which is good for plant growth. Ideal media should have 50% solid matter, 25% water and 25% air. Sand, silt and clay are the mineral particles found in soil. Relative amount of these three decides the texture of soil. Texture of soil is important in determining the water holding capacity of the soil. Soil structure refers to arrangement of soil particles. Pore space is the important feature of soil. Capillary pore spaces are extremely small and therefore hold water. They take up the water by capillary action. Non capillary pore spaces are large spaces and do not hold water. These are important for water drainage and for air movement. Clay soils have more of capillary pores whereas sandy soils have more of non-capillary pores.

Root Media Should Be Able to Perform Four Functions

1. Serving as a source of nutrients
2. Supplying water
3. Providing adequate aeration and drainage
4. Supporting the plant.

In general, for cut flower cultivation, media can be soil: sphagnum peat moss: perlite at the ratio of 1:1:1. Soil based media have higher capacity of water and nutrient holding. They are also heavy and provide adequate support to heavy plants. Soil based media are not uniform in its properties whereas soil less media are consistent in its features.

Sand

It is a material derived from weathering of rocks. As a component of substrate, it increases the porosity and provides good drainage.

Soil Less Media

They are lightweight and consist of both organic and inorganic materials. Necessity of organic components – to improve water holding capacity, drainage and aeration, to improve cation exchange capacity which determines the nutrient holding and supplying capacity, and to reduce compacting of root medium. Soilless root media are more popular for potted plant production.

Some of the Organic Ingredients Used in Root Media Are Given Below

1. Peat: It is made up of reminants of aquatic vegetation under water and in aerobic condition. It is partially decomposed stage. Three types of peat are available based on the source viz., moss peat or peat moss derived from sphagnum, reed sedge peat consists of grasses, reed sedge etc., and peat humus is a peat which is in the advance stage of decomposition.

2. Sphagnum moss: It is derived from dehydrated residues of sphagnum. It has high water holding capacity which is 10-20 times its weight.

3. Sphagnum peat moss: It is light brown in colour and is dark when wet. It is slightly decomposed sphagnum moss. It is very acidic with a pH of 3-4. So, it has to be amended with limestone to raise pH. Water holding capacity of peat moss is high. However, it is difficult to initially wet the peat moss. Hence the media consisting of peat moss should never be dried completely.

4. Composted bark: Wood shavings of red wood, cedar, fir, pine or various hard wood species can be used as a component in growing and propagation. It holds water for longer time, and used in orchid potting mixtures Bark has to be shredded to small pieces of less tha 1/4th inch in diameter. They should be composted for 6 months to one year before using.

5. Composted farm waste: It is biologically decomposed organic matter. Addition of compost increases water holding capacity, nutrient availability and the soil texture. All farm and farm animal waste are composted to give rich humus soil. Incorporation of compost in growing media reduces incidence of Pythium. Composting reduces root rot pathogen like Pythium. When composting is done, the temperature of media gets increased to 160 F and so there is no need of any pasteurization. When media is prepared, 20% composition of the media can be compost.

6. Coir: It has the properties similar to that of peat moss. Unlike peat moss this can be wet easily even after drying it completely. It has high water holding capacity. It has to be checked for soluble salts. Finding the high soluble salts, the media can be leached to made suitable for cultivation. It can be used as a single and entire media or can be mixed with vermiculite and perlite.

7. Perlite: It is volcanic rock type material heated to 1800oF. The high temperature turns up the rock to pop up like popcorn and produces porous and white material called perlite. The grey-white smilacaceous material is mined from lava flows. It is ideal to enhance drainage and aeration. But has low water holding capacity. And also has no cation exchange capacity and hence holding and supplying of nutrient is impossible by the perlite. Whenever perlite is used, it is important to keep fertigating the media continuously. Growers should be careful while using perlite for their pH value is slightly above 7 tending it towards alkaline.

8. Vermiculite: It is a mica type material heated to 1400oF. Instead of popping it expands and forms thin, parallel plates. Chemically it is hydrated magnesium – aluminium silicate. Vermiculite contains calcium, magnesium and potassium. It has good water holding capacity and cation exchange capacity. There are different grades based on texture and fineness. They are alkaline. Sometime it can be as high as to pH 9.

9. Rock wool: It is a synthetic material. Small pieces can be mixed to root medium to improve water holding capacity. It has very low nutrient holding capacity. It is available in cubes for propagation and in slabs for production purposes. Cubes and slabs come in many sizes. Each cube is covered by plastic on four sides with the top and bottom open.

10. Pumice: It is obtained from mines. Rich in silicon dioxide and aluminium oxide with iron, calcium, magnesium and sodium. It increases aeration and drainage.

12. Coco peat: It is a biologically decomposed product derived from coconut husk. It is quite porous and holds water. It is a good substitute for peat mass.

13. Charcoal: It is derived from burning of wood. It can hold water for long period It is a common ingredient for orchid growth media.

14. Wood bark: Bark pieces of trees forma a good component for potting media. It holds water for longer period. The aerial roots in orchid plants cling to the bark pieces and derive moisture.

15. Clay pebbles: Small pebbles of clay along with nutrients are made artificially. The pebbles when soaked in water can expand and hold water and nutrients for the plant growth.

16. Water holding polymers: These are made up of complex carbohydrate compounds. They absorb water many times that of their weight. It can be added to the root media to improve water holding capacity. Time between irrigation can be extended with the use of such polymers. Besides these, shredded tyres and rubber can also be used media. For other than coir pith, all other soil less media has to be added with wetting agents.

Bonsai Culture

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Introduction

Bonsai is an art of growing and training of a plant to a miniature form having a natural look of old age. It was originated from china, but it was called as the Japanese art. It involves techniques of extreme dwarfing. The optimum size of bonsai may be only 30 to 60 cm in height, but miniature sizes of below 25 cm have also been preferred. Bonsai of minimum 10 years old are period, but of 100 and even 200 years of age are available and are highly valued as 'venerable' specimens.

Plants Suitable for Bonsai Making

Selection of hardened woody plants that have been subjected to adverse conditions is a good starting point. Such kind of planting materials may be collected from rock crevices of from the walls of any buildings. Old seedlings kept in containers form any nursery or cutting, grafted plants or layers may be also utilized in bonsai culture.

1. *Ficus benjamina.*
2. *Ficus Carmona microphylla.*
3. *Ficus nerifolia.*
4. *Ficus retusa*.
5. *Ficus virens.*
6. *Ficus pelkan.*
7. *Ficus parasitica.*
8. *Ficus krishna.*
9. *Ficus elastica.*
10. *Ficus trangularis variegated.*
11. *Ficus mysorensis.*
12. *Ficus nooda Variegated.*
13. *Ficus tomentosa.*
14. *Ficus saliscifolia.*
15. *Ficus jaquinifolia.*
16. Ficus long Island.
17. *Ficus marginata.*
18. Ficus lipstick.
19. Bougainvillea.
20. Bottle Brush - Red / White / Lavender.
21. Black Olive.
22. Brazilian Raintree.
23. Cashew.
24. Casuarinas.
25. Chinese Banyan.
26. Chinese Mini Orange.
27. Duranta Gold.
28. Duranta Variegated.
29. Golden Cypress.
30. *Hamelia patens.*
31. *Hibiscus rosea sinensis.*
32. Inga Dulse Variegated.
33. Jackaranda.
34. Jasmine Kamini.
35. *Juniper chinensis.*

36. Karonda.
37. Lavender Brown.
38. Lavender Green.
39. Badam.
40. Mango.
41. Murraya exotica.
42. *Murraya paniculate.*
43. Neem.
44. Pine.
45. Pomegranate Mini.
46. Powder Puff - White / Pink / Red (Calliandra).
47. Poinsettia Mini.
48. Kumquat.
49. Sapota.
50. Scheffleura Variegated.
51. Silver Oak.
52. Surinam Cherry.
53. Tamarind.
54. Wood apple.
55. West Indian Cherry.
56. *Wrightia religiosa.*

Styles of Bonsai

1. Formal Upright
2. Informal Upright
3. Broom
4. Slanting
5. Windblown
6. The Clasped-to-Stone.

Containers (Shallow with 5 to 7.5 cm Deep)

1. Mostly terracotta or ceramic
2. Small in size
3. Square/round/rectangle/oval in shape
4. Preferred is oval / rectangle.

In round / square the plant is to be in the centre. In others placed in the sides of the containers.

Media Proportion

Loam soil-2 parts; Leaf mould-1 parts; Coarse sand – little quantity.

Media can be covered with moss and one or two pebbles can be placed to give a natural look.

Propagation

1. Sexual and asexual methods.
2. Seeds: Pines and Junifers.
3. Cuttings: Ficus, Pomegranate, Mulberry and Bougainvilleas.
4. Layers: Jasmine, Ixora, Bougainvilleas and Pome granate.
5. Grafts: Mango, Sapota, Citrus.

Season

1. July - August
2. February - March

Best time is before opening of the buds.

Potting and Repotting

1. 1/3 of the roots can be trimmed.
2. Long tap roots are to trimmed.
3. Excessive branches are to thinned out.
4. Balanced nutrition and adequate watering is must.
5. Potting is not advisable during winter or hot months.
6. Repotting is done after 2-3 years.

Potting Procedure

The next step is to prepare the container decide upon by covering the drainage holes with plastic netting and spreading a layer of soil over the bottom of the pot. The plant is taken out of its pot with the soil intact. The soil, which should be fairly dry, is carefully removed from the outside of the ball of earth, inwards and downwards until about two-thirds of it has been removed. The tap root is then to be identified and if the fine fibrous roots are plentiful it should be completely removed. If the small roots are not sufficient to supply the tree with sustenance a portion of the tap root is cut off and the remainder left till the tree re-potted. Any other thick roots may also be proportionately removed. The remaining fine roots are clipped back if too long and the plant is now positioned in its container. Soft is filled in around the tree to fill the pot and is poked under and around the remaining ball of earth with the pointed stick to eliminate air pockets and to firmly settle the tree. The top of the soil may be finished off with green moss which is thinly removed from the damp shady places where it grows and placed on the soil surface, being careful to press the edges firmly onto the soil to prevent them from curling up and drying. A tastefully chosen and positioned rock mat add to the aesthetic appearance of the tree.

Watering is now carried out by placing the planted tree in a basin of water which reaches within 1 cm of the top of the pot. The water will pass through the drainage holes and the bonsai may be removed from the water when all the soil is soaked. The bonsai is now to be kept outside in such a place that it is shaded from the sun and sheltered from wind.

After Care

Pinching: Once or twice.
Pruning: For its shape.
Training: Desirable shape.

It is achieved through copper wire or polythene tape. It is to be removed once the shape is attained.

Training

The health of the plant and free from pests is also to be assessed. Before potting the plant, a suitable style is to be decided on. Unnecessary branches are removed, the tip of the tree is chosen and the rest of the plant is cut off above this level.

Wiring

Copper wire is used to arrange the branches in the correct position and with any necessary curves. The wire must be thick enough to hold the branch or trunking wired in the position chosen, but not thicker than desired. The length of wire is a measure against the part to be wired and is cut off. For about 4-5 cm and coiled and the trunk in evenly-spaced, from, but not tight spirals as well above the last curve desired. When a branch is to wired the beginning of the wire must be fixed over the dark where the branch separates from the trunk, by passing loop of wire firmly round it and then continuing the wiring described for the trunk.

Bending

Trunk and branches may be bent, forced and tied by coiling them with heavy wire. This wire is removed after several months when training to shape has been accomplished. The bonsai plants may be trained to different shapes like twisted trunk, upright, S-shaped, semi-cascade, cascade, slanting or any other formal shape. Planting of both tips and roots is usually done at planting time and periodically pinching the tip and removing the excess side shoots are essential to maintain the general outline of design. Annually, the plants are either repotted or lifted from the pot, root pruned and reset.

Aftercare

The bonsai needs fresh air and sunshine, food and water, pruning and pinching, removal of weeds and dealing with pests and diseases besides repotting when necessary. The bonsai is an outdoor plant and depending on the species, needs its full share of sunshine. Morning sun for a few hours will sufficient but most bonsai prefer sunshine for a greater part of the day if they are shaded between the hours of 12 a.m. and 4 p.m. in summer. If sunshine is only available from one direction the bonsai must be turned round once a week to avoid lopsided growth.

Watering

Water has to be given when the top soil begins to dry and if given from above by the use of the spray attachment to a water-pipe or from a watering-can it must be given in such quantity that excess comes out through the drainage holes.

Nutrition

Fertilizers to use on bonsai are the various oilcakes like rape seeds cake or neem cake. The method of using them is to soak the oilcake in the proportion of 1 kg per ten litres of water in a well-covered vessel until fermentation has taken place which is in approximately two to four weeks depending on the season. Alternatively, good mixed NPK fertilizers can be used though very sparingly Superphosphates may be applied to encourage flowering as also bone-meal which may be added to the compost while potting or repotting.

Pruning and Pinching

The techniques used to shape the tree and to reduce the size of the leaves. After the new growth has developed to four or five new leaves, the twig if pinched off just beyond the first or second leaf depending on which way the leaf behind the cut is pointing. Daily care of the bonsai includes removing weeds, unnecessary new buds, and dealing with pests and diseases as they would be dealt with in the trees growing in the ground.

Repotting

Repotting of the bonsai is done once a year at the same time as the trees are normally potted, that is when they are budding. As a bonsai grows older, the repotting process needs to be performed once in two, three or more years depending on the age of the tree. To find if the tree needs repotting see if roots protruding from the drainage holes and if much resistance is met to a finger or thumb pressed on the surface of the soil. This denotes the presence of very little soil and a large number of roots. These two points besides the sudden need of the bonsai for excessive water without much change in weather are indications that it needs repotting. The bonsai with the soil intact is taken the container which washed, dried and prepared with netting over the drainage holes and a layer of soil wetting the bottom. Starting from the outer edge and proceeding inwards and downwards, the soil is removed between the fine roots till it is approximately one thirty of its original quantity and the fine roots are exposed. Base roots are clipped back almost to the remaining ball earth and also from its lower surface. Any thick roots will have grown are cut off. Fresh compost is added to described from potting and the bonsai is watered.

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Forchlorfenuron: A New Generation Growth Regulator for Fruit Crops

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Introduction

The plant hormones (or phytohormones) are the naturally producing organic substance in the plant that are produced in minute quantities and regulates the growth and other physiological functions of a plant. Hence, such chemical substances have proven to be an important component of modern fruit production technology both for improving the quantity as well as quality of fruit crops (Dubey et al., 2020; Hota et al., 2017g; Hota et al.,2018b). It alters the parameters like vegetative growth (Hota et al., 2017a; Priyadarshi et al., 2017), fruit set (Hota et al., 2017b), fruit drop (Hota et al., 2017c), yield attributing parameter (Hota et al., 2017d, Priyadarshi et al., 2018a), physical parameters (Hota et al., 2017e), chemical parameters (Hota et al., 2018a, Priyadarshi et al., 2018b) and physico-chemical parameters (Hota et al., 2017f). Forchlorfenuron which is also known as CPPU is a new generation growth regulator having properties of cytokinin. Besides, it also modifies other fruit characteristics such as shape, dry matter content, carbohydrate metabolism and ripening process. Its treatment could also increase firmness of individual fruit, reducing TSS content and TSS /acid ratio of fruit, as well as, promote starch degradation but had no effect on titratable acid content.

Time of Application

Time of application of growth regulator remarkably affect the size and yield of fruit. In most of the stone fruit application of CPPU at petal fall stage increase the fruit size (Hota et al., 2017c). The application at this stage may be related to the stimulus of ovule development, once the ovule produces endogenous hormones that help in fruit set and increase in size. It may also be due to accumulation of higher rates of auxin and cytokinin after the pollination and fertilisation, which act as an accelerator for increasing the size of fruit. While in contrast presence of growth inhibitor in dormant to semi-dormant (up to the induction of flower primordia) condition may inhibit the effect of exogenous application of growth regulator.

Effect of CPPU on Vegetative Growth

Hota et al. (2017a & b) conducted a research trial in 26-year-old apricot cv. New Castle by using CPPU and NATCA at Department of Fruit Science, Dr. Y.S. Parmar University of Horticulture and Forestry during the years 2015 and 2016. He found that CPPU @ 10 ppm at petal fall stage increases the tree height (17.40 %), tree spread (22.17 %), tree volume (27.82 %) annual shoot growth (61.66cm), trunk girth (5.38 %) and leaf area (32.42 cm2) at its maximum level than the control. The CPPU is a strong cytokinin which having role to retard the apical dominance and increase there by cause to lateral shoot growth. Another reason for stimulation of growth may be related to an increase in RNA and DNA content, polymerase activity, and protein synthesis.

Effect of CPPU on Fruiting and Yield

Hota et al. (2017 c, d & e) found that CPPU @ 10 ppm at petal fall stage decrease the fruit drop and increase the yield. It may also be due to accumulation of higher rates of auxin and cytokinin after the pollination and fertilisation, which act as an accelerator for increasing the fruit set and size of fruit. The application of CPPU at petal fall stage may be related to the stimulus of ovule development, once the ovule produces endogenous hormones that help in decreased fruit drop

Effect of CPPU on Fruit Quality

The fruit firmness increases and TSS and TSS/Acid ratio decreases when CPPU is applied as foliar application (Hota et al., 2017e & f). The application of plant growth regulators plays a role to re-enforce cell hormonal balance. CPPU applied alone has been shown to decrease the TSS content of the fruits. It may be due to solubilisation of assimilates in the larger fruits as the bigger fruits contain more moisture as compare to the smaller ones. In the other hand CPPU may maintain fruit firmness by reducing the various physiological activities related to the softening of fruits preventing the synthesis of hydrolytic enzymes such as cellulase which decomposes the cell wall. The increase in fruit firmness with different CPPU treatments could be due to the delaying effect of exogenous cytokinin on the senescence process.

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Locusts – An Overview

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In the nineteenth century, India experienced serious locust outbreaks in 1812, 1821, 1843-'44, 1863, 1869, 1878, 1889-'92, and 1896-'97. Several efforts were made to combat the swarms. The first of these measures was to systematically collect and record data regarding locust occurrences. Only after the 1927-29 outbreak that ravaged the central and western parts of India was the need felt for a centralized organization to gather information about locusts and control them. This resulted in the formation of the Standing Locust Committee in 1929 and the Central Locust Bureau in 1930. This culminated in 1939 in the establishment of the present-day Locust Warning Organization.

Locusts are members of the grasshopper family Acrididae, which includes most of the short-horned grasshoppers. Locusts differ from grasshoppers because they have the ability to change their behavior and physiology, in particular their color and shape (morphology) in response to changes in density. Adult locusts can form swarms which may contain thousands of millions of individuals and which behave as a unit. The non-flying nymphal or hopper stage can form bands. A band is a cohesive mass of hoppers that persists and moves as a unit. In general, most grasshoppers do not form bands or true swarms. However, the distinction between locusts and grasshoppers is not clear-cut since some of the latter do form bands (e.g. Melanoplus, Acridoderes, Hieroglyphus sp.) or small loose swarms (e.g. Oedaleus senegalensis). Locusts such as the Tree Locust have never been known to form bands.

Life Cycle Parameters

Stages	Egg, hopper, adult
Duration	Egg 10-65 days; Hopper 24-95 days (36 days average); Adult 2.5-5 months; Laying-fledging 40-50 days; Adult maturation 3 weeks-9 months (2-4 months average); Total 2-6 months
Larval moults	5-6 (solitarious), 5 (gregarious)
Phases	Solitarious, transiens, gregarious

Phase Terminology

Solitarious	Phase when individuals live mostly separate from each other
Gregarious	Phase when large numbers of individuals gather together
Transiens	Intermediate phase when locusts are grouping and starting to act as a single mass and are either changing from solitarious to gregarious (gregarization) or from gregarious to solitarious (dissociation).
Congregans	Part of the transiens phase during which locusts are congregating and are in transition from the solitarious to the gregarious phase. Often used for nymphs.
Dissocians	Part of the transiens phase during which locusts are in transition from the gregarious to the solitarious phase. Often used for nymphs
Solitaricolour	Showing types of colour associated with solitarious behaviour.
Gregaricolour	Showing types of colour associated with gregarious behaviour

The newspaper Hindu indicated that, this locust's attack has affected about 90,000 ha across 20 districts in Rajasthan. Favourable rain-bearing winds aided their transports towards India. The quickly growing swarm is now threatening to amplify into an agrarian disaster. The locusts that have come in this year (2020) are immature. Immature locusts are not fully grown and have the capacity to cause more harm. They also have a longer lifespan. The locusts which entered India were about 10-12 days old and were flying huge distances I search of food. Since the rabi crop harvesting is over and the Kharif sowing season is yet to begin, they were unable to find any vegetation. They will now start laying eggs after the onset of monsoon and continue breeding for two more months. According to Food and Agriculture Organization, the destructive power of a typical locust swarm can be enormous. The size of these swarms can vary from less than one square kilometer to several hundred square kilometers. A one square kilometer swarm contains about 40 million locusts. They can eat much as much food as 35,000 people assuming that each individual consumes 2.3 kg of food per day.

Extent of Damage Locust Caused During Previous Attacks

As per the Union Agriculture Ministry data, locusts damaged crops worth Rs 10 crore during the 1926-31 plague cycles. During the 1940-46 and 1949-55 locust plague cycles, the damage was estimated at Rs 2 crore per cycle, and at Rs 50 lakh during the last locust plague cycle (1959-62). The government does not consider locust upsurges during 1978 and 1993 and several in-between as major outbreaks. But as per the government records, 190 locusts' swarms had attacked an area of at least 3,10,000 hectares in Jaiselmer, Barmer, Bhuj and Jalore districts of Rajasthan in 1993. Large areas in these districts again had to be treated with chemicals to get rid of locust swarms in 1997 and 2005.

Conclusion

Plagued by an economic slowdown and Covid-19 lockdown, the Indian economy is already on the edge. While experts hope that things will improve after a vaccine for the novel corona virus comes into the market, an agrarian crisis due to locust attack will throw the government's plans off-balance. More relief packages will have to be announced and more money will have to be taken out of government coffers, less and less revenue will be generated and food inflation will skyrocket as supply will fall below demand.

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Nutritional and Medicinal Properties of Acid Lime

Article ID: 30470

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Introduction

Acid lime *(Citrus aurantifolia)* belongs to the genus Citrus of family Rutaceae with chromosome number 2n=18. It is originated in India. In India commonly known as nimbu. Other synonyms of nimbu are sour lime, acid lime, Indian lime, key lime and etc. The leading states of India in area and production of lime/lemon are Gujarat, Andhra Pradesh, Maharashtra, Odisha and Madhya Pradesh the area under lime/lemon is 296 thousand hectares with production of 3397 thousand MT and productivity 11.47 MT/Ha. (Anonymous, 2018).

Uses

1. The fruit is having good appetizing property.
2. Various beverages and refreshing drinks are prepared from the fruit juice.
3. The fruits are used for preparation of pickles, jam and jelly
4. The taste and aroma of the food is enhanced by using fruits in culinary preparations.
5. The oil extracted from fruit rind is used in cosmetics and perfume industry.

Nutritional and Biochemical Composition

Acid lime juice is acidic in nature and rich in citric acid, malic acid and succinic acid content. Vitamin C and B are the main vitamins present in the fruit. The flavedo of fruit contains pigments like chlorophyll and carotenoids. Albedo is rich in content of cellulose, hemicellulose, lignin and pectin. Flavedo also contains oil glands from which essential oils are extracted to use in cosmetics and perfume industry. The major volatile compounds present in the peel oil of fruit is limonene, citronellol, neral, γ-terpinene and β-pinene. Sugars, lipids, nitrogenous compounds and phenols are present in lime juice. Flavonoids that are of dietary importance include flavones, flavanols and flavanones (Fernando *et. al.*, 2010).

Medicinal Properties

The acid lime fruit is rich source of vitamin C, which helps in increasing the resistance to diseases. Toothache, dental caries and swollen gums are reduced by using the fruit. Lime improves the digestion and helps in reducing acidity problem, constipation and peptic ulcers. It will also help in curing obesity (Ganguly Subha, 2013). The vitamin C content of the fruit will cure the scurvy disease. It will cure the respiratory disorders, urinary disorders, piles, skin rashes and dandruff. Lime have the potential of anti-rheumatoid arthritis, anticancer, antidiabetic properties and effective in curing cardiovascular diseases (Mohanapriya et. al., 2013).

Conclusion

In India, production of lime is more and commonly using it in household for cooking practices to enhance the taste and flavour of dish. The vitamins (vitamin C and B) and minerals present in fruit are act as protective elements with nutrition supply. Lime also having the anti-viral, anti-bacterial, anti-tumour and anti-inflammatory properties as medicinal value.

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Mitigation of Antinutritional Compounds in Vegetables

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Introduction

Antinutrients are natural/synthetic compounds that block the absorption of nutrients and/or act as toxins, exerting negative effect on our body (Soetan et al.,2009). Reducing protein digestibility .It has very adverse effect on human body like binding to various nutrients, damaging the intestinal wall, Lowering digestive efficiency. Antinutrients are chemicals which have been evolved by plants for their own defence, they are produced by plants to defend themselves against fungi, insects and predators, and offer a protective mechanism for the plant.

These anti-nutritional factors are known to interfere with metabolic processes such that growth and bioavailability of nutrients are negatively influenced (Abara, 2003).The vegetables also contain some antinutritional factors which can affect the availability of the nutrients. Scientists such as Fetuga et al. (1973) and Fowomola et al.(2007) had studied and described the anti-nutritional factors of plant fruits and seeds. Antinutritional factors are a chemical compound synthesized in natural food and / or feedstuffs by the normal metabolism of species and by different mechanisms (for example inactivation of some nutrients, diminution of the digestive process or metabolic utilization of food/feed) which exerts effect contrary to optimum nutrition Soetan et al.(2009). Such chemical compounds, are frequently, but not exclusively associated with foods and feeding stuffs of plant origin.

These anti-nutritional factors are also known as 'secondary metabolites' in plants and they have been shown to be highly biologically active. These secondary metabolites are secondary compound produced as side products of processes leading to the synthesis of primary metabolites. One major factor limiting the wider food utilization of many tropical plants is the ubiquitous occurrence in them of a diverse range of natural compounds capable of precipitating deleterious effects in man, and animals compound which act to reduce nutrient utilization and/or food intake are often referred to as anti-nutritional factors Shanthakumari et al.(2008).

Table 1: Antinutritional Compounds Present in Vegetable Crops

Anti-nutritional Compounds	Name of Crop
Antitrypsin factors/ Trypsin inhibitors	Legumes
Solanine/ cyanogens	Potato
Glucosinolates	Cabbage
Saponine	Raw spinach, Asparagus, Tomato
Oxalates and Oxalic acid	Leafy vegetables, Elephant foot yam, Colocasia
Cyanoglucosides	Cassava
Dioscorine	Yam
Solasodine	Brinjal
Appin	Celery
Tomatine	Tomato
Haemaglutine, Pisatin, Phaseottin	Freanch bean
Vicine and Covicine	Broad bean

Table 2: Antinutritional Compounds and Adverse Effects

Vegetable	Antinutritional compounds	Adverse effect
Carrot	Carota-toxin	Neurotoxic symtoms
Letuce	Nitrates, alkaloids	Methemglobinaemia
Brassicaceae	Glucosinolates, choline-esterase inhibitor, s-methyl cystiene sulfoxides	Goiter, digestive disorder

Beats and Spinach	Oxalates, nitrates, phytate, saponins, nitrosamine	Methemglobinaemia reduse bioavailability of certain minrel such as Ca, Fe & Zn. carcinogenic
Sweet Potato	Ipomeamarone	Enzyme inhibitor
Watermelon	Serotonin	Elevates blood pressure
Pumpkin and Squashes	Choline-esterase inhibitor	neurotoxic
Legumes	Lectins, Cyanogenic glucosides, Haemagglutinins, Trypsin, Amylase	Alleagens
Asparagus	Saponins, Chaline-esterase inhibitor	Neurotoxic
Solanaceous Vegetables	Alkaloids	Birth Defects, Protease inhibitors
Potato	Solanine and Chaconine	Invertase inhibitor
tomato	tomatine	Gastric discomfort
chillies	capsaicin	Skin irritaton gastric -discomfort
Parsley, Celery	Psoralens, Terpenoid, Alkaloids, Choline-esterase inhibitor	Dermatitis

Source: Chatto et al. (2011)

Reduction Methods of Antinutritional Compounds

Natural toxins will only be harmful if consume them in large quantities over a long period of time. Reduction of those antinutritional compounds can be possible by following processes like thermal treatment, soaking, sprouting, fermentation and storage:

1. Thermal treatment: High heat, especially when boiling, can degrade antinutrients like lectins, tannins and protease inhibitors. Calcium oxalate is reduced by 19-87% in boiled green leafy vegetables. Steaming and baking are not as effective. Phytate is heat-resistant and not as easily degraded with boiling. The cooking time required depends on type of antinutrient, food plant and the cooking method.

2. Soaking: Beans and other legumes are often soaked in water overnight to improve their nutritional value. Most of the antinutrients in these foods are found in the skin. Many antinutrients are water- soluble; they simply dissolve when foods are soaked. In legumes, soaking has been found to decrease concentration of phytate, protease inhibitors, lectins, tannins and calcium oxalate. Example: 12-hour soak reduced the phytate content of peas by up to 9%.

3. Sprouting: Increases the availability of nutrients in seeds, grains and legumes. During sprouting, changes take place within the seed that lead to the degradation of antinutrients such as phytate and protease inhibitors. Sprouting reduce phytate by 37-81% in various types of grains and legumes.

4. Combination of methods: Example: Soaking, sprouting and lactic acid fermentation decreased the phytate in legume by 98%. Sprouting and lactic acid fermentation of corn and sorghum degraded phytate almost completely. Soaking and boiling pigeon peas led to a 98-100% reduction in lectins, tannins and protease inhibitors.

Conclusion

Nutrient intake digestion ,absorption ,utilization produces adverse effects like depressions in growth performance and animal health due to a variety of mechanisms including reducing protein digestibility, Binding to various nutrients ,damaging the intestinal wall ,lowering digestive efficiency. Hence it can be mitigated by thermal treatment, soaking, sprouting, and fermentation and by combination of methods.

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Fertigation - A New Approach to Increase Nutrient Use Efficiency

Article ID: 30472

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Application of fertilizer with irrigation water is called as fertigation. Fertigation combines the two main factors in the plant growth and development is water and nutrient. The right combination of water and nutrient is the key to high quality and productivity. Fertigation is a simple word coined with union of two words Fertilizer and irrigation, indicating application of fertilizer through an irrigation system. The Fertilizer is applied daily or alternate day as per the requirement of crops to the root zone.

In last one decade the awareness amongst the farmer for adoption of switching over to micro irrigation is tremendously increasing, however, for Indian farmers the concept of fertigation still new, obviously because either the suitable fertilizer is not available and secondly the adequate research support and extension effort are lacking. Fertigation is a key factor in modern inclusive agriculture. It was clear that reduced wetted soil volume of the new irrigation method, an adequate supply of nutrient to the root zone could only be achieved by synchronizing the supply of water and nutrients, irrigation water found to be an ideal carrier of nutrients into the root zone precisely. Fertigation through trickle irrigation requires careful planning. Important factors to be considered are uniformly of water application (uniform fertilizer application is possible only if the water application is uniform), method of injection, type of fertilizer and application scheduling. The most important requirement for effective fertilizer injection is system uniformity. Fertilizer cannot be applied uniformly to plants unless water delivery is uniform. A system uniformly of 80% and above is needed to be considered for fertilizer injection.

Rate and timing of fertilizer injection depends on the plant age, root distribution as well as soil type. Fertilizer injection provides the growers greater flexibility than ground application because fertilizer is delivered to the roots of plants when they need it. Plants recover injected N most efficiently because timing is improved and fertilizer is delivered directly to the root zone.

Importance of Fertigation

1. Uniform application of fertilizer throughout the irrigated area.
2. Quantity of the nutrients can be accurately worked out and adapted to the plant needs on daily basis and to the climatic condition.
3. Improves fertilizer efficiency and reduces nutrient leaching below the root zone.
4. Save labour and time.
5. Increase production and quality of crops.
6. Suitable for all types of irrigation system and growing condition.

Objective

1. To limit water supply to irrigated agriculture and to produce more food with less water.
2. Maximize profit by applying the right amount of water and fertilizer.
3. Minimize adverse environmental effects by reducing leaching of fertilizer and other chemicals below the root zone.

Suitable Forms of Fertilizer for Fertigation

The availability of 100% Water soluble solid or liquids is essential if it is to be applied through fertigation. The fertilizers which are traditionally available in the market are not fully soluble in water and it also contain some non-soluble solids which make them unsuitable for application through micro irrigation system.

For fertigation the special fertilizers are:
1. Clear liquid solutions (nutrient is in solution in a suitable fluid).
2. Suspension fertilizer (nutrient is in solid form but suspended in a suitable fluid).
3. Water soluble solids (nutrient in a solid powder or crystal form but easily and completely soluble).

Table - 1. Soluble Fertilizer

Sr. No.	Name of fertilizer	% NPK content
1	Ammonium Nitrate	35:00:00
2	Mono Ammonium phosphate	12:61:00
3	Potassium Nitrate	13:00:45
4	Mono potassium phosphate	00:52:34
5	Potassium sulphate	00:00:50
6	Calcium nitrate	16:00:00
7	Urea	46:00:00
8	Ammonium sulphate	21:00:00

Micronutrients

9	Chelated iron	12
10	Magnesium nitrate	N-12, mg-16
11	Magnesium sulphate	Mg-10, S-13
12	Zinc sulphate	23
13	Ammonium molybdate	52
14	Borax	10

(Source B. C. BISWAS Fertilizer Marketing News, Vol. 41 (10),)

Fertilizer Use Efficiency

1. Fertilizer use efficiency was significantly superior in drip irrigation or fertigation over furrow irrigation.
2. This was due to better availability of moisture and nutrients throughout the growth stages in drip and fertigation system leading to better uptake of nutrients and increase production.

Fertilizer Use Efficiency (%)

Nutrient	Soil application	Fertigation
Nitrogen	30-50	95
Phosphorous	20	45
Potassium	50	80

(Biswas B.C.2010)

pH of Fertigation Solution

1. High pH values in the irrigation water (>7.5) is undesirable in Fertigation as Ca and Mg carbonates precipitate readily in saline water.
2. High soil pH reduces the availability of Zn, Fe and P to Plants.
3. Ammonia use in fertigation is not recommended as it raises the pH of irrigation water.
4. Low pH affects root membrane and increase Al and Mn concentration in soil solution to toxic levels and can thus harm plants.

Recommended Doses of Fertilizer for Different Crop

Sr. No.	Name of Crop	NPK Kg/ha
1	Rice	60:30:30
2	Wheat	80:40:40
3	Maize	120:60:40
4	Sorghum	80:40:40
5	Green gram	20:40:00

(Source-Chhidda singh 2010)

Fertigation Equipment

Fertilizer can be injected into drip irrigation system by selecting appropriate equipment. Commonly used fertigation equipment are:

1. Venturi pumps
2. Fertilizer tank
3. Fertilizer injection pump

Conclusion

1. From the foregoing discussion it can be concluded that fertigation provides greater flexibility and control of nutrients when applied in small quantities when required.
2. It check nutrients leaching by over-irrigation. Emitter clogging problems resulting from reaction of the fertilizer with irrigation water is avoid.
3. Fertigation experiments have clearly elucidated the marked savings in fertilizer (20 to 40%) as compared to conventional method of fertilizer application.

Benefits of Desi Cow Milk Ghee

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Pure Desi ghee, is ghee made of cow's milk. There might be no one who doesn't know about the benefits of consuming cow ghee. If you belong to an Indian family there are a lot of benefits of cow ghee that you might have heard growing all these years. It contains butterfat, water and milk proteins. Cow ghee contains nutrients along with anti-oxidants, antifungal and antibacterial properties which helps an individual not with one but with many problems. It promotes digestion, helps in developing bone, protects arteries, provide immunity and many more.

Desi Ghee is Good for Our Skin

Desi ghee is a natural source to nourish our skin. It rejuvenates skin and gives a natural glow & acts as natural skin moisturize. The ghee remedy is used to relieve burning sensation, to relieve burn wounds, wound scar, herpes wounds etc.

Desi Ghee Helpful in Reducing Weight

Desi ghee helps to improve metabolism of our body. It contains medium- chain fatty acids & can help to boost fat bumping. It promotes healthy weight loss in our daily diet plan.

Desi Ghee Helpful in Improving Digestion

Consuming Desi ghee regularly improves digestion as it stimulates the secretion of digestive enzymes. It contains best source of butyrate, the short- chain fatty acid that is crucial to maintaining optimal digestive health. Butyrate available in ghee provides energy for the cells in the colon, help support gut barrier function and fights off inflammation.

Desi Ghee is Good for Your Heart

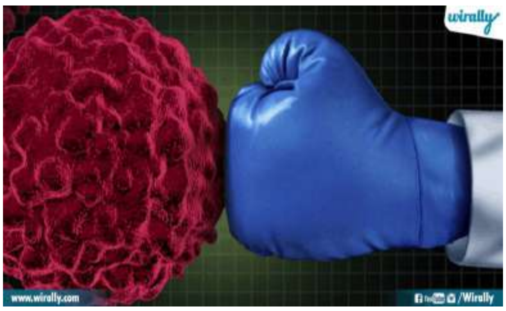
Desi ghee is good for heart health as it increases good cholesterol production in your body. Cholesterol prevents the cause atherosclerosis. As a healing agent in the body, levels of cholesterol increase during periods of stress or when inflammation is present. Maintaining healthy cholesterol through good quality fats, such as Desi ghee, allows the body to help address the inflammation.

Desi Ghee Strengthens Your Bones

Desi ghee is vitamin rich in nature and makes appropriate for good bone and joint health. Try massaging your bones with desi ghee. Regularly consuming a few servings of desi ghee into your daily diet can help you meet your vitamin K needs. Apart from strengthening your bones, vitamin K is essential to many aspects of health, such as blood clotting, heart health and brain function.

Desi Ghee Prevent Cancer

Desi ghee slows down the progression of cancer as it prevents free radical formation which is again due to its antioxidant rich nature. It is high in saturated fats as it has a high smoke point. Thus, it generates less free radicals when heated, which are known to increase your risk of cancer.



Desi Ghee Helpful in Treating Nasal Congestion Problems

Desi ghee derived from cow milk solves your nasal congestion problems. Desi ghee as a nasal drop is helpful in treating white hairs, Hair fall, Migraine, Tension , Headache, Tinnitus problems, lack of memory and concentration.

Desi Ghee is Good as a Brain Tonic

As per nutritionist, Desi ghee is good for the nerves and brain. It is rich source of high levels of omega-6 fatty acids and omega -3 fatty acids, which is ideal for overall health Hence, make it a habit to include ghee in your diet regularly as it can help your brain function better.

Desi Ghee is Free of Lactose and Casein

In properly prepared Desi ghee, there is no lactose and casein. Ghee is the perfect choice for those who are lactose and casein intolerant. While preparing it the milk solids containing the lactose and casein float to the top, where they are removed.

Desi Ghee is Cures Thyroid Dysfunction

Most of the women are suffering from common disorder- Thyroid dysfunction. This can lead to hormonal upheaval in the body along with reproductive problems. It contains no milk solids and is beneficial for those suffering from this unfortunate condition. The gastrointestinal tracts and the immune system, both are compromised by an abnormal thyroid gland, are protected by ghee. Also, thyroxine hormone is also regulated by chemicals present in ghee.

Identification, Symptoms of Damage and Integrated Management of Invasive Fall Army Worm in Maize

Article ID: 30474

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Summary

Fall army worm has recently been introduced into Asian countries and has already moved to many Indian states. Because in India, growing of maize during monsoon, winter and summer season provides a favourable environment for this pest to quickly multiply and spread to more areas.

Therefore, effective control should focus since it is impossible to avoid this problem unless developing sustainable management. There is an urgent need to increase awareness among the farming communities about this pest besides introducing sustainable management options including environmentally safe biorational insecticides.

Introduction

Maize is being considered as the third-most important cereal crop just after rice and wheat. India is one of the top ten maize producers in the world, contributes around 2-3% of the total global production. Recently, the appearance and infestation of invasive fall army worm (FAW), *Spodoptera frugiperda* (Lepidoptera: Noctuidae) has been noticed in India during 2018 (Maruthadurai *and Ramesh*, 2020).

It is native to the tropical and subtropical America and invaded many African and Asian countries by causing significant economic loss. However, the phylogenetic analysis has revealed that the Indian FAW population clustered with Florida, Ghana, Nigeria and Uganda maize strain (Kuate *et. al.*, 2019).

Identification

The larva of FAW has an inverted "Y" marking on head and bears four smaller spots in trapeze fashion on dorsal surface of other segments. But, the dorsum of the second-last abdominal segment has four large spots in square arrangement. The hind-wings of adult moths are pale white in colour.

Biology

Gravid female moth lays more than 1000 eggs in single or in multiple clusters near or inside the whorl. Larval stage has six instars and takes 14-17 days to attain pupation. Pupal stage varies from 7-8 days and the adult moths survive for an about 7-9 days. It may take about 30-55 days to complete a single life cycle.

Nature and Symptoms of Damage

Early instar larva shows the papery windows on leaf and partial defoliation, but the later instars often feed solitarily inside the whorls and create large holes accompanied by profuse excreta (Figure 1-3). In severe cases, the entire defoliation of plant may be observed. The larvae like to feed on tender foliage and tassel (male inflorescence).

Integrated Management

1. Monitoring: Installation of pheromone traps @ 5 per acre in the current and potential area of spread in crop season to ensure the appearance of the pest (Figure 4).

2. Scouting: Scouting should be done in "W" manner as soon as the maize seedlings emerge. Control measures should be taken when 5 per cent pants and 10 per cent whorls are damaged at 3-4 weeks and 5-7 weeks after emergence of crops.

3. Cultural control:

a. Deep ploughing should be done before sowing of seeds in order to expose the hibernating pupae over sunlight and predator.
b. Timely sowing of seeds and avoiding staggered sowing.
c. Erection of bird perches @ 10 per acre during early stage of the crop (up to 30 days).
d. Clean cultivation and balanced use of fertilizers should be adapted.

4. Mechanical control:
a. Hand picking and destruction of egg masses and neonate larvae in mass by crushing or immersing in kerosene water.
b. Application of dry sand into the whorl of affected maize plants soon after observation of FAW incidence in the field.

5. Trap:
a. Poison bait: Poison baiting is recommended for late instar larvae. Keep the mixture of 10 kg rice bran + 2 kg jaggery with 2-3 liters of water for 24 h to ferment. Then add 100 g thiodicarb 75 WP just half an hour before field application. The bait should be applied into the whorl of the plants (Figure 5-6).
b. Trap crop: Sowing of sorghum or napier around the main field of maize and spraying of neem seed kernel extract (NSKE) 5% or azadirachtin 1500 ppm on the border crop to reduce the larval emergence from eggs.

6. Biological control:
a. Diversity of natural enemies like *Metopius rufus*, *Campoletis chlorideae*, *Microplitis mainlae*, coccinellid predators etc. should be increased in the field (Sharanabasappa *et. al.*, 2019).
b. Augmentative release of *Trichogramma pretiosum* @ 100000 parasitized eggs per ha should be employed (Figure 7).
c. Foliar spray of *Metarhizium anisopliae* talc formulation (1×10^8 cfu g^{-1}) @ 5 g l^{-1} water or *Nomuraea rileyi* rice grain formulation (1×10^8 cfu g^{-1}) @ 3 g l^{-1} water or *Bacillus thuringiensis* var *kurstaki* @ 2 g l^{-1} water should be done at 25-30 days after crop emergence.

7. Chemical control:
a. Seed treatment with cyantraniliprole 19.8% + thiamethoxam 19.8% FS @ 4 ml per kg seed should be done before sowing as a preventive measure of FAW control.
b. Commercially formulated chemical insecticides in proper recommended dosages should be applied at the ETL of the pest (MUP, 2020) like novaluron 5.25% + emamectin benzoate 0.90% SC @ 90 g a.i. ha^{-1} or spinetoram 11.7 SC @ 30 g a.i. ha^{-1} or chlorfluazuron 5.4 EC @ 60 g a.i. ha^{-1} at the early stage of infestation, while chlorantraniliprole 9.3% + lambda cyhalothrin 4.6% ZC @ 35 g a.i. ha^{-1} or emamectin benzoate 1.5% + fipronil 3.5% SC @ 40 g a.i. ha^{-1} at the later stage.

Conclusion
The FAW has now become a serious issue where maize growers should be very much alert in this regard. However, calendar-based application of insecticides should be avoided as the pest has the potential of resistance development within a very short time. Integrated options are need to emphasize along with the rotation of different chemical classes for sustainable management of this pest in near future.

Fig. 1

Fig. 2

Fig 3

Fig 4

Fig 5

Fig 6

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Recent Reforms for One Nation-One Agriculture Market

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Recently, Union Cabinet headed by Prime Minister approved amendment to decade old Essential commodity act 1955 with the implementation of "The Farmer's Produce Trade and Commerce (Promotion and Facilitation) Ordinance 2020" and "The Farmers (Empowerment and Protection) Agreement on Price Assurance and Farm Services Ordinance 2020. The ordinances bring several APMC (Agricultural Produce and Marketing Committee) reforms paving way for 'One Nation-One Agriculture Market'. Before the ordinance, several restrictions for farmers were there regarding selling agri-produce outside the notified APMC market yards or their districts. This amendment in the act will help to attract various investments into the farm sector. The commodities such as cereals, edible oils, oilseeds, pulses, onions, and potatoes are going to be deregulated due to the removal of stock limit which was earlier applicable to processors or traders. This step would help the farmers to get free from the clutches of the Agriculture Producer Market Committee (APMC) as they can sell their produce anywhere at competitive prices. Farmers can also sell goods on e-NAM for which they will not be charged any tax on sale outside APMC markets.

1. The Farmer's Produce Trade and Commerce (Promotion and Facilitation) Ordinance 2020: this ordinance will promote transparent and barrier-free inter–State as well as intra-State trade for farmer's produce outside the physical premises of markets or deemed markets. Besides, the Ordinance will provide an electronic platform for trade.

2. The Farmers (Empowerment and Protection) Agreement on Price Assurance and Farm Services Ordinance 2020: This ordinance will further support, protects and empowers farmers to engage with agri- business firms, processors, wholesalers, exporters or large retailers for farm services and sale of their farm produce at a mutually agreed remunerative price framework in a transparent manner.

Three Legislative Reforms Under "One Nation One Agriculture Market"

1. Barrier free interstate and intra state trade in agriculture produce: It proposes to bar state government from imposing taxes on sale and purchase of farm produce undertaken outside the respective mandis and give farmers freedom to sell their produce at remunerative prices. Besides this if any conflict arises regarding transactions, SDM or DM will resolve the matter within 30 days.

2. Empowering farmers to engage with processors, aggregators, wholesalers, large retailers, exporters, etc through advanced contracts on pre agreed prices.

3. An amendment on the essential commodity act which removes few cereals, pulses, oilseeds, etc from the list of essential commodities.

Importance of One Nation One Agriculture Market to Farmers

Now a days increasing level of commercialization under agriculture led to decrease the share of farm produce that is sold within the state whereas the share sold outside increases. Moreover, increase in per capita income level further increased the demand for highly diversified food. People in the urban locations want to consume a range of products often grown outside the state and even outside the country. The increase in consumption demand for diversified food necessitates seamless flow of farm produce across the country without regulatory restrictions and barriers and excessive intermediation. This requires integrated supply and value chains that move products from the boundaries of one state to another state efficiently and further help in linking consumer with producer at distant locations. Such development will accelaret if we have uniform rules for all the producers and traders across the country to sell, buy and move produce without unnecessary barriers. Such 'one nation one agriculture market' will prove of vital importance in raising price realization by farmers, supply food to the consumer at competitive prices and to compete with import and give a boost to export. It is estimated that farmers, as well as traders, would take cognizance of the new trading opportunities created by law for them and will start preparing to do business as per the new policy reforms when Kharif crops will be harvested.

How it will Benefit the Farmers?

The main focus and goal of the three policy reforms were to help farmers get higher remunerative prices by creating new sale avenues and higher competition. The reduced marketing cost and market margin due to large intermediaries will led to increase the producer's share and lower the consumer's price. The high competitiveness levels in the sale of commodities will benefits producers and traders. Therefore, improved efficiency in the new marketing will benefit farmers having large marketable surplus. Small and marginal farmers here need to connect directly with consumers and also required to participate on sales platforms like e-NAM, etc. The small farmers can join hands with one another and form producer's group or Farmer Producer Organization. FPO is considered group/ organization/ institution for empowerment and protection of all type of farmers.

Significance of Move

1. It will help in unlocking rules of regulated agricultural markets which are wide spread across the nation.
2. It will create opportunities for the farmers outside APMC market yards due to creation of additional competition.
3. This will supplement the existing MSP procurement system and help in doubling farmer income.
4. It further help in integration of different inter and intra state markets.
5. The marketing cost would reduce to significant level.
6. The separate dispute resolution system/ mechanism will be set up for farmers which will resolve the matter within 30 days.

Way Forward

The major problem in agriculture marketing is not farmer's mindset but the restrictive as well as regulatory environment and missing opportunities for the small and marginal farmers. Better logistics, assurance about prices, sharing of market risk, farm-friendly infrastructure and incentive for diversification towards more paying quality produce and high-value produce will motivate farmers to go for transformation in farming and marketing of produce. We need to create enabling environment with favourable terms for the farmers to achieve the real goal of "One Nation One Agricultural Market" and for the success of "Atam Nirbhar Bharat".

Behavioural Control of Insect Pests

Article ID: 30476

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Introduction

Advances in chemical technology in the last three decades have allowed the discovery, identification and synthesis of specific chemicals that regulate or mediate growth and development and species behaviour. That may cause premature death (abnormal moulting or metamorphosis), attracting or repelling towards the source. Manipulation of pest behaviour is referring as "the use of stimuli that either stimulate or inhibit behaviour and thereby change its expression".

Hormone

Hormones are the secretion of internal ductless glands, which regulate the growth and development of the insect. Means to 'excite' and endocrine in origin also recognized as 'third generation pesticides'.

Types of Hormone

1. Neurohormones: Synthesized by neurosecretory cells of brain. Responsible for activation of CA and PTG. Allatotropin activates CA, Prothoracicotropin activates PTG.

2. Juvenile hormone: Produced by CA. Synthetic analogues are called as Juvenoids or JH mimics. Juvenile hormones are terpenoids in nature. Wigglesworth (1936) showed that JH inhibits metamorphosis and stimulates ovarian development. Methoprene was the first IGR registered and approved by EPA for mosquito control.

E.g. Methoprene (altosid) against Mosquitoes, Horn fly (Haematobia irritans), Greenhouse homopterans, Dipterous leaf minor. Fenoxycarb (foliar application) against fruit pest- Rice moth (Tiwari, 2018).

3. Ecdysone or moulting hormone: Produced by prothoracic gland. Synthetic analogues are called as ecdysteroids. It consists of two forms α-ecdysone and β-ecdysone. Death is caused by incomplete ecdysis and cuticle malformation. The best-known chitin inhibitors are the benzoyl phenyl urea, which include diflubenzuron and its analogues teflubenzuron, flufenoxuron and triflumuron.

Pheromone

Produced & discharged from glands with external ducts and influence other members of the same species and not the individuals that produce. Convey information to individuals of same species.

Types of Pheromone

1. Sex pheromone: Mainly secreted by female sex but cotton boll weevil, cabbage lopper and mediterranean fruit fly male insect secret sex pheromone. Sex pheromone released by specified glands situated at the terminal end of abdominal part of female. Sex pheromone are highly volatile and species specific. Nowadays more than 1500 pheromones of different insect species have been identified. Sex pheromones of major lepidopteran pests such as Helicoverpa armigera and Spodoptera litura are widely used as monitoring lures in vegetable production systems (Srinivasan et al. 2015).

2. Aggregation pheromone: Chemical and mixture of chemical produced by one or both sexes that brings organisms together to feed, protection or reproduction. Mainly produced in coleopteran and dictyopteran. The male of bark beetle (Ips confuses) produce aggregation pheromones.

E.g. Methoxy benzene (anisole) is the aggregation pheromone in whitegrub (Leal et al., 1996), frontalin in bark beetle, periplanone in Periplanata americana.

3. Alarm pheromone: Alarm pheromones are chemical substances released by insects to warn members of the same species about the presence of or attack by an enemy (mostly a predator). Generally, highly volatile, spread rapidly, act quickly. Aphids produce alarm pheromones. Alarm pheromone provides opportunity to improve the effectiveness of insecticides. Warning elicits different behaviour in different insects as dispersion or escape in aphids and bugs, aggression in ants and solider termites and attraction in wasps and worker bees.

Advantages

1. Effective in minute quantities.
2. Highly species specific.
3. Biodegradable, non-persistent and non-polluting.
4. Nontoxic to man, animals and plants.
5. Affects many aspects of insect development and physiology.
6. Labour saving.
7. Easy monitoring of pest population.
8. Best suited in IPM.
9. Reduces risk of insecticide residues.

Disadvantages

1. Highly volatile.
2. Not stable.
3. Difficulty in application.
4. Frequent application is required.
5. For monitoring equal amount is not released throughout the period.
6. Eco-friendly and economically based IPM.

Conclusion

1. Eco-friendly and economically based IPM.
2. Hormonal control effective against specific stages and periods.
3. Needs popularization among farmers.
4. Hormone analogues are unstable.
5. Limits commercial viability, no quick result.
6. Used effectively only at low population density.
7. Control of all pests to be investigated with greater efforts.
8. New trapping system need to ensure lure longevity and trap efficiency.

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Food Systems for Healthier Populations - A Need in Demand

Article ID: 30477

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Summary

Hunger can be overcome by food but the definition of healthy food is not limited to its nutritional score rather, it has be an end result of such a food system which conserves and protects natural resources, is environment friendly, grows to fulfil nutritional need of its population, boosts economy, conserves for future and leads to social welfare. And this food system involves a complete set of processes, activities, infrastructure including environment that encompasses production, processing, distribution, waste decomposition and food consumption. This broader understanding of food increases our focus from personal responsibility of eating a healthy diet to our collective social responsibility for creating a healthy and sustainable food system. It further increases the scope of environmental nutrition approach to be put into action and make food a fundamental part of prevention-based health care.

Introduction

Globally health care sector increasingly recognizes the role of nutrition in maintenance of good health and prevention of diseases. While considering nutrition as the ability to nourish ourselves and to promote health, it is pertinent to assess how food is produced, processed, and distributed, what completes the definition of healthy food and nutrition. This approach examines the public health impacts of social, economic, and environmental factors related to the entire food system. It does not aim for the support of solutions of producing enough or more food for increasing population (sustainable nutrition), neither does it contradict other similar concepts (sustainable nutrition security, nutritional life cycle assessment (LCA)) (Klein et. al., 2014). However, it calls for more definite estimation of the carrying capacity of the environment on personal, local, and national levels for the development of more efficient solutions of nutrition balanced in the limits of environmental carrying capacity. Environmental nutrition examines the public health impacts of social, economic, and environmental factors related to the entire food system. Traditional nutrition, on the other hand, is defined simply as "the intake of food, considered in relation to the body's dietary needs (Tilman et. al., 2014)

Evolution of Food Systems and the Resulting Threats

The initial emergence of food systems had few detrimental impacts on the physical environment, because of less population and limited production techniques, use of nutrients mainly from soil and energy from the sun. Humans and animals obtained nutrients and energy by eating plants, other animals, or both. Manure, crop rotation, polycultures, and routinely abandoning fields which were taken over gradually by natural vegetation were the main sources of maintaining soil vitality. Although instances of intensive agriculture have existed for thousands of years, agriculture largely became industrialized over the past 2 centuries; adversely affected biodiversity because of increased use of synthetic fertilizers, vitamins and antibiotics in agriculture production, including animal farming (Pew, 2014). All this has imposed a severe threat to human, animal and environmental health.

The environmental costs of food production are now substantial, including the degradation of inland waterways, nitrogen and phosphorus pollution, food wastage, GHG emissions contributing to climate change which in turn have adverse human health consequences including more deaths through temperature extremes, increased spread of infectious disease, reduced food yield in some regions, and increased threat to food security. Besides, all the emerging changes in food system has drastically changes human choices of food consumption, like increased consumption of calories and sweeteners; leading to obesity, high levels of processed meat and red meat consumption; associated with increased risk of cardiovascular disease and certain kinds of cancers.

So, the conventional food system results not only in environmental impacts but also contributes to the human disease burden and degrading of ecosystem functions on which all life depends. Furthermore, the natural resource conditions that enabled this system to develop, including abundant water and land resources and a stable climate, are rapidly changing. The food system requires re-imagining and re-structuring for long term resilience.

An Environmental Nutrition Approach

It is getting increasingly recognized to have a new approach in agriculture and towards nutrition in order to foster the health of nature and human communities as well. This shifting from an individualistic to a systemic perspective, highlights those bodies at greatest risk of suffering health problems related to food production, processing, distribution, and consumption who have the least power to change the food system, including agricultural workers, rural communities, and low-income communities. Evidence demonstrates that organic and agro-ecological methods can help mitigate climate change by sequestering carbon in soils through organic matter accumulation (Sabaté, et. al., 2017) Research has demonstrated that organic farming methods can also contribute to greater biodiversity by providing wildlife and soil biota habitat, help to conserve soil and water resources, and reduce or eliminate the use of synthetic fertilizers and pesticides that wreak havoc in ecosystems (Smetana, et. al., 2019) The environmental nutritional approach not only includes providing safe and healthy food to growing population and reduce hunger but also includes improved urban and rural livelihoods for economically sustainable development. It not only includes production but fair distribution of food as well. Methods of production that prevent water wastage and air pollution, soil erosion, loss to biodiversity all are highlighted in environmental nutrition approach. To reach these goals, there has to be a fundamental shift in agricultural science, technology, policies, institutions, capacity development, and investment as well.

Conclusion

It is high time that the existing food system combine nutrition and sustainability via setting environmental sustaining capacity as aiming point to avoid disastrous consequences for the biosphere. Given the intrinsic relationships between the environmental sciences and the nutritional sciences, it is imperative that public health research and practice begin a concerted focus on the new discipline of environmental nutrition, which seeks to comprehensively address the sustainability of food systems.

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Cultivation of Saffron (*Crocus sativus* L.): "The Red Gold"

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Introduction

Saffron (*Crocus sativus* L.) belonging to family Iridaceae and is called "The Red Gold". It is a herbaceous perennial cormous plant that can grow up to a height of 25 to 40 cm. Saffron is believed to have originated in the eastern Mediterranean region. It is the most expensive spice in the world and hence it is called "the red gold". Saffron being sold at a rate of 2.6 lakh per kg in the market (Anonymous, 2016). Since time immemorial the dried stigmas of the saffron flower have been considered valuable due to its odoriferous, colouring, and medicinal properties. Its stigmas possess various medicinal properties such as antidiabetic, anticancer, cardiotonic, antiseptic, antioxidant, antidepressant, digestive, anti-inflammatory, sedative, carminative, and stimulant, etc. It is also being used in food as a spice, for the preparation of dyes, perfumes, and cosmetics. Due to a decline in its population, this crop has been listed as an endangered species (Sagar, 2014). Saffron is being cultivated more or less intensely in Iran, Greece, India, Morocco, Spain, Italy, Turkey, France, Switzerland, Israel, Pakistan, Azerbaijan, China, Egypt, UAE, Japan, Nepal, Austria, California, Myanmar, Argentina, and Australia. In India, it is mainly cultivated in Pampore (Kashmir) where more than 16,000 families, presiding over 300 villages of the saffron growing belt of Pampore are involved in its cultivation.

Cultivation Aspects of Saffron

1. Mode of propagation: Saffron is propagated through corm. Therefore, the selection of healthy and good quality corms is an important factor in saffron production.

2. Climate: Saffron can be grown from sub-tropical to temperate climate and prefers rainfall in autumn, warm summers, and mild winters. It requires an annual rainfall of 800-900mm and well adapted to arid and semi-arid lands.

3. Soil: This plant grows well in sandy to well-drained clay loams, alluvial, and lacustrine (Nehvi *et al*., 2011). It requires higher pH ranging between 6.3 - 8.3 and the higher pH values coincide with higher yields.

4. Selection of corm: The corms which are healthy and free from any disease and pest infestation should be selected. Those corms with a diameter larger than 2.5 cm are selected for cultivation.

5. Field preparation: The field should be ploughed 4 to 5 times to a depth of 30 to 35 cm and then the soil is thoroughly mixed with farmyard manure at the rate of 10 tonnes per hectare. Besides, NPK (90:60:50 kg) and 5q of vermicompost per hectare can be applied. Beds of 2.5 x 2.5m size are laid out in the field and drainage outlets of 30cm wide and 15 cm deep are also made all around the beds (Joo and Ahmad, 2016).

6. Planting out: The outermost fibrous covering of the corms is removed and is dipped in a solution of 5% copper sulphate before planting. It is usually planted between the mid of July to the end of August. The healthy corms are planted at a rate of 1 to 1.5 q/ha with a spacing of 25 x 15 cm (Yasmin and Nehvi, 2012).

7. Intercultural operation: First irrigation is normally done 2-3 weeks before the initiation of flowers. The application of one irrigation at the time of the early flowering stage results in a higher rate of flowering. Hand-weeding, hoeing, mulching is done to control the weed growth. Weedicides such as simazine and atrazine can be applied at a rate of 10 kg per ha.

8. Harvesting: Saffron flowers are normally hand-picked in the early morning hours, while the flowers are still closed to obtain better quality. The hand-picked flowers are put in a wicker basket to prevent them from being damaged. Picking is carried out during the early two to three morning hours. Immediately after the flowers have been picked, separation of the stigmas from the flower is done by opening the flowers (tepals) and then cutting the stigmas with the fingers at the point where it divides into the three stigmatic branches. The fresh red stigmas are dried immediately after separation from the flower.

9. Yield: The yield of saffron in India is 1.5 - 2 kg per ha. About 110,000 - 170,000 flowers are needed to produce 1 kg of dried red saffron (Joo and Ahmad, 2016).

Conclusion

The saffron in India (Pampore, Kashmir) has already become endangered as its production as well as productivity has continuously been declined over the years. Due to which this valuable cash crop is in danger of extinction and therefore seeks the attention of scientists, researchers, farmers, and bureaucrats or policymakers. The high market demand encourages the saffron growers and provide an opportunity for the revival of its production and extend its cultivation in other parts of the country with similar climatic and edaphic conditions. There is a need for research focusing on genetic improvement, post-harvest technologies, good agricultural practices, and organic farming, etc. Stringent policy should be made and implemented to prevent the smuggling of cheaper (Iranian) saffron and using it as an adulterant.

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Applications of Remote Sensing and GIS technology

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Introduction

The primary aim of agricultural research is to find ways and means to increase agricultural production through an ecologically sustainable, judicious and optimal management of our land and water resources. For a country like India it has to be within the framework of sustained economic development to benefit millions of the rural poor. Reliable, up to date and comprehensive information on the resources can go a long way towards developing strategies for a better management rather than exploitation of the resources.

Remote Sensing and GIS

Remote sensing is the measurement of the acquisition of data about the Earth's surface without contact with it. This is done by sensing and recording reflected or emitted electromagnetic radiation. Geographic information system (GIS) is a computer-based information system used to digitally represent and analyze the geographic features present on the Earth's surface and the events that take place on it.

Application: Crop Condition Assessment

Crop monitoring at regular intervals during the crop growth cycle is essential to take appropriate measures and to assess information on the probable loss in production. The remote sensing-based methodologies can provide information on the occurrence and the areal extent of crop stress. However, the identification of the cause whether by pest and disease or by any other factor, still remains a major limitation.

Vegetation indices derived from remote sensing data are useful for crop condition assessment. Two such indices, which have been developed VCI (Vegetation condition index) and TCI (Temperature Condition Index) for monitoring drought. While VCI is the percentage of NDVI with respect to its maximum amplitude, TCI is the percentage is brightness temperature with respect to its maximum amplitude.

Application: Agriculture Drought Assessment

The district level agricultural assessment and monitoring using Normalized Difference Vegetation Index (NDVI) generated from NOAA-AVHRR helps in taking the timely preventive and corrective measure for combating drought is yet another area where remote sensing has been used. In India a National Agricultural Drought Assessment and Monitoring System (NADAMS) was initiated in 1986, using remote sensing data from the NOAA satellite and ground observation of rainfall and agricultural conditions. Soils the information on nature, extent and spatial distribution of soils is pre requisite for optimal land use planning for agriculture and other usage. Conventional surveys using topographical sheets and cadastral maps have been hitherto carried out for generating the aforesaid information on soils. Synoptic coverage of a fairly large area in discrete spectral bands and at regular interval provided by the orbiting satellites enable generating soil resources map in a timely and cost-effective manner. Many studies have been carried out to generate soil resources maps at scale ranging from 1:250000 to 1:50000 with the abstraction level of sub groups/ associating thereof and association of series, respectively. Besides, derivative information , namely land capability and irritability and suitability for different crops which in turn enable to prepare an optimal land use plant have also been generated.

The IRS IC PAN data with stereo coverage offers immense potential for generating information soil resources at 1:12500 scale. Such information is required for micro level optimal land use planning.

Soil moisture is a critical parameter in agriculture hydrology and meteorology. The launch of remote sensing satellites with microwave sensors enabled studying soil moisture in 15 cms of surface layer. The studies carried out world over have shown that a C band Synthetic Aperture Radar (SAR) operating at incidence angle of 10 and 15 degrees is ideal for generating information on soil moisture to a depth of 0 to 15 cm.

Degraded Lands

An estimated 175 mha lands are subjected to some kind of degradation. Active soil erosion by water and wind alone accounts for over 150 mha. Salt affected soils, waterlogged and shifting cultivation areas, etc. constitute rest of the degraded lands. In order to meet the growing demand of land for agriculture on a sustainable basis, every bit of available land need to be utilized based on its potential and limitations. Remote sensing data by virtue of large area coverage at regular intervals offer very good potential for detection, mapping and monitoring of degraded lands. The extent, spatial distribution and magnitude of eroded lands mainly due to rill and gully erosion, salt affected soils, waterlogged areas, extent of shifting cultivation etc., can be mapped at 1:250000 and 1: 50000 scales.

Land Use / Land Cover

Timely and reliable information on type, extent, spatial distribution of landuse/ land cover and changes therein is needed for optimal utilization of available land and water resources of any region. Space borne multispectral data have been used to generate land use / land cover maps, urban land use and sprawl maps and wasteland maps at 1:250000 scale and 1: 50000 scale. The IRS IC with high resolution data have opened new vistas in land use and urban planning.

Water Resources

Satellite remote sensing has become an effective tool for a number of applications related to water resources development and management. Space technology inputs have been particularly successful in the areas of water resources assessment, ground water targeting, flood monitoring and management, assessment and monitoring of environmental impacts of water resources projects, watershed management, water quality mapping and monitoring and reservoir.

Conclusion

Thus, remote sensing offers an immense potential to generate detailed information on natural resources at cadastral level and to study the processes through modelling in a GIS environment.

Epidemiology and Management of Chili Anthracnose

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Introduction

Chilli anthracnose disease caused by *Colletotrichum* species drastically reduces the quality and yield of chilli fruits resulting in low returns leading to huge economic losses worldwide. Anthracnose of chilli has been shown to be caused by more than one *Colletotrichum* species including *C. acutatum*, *C. capsici, C. acutatum*, *C. coccodes* and *C. dematium*. The use of appropriate integrated management practices such as cultural, mechanical, chemical and biological control are important in chilli anthracnose disease prevention and control. Typical anthracnose symptoms on chilli fruits include sunken necrotic tissues, with concentric rings of acervuli and fused lesions. Disease infection and disease progress of chilli anthracnose can be promoted at a temperature of approximately 27°C with 80% relative humidity and a soil pH of 5-6 (Roberts *et. al*., 2001). Several losses may occur in rainy weather because the spores of *Colletotrichum* are splashed or washed onto other fresh fruits resulting in more infection.

Causal Agents of Chilli Anthracnose

In the *Colletotrichum* patho-system, different *Colletotrichum* species can be associated with anthracnose of the same host (Cannon *et. al*., 2000). *Colletotrichum* species causing anthracnose of chilli have been reported from different countries and regions. Kim *et. al*., (2004) reported that different species cause diseases of different organs of the chilli plant; for example, *C. acutatum* and *C. gloeosporioides* infect chilli fruits at all developmental stages, but usually not the leaves or stems, which are mostly damaged by *C. coccodes* and *C. dematium*. Different *Colletotrichum* species may also play an important role in different diseases of mature stages of chilli fruit as well. For example, *C. capsici* is widespread in red chilli fruits, whereas *C. acutatum* and *C. gloeosporioides* have been reported to be more prevalent on both young and mature green fruits.

Survival of Pathogen

Colletotrichum species can survive in and on seeds as acervuli and micro-sclerotia (Pernezny *et. al*., 2003). Mycelia survive in heavily colonized seeds had abundant inter and intracellular mycelia and acervuli in the seed coat endosperm and embryo showing disintegration of parenchymatous layers of the seed coat and depletion of food material in endosperm and embryo (Chitkara *et. al*., 1990). Fungi can overwinter on alternative hosts such as other solanaceous or legume crops, plant debris and rotten fruits in the field (Pring *et. al*., 1995). *Colletotrichum* species naturally produce micro-sclerotia to allow dormancy in the soil during the winter or when subjected to stressful conditions and these micro- sclerotia can survive for many years (Pring *et. al*., 1995). During warm and wet periods, conidia from acervuli and micro-sclerotia are splashed by rain or irrigation water from diseased to healthy fruit and foliage and diseased fruit acts as a source of inoculums.

Disease Cycle Chilli Anthracnose

Colletotrichum species utilize diverse strategies for invading host tissues and produce a series of specialized infection structures such as germ tubes, appressoria, intracellular hyphae, and secondary necrotrophic hyphae. These pathogens infect plants by either colonizing subcuticular tissues intramural or being established intracellular. In pre infection stages conidia adhere and germinate on the plant surface, producing germ tubes that form appressoria which in turn penetrate the cuticle directly (Bailey and Jeger, 1992). Following penetration, the pathogens that colonize the intramural region beneath the cuticle invade in a necrotrophic manner and spread rapidly throughout the tissues (O'Connell *et. al*., 1985).

At later stages of infection, tissues were colonized inter- and intracellularly by the pathogen. This structural feature indicated that the infection was governed by necrotrophic fungal growth. *Colletotrichum* species are generally able to survive in or on seeds and one of the ways that anthracnose is introduced to the chilli field is through infected transplants (Manandhar *et. al*., 1995). *C. capsici* infection of chilli was shown to have two pathways: invasion through the seed coat and invasion through the openings of the testa (Jewsakun, 1978). However, very little is known about the disease cycle of the pathogens that cause anthracnose in chilli. There are still several questions to be answered.

Epidemiology of Chilli Anthracnose

Environmental factors play an important role in deciding the severity and spread of any disease. The favourable host, pathogen and weather conditions lead to establishment of disease (Agrios, 2005). Anthracnose disease of chilli is generally most common among the tropical and sub-tropical countries. Hot and humid environmental conditions support the spread of the disease other important environmental factors governing the severity of the disease include rainfall intensity and duration, humidity, leaf surface wetness and light. Amongst them leaf surface wetness has been directly linked with the severity of the disease owing to the better establishment of the pathogen in respect of germination, attachment and penetration into host tissues (Than et. al., 2008).

Temperature and humidity also affect the development of the disease. Temperature around 27 oC with relative humidity of 80% has reported to be optimum conditions for successful establishment of the disease in a given area (Roberts et. al., 2001). The development of the disease also depends on the host cultivar, along with its resistance against the pathogen. Thus, before proposing the management strategy of the disease, a thorough knowledge regarding the epidemiology of the disease should be studied. The duration of the surface wetness, however, appears to have the most direct influence on the germination, infection and growth of the pathogen on the host. Generally, infection occurs during warm, wet weather.

Management of Chilli Anthracnose

Management of chilli anthracnose has been a burning issue for the agriculturists and the farmers as till date, no effective control measures has been proposed. The fall in the chilli production and the drop in fruit quality have further intensified the need for developing a sustainable approach for controlling the spread of the disease. No single management technique has been found to efficiently control the disease. Generally, using a combination of the different strategies like chemical control, biological control, physical control and intrinsic resistance has been recommended for managing the disease (Agrios, 2005). The management strategies for controlling Colletotrichum spp. from spreading and establishing a disease can be discussed under four broad categories: Use of cultural Practices, use of chemical control, use of resistant varieties and finally the use of biological control gives a summarized information on the strategies used for controlling the anthracnose disease in chilli from different parts of the world.

Integrated Disease Management

Colletotrichum has high pathogenic variability and new races of the pathogen are reported frequently. Thus, integrated disease management is considered the most effective approach to minimize the yield losses to anthracnose. The integration of soil solarization, mancozeb seed treatment at a rate of 3 g/kg seeds and carbendazim foliar spray at a rate of 0.5 kg/ha were found to be effective in reducing bean anthracnose epidemics . Botanicals and biopesticides (10% extracts of *Adenocalymma alliaceae*, *Azadirachta indica* and *Lawsonia inermis*, 0.4% talc formulation of *T. viride* and Pseudomonas fluorescens along with fungicides (Carbendazim (0.2%) and Mancozeb (0.4%) were evaluated in a greenhouse and field experiment in India and gave promising results.

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Soil Organic Carbon Management for Sustainable Soil Quality Under Scenario of Climate Change

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Introduction

Maintaining or improving soil quality is becoming increasingly important to sustain modern agriculture under increasing demands to preserve biodiversity and environmental quality. Under conditions of anthropogenic stresses and extreme climatic changing, degradation of the inherent capacity of a soil to buffer changes creates a serious problem. Understanding the long-term changes in SOC is important because it directly affects soil quality by influencing soil physical, chemical and biological properties. Consequently, promote carbon sequestration by soil is an effective strategy to reduce atmospheric CO_2 and improve soil quality to sustain soil health. Due to intense rainfall and concurrent rise in temperature with changing climate, the fertile top soil is prone to severe degradation with depletion of SOC. Most soils in agricultural ecosystems have lost soil C ranging from 30 to 60 t C ha^{-1} with the magnitude of 50 to 75% loss (Lal, 2004). Therefore, restoration of SOC to threshold levels of at least 11 to 15 g kg^{-1} (1.1%–1.5% by weight) within the root zone is critical to reduce soil and environmental degradation risks.

Thus, attention must be given to:
1. The value of SOC to soil properties
2. Potential for increasing SOC management practices.

Predominant Reasons of Degradation of Soil Quality Include

1. Erosion of topsoil and the SOC stock which decline soil fertility.

2. Intensive deep and inversion tillage which leads to:
    a. Rapid decomposition of crop residues, further accentuated by high temperature
    b. Disruption of stable soil aggregates and increasing oxidation of entrapped SOC.
    c. Loss of microbial diversity of soil.

Severe decline of SOC (0.1%) is the primary process causes Secondary degradation (decline in soil aggregation & poor soil tilth) which leads to Tertiary degradation (decline in soil structure, water imbalances, loss of soil biodiversity and emission of GHGs).

How Much Carbon Can Soil Store?

The amount of organic carbon stored is the difference between all OC inputs and losses from the soil due to mineralization in each of the organic carbon pools. However, the storage of carbon in soil profile is governed by the factors viz., soil type, climate, management, mineral composition, topography, soil organisms and other unknown factors.

Role of SOC Pools in Relation to Soil Health

	Effects of SOC	C pools
Chemical fertility	Microbial decomposition of SOC releases nitrogen, phosphorus and a range of other nutrients for use by plant roots.	Labile & slow
Provides available nutrients to plants		
Physical fertility	Microbial decomposed product (resins, gums, polysaccharides etc.) that help bind soil particles together into stable aggregates & improved soil structure.	
Improves soil structure and water holding capacity		

Biological fertility Provides food for soil organisms	Organic carbon is a food source for soil organisms and micro-organisms.	
Buffers toxic elements and harmful substances	SOC can lessen the effect of harmful substances such as toxins and heavy metals by sorption.	Slow and recalcitrant

SOC Sequestration

Soil organic carbon sequestration is the process by which carbon is fixed from the atmosphere via plants or organic residues and stored in the soil. When dealing with CO_2, SOC sequestration involves three stages:

1. The removal of CO_2 from the atmosphere via plant photosynthesis;
2. Transfer of carbon from CO_2 to plant biomass; and
3. Transfer of carbon from plant biomass to the soil where it is store.

Mechanism of Stabilization of Newly Added SOC in Soil

There are three main mechanisms for stabilization of OM in soil (Sollins et al., 2006). They are (i) Physical protection, (ii) Chemical stabilization or stabilization by organo-mineral bonding, and (iii) Biochemical stabilization.

1. Physical protection: SOM can be physically protected within soil aggregation against decomposition by microbs. Aggregates act as barriers between SOM and microbes and enzymes and their substrates to protect SOM physically. The physical protection exerted by macro- and/or micro-aggregates on POM-C to make inaccessibility of substrate for microbes within aggregates.

2. Chemical stabilization or stabilization by organo-mineral bonding: Chemical stabilization of SOM resulting of chemical and physico-chemical binding between SOM and soil minerals (i.e., clay and silt particles) (Six et al., 2002). In addition to the clay content, types of clay influence the stabilization of SOM.

3. Biochemical stabilization: The stabilization of SOM due to its own chemical composition (e.g., recalcitrant compounds such as polyphenols and lignins) and through chemical complexing processes (e.g., condensation reactions) in soil is the Biochemical stabilization. Humified OM, i.e., humic acids and humin in particular, represents the most recalcitrant pool of SOM with mean residence times of several hundreds of years.

Carbon Sequestration Potential in Soils of India

Process	Carbon sequestration potential (Tg C/ y)
A. Soil organic carbon (SOC)	
-Restoration of degraded soils	7.2-9.8
-Agricultural intensification on un-degraded soils	5.5-6.7
B. Sequestration of secondary carbonates	21.8-25.6
C. Erosion control	4.8-7.2
Total	39.3-49.3

Source: Lal (2004)

Strategies for Soil Carbon Sequestration

The restoration of degraded / decertified or wastelands ecosystems (e.g. afforestation, improved pastures) and adoption of improved farm management practices can enhance soil organic carbon and improve soil quality and soil health.

Land Use Change: Restoration of Degraded Lands

The important measures for land restoration and carbon sequestration strategies are green manuring, mulch farming/conservation tillage, afforestation / agro-forestry, grazing management/ alley farming, integrated nutrient management/manuring, diverse cropping systems etc.

Erosion control: Soil conservation and water management, water harvesting and recycling are important strategies of minimizing losses of SOC and restoring soil quality.

Soil and Crop Management: Residue Management

Incorporation of plant residues is major way by which we can add organic matter to soil. Incorporation of crop residues favours immobilization because of wide C/N ratio in the crop residues.

Integrated Nutrient Management

Balanced use of inorganic fertilizers and organic amendments greatly influence accumulation of organic matter in soil and improves soil physical environment. Application of fertilizers in combination with manure resulted in greater accumulation and build-up of SOC by adding organic inputs.

Improved Cropping Systems

Principal mechanism of SOC sequestration with conservation tillage is the increase in micro-aggregation and deep placement of SOC in the subsoil. Reduced tillage will influence the protecting of C in un-decomposed residue and increase sequestered C in the soil. Incorporating plant residues adds organic matter to soil. Crop rotations had significant influence on OM content. Inclusion of legume in crop rotation resulted in build-up of SOM and improves soil quality.

Modified Land Use Systems

Alternate land use systems like agroforestry system has become principle approach to integrated land management, which represents the integration of agriculture and forestry. With an increase in the number of trees in a system, the overall biomass production per unit area of land will be higher, which in turn may promote more C storage in soils.

Biochar Application

Biochar is a carbon reach material produced by incomplete combustion of biological materials in absence of oxygen or with limited amount of oxygen. A huge amount of carbon can be stored in soil by converting agricultural and forestry residues and wastes to biochar through simple pyrolysis techniques.

Future Prespectives

1. Establishing new and continuation of the existing long-term (>10 years) field experiments to quantify the influence of recommended management practices (RMPs) on the soil C sequestration.
2. Quantifying soil C sequestration potential for diverse land use and management scenarios at regional and national levels and efforts should be taken to promote organic matter addition where ever possible.
3. Large scale awareness against burning of crop residues both in irrigated and rainfed agriculture need to be created.
4. Priority must be given to Conservation Agriculture practices and their promotion.

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Crop Diversification Options for Income and Nutritional Security

Article ID: 30482

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Introduction

Diversification of crops through technologically feasible and economically viable enterprises appears to be the only way to achieve revenue and nutritional security. Diversification of crops required for job creation, sustainable income, ecological balance and a reduction of risk due to crop failure. Not only is crop diversification a shift from traditional and less-remunerative crops to more remunerative crops, it is also a demand-driven, needs-based specific and national goal that seeks a continuous and dynamic concept and involves spatial, temporal, value-added, and resource-complementary approaches. New opportunities to promote crop diversification include technological breakthroughs, shifts in demand patterns, changes in government policy, irrigation and other infrastructure development, development of new trade arrangements, and others. Given the changing need for farmers and market globalization, crop diversification can be useful means in different situations to increase total productivity in terms of quality and monetary values.

Need for Crop Diversification

Sustainability of natural resources, ecological balance, output growth, buffer stocks, job creation, risk coverage and reduction of the magnitude of risk due to monocropping has become an important option to achieve several objectives. Similarly, market and price risks result from challenges and threats that require crop diversification; risk associated with existing crop-management practices.

Approaches to Crop Diversification

1. Horizontal diversification: It includes diversification of the farm through crop substitution and intensification of the crops. Diversification takes place by intensifying crops by adding new high-value crops in existing crop systems, using the gap between two crops, using the space available in fields or bonds as a way to improve a farm's overall productivity.

2. Vertical diversification: Various downstream activities are undertaken in this approach, and the existing economic products of various crops are refined, and additional values are added to the products produced. In the approach farmers add value to the products through processing, regional branding , packaging, merchandising, improving the product's marketable access.

Crop Diversification in New Niches

There is scope for legumes being introduced into new niches such as wasteland, reclaimed soils and rice fallow land by efficient watershed management and as a substitute for less remunerative crops. In order to maintain and improve the productivity of rice, pulses must be introduced in rice-based crop systems in various rice-growing areas in Peninsular India including the deltaic areas of important river viz, Krishna, Godavari, Kaveri, etc.

Crop Diversification Through Intercropping

Intercropping is one of the most important ways of increasing productivity and providing earnings stability under limited soil moisture conditions. In land-use efficiency, crop productivity and monetary returns in intercropping, significant advantages are observed compared to the sole cultivation of diverse agro-ecological situations.

Legume as Intercrop

Inter Legume such as pea pigeon, black gram, mung bean, and soybean are ideal intercrops in directly seeded rice on the upland. Under cereal-dominated system the scope of pulses intercrop further increases under conditions of water scars or aberrant weather conditions.

Diversification Through Annual Oilseed Crops

Oilseed crops by virtue of low irrigation requirement and better remunerative price are ideally suited to replace low yielding traditional crops and become popular even in non-traditional area.

Crop Diversification Through Crop Substitution

1. Rice equivalent yield from rice substituted crop: The intercropping of groundnut + pigeon pea was more promising as the rice replaced crops in the upland rice ecosystem. Groundnut yield in association with pigeon pea was higher, which may be due to less competition for light, nutrient, and space between these two crops due to their different growth habits.

2. Rainwater use efficiency from rice substituted crop: The efficiency of rainwater use (kg ha−1 mm−1) in terms of rice equivalent yield was calculated for all crop / crop combinations to visualize the increased efficiency of rainwater use in upland rice soils by substituting rice and diversifying crops.

Crop Diversification Through Agroforestry

In agroforestry trees, crops and animals are integrated into a long-term, conservative, sustainable, productive, and eco-friendly system where greater emphasis is placed on perennial multi-purpose trees which are once planted but yield long-term benefits.

1. Nitrogen fixing trees (NFT): Nitrogen-fixing trees offer immense possibilities of supplying organic matter, conserving soil moisture and supplementing nitrogen needs of crops such as *Albizialebbeck*, *Faidherbiaalbida* and *Acacia ferruginea*.

2. Carbon storage under agroforestry systems: Agroforestry systems are better land use systems for arresting land degradation and also enhance the productivity of degraded lands and can sequester carbon and produce a range of economic, environmental and socio-economic benefits.

Effect of Crop Diversification

1. Effect of crop diversification on productivity and profitability: With cluster bean-wheat sequence the maximum system productivity and system profitability was obtained. Higher productivity and profitability were due to higher yield and higher net return due to higher selling prices; however, sole castor recorded maximum land use efficiency and job generation efficiency due to long crop duration, more man days were needed for management practices and harvesting phase.

2. Impact of crop diversification on incidence of insect pest: Crop diversifications reduce the incidence of insect pest in intercropping system.

3. Crop diversification changes the soil fertility status: The crop diversification is build-up of P and N over the sole cropping due to the deep root system, mining of P from deeper soil layers takes place which result in increased available P. The legumes fix the N leading to increased N availability.

4. Effect on PAR interception, soil hydrothermal properties and weed dry weight: The intercrop components can result in more PAR interception compared to sole crops by intercropping. High interception of light by intercrops caused higher shading and hence lower soil temperature. In sole crop systems the weed biomass was greater than that of intercrop systems. This was because of the limited availability of weed species resources.

Constraints in Crop Diversification

1. Nearly 63% of the cropped area in the country is dependent on rainfall, which limits the choice and duration.
2. Poor supply of seeds and planting material of desired quality.
3. Fragmented land holding limiting modernization and mechanization.
4. Limited basic infrastructure like rural roads, power, transport and market etc.
5. Inadequate post-harvest infrastructure for handling of perishable produce
6. Very weak agro-based industry.
7. Weak research-extension-farmer linkages.
8. Large-scale illiteracy amongst farmers.
9. Host of diseases and pests affecting most crop plants.

Conclusion

Diversification of crops through the inclusion of legumes, oilseeds, vegetables, medicinal and aromatic plants and agroforestry in rainfed regions is of paramount importance for increasing over a period of time agricultural productivity, profitability and sustainability. Diversification of crops, including biological diversity above and below ground, can improve soil fertility and hydrothermal properties and result in the effective use of solar radiation. Agricultural forestry systems could be better land-use systems for stopping land degradation, improving the balance of soil water, and also leading to increased carbon storage. However, localisation of specific crop diversification options in harmony with other farming undertakings can provide sustainable production and livelihood for small and marginal farmers in the rainfed areas.

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Global Warming: Its Impact and Implication on Crop Production

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Global warming refers to an increase temperature of the earth surface. An elevated concentration of greenhouse gases leads to an increase in the magnitude of the greenhouse effect (called enhanced greenhouse effect). Climate change is now unequivocal, particularly in terms of increasing temperature, increasing concentration of CO_2, melting of snow and ice and rising global average sea level, while the increase in the frequency of drought is very likely but not as certain. Climate change affect forest genetic resources via many different demographic, physiological and genetic processes. Changing climatic events that kill large number of trees may become more common. More steady changes in temperature and precipitation may inhibit the capacity of forests to redevelop. In some places, pest and disease attack may become more severe because changing climatic conditions.

This condition become more favourable for the attacking because climate induced stress makes trees more susceptible. This result of global warming. Global warming is the observed century-scale rise in the average temperature of Earth's climate system. Since 1971, 90% of the increased energy has been stored in the oceans, mostly in the 0 to 700m region. Despite the oceans' dominant role in energy storage, the term "global warming" is also used to refer to increases in average temperature of the air and sea at Earth's surface.

Introduction

Solar radiation passes through the atmosphere and warms the Earth's surface. The Earth emits thermal radiation (also called infrared radiation) back to the space, part of which is absorbed by the molecules of "greenhouse gasses" (water vapor, H_2O; carbon dioxide, CO_2; some other micro gases) in the atmosphere and warms the atmosphere. This warming effect of the greenhouse gases is called the "Greenhouse Effect".

A regular increase in the overall temperature of the earth's atmosphere generally attributed to the greenhouse effect caused by increased levels of carbon dioxide, CFCs (chlorofluorocarbons) and other pollutants. The "greenhouse effect" & global warming are not the same entity. Global warming refers to an increase in the temperature of the earth surface. An increase in the concentration of greenhouse gases leads to an increase in the magnitude of the greenhouse effect (called enhanced greenhouse effect). This result is global warming. Global temperature during the 20th century increased by 0.6 ± 0.2°C @ of 0.17°C per decade since 1950.

The additional greenhouse effect caused by the other greenhouse gases in the atmosphere due to human activities (fossil fuel burning, deforestation etc.) If there were no greenhouse gases (hence no greenhouse effect) the Earth's temperature would be -18°C (not +15 °C as it is at present).

Table 1. Greenhouse Gases and Their Contribution to Global Warming (IPCC, 2007)

Greenhouse gases	Atmospheric conc. (ppm)	Lifetime (yr)	GWP (relative to CO_2)	Sources
CO_2	379	5	1	Fossil fuel combustion (80%),deforestation
CH_4	1.72	12	32	Biomass decomposition, wetland paddies, swamps, marshes, peat lands, etc.
N_2O	0.31	114	150	Fertilizer use, fossil fuel combustion, biomass burning flooded soil

O_3	Variable	2-5days	2000	Reactions involving pollutants such as CH_4, NO_2, CFCs and sunshine
CFC-12	527ppt	100	10,000	Aerosols, refrigerator
SF6	7.79ppt	3200	22800	Human activities
NF_3	326ppb	740	17200	Human activities

Impact on Crop Production

1. High Temperature:

a. Positive impact: Reduced Cold & frost event.

b. Negative impact:

i. Reduced yield due decrease grain filling period and shorten crop duration.
ii. Increase respiration.
iii. Increase extreme weather condition i.e. drought, heat wave.
iv. Increase evaporative losses.

2. High CO_2

a. Decrease evaporative losses
b. Increase yield in C3 plants e.g. rice & wheat as compare to C4 plants
c. Adverse effect on quality of fruits.

3. Other:

a. Increase rate of organic matter decomposition
b. Lower organic matter content & quality
c. Decrease nitrogen availability
d. Changes in seasonal precipitation patterns.

Impacts of Global Warming

1. CO2 effects on yield components and grain composition affecting quality:

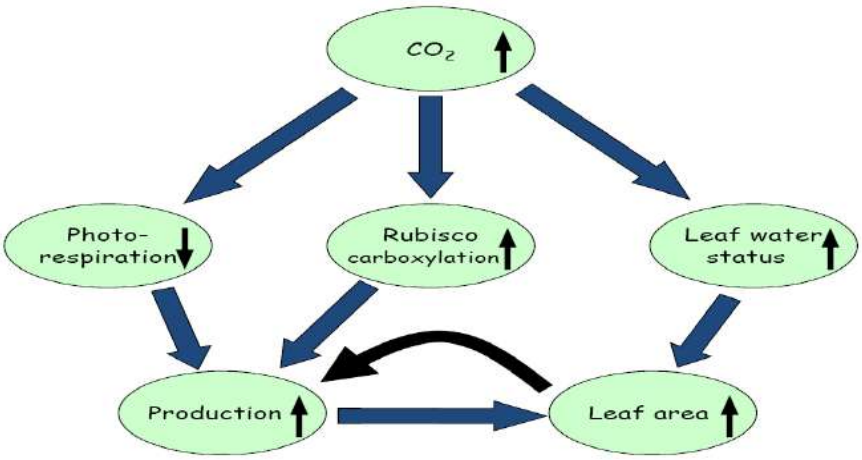

Fig. CO2 concentrations stimulate photosynthesis in many crops

2.CO_2 effects on yield components and grain composition affecting quality: Since several significant impacts of CO_2 exposure system, rooting volume or interactions between these parameters were observed for grain quality traits.

3.CO_2-induced responses of wheat grain proteins and protein components: The average relative effects of elevated CO_2 (550 vs. 380 mmol mol^{-1}) on protein concentration. Overall, the total gluten concentration as well as concentrations of dry and wet gluten decreased under CO_2.

4.CO_2-induced impacts on non-protein components: The mean responses of macro-elements to CO_2 enrichment were decreases in concentration by 0.7–19.5%, except for potassium and phosphorus which increased by 3.9 and 1.1%.

5. Responses of wheat yield components to atmospheric CO_2 enrichment: In terms of wheat productivity, elevated CO_2 was shown to increase yield components, with increases in TGW, grain number per ear (McKeen *et al*., 2002) or the number of flowering tillers per unit ground area.

6. Effects of CO_2 enrichment on the composition and quality of wheat: Physiological background CO_2-induced increase in wheat biomass and grain yield are associated with changes in nutrient metabolism, resulting in significant changes in the chemical composition of different plant organs (Idso, 2001). The induced CO_2 decrease in nitrogen concentration is largely the result of the accumulation of carbohydrates and other organic compounds in leaves and possibly other organs as a result of the stimulation of photosynthesis (Kimball, 2004). In addition, elevated CO_2 predominantly reduces the amount and activity of foliar ribulose-1,5-bisphosphate carboxylase/oxygenase (RubisCO) (Ainsworth and Long, 2002).

Thus, reallocation of N away from RubisCO to light harvesting and sucrose synthesis will increase NUE (Moore *et al*., 1999) as ribulose-1,5-bisphosphate- (RuBP) and inorganic orthophosphate- (Pi) regeneration will limit the CO_2 assimilation rate under CO_2 enrichment.

7. Effects of CO_2 Increase in Combination with Temperature Increase: There could be beneficial interaction of CO_2 enrichment and temperature on dry matter production (greater response to CO_2 as temperature rises) for the vegetative phase of non-competitive plants.

8. Interactions of Elevated CO_2 with Nitrogen Fertility: For non-legumes like rice, there is clear evidence of an interaction of CO_2 enrichment with nitrogen (N) fertility regime. For *japonica* rice, Nakagawa *et al* (2010) reported 17, 26, and 30 percent responses of biomass to CO_2 enrichment, at N applications of 40, 120, and 200 kg N ha^{-1}, respectively.

9. Effects of CO_2 Increase on Water Use and Water Use Efficiency: When plants are young and widely spaced, increases in leaf area are approximately proportional to the increases in growth, and transpiration increases accordingly. More importantly, duration of leaf area will affect total seasonal crop water requirements. Thus, the lengthening of growing seasons due to global warming likely will increase crop water requirements.

On the other hand, for some determinate cereal crops, increasing temperature can hasten plant maturity, thereby shortening the leaf area duration with the possibility of reducing the total season water requirement for such crops. Elevated CO_2 causes partial stomatal closure, which decreases conductance and reduces loss of water vapor from leaves to the atmosphere.

10. Temperature effects on crop yield: Yield responses to temperature vary among species based on the crop's cardinal temperature requirements. Plants that have an optimum range at cooler temperatures will exhibit significant decreases in yield as temperature increases above this range. However, reductions in yield with increasing temperature in field conditions may not be due to temperature alone, as high temperatures are often associated with lack of rainfall in many climates.

Conclusion

It may be concluded that we should try to reduce the emission of greenhouse gases by indiscriminate burning of fossil fuels and other human activities which raise GHGs emission and try some carbon sequestration technologies so that the released CO2 can be trapped again in the soil or other reservoirs to mitigate the effects of climate change. Breeding approaches have the potential to contribute to reduced emissions of nitrous oxide and methane from both grazing animals and the soil, as well as directly from the plant and to boost the capture (sequestration) of carbon in the soil.

A key area where genetic approaches can have an impact is in improving the nitrogen use efficiency (NUE) of crops to allow lower fertilizer application and, hence, reduce N2O emissions throughout the soil-plant-(animal)-soil cycle.

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Role of Green Manuring in Nutrient and Soil Management

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Introduction

Green manuring is a practice of ploughing or turning into the soil undecomposed green plant tissues for improving physical structure as well as soil fertility. The practice of green manuring is as the art of manuring crops. The first serious test was made in 1882 at Kanpur agriculture station in Uttar Pradesh. India was the pioneers in giving a systematic practice of green manuring as far back as 1890 in the coffee estates of southern India.

It is well known fact that N, for which soils have the greatest hunger, is a costly plant nutrient. This can be cheaply obtained by the inclusion of leguminous crops in rotations and their ploughing under. The example of green manuring crop is given in Table 1.

Methods of Green Manuring

1. Green manuring *in situ*: Any crop plant (generally leguminous) grown and incorporated in same field is called as in-situ green manuring.

2. Green leaf manuring: Turning under of green leaves and tender green twigs collected from shrubs and trees grown on the bunds, wastelands and nearly forest areas.

Why Green Manure is Needed?

1. It has been seen that considerable loss of organic matter is occurring from the soil due to high temperature, oxidation of organic matter, high annual rainfall, high dose of inorganic fertilizer uses and poor aeration.

2. Green manure crops play a very valuable role in agriculture because to improve soil condition and nutrition. So that the choice of green manuring crops has to be made in relation to the soil, climate, time available to raise the green manure crop and irrigation facility.

Benefits of Green Manuring

1. Enhances soil fertility
2. Improvement of soil structure
3. Supplement for nutrients
4. Positive influence on the physical and chemical properties of soil
5. Maintain the organic status of soil
6. Prevention of soil erosion
7. Increase activity of micro-organisms
8. Used as mulch help to weed control
9. Used in mixed and intercropping.

Crops suitable for green-manuring

Crop	Season	Green matter (Qtl/ha)	N added (kg/ha)
Sannhemp	Kharif	152	84
Dhaincha	Kharif	144	77
Pillipesara	Kharif	132	55
Moong	Kharif	57	37
Cowpea	Kharif	108	56
Guar	Kharif	144	62
Senji	Rabi	206	134
Berseem	Rabi	111	60

Source: *Manures and Fertilisers* by Yawalkar and Aggawal

Source: www.punjabenvironment.com/ image/tb.gif

Nutrient Management Through Green Manuring

Presently, comprehensive balanced nutrient management approach is gaining importance as it will take care and ensure maintenance of good soil health and sustainable crop production and productivity. So that it needs better nutrient management through green manuring. Singh *et al.*, (1992) revealed that fresh weight, yield and dry matter accumulation of *sesbania*, cowpea and *crotalaria* increased with age and highest biomass accumulation was recorded at 60 days after planting. But the N% content tops showed inverse relationship with age. Chavan *et al.*,(2005) observed that the green leaf manuring of sunhemp gave significantly higher oil content (48.02%) and oil yield (4.91 q ha^{-1}) over the sole castor and and castor with *in situ* green manuring. Bandyopadhayay *et al.*, (2004) revealed that highest grain and straw yield of rice in application of green leaf manure mixture of @ 5 t/ha + urea N (3 splits) making total N dose as 100 kg N/ha in under coastal saline soils.

Soil Management Through Green Manuring

Sur et al., (1993) observed that green manuring decreased bulk density, modules of rupture, linear shrinkage and increase water stable aggregates, pore space, water intake and water retention. Kirchner et al., (1993) found that the application of green manuring plot which significantly greater number of microbial activity than no- green manure plot. Sharda et al., (1999) revealed that comparatively less runoff and loss was recorded in the treatments where grown as a green manure crop. The soil loss is 100 per cent controlled in the Green Manure-Rice-Wheat cropping sequence as compared to other sequences. Yadav and Agarval (1961) reported that application of dhaincha as green manure which marked reduction of exchangeable sodium, PH, total anions, CEC, ESP, C:N ratio and increase total nitrogen, organic carbon and permeability under saline-alkali soil.

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Contemporary Studies Divulges Plummeting Insect Numbers in Terrestrial and Revivals in Freshwater Ecosystems

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Introduction

A worldwide assembly of long-term studies on insect abundance shows a decline in the number of land-dwelling insects. On average, there is a global decline of 0.92 percent per year which translates over 30 years to about 24 percent. At the same time, the number of freshwater insects, such as midges and mayflies, has increased annually by an average of 1.08 per cent. This is presumably due to water bodies' successful security policies. Regardless of these national averages, local trends are extremely variable and there tend to be poorer patterns in regions that have been less affected by humans. A number of studies have been published over the past few years, showing a dramatic decrease in insect numbers over time from various parts of the world. But so far, no one has compiled the available data on the worldwide trends in insect abundance to examine just how widespread and serious declines in insects are to be.

Global Insect Inhabitants Shows Highly Variable Local Trend

Worldwide, between 1925 and 2018, a long-term survey was undertaken to examine patterns in insect abundances (number of individuals, not species). The complex analysis showed strong pattern differences, including between neighbouring sites. For example, in countries where many insect surveys have taken place, some places experienced declines while others quite close by indicated no changes, or even increases. However, the researchers were able to predict how overall insect abundances changed on average over time when all of the patterns around the world were combined. It has been recorded that there has been an average decrease of 0.92 per cent per year for terrestrial insects (such as butterflies, grasshoppers and ants).

Plummeting Insect Numbers

A global decrease of 0.92 percent does not sound significant, but it actually means 24 percent fewer insects in 30 years and 50 percent fewer insects over 75. Insect declines happen in a quiet way and from one year to the next we don't even note them. The world's insects are damaging the extinction road, causing a 'catastrophic failure of the habitats of nature and could disappear at the current rate of decline within a century. Insects play a crucial role in the animal food chain, pollinating plants and collecting environmentally beneficial nutrients. They take other animals with them if they go, and this is a big problem in maintaining an environment in which we all live.

Fewer Insects in the Air

The extinction of the insects, sometimes attributed by the mass media to the windscreen phenomenon and the belief of the human being that fewer insects are now splattering on their cars' windscreens compared to several decades ago. The new research at least confirms the finding on average. Many insects can fly, and it's those that get smashed by car windshields. It has been shows that flying insects have indeed decreased on average. Nevertheless, most insects are less conspicuous and live in the soil, in tree canopies or in water out of sight. The researchers have also collected data from many of those unknown environments for the new analysis. This shows that, on average, today there are less insects living in the grass and on the ground than compared to the flying insects of the past. By contrast, the number of insects living in tree canopies has, on average remained largely unchanged.

Freshwater Insects Have Recovered

At the same time, studies of insects living most of their lives under water, such as midges and mayflies, showed an annual average rise of 1.08%. This correlates to a rise of 38 per cent over 30 years. These numbers indicate that we can reverse those negative trends. Numerous measures have been taken over the last 50 years to clean up polluted rivers and lakes in many parts of the world. Maybe this may have helped many species of freshwater insects to recover and makes us hope that we will reverse the trend for habitats that are declining at present. It's just not always easy to identify the causes of declines, and thus the most effective measures to reverse them. And these may also differ between locations.

Habitat Destruction Most Likely Causes Insect Decline

While its challenge to tell for certain precisely why these trends have emerged both negative and positive, there are few possibilities which cause insect decline. Most importantly, they found that destruction of natural habitats particularly through urbanization, intensive agriculture; use of pesticides (particularly insecticides) and industrialization, introduced species and climate change are associated with the decline of terrestrial insects. Other reports, such as the IPBES Global Assessment, also noted that land-use change and habitat destruction are the possible causes of global biodiversity change.

Conclusion

Declining patterns seemed to be associated with land-use intensification across the sites described in this novel analysis, with no signs of climate impacts. Increasing trends particularly in the field of freshwater coincided with the establishment of firmer water policies, showing that effective legislation can have positive implications for biodiversity. Yet the world is a dynamic and dangerous mosaic. As scientists address the task of unravelling drivers of different trends in insect biodiversity, they will be better able to predict the implications for the operation and services of the environment, such as organic decomposition, pollination and pest control.

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Mystery of Bamboo Rice and its Nutritional Value

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Summary of Article

Bamboo is boon for the humankind and one of the major sources of livelihood for the tribal people. It can be used in many ways but particularly its seed which comes after overcoming many vegetative phases nearly in the stage of death it comes to flowering giving huge amount seeds which is called bamboo rice. It is high nutritious and it can be used for curing many diseases like impotency, joint pain and reduces blood cholesterol level. Apart from that if it is cultivated in commercial basis it may be a great option of livelihood which can generate employment with a huge income for young generation.

Introduction

Bamboo popularly known as 'green gold', have a great significance for the human bread and butter. It has played a pivoted role in human civilization since old age to till today contributing a major subsistence of over two billion people nourishment in the tropical and sub-tropical region of Asia, western region like Latin America and Africa. It is the source of fuel, food, housing and shelter for tribal communities (Sastry and Panigrahi, 2003). 26 species of pacific Asia region are avail oneself of for the design of engross. Due to commending geographical location, favorable agro climate, heavy rainfall and good soil conditions, Southern western Ghats of Kanyakumari district supports two bamboo species, *Bambusa arundinacea* Wild. and *Dendrocalamus* strictus Nees (Savur, 2003). The lineal have a good grip about the exertion of these bamboo resources for their livelihood. *Kanis*, *Kanikaran* or *Kanikars* are the tribes dwelling in the forests of Kanyakumari and adjoining Kerala forests. These are basically agriculturists depends on hunting and gathering for livelihood, have also rich in cultural heritage that is closely associated with nature. Bamboo seeds or bamboo rice or *Mungil Arisee* (in Tamil) or Mulayari looks like wheat when intact with husk and upon dehusking it resembles like rice grain. Nutritionally it is equivalent to rice and superior to wheat (Rao *et. al.*, 1955). It seems that bamboo rice is highly nutritious indigenous food, and it can be better option over rice and wheat in term of nutritional value.

Methods of Collection

Plants flower once in life time (20 to 50 years) and die out subsequently. When bamboo seeds get matured, the tribes clean the area and patch with cow dung and fallen seeds are collected from clean area. They use traditional traps like *Elipori* (Rat trap) for rodents' management. Tribal women and children are attached for seed collection. On the completion of collection seed are sun dried for storage, huge earthen bins called *Kulukkai* are used for long term storage in large quantities and small quantities storage they use a bin called *Manpanai.* Bin mouths are covered with mud and cow dung, *Azadirachta indica* A. Juss. and *Pongamia pinnata* Vent are used as insect repellent, similar methods are also followed by the Meghalaya tribes so it seems that traditional and indigenous techniques still remained in the lineal peoples like a treasure box. Seeds are dehusked and cook like rice and eaten with fish curry and vegetables curry.

Bamboo seeds

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People of North East India and rest the world thinking that the bamboo flowering is one of the reasons for famine. It is found that convivial flowering produces huge amount of seeds which leads to sudden increase of rat population as major source of food for them and may cause huge damage to the stored food materials leading to famine. So, it is advised at most care should be taken to control the rat population to reduce the chances of rat damage to stored food.

Bamboo in blooming stage

Nutritional Value

Bamboo seeds are highly nutritious, contains: crude protein 12.0, ether extractive 0.9, ash 1.1, fiber 2.6, carbohydrate (by difference) 73.4, calcium 25.0 mg %, phosphorus 218.0 mg %, iron 9.2 mg %, vitamin B1 0.1 mg (33.3 International Unit) %, Nicotinic acid 2.03 mg %, riboflavin 36.3 µg %, carotene 12.0 µg % (20 International Units of Vitamin A) and calorific value 98.0 (calorie per ounce) (Rao et. al., 1955). It contains glutelins with isoelectric point at pH 4.6. It contains all essential amino acids (Rao et. al., 1955) and the biological value of the bamboo seed protein is as high as normal rice proteins and higher than that of wheat proteins. In the matter of protein content, the seeds are comparable with wheat but superior to rice.

Table. 1 Physical Properties of Bamboo Seeds (Singh Et Al., 2011)

Sl. No.	Property	Dehusked	Milled
1	Grain weight(mg) (Based on 1000 kernel weight)	12.9	11.5
2	Length (mm)	5.9	5.2
3	Width (mm)	Not estimated	-
4	Thickness(mm)	Not estimated	1.4

Table. 1 Physic-Chemical Properties of Bamboo Seeds (Singh Et Al., 2011)

Sl. No.	Properties	Seed		Starch
		Dehusked	Milled	
1	Moisture, % (w.b.)	12.5	12.5	12.5
2	Protein % (N×5.95)	11.2	9.6	0.31
3	Fat %	1.0	0.46, 6.96* 5.98**	0.23
4	Equilibrium moisture content (% w.b.)	33.60 @ 32.40	31.20	-
5	Cooking time mins.	-	23.00	-
6	Starch content,(%, d.b.)-	-	80.80	98.30
7	Iodine binding capacity()IBC (mg/100mg polysaccharides)	-	-	4.30
8	Amylase equivalent (d.b.)	-	-	22.30
9	Amylase content, (%, d.b.)	-	27.3	32.80
10	Insoluble amylase content% (d.b.)	-	10.3	14.70
11	Gelatinizing temperature (1 using brabender at 10% concentration)	-	76.5	ND
12	Average molecular weight (Mn)	-	-	1.8x10-5

*Fat content of bran obtained after 2 min of polishing, ** Fat content of bran obtained after 5 min. of polishing @ value of undehusked grain, ND could not be read accurately for the viscogram.

Advantages of Bamboo Rice

1. The *Kani* tribes believe that the seeds of *Bambusa arundinacea* enhance the fertility, so that there is great demand of seeds of this species in pharmaceutical industry to manufacture drugs to improve fertility.
2. Good source of protein as compared to normal white rice helpful in muscle building.
3. Contains less than 0.45% fat which helpful to reduce obesity on regular consumption
4. Anti-diabetic properties due to low glycaemic index compared to other varieties of rice, which is considered to be a healthier option for diabetics.
5. The tribes in Kerala use this rice to cure joint pain, back pain and rheumatic pain as well owing to the presence of immense calcium and phosphorus content.
6. For those suffering from cholesterol issues, regular consumption of bamboo rice helps lower cholesterol levels.

Conclusion

Bamboo rice is not new to the mankind as it known from many years to the lineal people, which is very nutritious and loaded with many health benefits. It is natural; devoid of many harmful chemicals which has very good impact on health. It is very helpful to clear human impotency, for curing joint pain, reduces cholesterol, good source of protein and anti-diabetic. So, use of bamboo rice in consumption purpose is a wise decision and large-scale commercial production may generate employment.

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The Third Tranche

Article ID: 30487

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Pivoting on the life post pandemic and to curtail the prevailing COVID-19 crisis, Prime Minister Modi summoned nation on 12th May 2020 for a self- Reliant India Movement – Atmanirbhar Bharat Abhiyaan. This is much needed to boost the inner strength of nation to be self-dependent or self-reliant. This glittery floor sets well on the powerful five vertical braces including – economy, infrastructure, systems, vibrant demography and demand. A special economic and comprehensive package of 20 lakh crores equivalent to 10% of India GDP has been announced. Atmanirbhar Bharat Abhiyaan, a fast track programme converging points on quantum jump rather than incremental changes, utilizing and representing technology driven modern India, fullest usage of power, demand and supply of goods and services using its vibrant demography. Ventilating the ideas and allocating the budgets on various sectors, 3rd tranche has been enlightening on agriculture and allied sectors whereas in her 2nd slab was buttressing farmers. All the way back, framers used to be completely self-dependent for their source income but input are now regulated by government. All the 11 dots measuring to strengthen infrastructure, logistics and capacity building in agriculture and allied sectors, underlines the principle to empower people with resources, to produce for themselves rather than entitlements, in-turn generating more employment opportunities.

Allocation of Funds on 8 Prominent Slabs and Briefing Ideas on 3 Points of Governance and Administrative Reforms for Better Approach Towards Agricultural Activities and Contract Farming.

1. Pulling apart an amount of Rs 1 lakh crore, to be created immediately shall be allotted at farm-gate and aggregation points such as Primary Agricultural Cooperative societies, Farmers Producer Organization, Agriculture entrepreneurs, start-ups etc. Bridging of gaps in value chains with availability of sufficient cold storage and Post-Harvest Management Infrastructure etc.

2. Focusing on vision of PM Modi "Vocal for local with Global Outreach", fund of Rs 10,000 crore has been provided under the schemes for formalization of Micro Food Enterprises (MFEs). Subjecting over 2 lakh MFEs, largely women, STs, SCs, to attain goals under cluster-based approach scheme will be launched. Local agricultural wonder of every state to be improved for attaining FSSAI food standards, building brands, marketing and enhancing incomes for local market. Basic starred local agro produces like Tapioca in TN, chilli in AP, Kesar in J&K and state wise minor forest products ought to be given immense importance.

3. Pradhan Mantri Matsya Sampada Yojana will cement the gaps in fisheries value chain. The scheme launched by Government will be an integrated and sustainable approach for development of marine and inland fisheries. An amount of Rs 11,000 crore for activities like Marine, Inland fisheries and Aquaculture, and targeting increment in activities like cage culture, sea weed farming etc. Supply chain of fisheries has been provided with Rs 9000 crores for infrastructural developments like fishing harbours, cold chain, markets etc. Provision for supporting fishermen during the restricted fishing period allowing them with personal and local insurance has been done. This strategy would cloud up additional production of 70 lakh tonnes over 5 years generating employment for 55 lakh people and doubling export to Rs 1,00,000 crore.

4. Total outlay of Rs 13,343 crore for National Animal Disease Control Programme providing 100% vaccination against FMD and Brucellosis of cattle, Buffalo, sheep, goat and pig gathering near about 53 crore animals.

5. Objectifying dairy processing, value additions and cattle feed infrastructure as major potential units for export of dairy products, an Animal Husbandry Infrastructure Development fund of Rs 15,000 crore will be set up.

6. Drawing attention towards cultivation of Medicinal plants, National Medicinal Plant Board will initiate cultivation in 2.25 lakh hectare area and about 800 hectares along the banks of Ganga for developing herbal corridor. With an outlay

of Rs 4000 crore, 10,00,000 crores of land will be intensified for Herbal cultivation of within 2 year, generating income of Rs 5000 crore for farmers.

7. Honey bees are life lending insects. Pollination for increasing yield and quality of crops is a need cannot to be overviewed. Several schemes will be implemented by Government thrusting on women and 2 lakh beekeepers. This initiation would include an amount of Rs 500 crores.

8. Operation green will be extended from Tomatoes, Onion, and Potatoes (TOP) to all fruits and vegetables (Total). Allocation of Rs 500 crores for smoothening the supply chain, price regulation, reduced wastage etc. The schemes are so featured with 50% subsidy on transportation from supply to deficient markets and 50% subsidy on storage, including cold storage.

9. Essential commodity Act, 1955 was promulgated during scarcity days for agriculture food stuffs. Certain amendments will be done in Essential Commodity act enabling better price realization for farmers by fetching investments. Deregulations of cereals, edible oils, oilseeds, pulses, onion and potatoes will be done.

10. Agricultural Marketing reforms to be formulated providing adequate choices to farmers to sell produce at competitive price; barrier free inter-state trade and framework for e-trading of agriculture produce.

11. Formulizing legal framework for risk mitigation for farmers, assured returns and quality standardization shall be important part under Agricultural Produce Price and Quality Assurance.

Union Finance Minister Announced a 20-Lakh-Crore Economic Stimulus Package to Deal with the COVID-19 Pandemic

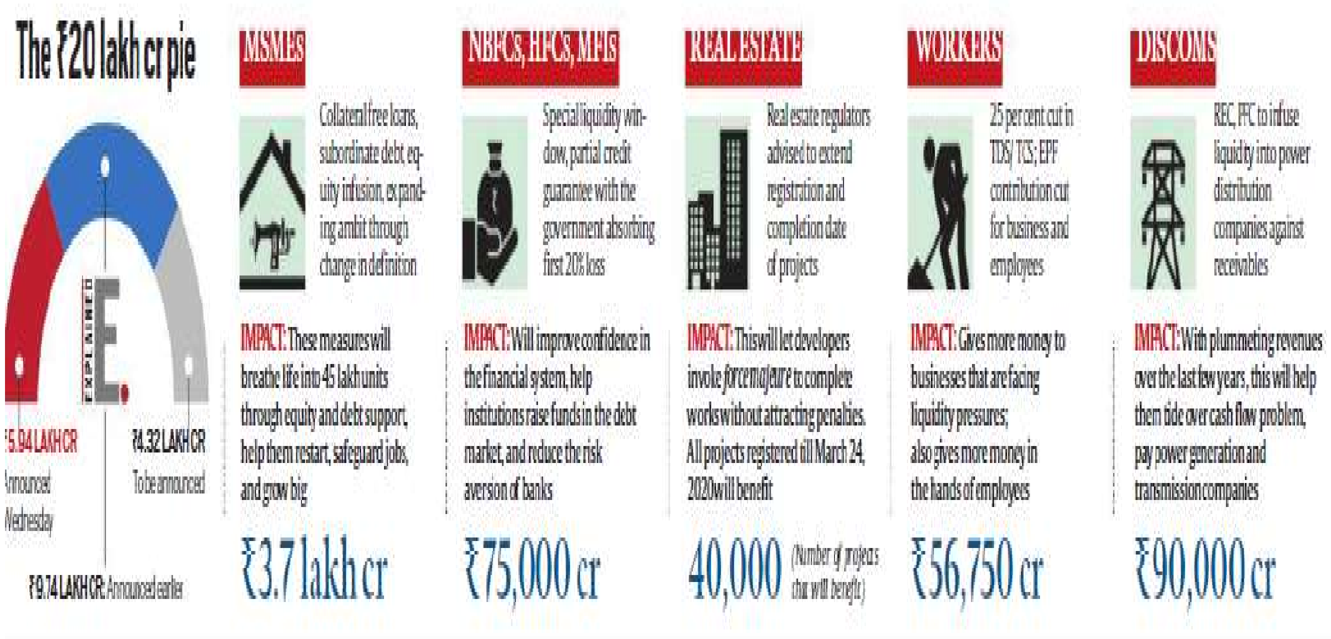
1. This is the first tranche of the Atmanirbhar Bharat Abhiyan announced by Prime Minister Narendra Modi recently as a Rs 20 lakh crore economic package.

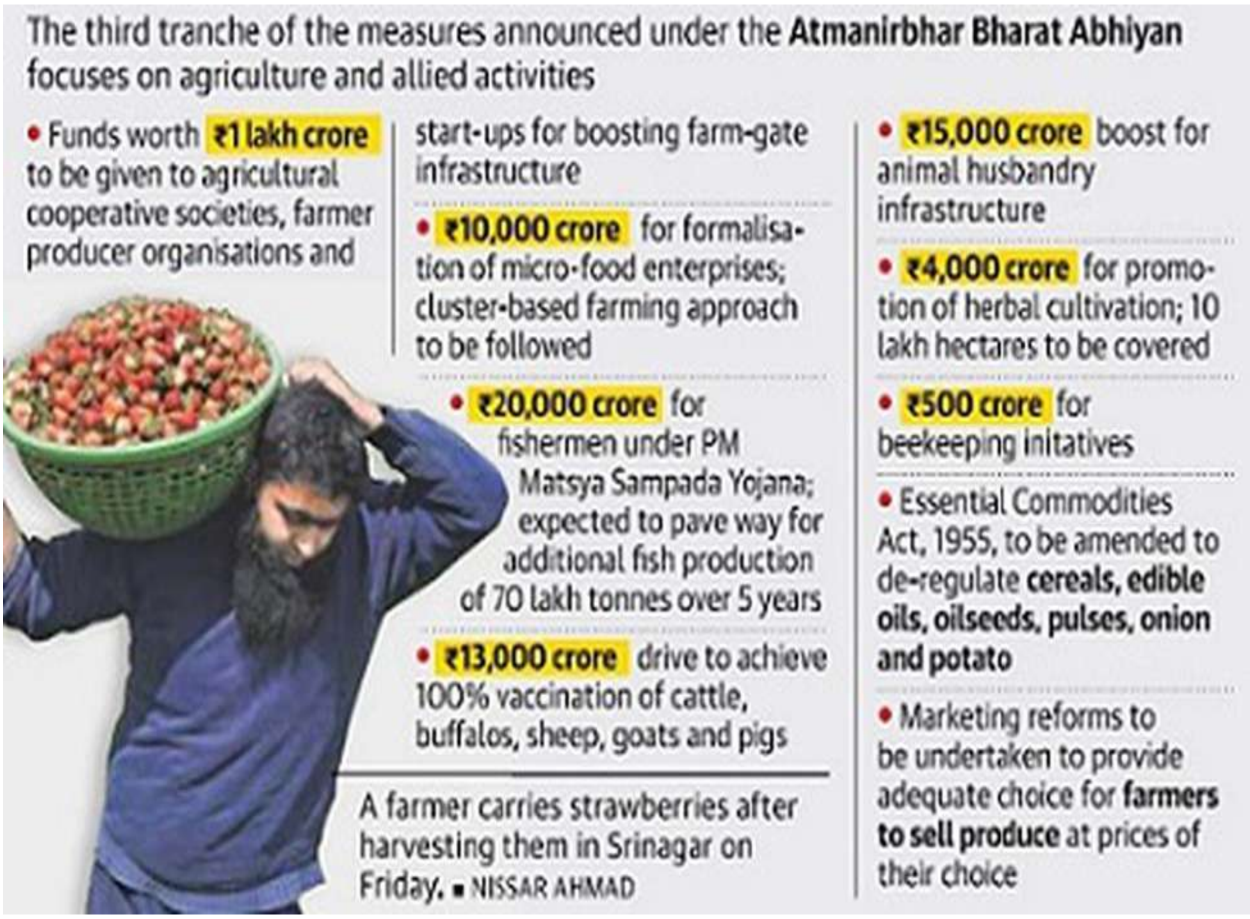
2. That package includes the ongoing Pradhan Mantri Garib Kalyan Yojana, meant to support the poorest and most vulnerable communities during the pandemic, as well as several measures taken by the Reserve Bank of India to improve liquidity.

3. More tranches are expected in the next few days.

Dissecting the Current Economic Package

The global pandemic has tripped up recession worldwide puncturing global economy. India could not but had to put a step ahead becoming its own saviour. Possessing an agrarian economy, Indian Government has rationalized the need of farmers and polarized agriculture and allied sectors allocating funds and reasonable governance and administrative reforms. Sectorial financing will aid in strengthening at its grass root level. Being apprehensive but anticipating a positive outcome should accompany law- abiding and upright workforce. Agriculture in itself is self-standing and self-supporting endurance, with well-intended pavement it would prop up the entire nation.





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Soil Degradation in Agriculture

Article ID: 30488

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Introduction

Process by which one or more of the potential ecological functions of the soil are destroyed. Soil degradation is the decline in soil quality caused by its improper use, usually for agricultural, pastoral, industrial or urban purposes. Soil degradation is a serious global environmental problem and may be exacerbated by climate change. Soil degradation occurs whenever the natural balances in the landscape are changed by human activity through misuse or overuse of soil. Degraded soils which result in poor or no production are also called problem soils.

Total degraded area of India is 146.8 Mha. Percentage degraded area to total ground area (TGA) is higher in Mizoram(89.2%), while lower in union territories(24.8%).[NBSS & LUP (2005)]. Total degraded area in Gujarat is 3,129 thousand ha (about 16% of TGA).[ICAR and NAAS (2010)].

Causes of Soil Degradation

1. Nutrient disorder
2. Soil erosion
3. Salinity
4. Water-logging
5. Acidity
6. Shifting cultivation.

Agriculture Activities Leading to Soil Degradation

1. Low and imbalanced fertilization:

a. The imbalanced consumption ratio of 6.2:4:1 (N:P:K) in 1990-1991 has widened to 7:2.7:1 in 2000-2001 and 5:2:1 in 2009-2010 compared with a target ratio of 4:2:1.

b. Prasad and Bisvas (2000) reported that nutrient loss through soil erosion is reason for soil fertility depletion, accounting for an annual loss of 8 Mt of plant nutrients through 5.3 billion tons of soil loss.

2. Excessive tillage and use of heavy machinery:

a. Excessive tillage coupled with use of heavy machinery for harvesting and lack of adequate soil conservation measures causes a multitude of soil and environmental problems.

b. Hobbs et al. (2008) reported that puddling of soil for rice degrades soil physical properties and has negative impacts on soil biology.

3. Crop residue burning and inadequate organic matter inputs:

a. In India, nearly 3.7 M ha is deteriorated due to depletion of organic matter. Burning of crop residues for cooking, heating or simply disposal is a pervasive problem in India and contributes to organic matter loss.

b. According to the MNRE (2009), ~500 Mt of crop residues are generated every year and ~125 Mt are burned.

4. Poor irrigation and water management:

a. Improper planning and management of irrigation systems have resulted in a rise of the water table in most canal command areas and the development of saline-sodic soils because of poor irrigation and drainage management.

b. Barman et al. (2013) reported that cracking of soil from poor irrigation management leads to bypass flow of water and subsequent nitrate leaching.

5. Improper crop rotations:

a. The farmers have adopted intensive cropping patterns of commercial crops in place of more balanced cereal-legume rotations.
b. Intensive cultivation leads to removal of large quantities of nutrients from the soil which results to in loss of soil fertility.

6. Pesticide overuse and soil pollution:
a. Indiscriminate use of pesticides together with sewage sludge and composted municipal wastes leads to contamination of soil and water with toxic substances and heavy metals.
b. Some commercial fertilizers also contain appreciable quantities of heavy metals, which have undesirable effects on the environment.

Management Strategies for Soil Degradation

1. Soil erosion control: Integrated watershed management, which involves soil and water conservation coupled with suitable crop management is an excellent strategy for mitigating soil erosion. It involves construction of check dams along gullies, bench terracing, contour bunding, land levelling and planting of grasses.
a. Srinivasarao *et al.* (2014) reported that mechanical measures, e.g., physical barriers such as embankments and wind breaks, or vegetation cover are important measures to control soil erosion.

2. Intercropping and contour farming: Strip cropping is a combination of contouring and crop rotation in which alternate strips of row crops and soil conserving crops are grown on the same slope, perpendicular to the wind or water flow in drylands and hilly regions, respectively.

3. Integrated nutrient management and organic manuring: Integrated nutrient management, *i.e,*the application of NPK mineral fertilizers along with organic manure, increases crop productivity, improves soil organic carbon content, and decreases soil loss.
a. Bhattacharya *et al.* (2011) reported that annual farmyard manure addition improved labile (movable; short-lived) and long-lived C pools.

4. Irrigation management for improving input use efficiency: Scheduling of irrigation based on critical stages of crops stimulates optimum plant growth, thereby improves crop productivity and decreases soil degradation.
a. Surface irrigation methods like sprinkler or drip give better input efficiency.

5. Conservation agriculture: The concept includes: (1) causing minimum disturbance to the soil surface by using no- or minimum-tillage; (2) keeping the soil surface covered all the time through practices such as retention of crop residue, mulching, or growing cover crops; (3) adopting crop sequences or rotations that include agroforestry in spatial and temporal scales.

6. Management of saline and sodic soil: Inversion tillage can decrease potential soluble salt accumulation in the root zone compared to zero tillage.
a. The most efficient method is through application of high-quality irrigation water and growing of salinity tolerant crops.
b. Salt affected soils are reclaimed by leaching followed by application of green manures.
c. Gypsum is the major chemical used for reclamation of alkali soils.

7. Management of acid soil: It include addition of lime and other chemical amendments to correct the acidity and manipulate the agricultural practices so as to obtain optimum crop yields. Grow acid tolerant crops and varieties, water management and other agronomic practices.
a. Bhat *et al*. (2008) reported that lime raises soil pH, thereby increasing the availability of plant nutrients and reducing toxicity of Fe and Al.

8. Remediation of as contamination: Mitigation of As contamination could be achieved by replacing *boro* rice requiring more ground water with summer legumes and pulses, decreased irrigation coupled with addition of zinc sulphate, greater use of organic/green manures.

9. Agroforestry: Perennial woody vegetation recycles nutrients, maintains soil organic matter, and protects soil from surface erosion and runoff. Vegetative buffer strips to decrease surface transport of agrochemical pollutants.

10. Reforestation, grassland and horticulture development: In the hills, the majority of the upper slope is covered with horticultural crops using half-moon terraces and contour bunds and the remaining one-third of the lower section is used for cultivation of cereals, or oil crops with bench terraces.

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Integrated Pest Management of Tea Red Spider Mite *(Oligonychus coffeae)*

Article ID: 30489

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Introduction

Tea, *Camellia sinensis* (L.) O. Kuntze, is a perennial crop and grown as a monoculture on large contiguous areas. Tea plant is subjected to the attack of several notorious pests such as insects, mites, nematodes, diseases and weeds. Globally 1034 species of arthropods and 82 species of nematodes are associated with tea plants. Among them 25 species of insects, 4 species of mites and 10 species of nematodes are recorded. Mites, as a group, are persistent and the most serious pests of tea in almost all tea producing countries. In India 13 species of mites belonging to eight families were reported. *Oligonychus coffeae* is one of the most destructive pests in all the tea growing regions of North East India causing considerable crop loss in tea .RSM has been a major threat to tea cultivation, as a result of infestation by the RSM, plant growth and leaf productivity are seriously affected. This pest has been causing a considerable damage to tea cultivation in India since 1960, but recently its havoc is more prominent in North Bengal tea plantation due to environmental changes. In tea husbandry, integrated pest management measures are needed to be given more importance in management programme. A tentative IPM strategy for tea cultivation in India has been proposed in this article. Thus, the proposed integrated pest management (IPM) strategy should help tea industry for successful long-lasting plantations which will ensure consistent crop with much care but lesser cost.

Integrated Pest Management

1. Pruning: Pruning is an essential agronomic practice implemented in winter for renovating vegetative growth at the expense of reproduction, to increase crop productivity in subsequent years. Pruning removes a large part of the RSM populations present on the Leave. Red spider mite, scarlet mite and purple mite are removed during pruning operation.

2. Shade regulation: The culture of shade trees and many ancillary crops in the tea ecosystem is considered to be a necessary evil. In tea, shade regulation plays a predominant role in mites is seen more in tea fields devoid of shade. So, the recommendation of shade management will help to prevent the excessive build-up of mites.

3. Filed sanitation: Field sanitation assumes significance in the management of several pests. Weeds offer excellent hiding places and serve as alternate hosts for Red spider mites. Weeds like *Urena lobata* weeds act as alternate host of Red spider mite. Weed free cultivation and preventing trespassing of cattle, goat, and other animals from RSM-infested fields reduce its spread.

4. Trap crop: A trap crop also manipulates the habitat in an agro ecosystem, which can be included under the ecological engineering approaches for the purpose of IPM. However, Marigold is an ornamental plant and in tea it can be used as a trap crop of red spider mite. In cases where part of a garden becomes badly affected with Red spider mite every year it is essential to put down a protective barrier between the affected and unaffected tea. One row of marigold can be planted at the outer periphery and also in the vacant area of the section. Border plantings of *Adhatoda vesica serve* as a barrier for red spider mite, *Oligonychus coffeae*.

5. Effect of shade: Shade is an integral part of tea cultivation in most of the tea-producing countries. Temperature of tea leaves under shade is 1–2 C below ambient temperature while in the unshaded areas it may go up by 2–4 C. The incidence of RSM is less in shaded areas and their vertical distribution is also remarkably different in shaded and unshaded bushes, indicating the influence of leaf temperature and light penetration.

6. Water pressure sprays: An effective tool to manage the mites and other small bodied arthropods. A forceful stream of water should be used on where the mite population is high while on the sturdy plants take measures to avoid damage. Care should be taken that the water should be used early in the morning thus helping the fields to dry out and make the less chances of disease and other fungus attack.

7. Use of botanicals: Botanical products are environmentally safe, less hazardous, economic and easily available. Certain products derived from indigenous plants are used for tea pest control. Recently, Neem (*Azadirachta indica*), in various commercial formulations, is widely recommended in tea plantations against the RSM. *Clerodendrum* extracts may also effective against major pests of tea such as red spider mites etc. and *Melia azadirach* (Meliaceae) showed great promise in controlling RSM population at field level. garlic lectin (The LC50 value: 12.4 ± 1.918 lg/ml) on and Neem Kernel Aqueous Extract (NKAE) @ 5.0 % concentration was effective against RSM on tea.

8. Biological control: Biological methods of control involve the conservation, preservation and introduction of natural enemies like predators, parasitoids and pathogens for suppression of pests within tolerable levels. Several predatory mites, mostly belonging to Phytoseiidae, Stigmaeidae and Tydeidae, mainly prey upon phytophagous mites infesting tea. *Oligota flaviceps* is identified as a predator of Red spider mite in tea. *Mallada boninensis* Okamoto, *Mallada basalis* Walker and *Mallada desjardinsi* Navas had been reported as efficient predators of RSM infesting tea in India. *Amblyseius herbicolus* and *Euseius ovalis* are the two main common predators of *Acaphylla theae* and *Calacarus carinatus*. Preying mantids are identified as the potential predator of red spider mite. *Oligota flaviceps* is identified as a predator of Red spider mite in tea [4]. The ladybird beetle, *Stethorus gilvifrons* Mulsant, is a major predator of the RSM. Adults and larval stages of *S. gilvifrons* predate indiscriminately on the eggs, nymphs and adults of the RSM.Use of entomopathogenic fungi is a new area of research for management of RSM. Fungi are the predominant pathogens found in RSM populations, and are unique in their ability to infect their hosts through the external cuticle. *Paecilomyces fumosoroseus* from south Indian tea field has been found effective against RSM and another fungal pathogen *Hirsutella thompsonii* has been found efficient against RSM in North East India.

9. Chemical control: Chemical control is the primary mode of management of RSM and a wide range of acaricides belonging to different chemical groups is currently used worldwide to control this pest. Spiromesifen (oberon) 240 SC @ 72-96 g.*a.i*/ha, fenpyroximate 5% EC @ 0.75 ml/L or dicofol 18.5% EC @ 5 ml/L or fenazaquin 10% EC @ 2.5 ml/L or phosalone 35% EC @ 2 ml/L or profenofos 50% EC @ 2 ml/L, propargite 57% EC @ 2 ml/L or fenpropathrin 30% EC @ 0.4 ml/L or hexythiazox 5.45% EC @ 0.75 ml/L or ethion 50% EC @1 ml/L for effective control of mites.

Conclusion

Need based, judicious and safe application of pesticides is the most vital aspect of chemical control measures under IPM strategy. It involves developing IPM skills to play safe with environment by proper crop health monitoring, observing ETL and conserving the natural bio- control potential before deciding in favour of use of chemical pesticides as a last resort. Habitat management, exploitation of hitherto under used natural enemies such as predator, parasitic & entomopathogen, use of the novel biorational pesticides, management of pesticides to extend their useful life, proper use of semiochemicals and the use of information technology are some major tactics to be employed in the IPM programme in tea.

Natural Farming - Sustainable Way of Farming

Article ID: 30490

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Introduction

Modern agricultural practices have a major impact on the environment. Climate change, deforestation, genetic engineering, irrigation problems, pollutants, soil degradation and waste are some of the concerns that are connected with agriculture. Excessive use of fertilisers such as urea, nitrate, phosphorous along with many other pesticides have affected air, water, and soil quality.

Genetically engineered crops are herbicide-tolerant and their overuse has created herbicide resistant 'super weeds'. Non-target plants, birds, fish and other wildlife have also been killed because of pesticide application. Soil degradation has affected the microbial community of the soil, altering the nutrient cycle, pest control and chemical transformation properties of soil.

Natural farming is the solution to reducing all these hazards. This sustainable way of farming is also known as 'Do-nothing farming' or 'No-tillage farming'. It was first popularised by Masanobu Fukuoka, in the 1940s in Japan. The idea is to let nature play a dominant role to the maximum extent possible. In natural farming, the farmer is considered only a facilitator and the real work is done by nature itself. In a natural farm, there are no good or bad organisms; all are vital for a balanced ecosystem.

Main Features of Natural Farming in India

1. Physical work and labour can be highly reduced as compared to other agricultural systems
2. Yields similar to chemical agriculture is possible
3. There is an increase in soil fertility year after year
4. Water requirement is minimized.

The idea of natural farming is, however, not something that is imported from Japan. Similar ideas have been widely practised in Indian agriculture for over thousands of years. In India, natural farming is often referred to as 'Rishi Kheti', which is based on ancient Vedic principles of farming like the use of animal waste and herbal juices for controlling pests and promoting growth of plants.

The Key Principles of Natural Farming

1. No till farming: Ploughing the soil alters the natural environment of the soil and promotes the growth of weeds.

2. No weeding by tillage or herbicides: Weeds are not eliminated but can be suppressed by spreading straw over freshly sown land and growing ground cover.

3. No chemical fertilizers: This is because adding chemical fertilizers help in the growth of the plant but not of the soil, which continues to deteriorate.

4. No dependence on chemical pesticides: Nature's own balancing act prevents any one species from gaining the upper hand.

No Till in Natural Farming

Natural farming recognizes soils as a fundamental natural asset. Ancient soils possess physical and chemical attributes that render them capable of generating and supporting life abundance. It can be argued that tilling actually degrades the delicate balance of a climax soil:

1. Tilling may destroy crucial physical characteristics of a soil such as water suction, its ability to send moisture upwards, even during dry spells. The effect is due to pressure differences between soil areas. Furthermore, tilling most certainly destroys soil horizons and hence disrupts the established flow of nutrients. A study suggests that reduced tillage preserves the crop residues on the top of the soil, allowing organic matter to be formed more easily and hence increasing the total organic carbon and nitrogen when compared to conventional tillage. The increases in organic carbon and nitrogen increase aerobic, facultative anaerobic and anaerobic bacteria populations.

2. Tilling over-pumps oxygen to local soil residents, such as bacteria and fungi. As a result, the chemistry of the soil changes. Biological decomposition accelerates and the microbiota mass increases at the expense of other organic matter, adversely affecting most plants, including trees and vegetables. For plants to thrive a certain quantity of organic matter (around 5%) must be present in the soil.

3. Tilling uproots all the plants in the area, turning their roots into food for bacteria and fungi. This damages their ability to aerate the soil. Living roots drill millions of tiny holes in the soil and thus provide oxygen. They also create room for beneficial insects and annelids (the phylum of worms). Some types of roots contribute directly to soil fertility by funding a mutualistic relationship with certain kinds of bacteria (most famously the rhizobium) that can fix nitrogen.

Other Forms of Natural Farming

1. Fertility farming: In 1951, Newman Turner advocated the practice of "fertility farming", a system featuring the use of a cover crop, no tillage, no chemical fertilizers, no pesticides, no weeding and no composting. Although Turner was a commercial farmer and did not practice random seeding of seed balls, his "fertility farming" principles share similarities with Fukuoka's system of natural farming. Turner also advocate a "natural method" of animal husbandry.

2. Native American: Recent research in the field of traditional ecological knowledge finds that for over one hundred centuries, Native American tribes worked the land in strikingly similar ways to today's natural farmers. Author and researcher M. Kat Anderson write that "According to contemporary Native Americans, it is only through interaction and relationships with native plants that mutual respect is established."

3. Nature Farming (Mokichi Okada): Japanese farmer and philosopher Mokichi Okada, conceived of a "no fertilizer" farming system in the 1930s that predated Fukuoka. Okada used the same Chinese characters as Fukuoka's "natural farming" however, they are translated into English slightly differently, as nature farming. Agriculture researcher Hu-lian Xu claims that "nature farming" is the correct literal translation of the Japanese term.

4. Rishi Kheti: In India, natural farming of Masanobu Fukuoka was called "Rishi Kheti" by practitioners like Partap Aggarwal. The Rishi Kheti use cow products like buttermilk, milk, curd and its waste urine for preparing growth promoters. The Rishi Kheti is regarded as non-violent farming without any usage of chemical fertilizer and pesticides. They obtain high quality natural or organic produce having medicinal values. Today still a small number of farmers in Madhya Pradesh, Punjab, Maharashtra and Andhra Pradesh, Tamil Nadu use this farming method in India.

5. Zero Budget Farming: Zero Budget Farming is a variation on natural farming developed in, and primarily practiced in southern India. It also called spiritual farming .The method involves mulching, intercropping, and the use of several preparations which include cow dung. These preparations, generated on-site, are central to the practice, and said to promote microbe and earthworm activity in the soil. Indian agriculturist Subhash Palekar has researched and written extensively on this method.

Advantages of Natural Farming

1. Actual physical work and labour have been reduced by up to 80% compared to other agricultural systems.
2. Improves soil quality
3. Humus is created
4. Water retention is improved. So, it saves 60 to 80 percent of water.
5. Micro-climate around the plants
6. Beneficial insects are attracted.

Conclusion

Natural Farming is contemplated by its protagonist as one of the most potential crop cultivation methods to drastically cut down production costs by reducing dependence on market for purchase of critical inputs. Being considered as an agroecologically diverse farming practice, it brings hosts of ecological and social benefits.

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Nutritional Importance of Small Millets

Article ID: 30491

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Introduction

Small millets have myriad of health benefits and due to high levels of insoluble dietary fibre, phytates, phytochemicals catechins, flavonoids etc., they are rich source of minerals like copper and iron. Unlike rice, they release glucose steadily without affecting the metabolism of the body. The incidence of diabetes is rare among the population which consumes small millet diet. The millet protein characterization showed that its protein concentrate is a potential functional food ingredient and the essential amino acid pattern suggests possible use as a supplementary protein source to most cereals because it is rich in lysine. Small millets are minor millets and major studies are done for foxtail millet, barnyard and proso millet.

The foxtail millet is also known as Italian millet. It is one of the world's oldest cultivated crops. In the northern area of China, it has been widely used as a nourishing gruel or soup for pregnant and nursing women and has been applied to food therapy. It has been recorded that millet has many nutritious and medical functions. Foxtail yellow seeded cultivars, medicinally used as astringent, digestive, emollient and stomachic. It is also used in the treatment of dyspepsia, poor digestion and food stagnancy in abdomen. White seeds are refrigerant and used in the treatment of cholera and fever while the green seeds are diuretic and strengthening to virility. This millet contains 12.3% crude protein and 3.3% minerals.

Barnyard millet showed comparable amounts of crude protein with foxtail millet which was highest among all the millets studied. The work of Liang et al. presented the general properties of millet oil and its fatty acid profile. It is apparent that millet oil could be a good source of natural oil rich in linoleic acid and tocopherols. Millets are good sources of magnesium and phosphorus. Magnesium has the ability to help reduce the effects of migraine and heart attacks, while, phosphorus is an essential component of adenosine triphosphate (ATP) a precursor to energy in the body.

Proso millet is the best alternative crop for diversifying and intensifying winter wheat-based dryland production systems. Proso Millet is calculated to be 356 Kcal per 100 gm. The protein content is similar to that of wheat, but it contains no gluten and by itself is not suitable for yeast-leavened bread. The protein content was found to be (11.6% of dry matter) and was significantly rich in essential amino acids (leucine, isoleucine, and methionine) than wheat protein. It is rich in vitamins and minerals such as copper and magnesium. Proso millet also improved glycemic responses and plasma levels. In addition, proso millet protein concentrate has protective effects against D-galactosamin-induced liver injury in rats (Ito et al., 2008). Choi et al. (2005) and Park et al. (2008) concluded that proso millet protein could be a potential therapeutic intervention in type-2 diabetes. Devi et al. (2011) review the nature of polyphenols and dietary fiber of finger millet and their role with respect to the health benefits associated with millet. The composition of free and bound lipids in proso millet flours and brans were analysed and found that, in the free lipids, hydrocarbons, sterol esters, triacylglycerols, diacylglycerols, and free fatty acids were present. Proso millet is rich source of B vitamins, especially vitamin-B6 and folic acid.

Health Benefits of Small Millets

1. Small millets are highly nutrious and renders various health benefits. The nutritional facts of small millet are listed below.
2. Helps control Blood sugar levels when consumed on regular basis. It showed lowered triglyceride levels, LDL/VLDL Cholesterol and increase in HDL Cholesterol.
3. It is known for its Low Glycemic index- gradual increase in blood sugar after food intake when compared to rice.
4. Ideal food for people suffering from Diabetes & Gastric problems.

5. Reduces risk of Heart Attack.
6. Helps in the development of Body Tissue & Energy Metabolism.
7. Rich in Anti-oxidants.

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Health Benefits and Nutritional Facts in Finger Millet

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Finger millet is an annual plant widely grown as a cereal in the arid areas of Africa and Asia. It remains one of the main ingredients of the staple diet in Karnataka. Nutritionally, finger millet is good source of nutrients especially of calcium, other minerals and fibre. Total carbohydrate content of finger millet has been reported to be in the range of 72 to 79.5%. The carbohydrates include starch as the main constituent being 59.4 to 70.2%.

Finger millet starch granules exhibit polygonal rhombic shape. About 80 to 85% of the finger millet starch is amylopectin and remaining 15 to 20% is amylose. The non-starch polysaccharide accounts for 20 to 30% of the total carbohydrates in finger millets. It contains around 1.5% reducing sugar and 0.03% non-reducing sugar. The white varieties have higher protein content than the brown varieties of the finger millet. Finger millet contains 44.7% essential amino acids of the total amino acids, which is higher than the 33.9 % essential amino acids. Since ragi does not contain gluten, it is a wonderful grain alternative for people who are gluten-sensitive.

The total dietary fibre (TDF), insoluble dietary fibre (IDF), and soluble dietary fibre (SDF) con tent in finger millet was found to be 12, 11 and 2%, respectively. It was reported that 18.6% dietary fibre and 3.6% crude fibre in finger millet (Kamath and Belavady, 1980). The health benefits associated with high fibre foods are delayed nutrient absorption, increased faecal bulk, lowering of blood lipids, prevention of colon cancer, barrier to digestion, mobility of intestinal contents, increased faecal transit time and fermentability characteristics. Finger millet is a good source of energy for weight watchers, as it contains the amino acid tryptophan that reduces the appetite.

Total antioxidant capacity of finger, little, foxtail and proso millets were found to be higher and their total carotenoids content varied from 78–366 mg/100 g in the millet varieties. Finger millet has the higher amount of calcium (344 mg) and potassium (408 mg). Calcium helps in keeping your bones and teeth healthy. It has higher dietary fibre, minerals, and sulphur containing amino acids compared to white rice, the current major staple in India.

However, the finger millet also contains phytates (0.48%), polyphenols, tannins (0.61%), trypsin inhibitory factors, and dietary fiber, which were once considered as "anti-nutrients" due to their metal chelating and enzyme inhibition activities, but nowadays they are termed as nutraceuticals. It is now established that phytates, polyphenols and tannins can contribute to antioxidant activity of the millet foods, which is an important factor in health, aging and metabolic diseases. It functions as an amazing common relaxant and serves to battle fidgetiness, a sleeping disorder and discouragement. Additionally, assists in treating headache cerebral pains. Antioxidant effects of finger millet on the dermal wound healing process in diabetes induced rats with oxidative stress-mediated modulation of inflammation were studied by Rajasekaran et al. (2004). They reported that the role of finger millet feeding on skin antioxidant status, nerve growth factor (NGF) production and wound healing parameters in healing the impaired early diabetic rats.

Health Benefits of Finger Millet (Mathanghi and Sudha, 2012)

1. Finger millet also is known to have several potential health benefits. Some of the health benefits are attributed to its polyphenol contents. The phenolic acid content of brown finger millet 96% higher compared to white variety

2. It contains more lysine, threonine, and valine than other millets. In addition, black finger millet contains 8.71 mg/g dry weight fatty acid and 8.47 g/g dry weight protein.

3. Finger millet is reported to have anti-ulcerative properties and finger millet diets lowered blood glucose and cholesterol in diabetic rat models (36% reduction in blood glucose levels) • Finger millet seed coat matter which is a rich source of dietary fibre and phenolic compounds were found to exhibit blood glucose and cholesterol lowering, nephron-protective and anti-cataractogenic properties in streptozotocin induced diabetic rat models.

4. Supplementing infants with the germinated finger millet-based food showed a general improvement on hemoglobin status.

5. Lower serum cholesterol and triacylglycerol levels (43% and 62%, respectively) compared to diabetic controls.

6. Finger millet extracts were also reported to possess free radical scavenging, anti-protein glycation, anti-cataractogenic and antimicrobial properties in 'in vitro'. Inhibition of snake venom phospholipases by finger millet phenolics in 'in vitro'

7. High reducing power for seed coat polyphenol extract compared to the polyphenol extract from finger millet whole flour. Higher antioxidant activity for finger millet seed coat polyphenol extract (86%) compared to polyphenol extract from finger millet whole flour (27%).

8. Offered protection against mucosal ulceration, epithelialization, increased synthesis of collagen, activation of fibroblasts, and mast cells.

Nutritional Facts of Finger Millet

Finger millet is highly nutritious and renders various health benefits. The nutritional facts of finger millet are listed below:
1. Finger millet/ Ragi for losing weight: Ragi contains an amino acid called Tryptophan which lowers appetite and helps in keeping weight in control. Ragi gets digested at a slower rate thus keeps one away from intake of excessive calories. Also, fibres present in ragi give a feeling of fullness thus controls excessive food consumption.

2. Finger millet/ Ragi for bone health: Ragi is rich in Calcium which helps in strengthening bones. It is an excellent source of natural calcium for growing children and aging people. Ragi consumption helps in development of bones in growing children and in maintenance of bone health in adults. Ragi keeps diseases such as osteoporosis at bay and could reduce risk of fracture

3. Finger millet/ Ragi for diabetes: Finger millet's phytochemicals help in slowing digestion process. This helps in controlling blood sugar level in condition of diabetes. In a study conducted in 2000, it was found that Finger Millet based diet helps diabetic as it contains higher fibre than rice and wheat. Also, the study found that diet based on whole finger millet has lower glycemic response i.e. lower ability to increase blood sugar level. This is due to presence of factors in ragi flour which lower digestibility and absorption of starch.

4. Finger millet/ Ragi for lowering blood cholesterol: Finger millet contains amino acids Lecithin and Methionine which help in bringing down cholesterol level by eliminating excess fat from Liver. Finger Millet also contains Threonine amino acid which hinders fat formation in the liver, which brings cholesterol level of the body down.

5. Finger millet/ Ragi for anaemia: Ragi is a very good source of natural Iron. Ragi consumption helps in condition of Anaemia.

6. Finger millet/ Ragi for relaxation: Ragi consumption helps in relaxing body naturally. It is beneficial in conditions of anxiety, depression and insomnia (sleepless nights). Ragi is also useful for migraines.

7. Finger Millet/ Ragi for Protein/ Amino Acids: Ragi is rich in Amino Acids which are vital in normal functioning of body and are essential for repairing body tissues. Finger Millet contains Tryptophan, Threonine, Valine, Isoleucine and Methionoine amino acids. Isoleucine helps in muscle repair; blood formation contributes to bone formation and improves skin health. Valine is essential amino acid which facilitates metabolism, helps in muscle coordination and repair of body tissues. It helps in balancing nitrogen in the body. Another essential amino acid, not found in most cereals, is Methionine which is useful in various body processes, helps in eliminating fat from the body, and is main provider of sulphur in body. Sulphur is essential for production of Glutathione - body's natural antioxidant.

8. Finger Millet for other health conditions: If consumed regularly, Ragi could help in keeping malnutrition, degenerative diseases and premature aging at bay. Green Ragi is recommended for conditions of blood pressure, liver disorders, and asthma and heart weakness. Green Ragi is also recommended to lactating mothers in condition of lack of milk production.

9. Ragi is an extremely nutritious cereal and is very beneficial for maintaining a good health. However, its high intake could increase quantity oxalic acid in the body. Therefore, it is not advised to patients having kidney stones (Urinary Calculi). Ragi could be enjoyed in different forms and preparations. Ragi Roti, Ragi Dosa, Ragi Porridge, Ragi Upma, Ragi Cakes, Ragi Biscuits are few popular dishes of Ragi.

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Antidotes of Herbicides and Protectors of Crop Plants

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Herbicide safeners are molecules used in combination with herbicides to make them "safer" - that is, to reduce the effect of the herbicide on crop plants, and to improve selectivity between crop plants vs. weed species being targeted by the herbicide. Herbicide safeners can be used to pre-treat crop seeds prior to planting, or they can be sprayed on plants as a mixture with the herbicide. Herbicide safeners selectively protect crop plants from herbicide damage without reducing activity in target weed species.

Herbicide safeners, formerly referred to as herbicide antidotes, are chemical agents that increase the tolerance of monocotyledonous cereal plants to herbicides without affecting the weed control effectiveness. Safener also known as antidote or crop protectant is a sort of physical barrier (externally active) or a chemical (internally active), which protects a crop from being injured on application of an herbicide normally non-selective to it. Father of safener- Otto L. Hoffman.

List of Safeners

Chemical class	Name	Herbicide	Crop	Application method
Anhydride	1,8-Naphthalic anhydride (NA)	Thiocarbamates	Maize	Seed treatment
Dichloroacetamide	Dichlormid	Thiocarbamates, chloroacetanilides	Maize	PPI,PRE
	Furilazole	Acetochlor, Halosulfuron-methyl	Maize	PRE
	AD-67	Acetochlor	Maize	PRE
	Benoxacor	Metolachlor	Maize	PRE
Oxime ether	Cyometrinil	Chloroacetanilides (metolachlor)	Sorghum	Seed treatment
	Oxabetrinil	Chloroacetanilides (metolachlor)	Sorghum	Seed treatment
	Fluxofenim	Chloroacetanilides (metolachlor)	Sorghum	Seed treatment
Triazole carboxylic acid	Flurazole	Alachlor	Sorghum	Seed treatment
Dichloromethyl-ketal	MG-191	Thiocarbamates, Chloroacetanilides	Maize	PRE
Phenylpyrimidine	Fenclorim	Pretilachlor	Rice	PRE
Urea	Dymron	Pyributicarb, Pretilachlor, pyrazosulfuron-ethyl	Rice	PRE,POST
Piperidine-1-carbothioate	Dimepiperate	Sulfonylureas	Rice	POST

Benefits

1. Non-selective herbicides could be used for selective weed control.
2. Higher dose of an herbicide can be used since antidotes normally increase the safety/selectivity margin of an herbicide.
3. A composite culture of weeds similar or dissimilar to crops can be controlled.
4. Ready-mix/in-built combination of antidotes in the formulation or their tank-mixes may save crops from damage of the non-selective herbicides applied accidentally.
5. Antidotes offer greater insurance/reliance against crop damage particularly under situations like susceptible crop varieties, soil conditions or adverse weather conditions, where crops are likely to receive phytotoxicity.

Limitations

1. Using herbicide antidotes may increase the cost of weed control in particular and the cost of crop cultivation in general since antidotes incur some cost.
2. Their antagonism with certain herbicide may protect some important weeds of a crop.
3. The chemical antidotes are not phytotoxic, but toxic to other organisms including humans. Therefore, their use with herbicides increases the toxicity load to the environment.
4. The effect of antidote is not constant/uniform, but varies across climates and soils based on temperature, moisture, texture etc.

Methods of Antidotes Application

1. Externally active antidotes:

a. Root dipping or stem application of seedlings/transplants into the slurry of charcoal is effective before their transplanting in herbicide treated soils in case of transplanted crops (rice, vegetables and forest/plantation crops). It gives protection against 2,4-D. atrazine, propazine.

b. Crop seed coating before sowing: coating with charcoal improves selectivity of herbicides like EPTC to maize and cowpea and chloramben, butachlor and EPTC to rice. For seed pelleting rate is 5g/kg seed.

c. Band application over crop seed rows at the time of sowing: Charcoal as a uniform 2.5 cm uniform band over partially covered seed rows is effective against 2,4-D. Rates are 130kg charcoal per hectare in clayey loam soil and 390 kg/ha or more on sandy soils. Charcoal requirement for root dipping and seed hole application is quite low than in furrow or band application.

2. Internally active herbicides:

a. Tank-mix/Ready-mix Ex: R-25788 @ 0.6 kg/ha with EPTC.

b. Seed treatment Ex: R-25788, NA @ 0.5g/kg, CGA 43089 @ 1-1.5g/kg.

c. Soil treatment Ex: NA.

Desert Locust - National Disaster

Article ID: 30494

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Introduction

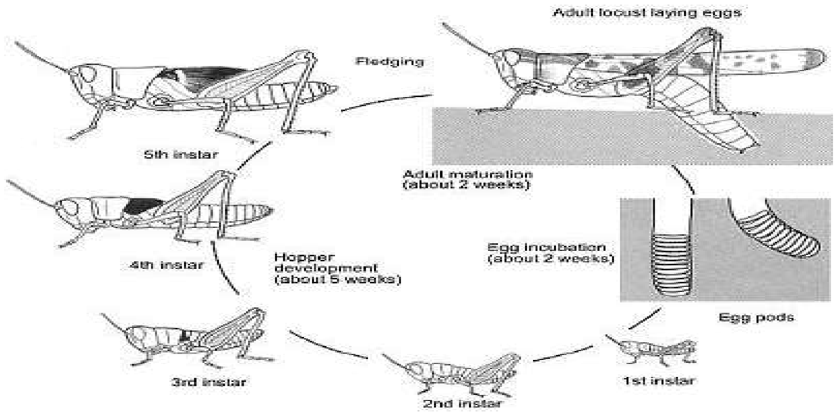
The word locust is derived from the Latin word *locusta* meaning grasshopper. Locusts are the swarming phase of short-horned grasshoppers in the family Acrididae belongs to order Orthoptera. There are 10 important species of locust in the world. In Indian condition normally 4 species of locusts are reported *i.e.*, Migratory locust (*Locusta migratoria*), Desert locust (*Schistocerca gregaria*), Bombay locust (*Nomadacris succincta*) and Tree locust (*Anacridium* spp.). Among this Desert locust (*Schistocerca gregaria*) as the name suggests, they normally live and breed in semi-arid/ desert regions. These species under suitable conditions can breed rapidly and subsequently become gregarious and migratory. They can migrate over long distances *i.e.*, travel up to 100-150 kilometre in one day and damage the crop to a large extent. A desert locust swarm can be 1,200 square kilometres in size and pack between 4 to 8 crores locusts in less than one square kilometre. Each locust will eat its weight in plants each day, so a swarm of such size would eat 192 million kilograms of plants every day.

Difference Between Solitary and Gregarious Locust

Characters	Solitary Locust	Gregarious Locust
Population density	Less than 3 per 100m2	More than 1000,000 per 100m2
Behaviour	Behave independently Repelled from other locusts	Behave as a Cohesive unit Attracted to conspecific
Final instar nymph	1. Cryptic colouration	1. Aposematic colouration
	2.Slow creeping	2. Highly active
	3.Large eyes and antennae	3. More mechano and taste receptors.
Adult	1.Low-fat deposits	1. High fat deposits
	2.Crepuscular (dawn & dusk)	2. Diurnal (day)
	3.Restricted diet	3. Broad diet

Growth and Development

There are mainly three stages present in the desert locust i.e., Egg, hopper and adults with wings. For egg-laying, they require bare ground which is rarely found in areas with dense vegetation, so they prefer open deserts areas. Adult mature female probes in the loose sandy soil by stretching her abdomen like the telescope and digs a hole into which an egg pod containing up to hundred eggs is deposited around 10 cm below the ground. The eggs are surrounded by foam and this hardens into a membrane and plugs the hole above the egg pod which looks like a bunch of bananas and absorb moisture from the surrounding soil. The duration of the egg stage varies from 10-65 days. The newly hatched nymph (hopper) feed on green vegetation, which is good for its growth and development.



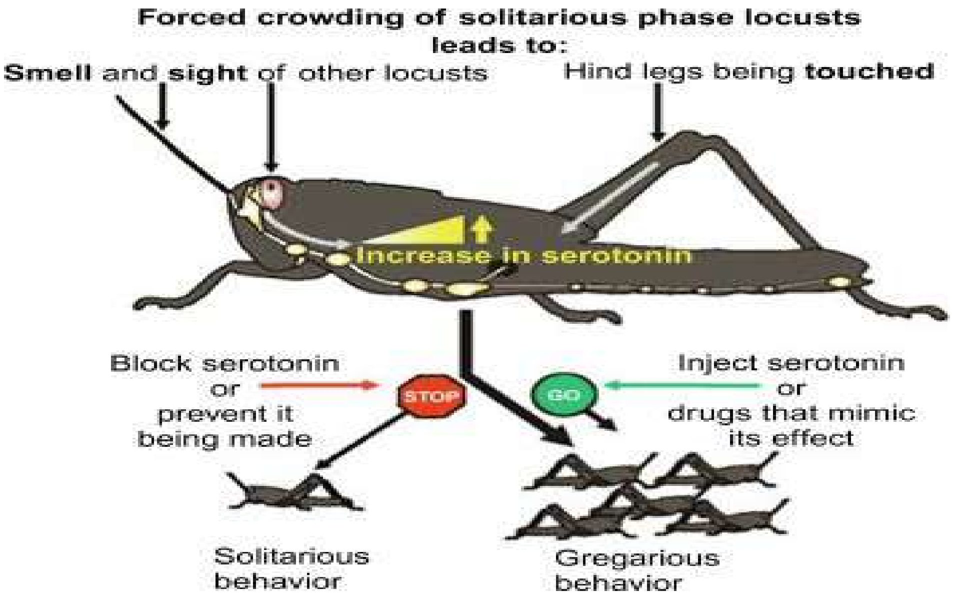
The duration of hopper development is 24-95 days (36 days average). As it grows it needs to moult so, the desert locust nymph (gregarious) undergoes five moults before becoming a winged adult and in solitary phase, the nymph moults 5-6 times. The adult duration is 2.5 to 5.0 months. When last nymphal instar moult to adult, that stage is called fledging stage (immature adult).This immature are pinkish, they will be flying, feeding but there will be no mating. The duration of fledging is 40-50 days. Afterwards, the immature adult turns to mature adult which are yellow to a black colour and capable of flying, feeding, mating and egg-laying. The adult maturation period varies from 3 weeks to 9 months (2-4-month average). The solitary adults are brown. The total period for growth and development of desert locust takes 2-6 months.

When the conditions are favourable for reproduction i.e., (loose sandy loam soil for oviposition, good rainfall, increase in soil moisture, increase in humidity, decrease in temperature and green vegetation for hopper development) desert locust increase in number and change their behaviour from solitary to gregarious (Bennett 1975; Pedgley 1968).Green vegetation is good for hopper development- the stage between the nymph that has hatched and before its turning into a winged adult moth-such cover is not widespread enough in the desert to allow the growth of large locust populations, therefore the locusts start migrating to long distances, feed on the green vegetations and damages the crops extensively.

What Triggers Them to Form a Swarm?

1. In the gut of desert locusts, Guaiacol is produced, by the breakdown of plant material. This process is carried out by the gut bacterium Pantoeaagglomerans. Guaiacol is one of the main components of the pheromones that cause locust swarming (Dillon, Rod J. et al., 2000).

2. Under suitable conditions of drought followed by rainfall (rapid vegetation growth), serotonin in their brains triggers a dramatic set of changes then, they start to breed abundantly and becoming gregarious and migratory when their populations become dense enough. They establish bands of wingless nymphs which later develops to swarms of winged adults. Both the bands and the swarms move around and rapidly strip fields and cause damage to crops, wherever the swarm settles.

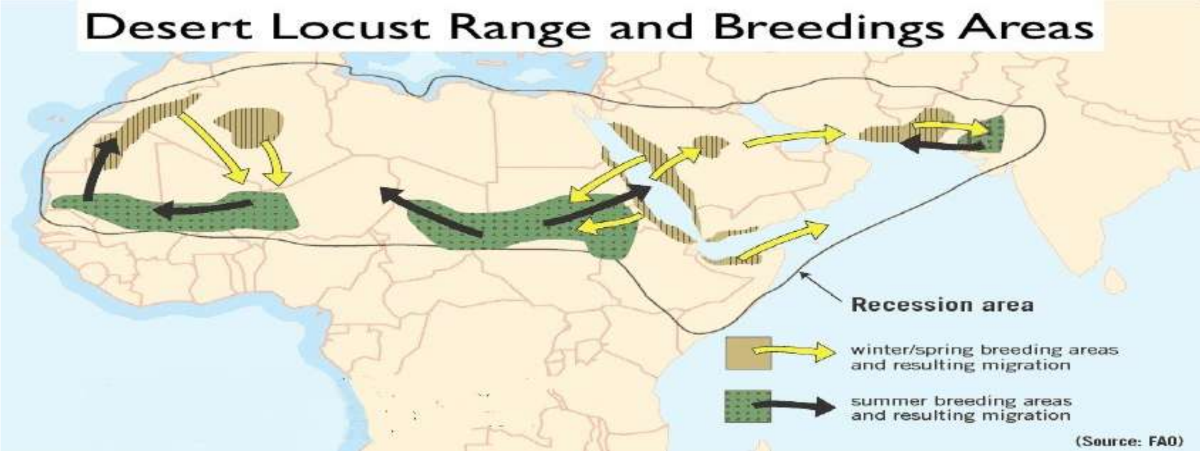


Where the Swarm Occurs?

The desert locust is very notorious, found in Sahara Desert, East part of Africa, Middle East, Southern Asia, Iran, Iraq, Baluchistan and India (Rajasthan and some parts of Gujarat). It inhibits 60 countries and can cover one-fifth of Earth's land surface.

1. Recession area: During recession periods (quiet periods) desert locust (solitary phase) are usually restricted to the semi-arid and arid deserts of Africa, the near east and southwest Asia, just moving to neighbouring areas, desert plants for food. It covers 30 countries of Africa and Asia.

2. Invasion area: During invasion periods gregarious adults form swarms that can be carried by the wind over great distances and threatens crops and pastures. It covers 60 countries and affects 20% of the landmass.



The primary bands of gregarious hoppers are called as "outbreaks", and when these joins together into larger groups, the event is known as an "upsurge". Continuing agglomerations of upsurges on a regional level originating from several entirely separate breeding locations are known as "plagues" (Showler, 2013). During outbreaks and the initial stages of upsurges, only part of the locust population becomes gregarious, with scattered bands of hoppers spread out over a wide area. As time goes by, the insects become more united and the bands become concentrated in a smaller area. In the desert locust plague in Africa, the Middle East, and Asia that lasted from 1966 to 1969, the number of locusts increased from two to 30 billion over two generations, but the area covered decreased from over 100,000 square kilometres to 5,000 square kilometres (Krall et al.,1997).The desert locust plagues of 1986-1989 and subsequent upsurges in 1992-1994 and 1996-1998 demonstrated how quickly this pest increases in the number and spreads across national borders adversely affecting economics and the environment in locust prone countries. The major desert locust upsurge in 2004–05 caused great crop losses in West Africa and decreased food security in the region.

Swarms of locusts have invaded India since April of this year. They entered several districts of Rajasthan via Pakistan and after few days they entered neighbouring states Gujarat, parts of Maharashtra, Madhya Pradesh, many districts in Uttar Pradesh and Haryana. About 49,000 hectares (120,000 acres) of cotton, summer pulses and vegetable crops have been affected by locusts across these six states.

Management

1. The primary of controlling desert locust infestations is with insecticides applied in small concentrated doses by vehicle-mounted and aerial sprayers at Ultra-low volume (ULV) rates of application (Malathion 50% EC, Malathion 25% WP, Lambda Cyhalothrin 5% EC, Lambda-cyhalothrin 10% WP, Deltamethrin 2.8% EC, Chlorpyriphos 50% EC, Chlorpyriphos 20% EC, Fipronil 5% SC, Fipronil 2.8% EC and Bandiocarb 80% WP).

2. Spray Neem based formulation (0.15% EC) @ 45ml/ 15 liter water on standing crop as feeding deterrent.

3. Mechanical means often followed by farmers for killing locusts, such as digging trenches and burying hopper bands, but this is very labour- intensive and is difficult.

4. Farmer also tries to scare locust swarms away from their fields by making noise, burning tires or other methods. This tends to shift the problem to neighbouring farms, and locust swarms can easily return to re-infest previously visited fields.

5. Biological control products have been under development since the late nineties for control of locust-like Green muscle and NOVACRID are based on a naturally occurring entomopathogenic fungus, *Metarhizium acridium.*

6. The desert locust has natural enemies such as predatory wasps and flies, parasitic wasps, predatory beetle larvae, birds and reptiles. These may be effective at keeping solitary populations in check but has limited effects against gregarious desert locusts because of the enormous numbers of insects in the swarms and hopper bands.

Conclusion

"All Locusts are grasshopper but all grasshopper is not Locust". Locusts are not as dangerous as long as they are individual hoppers or small isolated groups of insects, what we called the solitary phase. It is when their population grows to a large number-the resultant crowding induces behavioural changes and transformation from the solitary to gregarious phase-that they start forming swarms. Locust survey and control operations are the responsibility of the Locust Warning Organization (LWO). It is the oldest national locust monitoring system, within the Ministry of Agriculture, Department of Agriculture and Co-operation, Directorate of Plant Protection Quarantine and Storage (DPPQS).

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Insect as Bio-Indicator

Article ID: 30495

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Introduction

Bioindication or biomonitoring can be considered a type of applied ecology. Its primary goal is to use organisms living within natural communities to monitor the impact of disturbance and to use this knowledge in the management of the ecological system. It can also be used in urban settings and in agricultural communities. For this the indicator taxon is one that is of narrow amplitude with respect to one or more environmental factors, when the species is present, it indicates the presence of certain environmental parameters. In this regard insects are most promising one. Insects are the most abundant animals in almost all ecosystems and can be used to evaluate the impact of environmental change. Through population and behavioural studies and the taxonomy of species, it's possible to estimate what the current degradation rate is and its future consequences.

Characteristics of Insect Groups for Environmental Indicators, Rocha Et Al. (2010)

Richness and species diversity.	→	Four in five species of animals are insects.
Easy handling.	→	Most species require few efforts for their capture, except toxic species. The small size of samples helps to their capture and transport.
Ecological faithfulness	→	Many species may have low tolerance to abiotic factors, which allows to link certain insect groups with certain habitats.
Fragility to small changes	→	It allows to select demographical or behavioral variables that can be measured or observed in the field, and have a close correlation with the pre-selected abiotic variables.
Organism's responses	→	To identify levels of environmental change.

Insects are Used as Bioindicators Because

1. Respond quickly to environmental changes
2. Have few generations per year
3. Are reliably identified, sampled and identified
4. Show high sensitivity for detecting early changes in their geographical area;
5. Provide information without interruption of the extent damage caused by environment alteration or pollution.

Description

In aquatic ecosystem, several aquatic insects' groups are used as aquatic environment bioindicators. Odonata (dragonflies) species are very sensitive to changes caused to their habitat, especially lakes and flooded drainage areas and they have the potentiality as indicators of water quality. Several other species of the families Gyrinidae, Dytiscidae, Hydrophilidae (Coleoptera), Notonectidae, Veliidae (Heteroptera) and Plecoptera and Ephemeroptera Orders have high adaptive capacity, colonizing most of the environments and occurring throughout the year, reflecting ecological and geographical changes and hence their conservation status. The genus *Halobates* are suitable for bioindication of cadmium and mercury.

The Order Coleoptera represents approximately 20% of the total diversity of arthropods and plays roles in maintaining soil quality, population regulation of other invertebrates and energy flow and contributes to the physical and chemistry of soil formation. Specifically, family Carabidae has the role of biological control, biological monitoring of pollution from oil, sulfur, herbicides, CO_2, insecticides and radioactive phosphorus.

Some lepidopteran groups are used as environmental pollution indicators by heavy metals and carbon dioxide (CO_2 concentration) in locations close to industrial areas and even within urban areas. Presence and consequences of copper, iron, nickel, cadmium, sulfuric acid ions and other substances used in fertilizers were studied with pupae of different Geometridae and Noctuidae species. Collembola are primitive insects are very sensitive to changes in the soil and diversity reduction can show us pollution by heavy metals, pesticides in agricultural soils and soil water acidification by organic pollutants and wastes, Rusek, J. (1998). Ants are used as soil quality bioindicators and have a key role in the recovery of degraded and reforested areas.

Pollinators, especially honeybees (*Apis mellifera*), are considered reliable biological indicators because they show environment chemical impairment due to high mortality rate and intercept particles suspended in air or flowers. Larvae of family Chironomidae indicates concentration of iron and manganese concentration. Wasp (*Polistes sp.*) act as bioindicator for lead pollution.

Conclusion

The use of bioindicators is essential for environmental monitoring. It provides the opportunity to use different insects as the tool to study environmental quality and conditions. And also helps us for management of challenging ecosystems by monitoring through promising insect taxa.

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Probiotics and Plant Health

Article ID: 30496

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Introduction

Probiotics are live microbial cultures used to encourage host health and vigour. Plant probiotics are microbial culture which shows plant growth-promoting and/or biocontrol potential by intrinsic worth of their diverse activities including nitrogen fixation, phosphate solubilization, siderophore production and improved plant immunity against diseases (Nadeem et al. 2015). They also recover soil structure by aggregating the soil particles together by secretion of extracellular metabolite, increasing the breakdown of complex organic material and insoluble nutrient into simpler forms for plant growth and inducing resistance against stress and diseases (Maheshwari et al. 2012). Bacteria involved in phosphate solubilization, nitrogen fixation and biological control of plant disease are some of the excellent examples of plant probiotics (Prakash et al. 2016).

What are Microbial Plant Probiotics?

Plant fitness is reliant on various components including environmental, climatic and edaphic factors. Research in past decade has been directed on identifying the role of soil microbes on overall plant health and productivity. Results obtained through such extensive investigations have revealed that microbes are important component of plant well-being and can even improve resistance, tolerance and resilience of plants under biotic and abiotic stress conditions.

Why Plant Probiotics?

Unscrupulous and unprecedented usage of chemical fertilizers and pesticides on the crops has damaged the sustainability of agriculture systems leading to augmented expense of farming thereby escalating the average farmer's income in turn ensuring food security and safety into a formidable task.

Excessive usage of chemical fertilizers, along with chemical pesticides and inaccessibility or less use of organic manures, has steered to extensive turn down in soil health and vigour. Continued dependence on chemical fertilizers for imminent agronomic progress would result in more damage to soil quality and risks of water pollution and contamination leading to untenable obstacle on the economic structure. Biological-based agriculture is an all-inclusive production management structure which augments agroecosystem vigour, together with biodiversity, biological cycles as well as soil biological activity.

Conclusion and Future Prospects

The application of plant probiotics for their plant growth-promotion potentials and for the other activities is mainly based on the concept of bio-augmentation: augmenting the cell number of desired organisms using several approaches like seed coating, foliar spray or inoculating them during the time of showing. But despite the availability of a large amount of efficient fungal and bacterial strains with efficient probiotic potentials, their formulation and applications are still facing lots of problems due to several inherent reasons. Long-term viability and multiplication of applied cells in the natural climatic condition is still a major pitfall of this technology due to variability in climatic as well as geographical conditions like pH, temperatures, aeration, moisture, nutrients, soil organic contents and soil microbial community structure.

In addition, the generation of huge amount of inoculum and their formulation is commercially is an expensive approach for using the probiotics on the concept of bio-augmentation. Due to the biological nature of inoculum, survival of formulated cells at room temperature for longer storage and their further revival is a constant problem. Another concern is partial taxonomic characterization of microorganism used for formulation and application which gives biased information about their taxonomic status and biosafety classes. Furthermore, we need to isolate and select physiologically robust strains which can survive in a wide range of geographical and climatic conditions for formulation and application purposes to get the better result.

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Most Destructive Pests of Tomato: Tomato Fruit Borer *(Helicoverpa armigera)* and Their Integrated Pest Management

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Introduction

Tomato fruit borer is one of the most destructive pests of tomato belonging to the order lepidoptera and family noctuidae. The adult's laid majority of the eggs in singly on the upper and lower leaf surfaces of the first four leaves in the top canopy. They are yellowish to brown about 0.5 mm diameter. Larva can feed on any plant tissue but are most likely to attack reproductive part of the plants like flowers and fruits. Initial instar larvae scrape the tomato foliage, causing little damage, later one's bores into flowers or the young fruit, while feeding the caterpillar thrust its head inside the fruit leaving the rest of the body outside making it unfit for consumption and marketing also cause serious damage. Around the feeding holes frass is visible sometimes its lead to the rotting of the affected tissues. In severe cases of infestation, more than 80 per cent fruits get damaged. One caterpillar is capable of destroying 2-6 fruits, due to this reason *H. armigera* is one of the most destructive pests of tomato.

Damage is caused by the larvae of tomato fruit borer, *Helicoverpa armigera*. Adults are usually light brown in colour, about 35 mm long, with brown forewings mottled with darker patterns. Hind wings are whitish, with a large black patch on the edges. The colour of the larvae varies from dark-green to reddish black depending on maturation stage. Their body is speckled with little black spots and they have a dark head. At later maturity stages, lines and bands develop along their back and flanks. Its life cycle is influenced by environmental conditions and diet food. Generally peak population observed during fruit development, which results in high yield loss.

Management

1. After harvesting the crop deep ploughing to expose the pupae for natural killing.
2. Remove the infected fruits from the field.
3. Use of African marigold *(Tagitus erecta)* as a trap crop for management of the fruit borer.
4. Setting up light traps to attract and kill the adult moths of the fruit borer.
5. Use of pheromone traps at 8-10 /hectare for the management of the fruit borer.
6. In small area hand picking of larvae is also recommended.
7. Spray 5% Neem seed kernel extract to kill early instar larvae of the fruit borer.
8. Use the bird perches @ 15-20 per ha helps in inviting insectivorous birds for management of the fruit borer.
9. Use of NPV @ 250-300 LE/ha along with juggary @ 20 g/l when sprayed at 10 days interval also given protection against fruit borer.
10. Spraying of Cypermethrin 10EC @ 500 ml/ha in 250 litters of water /ha the first spray should be at the flowering stage and followed by sprays at either 10- or 15-days interval gives effective control of fruit borer
11. Also most preferred new molecules flubendiamide 40 WDG @ 250 gm/ ha and imidaclopride at 0.03%.

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Use of Remote Sensing and GIS in the Field of Water Resources

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Water is a precious gift provided by nature to human life. Water is an essential resource for human life, agriculture and hydropower projects. Occasional and spatially uneven rainwater, flood and drought are the main causes of problems. Due to the solution of various problems including problems such as floods and droughts and increasing demand for water, proper use and management of water resources is very important. Survey and map of water resources is an essential task for effective water management. The use of traditional methods such as topographic mapping, aerial shading takes a lot of time and has some limitations. Remote sensing and geographic information system are being used as a modern method in the last few years.

The remote sensing method can measure a large area in a very short time. In the last nearly 20 years, remote sensing satellites of various capacities have been installed in space, from which continuous remote sensing data is being obtained. By analyzing these data by software, many maps related to land can be made. However, remote sensing data is not sufficient for the instructions and other methods being used for proper management of water resources. Geographical information system is a modern technique for using these data. Remote sensing and geographic information system systems in many areas of water resources and management, such as: land use / land cover classification, floodplain management, mapping and management of water separators, drainage field studies, glaciation mapping, reservoir sedimentation, water quality studies and It is being highly used in ground water studies etc.

Water is a very valuable gift for our human life. Water resources are very important for human life, agriculture and water power generation. The problem of floods and drought is found in our country due to the timely and endemic irregular distribution of rainfall. Continuous increase in demand for water for various purposes and optimum utilization and proper management of this valuable resource is very important for the solution of flood and drought problems by the country. Apart from this, proper development and management of water resources for irrigation and drainage system is very important. Integrated management of water resources is very important for surface water as well as ground water. There is a need to accept suitable water management methods to solve all water related problems like flood, drought, proper irrigation management etc. Knowledge of water resource sources is very important for the solution of problems related to water control, distribution and allocation of rivers and catchment areas.

Effective water management is the basic requirement of survey and mapping. Topographic maps, aerial photography and geo-surveying are essential methods for conservative engineering studies. But the application of all these methods is expensive, time consuming and difficult. For the effective management of water resources, remote sensing and geographical information system techniques help in laying the basis of appropriate information. The remote sensing data provided by the satellite and the analysis capabilities provided by the Geographical Information System provide a technically appropriate method for studying various specifications related to land and water resources. It is notable that remote sensing techniques have some limitations. Due to which it is not possible to completely convert conservative survey techniques into modern techniques.

Remote sensing, pure and real-time assessment makes continuous monitoring and forecasting of assessment and forecasting of inland water resources. This system is used to observe the Earth's surface from various platforms, e.g. satellite and airplane, and it shows the possibility of aggregation and analysis of information about resources and environment over vast areas. Remote sensing techniques collect electromagnetic energy emitted or reflected from the Earth's surface. These features provide the possibility of measurement, mapping and monitoring of remote sensory data obtained using satellite or aircraft. The images obtained from the satellite provide low cost and strong possibilities for the monitoring and measurement of various land-cover characteristics. An important advantage of the use of remote sensing data is the convenience of generating spatial and periodic information for hydrological monitoring and demonstration. Which are very important in water management studies?

Remote sensing data alone is not sufficient for many water related studies. It is necessary to merge these data with data collected from other sources. Rain, evaporation, vegetation, geomorphological and soil data are considered in local remote sensory data for a study. Apart from this, other information such as the condition and type of tube wells, information about rainfall and rainfall, etc., is necessary. This available information can be displayed by various maps with the help of geographical information system. Geographical information system is a powerful software for data collection, management and display and can be used effectively in hydrology and water resources studies.

Many problems of nature are associated with the development and management of water resources, such as flood and drought conditions, water sedimentation, increased reservoir sedimentation, water quality pollution, assessment of glacial area and inaccessible field studies etc. To address all these problems, remote sensing data and GIS There is a need to experiment with a systematic approach by mixing. Use of remote sensing and geomorphic information system systems for classification of water resources and water management such as land use / land cover classification, flood plain management, mapping of water separators and monitoring of catchment area, ground water studies and decision-making GIS Is becoming more and more in applications etc.

Plant Epigenomics and Application in Plant Breeding

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Introduction

Homogeneity in the crop varieties cause genetic erosion that ultimately lead to yield stagnation. Present world needs to deal with various edaphic challenges for which breeders need variability in the genetic materials. Creation of variation by classical plant breeding includes distant hybridisation, mutation and polyploidisation. Among the modern plant breeding tools, cell fusion, tissue culture, transformation and genome editing are the major tools of variation. The variation in phenotypic expression is the result of heritable changes in the DNA sequences leads to genotypic variation.

Sometimes the phenotypic variation does not include change in DNA sequences which is known as epigenetics which satisfies its literal meaning "above the gene sequences". In this article, we are going to discuss brief about epigenetics and how Plant Epigenomics can be proved wonderful in creating variation.

Important Points About Epigenetics

1. Epigenetics controls genes: Nature of individual and the nurturing environment helps epigenetic to determine the cell specialisation by switching on or off the gene expression.

2. Epigenetics is everywhere: Whatever an individual activity, like having food, exercise etc., these can chemically modify the genes that will turn those genes on or off over time.

3. Epigenetics makes individual unique: The different combinations of genes that are turned on or off due to the epigenetic changes in individual, is what makes each is unique. Each individual is different from other with its external features, social ability, dealing with stress etc.

4. Epigenetics is reversible: By analysing the particular cause of an epigenetic change in individual, if we can reverse that state of gene from being turned on to off or vice-versa, then maybe we can overcome so many dreaded diseases, stress.

Epigenetic Changes

As a rule of central dogma, the transcribed mRNA from the DNA will translate protein molecules responsible for gene expression to occur. In eukaryotes, the gene expression of is affected by different states of the chromatin, which has euchromatin (transcriptionally active) and heterochromatin (transcriptionally inactive) regions. The epigenetic changes mostly occur in the heterochromatin regions that are the chemical modifications to the DNA itself or to DNA associated histone proteins sometimes may cause a heritable change in the phenotypic expression of the progeny by altering the chromatin conformation.

Mechanism of Epigenetic Changes

The tools of epigenetics are DNA methylation, the histone modification, noncoding RNA, and nucleosome positioning.

DNA Methylation

This is the most common mechanism responsible for epigenetic changes that leads to switch off the gene expression. The occurrence of methylation is seen in several cellular processes like embryonic development, X-chromosome inactivation, genomic imprinting, and chromosome stability. The process involves covalent transfer of a methyl group to the C-5 position of the cytosine ring of DNA by DNA methyl transferases (DNMTs) by creating a heritable epigenetic mark. In plants, cytosines are methylated in both symmetrical (CG or CHG) or asymmetrical (CHH, where H is A, T, or C) contexts (Jin et al., 2011).

Histone Modification

Histone proteins are the DNA packaging proteins, forms a nucleosome that wraps around the eight histones into chromosomes. A histone modification is a post-translational modification to histone proteins, which includes the process of methylation, phosphorylation, acetylation, ubiquitylation, and sumoylation. These processes alter chromatin structure, recruiting histone modifiers, affects transcriptional activation/inactivation, chromosome packaging, and DNA damage/repair.

Non-Coding RNA

A non-coding RNA is a functional RNA molecule that is transcribed from DNA but cannot be translated into proteins. This includes microRNAs (miRNA) short interfering RNAs (siRNA), piwi-interacting RNAs (piRNA) and long non-coding RNAs (lncRNA). In general, these RNAs regulate gene expression at the transcriptional and post-transcriptional level.

Chromatin Remodelling

High-order structure of nucleosome-DNA complex makes DNA inaccessible for proteins to find their target sequence. Nucleosome remodelling involves changing histone–DNA interactions as a means of disrupting, assembling or moving nucleosomes by biochemical coupling to ATP hydrolysis (Becker and Workman, 2013). All these mechanisms interact with each other in order to provide a stable epigenetic change.

Epiallels and Epimutants

An individual with altered epigenetic changes may produce offspring with different phenotypes, excluding the change in DNA sequences the reason is not being DNA mutations but by epigenetic alterations, the agents are called 'epimutants' and the corresponding epigenetic alleles responsible for the altered phenotypes are called an 'epialleles'. These are of both natural occurring and artificially induced as well.

Epigenome Engineering

Epigenome engineering is the process in which DNA binding modules are fused with epigenetic modifiers such as DNA methyl transferase and DNA demethylase to induce epigenetic alterations at target loci with a trait of interest. This includes collaboration with the most recent gene editing tools like ZFN, TALEN, CRISPR/cas system (Gaj et al., 2013).

Application in Plant Breeding

The first epimutants reported in *Arabidopsis* were induced in mutant backgrounds defective in DNA methylation. Maintenance of DNA methyl transferase and a SWI/SNF-like ATP-dependent chromatin remodeling factor are encoded by methyltransferase1 (*MET1*), and decrease in DNA methylation1 (*DDM1*) respectively (Jeddeloh *et al.*, 1999). The mutants showed a genome-wide decrease in DNA methylation levels with severe developmental defects and abrupt activation of transposable elements which induced heritable epimutation to change the phenotype of the progeny (Lippman *et al.*, 2004).

In tomato (*Solanum lycopersicum*), fruit ripening is governed by *colorless non-ripening* (*cnr*), which is mutated. Its promoter in the *cnr* mutants were found to be hypermethylated leading to gene silencing (Manning *et al.*, 2006). A rice epimutation was found to occur in the *wealthy farmer's panicle* (*WFP*) gene encoding QTL for panicle branching, OsSPL14, promote panicle branching and high grain yield. *OsSPL14* expression was limited in Nipponbare (the standard rice variety) because of DNA methylation. A less methylated *OsSPL14* ^{WFP} allele was introduced into Nipponbare resulted in increased rice production (Miura *et al.*, 2010). Most crop species lack equivalent induced mutant lines, hence as an alternative, a DNA methyltransferase inhibitor 5-aza-2'- deoxycytidine (5-azadC) has been used as an epimutation inducer. For example, rice plants resistant to the bacterial pathogen *Xanthomonas oryzae* were obtained by 5-azadC treatment of seeds (Akimoto *et al.*, 2007). The resistance resulted from hypomethylation of a disease resistance gene *Xa21G* .

Paramutation is a type of epigenetic phenomenon was obsrerved in tomato *sulf* locus, which manifests as sectors of chlorosis (i.e. yellowing, thus the *sulfurea* designation) in *sulf*/+ leaves (Gouil *et al.*,2016). This individual with paramutagenic effect *showed an elevated methylation by over expressing DMR1 gene.* When a population was derived from a cross with the wild progenitor (*Solanum pimpinellifolium*) of the cultivated tomato confirmed prior localization of *sulf* to a region of chromosome 2 in the progeny. Expression of DMR1 sequences in normal tomato plants resulted in elevated levels of both DMR1 promoter methylation and corresponding 23–24-nucleotide siRNAs, in addition to leaf chlorosis analogous to the *sulf* mutation. Recently, through epigenome engineering targeted DNA methylation was achieved in *Arabidopsis* using a ZF-SUVH2 fusion to recruit RdDM machineries to the target gene (Johnson *et al.*, 2014).

Conclusion

In addition to the induction of novel epialleles, targeted epigenome engineering may be another promising way to alter the expression of specific genes associated with a trait of interest. This "reverse epigenetics approach" can prove itself a modern plant breeder's tool of creating genetic diversity in the available germplasms.

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Impact of Climatic Variability on Agriculture and its Management Strategies

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Introduction

Climate change is a change in the weather patterns that lasts for a long period of decades to millions of years. This is a change in the statistical properties of the climate system when considered over long periods, regardless of cause. Respectively, fluctuations over the periods shorter than a few decades, such as El Nino, do not represent climate change. The term used to refer specifically to climate change caused by human activities, as conflict with changes in climate that may have resulted as part of the earth's natural processes. In this sense, principally in the context of environmental policy, the term climate change has become synonymous with anthropogenic global warming. The Intergovernmental Panel on Climate Change (IPCC) was unitedly installation by the World Meteorological Organization (WMO) and the United Nations Environment Programme (UNEP) to assess the technical, scientific and socio-economic information relevant for the recognition of the risk of human-induced climate change. The scientific consensus on climate change is in larger part caused by human activities, and it is largely irreversible. In these concerns, anthropogenic factors are the increase in CO_2 levels by emissions from fossil fuel combustion, followed by aerosols (particulate matter in the atmosphere) and the CO_2 released from the cement manufacture. Other factors including land use, animal husbandry, ozone depletion, agriculture and deforestation are also a concern in the roles they play in climate change.

Impact of Climate Change on Agriculture

The comprehensive analysis of the data from WMO (World Weather Watch) and world climate program by the scientist of UK so that global temperature has increased by little more than 0.1°C, over the 100 years with a similar increase in both the hemispheres (NASA, 2020). The effects of climate can be broadly classified as direct and indirect effects on agriculture.

Direct Effects

Despite the increasing CO_2 concentrations and consequent warming of the planet due to the greenhouse effect, the yield of major food crops in the USA, Western Europe, India, China, etc., which may be attributed to the advanced agriculture and management technologies. On the other hand, it may be due to the fertilizer effect of CO_2 enrichment. The increase in CO_2 in the atmosphere could enhance plant growth by increasing the rate of photosynthesis is the net accumulation of carbohydrates formed by the uptake of CO_2, so it increases with increasing CO_2. The response to CO_2 varies according to the biochemical pathway for photosynthesis. The C_3 plants (Wheat, rice, barley, groundnut, cotton, sugar beet, potatoes, chickpea, coconut, etc.,) respond more favourably to increasing CO_2 than C_4 plants (Maize, sorghum, millet, sugarcane, etc.). Higher CO_2 concentrations have comparatively little effect indirectly stimulating photosynthetic response and the increase in yield is 0 to 10% (Warrick, 1990). Although C_4 crops account for only about $1/5^{th}$ of the world's food production, maize alone accounts for 14 percent of overall production and about three-quarters of all traded grains. On the other hand, C_3 crops in temperate and subtropical regions could also benefit from reducing weed infestation.

Indirect Effects

1. Cropping pattern: The combination of the effect of climatic change on agriculture crops likely to bring about a spatial shift in crop potential. The areas that are at present judged to be most suited to give a crop or a combination of crops may no longer remain as such after climatic shift. Wheat belts may replace by barley, barley by maize and maize by soybean and so on.

The area under rainfed wheat in central India may require either alternative crops or development of suitable genotypes tolerant to water stress and high temperature. This region however contributes very little to total wheat produced under irrigated conditions in Punjab, Haryana and U.P. Therefore, the effects of elevated temperatures of 1 to 2°C could be absorbed by adjusting seeding time and developing suitable varieties of wheat. Thus, the CO_2 enrichment has a positive effect on the productivity of rainfed wheat. In hilly regions and irrigated wheat in the plains of North India (Mall *et al.*, 2016).

Similarly, under 1°C warming and 100 mm precipitation yields of rice are expected to increase in India if late-maturing varieties needing high temperatures for cultivation are adopted. An increase in temperature promotes sterility in rice resulting in a reduction in yields but an increase in precipitation would lead to an increase in area and yield. Since almost one-third of rice in a reduction in yields but increase in precipitation would lead to an increase in area and yield. Since almost one-third of rice is grown in non-irrigated conditions, it may benefit from increased precipitation leading to yield increase in many developing countries. Even shortening of maturity duration of rice with global warming will beneficial to maintain proper soil health in Haryana and U. P. (Singh *et al.,* 2008). Cultivation of groundnut and cotton is also likely to be benefited. The reduction in length of the growing season of cotton with a rise in temperature will make this crop even more suitable in double-cropping systems. Groundnut cultivation may shift from monsoon to spring season and from monsoon maize to winter maize in North India.

Rajasthan district of Jhalawar is located in a semi-arid area that receives an average of 943 mm of rainfall annually. Besides, high degrees of climate sensitivity, it also ranks among the districts with the lowest adaptive capacity. In the past 10 years, many farmers in Jhalawar have shifted from traditional crops, such as pearl millet and sorghum, to soybean, which receives higher market prices and yields quick returns owing to a shorter life cycle.
The susceptibility of India's coastal areas is highlighted in Jagatsingpur, Odisha, where the loss of mangroves due to biotic and abiotic pressures in the past few decades has left the coast exposed to the violence of cyclones and storm surges. The aftermath of the 1993 super cyclone witnessed intensive rehabilitation and reconstruction efforts, not all of which have been correctly targeted and effectively applied.

Andhra Pradesh district of Anantapur is another drought-prone area that can be considered 'double-exposed' to climate change and globalization. Groundnut is the principal crop grown in Anantapur, but farmers are now facing a crisis due to growing import competition and stagnating market prices, which have coincided with a multi-year drought. Without irrigation, water harvesting systems, or alternatives to groundnuts, dryland farmers in Anantapur are highly vulnerable to both climate change and trade liberalization.

2. Water requirement: Higher than normal levels of atmospheric carbon dioxide induce greater water use efficiencies (ratio of crop biomass accumulation to the water used in evapotranspiration). On the higher atmospheric CO_2, leaf transpiration rate and hence increase the water use efficiency. This protects crops from drought and other water-related stresses and also decreases the irrigation requirements of the crops. On the other hand, increased leaf area index with rising CO_2 while allows greater interception of solar radiation, but it can also increase canopy evapotranspiration due to the presence of the more transpiring surface. Water use efficiency with increasing carbon dioxide increased in winter wheat but deceased in soybean (Jerry and Christian, 2019) because in soybean while the rate of photosynthesis remained unchanged in the increased canopy, its evapotranspiration was increased.

In the Indian subcontinent, it is expected that with the doubling of CO_2 here will be 1 to 2°C rise in temperature and 5 to 10 percent increase in precipitation. It is known that higher temperatures accelerate plant development and shorten the growth period. This could lead to drought escape and realization of some yield in water deficit season but could be detrimental to attain higher productivity in good rainfall years from dryland areas in general and irrigated areas in particular. This has implications for arable dryland in India which constitutes about 68.6 percent of the 142 million hectares cultivated area and contributes 45 percent of cereals and 75 percent oilseeds and grain legumes (Jerry and Christian, 2019).

3. Pest problems: Since insect pests are cold-blooded (poikilothermous) animals, their body temperature varies with the surrounding temperature. Hence, any change in the climate and weather is bound to influence the activity of insect pests. Insects may be directly influenced by temperature, precipitation, humidity, wind speed and other climatic parameters, in terms of their rate of development, reproduction, distribution, migration and adaptation. Also, they may be indirectly influenced by the effect of climate on the insect host plants, natural enemies and interspecific interactions with other insects. Thus, the potential climatic changes may have a significant bearing on the development, distribution and population density of agricultural insect pests (Sharma *et al*., 2012).

The increase in temperature as a result of future climatic changes may have the following implications for agricultural pests:

a. Changes in population growth rates.
b. Increased the number of generations.
c. Extension of development season.
d. Extension of geographical range.
e. Increased overwintering.
f. Changes in crop pest synchrony.
g. Changes in interspecific interactions.
h. Increased risk of invasion by migrant pests.
i. Introduction of alternate hosts.
j. Availability of overwintering hosts (Abhishek *et al*., 2017).

The climatic changes may, thus, result in increased problems with agricultural insect pests. However, there is still great uncertainty about some aspects of climatic change which are important for insect pests. These include regional and local variations in climate, changes in annual and seasonal variations in rainfall, changes in wind speed, relative humidity and the rate at which climate is likely to change. Hence, much more work is required to identify the specific effects of weather and climate on important pests and determine the climatic variables to which different species are most sensitive.

4. Management practices: With a changing climate, agriculture may have to undergo a great change in terms if suitable crop adjustment, developing proper genotypes and adopting proper technology for the changed environmental conditions. There will be a substantial increase in the need for irrigation which will probably lead to higher cost of production and possible shift towards less water demanding uses. Conversely, an increase in rainfall particularly in regions characterized by monsoon rainfall will require changes in management practices to prevent soil erosion. Besides, in areas where greater rainfall is likely increased the using of fertilizer.

The different responses of C_3 and C_4 pathway crops may encourage changes in sown areas. For example, sugar beet, a temperate C_3 crop will gain some advantage over sugarcane, a tropical C_4 crop. Therefore, the sugar exporting tropical countries will have to find alternatives to cane sugar for export. Likewise, for staple starchy C_4 crops like maize and sorghum, gradual partial substitution by CO_2 responsive C_3 alternatives like sweet potato, cassava, rice or wheat bread for high-temperature areas might be possible. In India, a recent trend towards wheat, rice, and away from maize and millet has been largely driver by the promise of greater increases in yield.

Conclusion

Agriculture can adjust to limited climatic change with the use of proper technology and agronomic manipulations. This capability, however, varies greatly between regions. It is important to establish in more detail the nature of this adaptability and the critical rates of climatic change that agriculture can adapt to under Indian conditions. To improve our understanding of the significance of climatic change and its consequences for agriculture and humankind, considerable research is needed into how agriculture can best adapt to avoid or gain from annual, seasonal and intra-seasonal variability in climate in different agroclimatic regions of the country. Improved knowledge is needed to effects changes in climate on crop yields and physical processes such as rates of soil erosion, salinization, nutrient depletion, insect pests, diseases and hydrological conditions. Information is also needed on the range of potentially effective agronomic adjustments such as irrigation, crop selection, sowing time fertilization, etc. New research programs should be aimed at identifying or developing cultivars and management practices appropriate for altered climates.

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Entomophilic Nematodes

Article ID: 30501

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Entomophilic Nematodes

Entomophilic nematology is the branch of parasitology that deals with nematodes associated with insects. The association may be one in which insects serve as intermediate hosts for the transmission of vertebrate parasites, i.e., Filaria, or one in which insects are the definitive hosts or provide specialized niches for nematodes during part of their life cycles. Filipjev is considered as the "Father of Insect Nematology". (Welch,1965).

Entomophilic nematodes were found in about 27 families of 8 orders Rhabditida, Tylenchida, Aphelenchida, Strongylida, Oxyurida, Ascaridida, Spirurida and Mermithida.

Insect Nematode Associations Can Be Grouped into Three Basic Types

1. Phoretic relationship (insect associated).
2. Facultative parasitism.
3. Obligate parasitism.

Phoresis or Insect Associated Relationship

1. This is a form of relationship in which one organism associates with another species in order to obtain transportation and is common between insects and nematodes.
2. These occur in many Rhabditids, which are carried from one habitat to another by insects frequenting decomposing matter.

Facultative Parasitism

1. Some nematodes are able to infect healthy insects as well as have the ability to complete their life cycles as free-living organisms.
2. These nematodes are regarded as facultative parasites of insects. Some rhabditids, diplogasterids and aphelenchids are facultative parasites.

Obligate Parasitism

1. Obligate parasites cannot complete their life cycle in nature without a living insect. Most of the obligate nematode parasites such as mermithids, tetradonematids, allontonematids, sphaerulariids and rhabditids occur in the hemocoel, exceptions being, oxyurids and a few other groups that are found in the insect's gut.
2. Most of these nematodes castrate, debilitate, or kill their host and are potential candidates for biological control of insect pests.

Host Selection Process of Entomophilic Nematodes

1. Host habitat finding
2. Host finding
3. Host acceptance
4. Host suitability.

Insects Act as Definitive Hosts

S. No	Insects	Nematodes
1	Mosquitoes	*Romanomermis culicivorax*
2	Grasshoppers and locust	*Mermis nigrescens*, *Agamermis* spp.

3	Cockroaches	✓ *Hammerschmidtiella diesingi* ✓ *Leidynema appendiculata* ✓ *Thelastoma indiana* ✓ *Desmicola lamdongensis*
4	Thrips	*Thripinema fuscum*
5	Bumble bee	*Sphareularia bombi*
6	Ants	✓ Mermithidae ✓ Tetradonematidae-*Tetradonema solenopsis*, *Myrmeconema neotropicum* ✓ Allantonematidae-*Formicitylenchus oregonensis* ✓ Seuratidae
7	Face fly	*Heterotylenchus* spp.
8	Sirex wood wasp	*Beddinga siricidicola*

Insect Act as Intermediate Hosts

S. No	Nematode	Insect	Plant host
1.	*Bursaphelenchus xylophilus*	Pine sawyer beetles in the genus *Monochamus*.	Pine
2.	*Bursaphelenchus cocophilus*	Red palm weevil-*Rhynchophorus ferrugineus*	Coconut

Conclusion

Some of the entomophilic nematodes were formulated and commercialized in the market. “Skeeter Doom” is the popularized product which can parasitizes Mosquitoes. An entomophilic nematode, *Beddinga siricidicola* completely parasites Sirex wood wasp. Entomophilic nematodes formulation was not popularized because of several physical, chemical and biological factors limits the survival of entomophilic nematodes. To mitigates above limitations and formulate the products in markets.

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Invasive Tomato Pin Worm, *Tuta absoluta* (Meyrick) Infestation Under Polyhouse Tomato Crop in Udaipur Region

Article ID: 30502

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Introduction

Polyhouse farmers are informed that their polyhouse tomato crop may be invading by an introduced notorious pest, tomato pin worm, Tuta absoluta (Meyrick). This belongs to the Gelechiidae family of the Lepidoptera order. This pest is originated from South America and known for various other names in the different parts of world viz., tomato leaf miner, South American tomato moth, South American tomato pinworm, tomato borer, American leaf miner etc. It has been accidently introduced into India in the year 2014 in Pune, Maharashtra first and thereby other states of the country. It was earlier known to a pest of tomato crop in open field conditions only, but recently, it has been observed under polyhouse conditions in the Udaipur region of Rajasthan in a low incidence. However, now a days, it is found to invade the polyhouses tomato crop in a devastating way and becoming notorious pest for the farmers.

Host Plants

Tomato prefers primarily but known to feed on other solanaceous plants like brinjal and potato.

Identification of the Pest

The eggs of this pest are elliptical, and oyster-white to bright yellow in colour. The female moths mostly laid eggs on the upper side of the tomato leaves. The first-instar larvae are whitish soon after hatching, become greenish or light pink in the second to fourth instars according to food (leaflet or ripe fruit, respectively). There are usually four instars. Last instars leave the mines and build silk cocoons on the leaflets or in the soil for the pupation. Pupation takes place in soil or on plant parts such as leaves and stem. Pupae are obtect with greenish coloration at first, turning chestnut brown and dark brown near adult emergence. Adult moths are about 10 mm long, with silverish-grey scales, filiform antenae, alternating light or dark segments and recurved labial palps which are well developed.

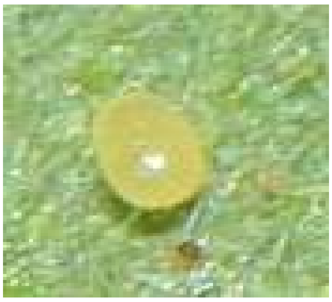

Fig 1. Egg

Fig 2. Larva

Fig 3. adult

Symptoms of Damage

Larvae mine in the mesophyll of leaves and make irregular, papery mines. The larvae also mine apical buds and stems. In cases of heavy infestation, both green and red fruits are attacked and infested fruits show small pin holes on the surface of the fruits and the larvae tunnel below the surface.

Fig 4. Infested leaves

Fig 5. Infested fruit

Management Includes

1. Collect and destroy the affected plants and fruits.
2. Avoid cultivation solanaceous crops after tomato like brinjal, potato etc.
3. Use healthy seedlings for transplanting.
4. Install pheromone traps @ 16 nos./acre to attract and kill the adult moths.
5. Install yellow sticky traps above the crop canopy to attract the moths.
6. Install light trap @ 1/ha to kill adult moths.
7. Conserve the natural enemies of *T. absoluta* such as *Trichogramma exiguum*, *Trichogramma pretiosum* (Trichogrammatidae: Hymenoptera) and *Nesidiocoris tenuis* (Hemiptera: Miridae) etc.
8. Spray biopesticide like Neem formulation (Azadirachtin 1% or 5%) @ 400-600 ml/acre or *Bacillus thuringiensis* 0.5 kg/ha during initial infestation.

9. If case of high incidence, spray chemical insecticides such as Spinosad 45% SC 0.25 ml/L or Flubendiamide 20% WG @ 0.20 ml/L or or Indoxacarb 14.5% SC @ 100 ml/ha. During the peak emergence of the adult moths, spray decamethrin 2.5 EC @ 1 ml/l for killing adults.

Future Impacts

Following its introduction into Europe, North Africa and the Middle East, T. absoluta has already caused extensive economic damage. The impact of the pest includes severe yield loss reaching up to 100%, increasing tomato prices, bans on the trade of tomato, increase in synthetic insecticide applications, disruption of integrated management programs of other tomato pests, and an increase in the cost of crop protection would be observed.

Integration of Pheromone Traps for Management of Insect Pests

Article ID: 30503

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Introduction

The application of insecticides to suppress the key pest population also resulted in destruction of beneficial insects thus accelerating the emergence of secondary pests and other environmental hazards. Among non-polluting insect management methods, pheromone traps can be used as an integrated approach for the management of insect-pests (Ahmad et al., 2001). Pheromones or ectohormones are substances liberated by external glands which produce specific reactions in other individual of same species used as a trap to lure insects. Sex pheromones and aggregating pheromones are the most common types used. For commercial application they are used as pheromone-baited traps for monitoring, mass trapping by lure and kill and by disrupting mating of target species e.g. PB-Rope L for pink bollworm in cotton. Bioagents can be employed as biopesticides, include parasitoids, predators, disease causing fungi, bacteria and viruses which are the natural enemies of insect pests. Preference of insecticides depends on their easy availability and applicability, but their excessive and indiscriminate use has resulted in the development of insecticidal resistance in the pests and environmental pollution. Hence, there is a need to explore alternatives, encompassing available pest control methods and techniques in order to reduce the sole dependence on insecticides. For this purpose, integrated pest management include the use of pheromone traps seems to be the most appropriate approach to achieve sustainability in crop production and ecologically based pest management.

Pheromones

Pheromones or ectohormones are substances liberated by external glands which produce specific reactions in other individual of the same species. Pheromones are exocrine secretions of insects which are used for communication among different individuals of the species. Olfactory pheromones include sex attractant substances produced by lateral glands of last abdominal segments of virgin females. These are highly selective, species specific, biologically active and effective at low concentrations.

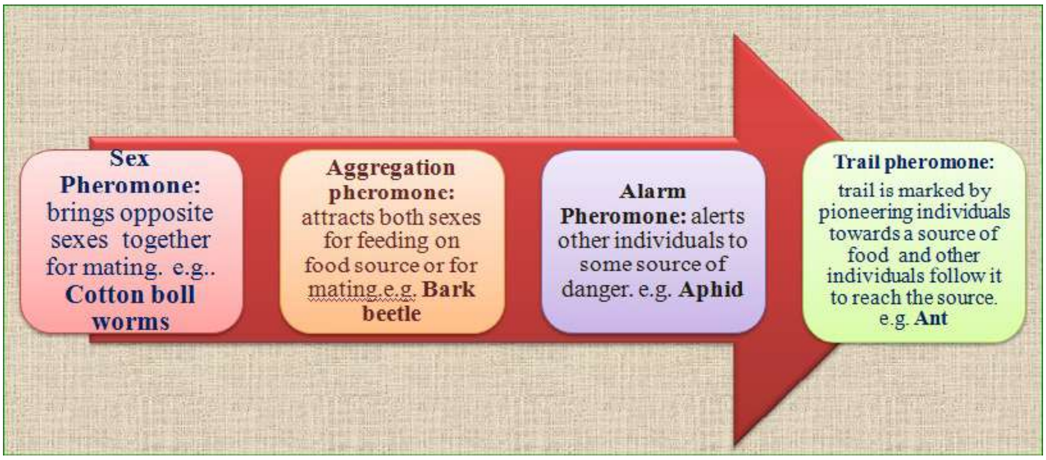

Fig. 1. Different types of pheromones

Pheromone Traps

A pheromone trap is a type of insect trap that uses pheromones to lure insects. Sex pheromones and aggregating pheromones are the most common types used. Pheromones are packaged (or encapsulated) in slow release dispensers (rubber septa), hollow fibers or rope wicks that are used as a lure in traps of various design. At lower densities, these pheromone traps are valuable monitoring tool, providing information on the density and distribution of pest population.

At higher densities, they can be used for mass trapping sexually active adults in efforts to reduce population density. For commercial application they are used as described below.

Pheromone-Baited Traps for Monitoring Insect Population

Female sex pheromones are formulated in slow release dispensers and deployed in monitoring traps to attract male members of a species. e.g. Helilure *(Helicoverpa armigera)* pheromone traps can be used to detect both the presence as well as the density of pest species. Detection of pest, measurement of pest density, assessment of density of natural enemies, pest phenology and mating disruption, monitoring of insecticide resistance and decision support are the advantages.

Use of Pheromones Combined with Insecticides in a Lure and Kill Approach or Mass Trapping

Mass trapping is possible in case of adult insects with a highly developed ability to respond to attractants. The pheromone is deployed in dispensers and has no direct contact with crop. A modification of mass trapping technique is the lure and kill method, where instead of being trapped, the responding insects come in contact with a conventional insecticide.

Fig. 2. Installation of pheromone trap in the field

Approaches of Pheromone in Mass Trapping

1. Lure and kill: In this case insect come in contact with the toxicant and get killed, e.g. Methyl eugenol + malathion - for oriental fruit fly.

2. Lure and infect: It combines attractive lure with an entomopathogen. It is also known as auto-dissemination, e.g. Use of entomopathogenic nematodes, bacteria, fungi and viruses.

3. Disrupt mating of the target species: Control of insect pests by mating disruption technique is achieved by widespread application of synthetic pheromones over the treated crop. Various slow release formulation deployed in trap which either permeate the air with relatively high level of pheromone to achieve sensory adaptation that cause false trails. Mating disruption is to release sufficient sex pheromone over large enough area so that males cannot find and fertilize females.

Advantages of Mating Disruption

1. Safety to applicator.
2. No residues at harvest.
3. Harmless to beneficial species.
4. No secondary pest outbreaks.
5. Applied less often than insecticides.
6. Resistance less likely.

7. No specialized equipment needed.
8. Slows or prevents pesticide resistance.

Disadvantages of Mating Disruption

1. Species specific.
2. Need to monitor carefully.
3. High cost of pheromone dispensers.
4. Dispenser longevity critical.
5. Failure likely with high populations.
6. Uniform blocks recommended.
7. Need large blocks.
8. May need to place in tops of trees.

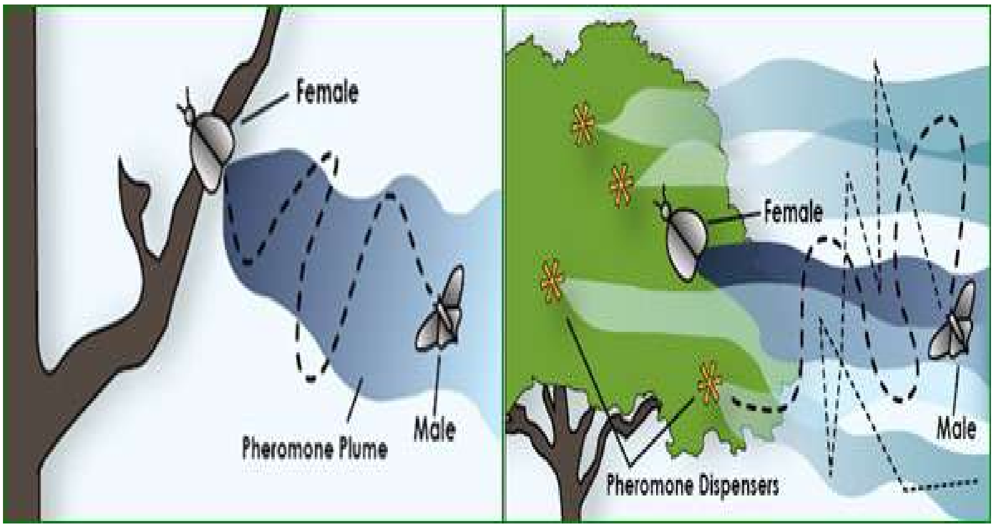

Fig. 3. Diagram showing pheromone action

Successful Examples

1. Management of pink bollworm *(Pectinophora gossypiella)* through a sprayable formulation of gossyplure with cypermethrin produced the best control with minimum boll damage (9%), locule damage (3.1%) and maximum seed cotton yield (1684 kg/ha) (Dhawan and Simwat, 1993).

2. Effect of integrating pheromone mass trapping (20/ha) and biological control (*Trichogramma chilonis* @1, 00, 000/ ha @ 3 to 5 releases) for management of two major rice pests, rice yellow stem borer *Scirpophagaincertulas* and rice leaf folder *Cnaphalocrocismedinalis* in Nellore (A.P) significantly reduced both stem borer and leaf folder damages resulting in significant increase (38 to 45%) in grain yield (Katti et al., 2001).

3. Singh and Yadav (2006) reported that IPM module viz., pheromone trap for *H. armigera* @ 10 traps/ha; Bt based formulation (halt) @ 2 kg/ha; Indoxacarb spray @ 0.4 ml/l; Spinosad spray @ 0.2 ml/l; Nimbecidine spray @ 0.5%) was most effective in reducing pod damage in pigeon pea. The effectiveness of this module was also confirmed with highest grain yield (22.04) and cost benefit ratio (1:27.23) as compared to other treatments.

4. Usman et al. (2015) reported that among the tested IPM modules, the module include Pheromone trap + Mechanical eggs destruction + *T. chilonis* @ 75000 parasitized eggs ha-1 (twice at weekly interval) + Chlorantraniliprole @ 80ml acre-1 was found to be most effective, with lowest fruit damage (5.74%) and higher yield (22013 kg ha-1).

Table 1. Recommended Pheromone Traps for Major Pests of Different Crops

Crop	Insect pests	No. of pheromone traps (per ha)
Sugarcane	Borers	10
Cotton	Bollworms and *Spodoptera*	5
Rice	Yellow stem borer	5

Pulses	*Helicoverpa armigera*	5
Brinjal	Shoot and fruit borer	10
Okra	*Earias spp.*	10
Cabbage, cauliflower	*Spodoptera* and DBM	10
Groundnut	*Spodoptera* and *Helicoverpa*	10
	Leaf miner	25

Future Strategies

1. Pheromone lures with season long persistence/attractancy should be developed.
2. Indigenous development and production of pheromones of the important pests should be stepped up.
3. Utilization of molecular approaches will go a long way in overcoming the major limitations of biological pest control.
4. With these advancements, integrated approaches appear to play a greater role in sustainable insect pest management as an alternative to insecticide in future.
5. To cope up with the pest complex and variability of the insect species more chemists and chemical labs should be motivated to take up this work on priority basis.
6. There is also a need to strengthen research in strategic areas like genetically improved bioagents/ biopesticides and pest-resistant transgenics.

Conclusion

Integration of pheromones along with other method of management is efficient in controlling the key pests and cost-effective alternative to conventional insecticidal application. The use of pheromones against key pests does not result in any outbreaks of secondary pests or pest resurgence. Such type of integrated approach found ecologically safe to non-target pests, livestock as well as for human beings.

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Innovative Farming and Rural Livelihood

Article ID: 30504

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Agriculture plays a major role in the Indian economy, 17% to the total GDP and employment to about 60% of the population. Agriculture is an important occupation in India. Traditional agriculture has transformed today with invent of modern tools and technologies. To meet the new challenges of increased food requirement, climate change, environment issues, marketing and nutrition innovative agriculture is need of the hour.

Conservation Agriculture

Conservation agriculture refers to a range of soil management practices that minimize effects on soil composition, structure, natural biodiversity and reduce erosion and degradation. Such sustainable practices include direct sowing, no/minimum tillage or soil cover disturbance, surface-incorporation of crop residues and growing cover crops in both annual and perennial crops, no crop residues burning, integrated disease and pest management and . Practices protect soil from rainfall and erosion; the soil aggregates, organic matter and fertility level naturally increases and soil compaction is reduced.

Crop Management

Crop management aims the productivity, sustainability and utilisation of major crops and cropping systems. Such programmes target various production problems of field crops and provide solutions. Certain examples are pruning of trees around agricultural land to open-up canopy for light penetration, in-situ mulching, composting or incorporation of such foliage in soil under puddled condition, harvest maize cob instead of grain to save irrigation water, transplanting of summer rice is advisable where assured irrigation facilities are available, land tilling for spring maize, moong, urad, sugarcane, sunflower, jute and maize for fodder, timely completion of transplanting of boro rice for farmers of eastern region, growing rice seedlings by dapog method to compensate frost injury, weeding and interculturing of rabi crops specially winter maize, wheat, hand weeding of onion, garlic & other spices, sugarcane rationing, desuckering of tobacco crop, top dressing with urea in wheat, pulses, oilseeds, maize, fodder crops followed by irrigation etc.

Protected Agriculture

Cultivation of high-value vegetables and other horticultural crops in mulches, row covers, shade structures and greenhouses are protected agriculture. It uses structures that modify natural light, wind, temperature and humidity to raise crops better in quantity and quality. It allows farmers to grow viable crops on off season nurseries, hybrid seed plots, small plots, marginal, water-deficient areas and poor soils. Hydroponics, aeroponics, green houses, glass houses, expensive poly houses are different variants in protected agriculture. Training and subsidies help farmers to venture protected agriculture.

Timely Information, Monitoring and Early Caution

Timely information, monitoring and early caution of changing weather inform farmers to take precautions in agriculture. Unprecedented and untimely rains, weather pattern changes, severe winds and droughts ruin the agricultural practices of especially rainfed farmers. Up-to-date weather information and better crop forecasts can help farmers to know when to sow, crop care, when to harvest and when to carry out farm practices.

Genetically Modified Crops and Improved Varieties

Genetically Modified Crops are the crops that have a gene extracted from another living being and placed in it scientifically. Such crops can benefit agriculture by using fewer pesticides, fertilizers and water. Gene modification can improve immunity in livestock and poultry.

Water Smart Agriculture

Water is the most important input in agricultural. The amount of rainfall in various regions in the country is variable. Hence, irrigation in India has been of primary importance. Though there has been a 161 % increase in the land under irrigation in India over the past 4 decades, it is supposed to be only 33 % of the estimated potential. India has numerous rivers with an estimated total catchment area of 252.8 million ha (mha) out of about 1,869 km3 of surface water resources, about 690 km3 of water is available for different uses. Smart solutions are available to achieve yields and growing food demand with energy and water efficiency. Water smart solutions include precision irrigation such as drip irrigation, effective technology-based water usage and drainage, using external membranes covers like peat moss, perlite to increase soil penetration. However, at policy level main areas of focus have been public investments in surface systems which include large dams, long canals, and other large-scale projects. Some of them require huge outlays of capital for a long period of time. Long term plans also include deep-well projects, which require huge outlays of capital.

Organic Farming

Organic farming is an environment safe, economically sustainable agricultural production systems with the use of local or farm-derived renewable resources. It includes management of self-regulating ecological, biological processes and interactions in order to provide acceptable levels of crop, livestock and human nutrition, protection from pests and diseases. The benefits of organic farming are: maintaining organic matter and biological activity in soil, provision of crop nutrient indirectly by use of insoluble nutrient sources of soil micro-organisms, using legumes facilitate nitrogen self-sufficiency, biological nitrogen fixation and recycling of organic materials with livestock manures and crop residues. Vermiculture and organic agriculture developed side by side in India.

Farm Machinery

Most of the farm machinery / instruments / equipment of modern times are equipped with features like real time monitoring systems, GPS locators and self-steer programs, making them more functional, precise and leading to less wastage of fuel, seed or fertilizer. Farming techniques include use of mechanization, agrochemicals, farming methods, use of land and water. Recent developments and trends in technology have made the profession very sophisticated.

Agriculture Business

Today, India as an agrarian country holds a major share of world market. Agriculture business involves food production, including farming, seed supply, agrochemicals, farm machinery, wholesale and distribution, processing, marketing, and retail sales. Agriculture business not only involves only farming related activities but also includes horticulture, floriculture. An individual interested to do agriculture business in India has the several potential and prospects. India being the largest producer of grains, the export opportunities for crops are high due to the growing demand overseas. Domestically an agriculturist can make profits of what he has cultivated through proper distributing channels or by self. Indian agriculture can benefit immensely by induction of right technology, professional management and marketing capabilities to handle processing and distribution in the post-harvest phase of agri-business. In most of the areas with diverse agro climatic regions the prospects of agricultural growth are immensely high. Low levels of productivity mean that potential is not tapped and, therefore, there is a high prospect for investment opportunities in infrastructure, seeds and fertilizers. India has a large pool of research manpower, large marketable surpluses and abundant raw materials for agribusiness. The country also has enormous production base.

Portals / Websites

A number of useful applications have been made to suit requirements of agricultural sector in India. To support the agriculturist many, IT based expert systems were developed. Some of them are COMAX, Grain Marketing Advisor, SUBERMAX, SOYEX, FINDS. Today in India many online resources are available for an individual to access the queries/information that he requires. There are many online agriculture portals/websites that provide all types of assistance to agriculturists to enhance the business by interlinking producers, suppliers and consumers.

Conclusion

The wise utilization of technology and updated knowledge under changing climate, global and local scenario can help farmers do resilient and profitable agriculture.

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Higher Production of *Flemingia semialata* Seeds by Mulching with Silver / Black Polyethylene

Article ID: 30505

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Introduction

India is highest producer (16352 tons) of lac in the world. Lac production is one of the most important sources of livelihood of tribal people in India. For lac production tribal people mostly depend on host plants which mostly grow in forest areas. These trees are reducing in number due to deforestation. Also, lac production from these trees is difficult as it requires climbing on trees. Further, gestation period of these trees is 5-15 years. These problems of lac production can be mitigated to a larger extent by adopting semialata as host plant. Semialata is bushy leguminous plant of 5-6 ft. height. Semialata can be grown in any type of land except marshy land. The plant of semialata becomes ready for lac cultivation in one year. Being short in height all lac culture operations can be carried out from ground itself which can be performed by women also. The seeds of semialata are costly (Rs.2000-4000/Kg) and are not easily available.

In India, lac is found in the forests of Jharkhand, Chattisgarh, West Bengal, Orissa, Madhya Pradesh, Utter Pradesh, some pockets of Deccan plateau, Rajasthan, Gujarat and Assam (Srivastava, 2011). Lac is secreted by an insect *Kerria lacca (Kerr.)*, which thrives on host plants. The major host plants include fourteen species in which *Kusum* (*Schleichera oleosa*), *Palas* (*Butea monosperma*), and *Ber* (*Ziziphus mauritiana*) are the excellent hosts in India. In addition to these host plants, *Flemingia semialata* and *F. macrophylla* are the emerging host plants which are found to be economically suitable. In India, the number of host plants recorded for Indian Lac insect is 129 and out of which 19 host plants are of good quality and commercially important (Sharma, 2017). Lac host plants of Indian Lac insect and their distribution which are of commercial and specific importance is shown in table 1

Table 1: Lac host plant of commercial and specific importance and their distribution:

Host plant	Common name	and their distribution
Butea monosperma	Palas	All over India
Schleichera oleosa	Kusum	All over India
Zizyphus mauritiana	Ber	All over India
Flemingia semialata	Van chhola/Semialata	All over India
Flemingia macrophylla	Bhalia	All over India

(Source: Sharma, 2017; Kumar and Kumar, 2013).

Raising of Semialata Plantation

Semialata plants can be transplanted in field from nursery in the month of July and from next July they become ready for lac production. Raising plantation in triangular system in paired row is most suitable for *semialata*. Spacing for paired row method is kept 1.0 meter between plant to plant and 0.75 meter between one paired row. Between two paired rows, two-meter space is given for sufficient aeration and to facilitate mechanical operations like ploughing by power tiller. This space may also be utilized for inter cropping of suitable vegetables. In this system, 8,000 plants are accommodated in one hectare of land. This option provides opportunity of intercropping of vegetables like ginger/okra, tomato and bitter gourd during kharif, rabi and zaid seasons, respectively, for additional income to growers.

Water Management

Under lac cultivation, the plant requires moderate amount of irrigation after November, as ground water level starts falling after this month. Lac is harvested in the month of February, but *semialata* seeds are collected in the month of April. Therefore, need for water is much more felt in seed production. Day by day water is going to be a scarce resource. To preserve it in judicious manner is the need of the hour. Plastic mulch has emerged to be one of the successful measures in this direction. In one hand it is a cheap material and on other hand it reduced evaporation significantly. Thus, it saves water significantly.

Silver / Black Polyethylene

The thickness of silver/black polyethylene is kept as 25 microns. The width of the silver/black polyethylene is kept as 130 cm and the length is kept equal to the length of row.

For laying silver/black polyethylene in *semialata* field, the field is ploughed well. After that soil is made smooth so that polyethylene remains in contact of the soil which enables sun light to warm the soil resulting in faster growth of plant. A trench of 6 inches depth is dug around each paired row. The polyethylene is anchored in this trench with the help of soil.

By the use of silver/black polyethylene as mulch in furrow irrigation in *semialata*, 51.74% higher seed yield can be obtained even when 50% less amount of water is supplied.

Effect of Silver / Black Polyethylene

Weeds hamper growth of any crop as they compete with crop for water and nutrients. Silver/black polyethylene completely absorbs sun light which cuts sun light to weeds which are growing beneath it. This retards the growth of weeds as no photosynthesis takes place and they die. By the use of silver/black polyethylene in furrow irrigation of *Flemingia semialata* a 52.48% reduction in weed weight can be achieved.

Crop Yield

Normally by using paired row triangular method of plantation one can harvest 41.28 kg *semialata* seed from one-hectare plantation. By using silver/black polyethylene mulch with furrow irrigation, a yield of 62.64 Kg of *Flemingia semialata* seeds per hectare can be obtained with the supply of 50% less water.

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Impacts of Climate Change on Insect Pest

Article ID: 30506

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Introduction

Agriculture is the basic activity by which humans live and survive on the earth. Assessing the impacts of climate change on agriculture is a vital task. In both developed and developing countries, the influence of climate on crops and livestock persists despite irrigation, improved plant and animal hybrids and the growing use of chemical fertilizers. The continued dependence of agricultural production on light, heat, water and other climatic factors, the dependence of much of the world's population on agricultural activities, and the significant magnitude and rapid rates of possible climate changes all combine to create the need for a comprehensive consideration of the potential impacts of climate on global agriculture.

Global Changes in Climate Will Influence

1. Activity, diversity and abundance of insect-pests.
2. Geographical distribution of insect-pests.
3. Development.
4. Expression of host-plant resistance to insects.
5. Pest outbreaks and invasion.
6. Effectiveness of crop protection technologies.

Direct Impacts of Climate Change on Population Dynamics

1. Development & Reproduction.
2. Diapauses.
3. Mortality.
4. Flight & dispersal.

Impact of Climate on Insect Pest Scenario

Climate change driven global warming is affecting the distribution, demography and life history of many species, particularly insects. It is also influencing the phenology of insects including arrival times and emergence time of a range of insects. These changes are having, and will have, consequences for human livelihoods, including an increased spread of pest and diseases of important crops. Following are the notable effects of climate change on insect pest scenario and pest population dynamics.

1. Expansion of geographic ranges: Altered temperature and rainfall regimes with the predictable changes in climate will determine the future distribution, survival and reproduction of the species. With rise in temperature, the insect-pests are expected to extend their geographic range from tropics and subtropics to temperate regions at higher altitudes along with shifts in cultivation areas of their host plants. This may lead to increased abundance of tropical insect species and sudden outbreaks of insect-pests can wipe out certain crop species, entirely. At the same time; warming in temperate region may lead to decrease in relative abundance of temperature sensitive insect population. In future, projected climate warming and increased drought incidence is expected to cause more frequent insect outbreaks in temperate regions also.

Range extension in migratory species like *Helicoverpa armigera* (Hubner), a major pest of cotton, pulses and vegetables in North India is predicted with global climate warming. Subsequently, these ongoing shifts in insect-pest distribution and range due to changing climate may alter regional structure, diversity and functioning of ecosystems.

2. Increase in number of generations: As temperature being the single most important regulating factor for insects. Global increase in temperature within certain favourable range may accelerate the rates of development, reproduction and survival in tropical and subtropical insects. Consequently, insects will be capable of completing more number of generations per year and ultimately it will result in more crop damage.

3. Risk of introducing invasive alien species: According to the Convention on Biological Diversity (CBD), invasive alien species are the greatest threat to loss of biodiversity in the world and impose high costs to agriculture, forestry and aquatic ecosystems by altering their regional structure, diversity and functioning.

It is expected that global warming may exacerbate ecological consequences like introduction of new pests by altering phenological events like flowering times especially in temperate plant species as several tropical plants can withstand the phenological changes. Invasion of new insect-pests will be the major problem with changing climate favouring the introduction of insect susceptible cultivars or crops.

4. Impact on pest population dynamics and outbreaks: Changes in climatic variables have led to increased frequency and intensity of outbreaks of insect-pests. It may result in upsetting ecological balance because of unpredictable changes in the population of insect-pests along with their existing and potential natural enemies. Outbreak of sugarcane woolly aphid *Ceratovacuna lanigera* Zehntner in sugarcane belt of Karnataka and Maharashtra states during 2002-03 resulted in 30% yield losses. These situations of increased and frequent pest damage to the crops have made another big hole in the pockets of already distressed farmers by increasing the cost of plant protection and reducing the margin of profit.

5. Breakdown of host plant resistance: Expression of the host plant resistance is greatly influenced by environmental factors like temperature, sunlight, soil moisture, air pollution, etc. Under stressful environment, plant becomes more susceptible to attack by insect-pests because of weakening of their own defensive system resulting in pest outbreaks and more crop damage. Thermal and drought stress associated breakdown of plant resistance have been widely reported. With global temperature rise and increased water stress, tropical countries like India may face the problem of severe yield loss in sorghum due to breakdown of resistance against midge *Stenodiplosis sorghicola* (Coq.) and spotted stem borer *Chilo partellus* Swinhoe.

The environmental factors like high temperature have been found affecting transgene expression in Bt cotton resulting in reduced production of Bt toxins, this lead to enhanced susceptibility of the crops to insect-pests like bollworms viz., *Heliothis virescens* (F.), *Helicoverpa armigera* (Hubner) and *Helicoverpa punctigera* (Wallen).

6. Increased incidence of insect vectored plant diseases: Climate change may lead to more incidence of insect transmitted plant diseases through range expansion and rapid multiplication of insect vectors. Increased temperatures, particularly in early season, have been reported to increase the incidence of viral diseases in potato due to early colonization of virus-bearing aphids, the major vectors for potato viruses in Northern Europe.

For laying silver/black polyethylene in *semialata* field, the field is ploughed well. After that soil is made smooth so that polyethylene remains in contact of the soil which enables sun light to warm the soil resulting in faster growth of plant. A trench of 6 inches depth is dug around each paired row. The polyethylene is anchored in this trench with the help of soil.

By the use of silver/black polyethylene as mulch in furrow irrigation in *semialata*, 51.74% higher seed yield can be obtained even when 50% less amount of water is supplied.

Pest Management Adaptations to Changing Pest

1. Breeding climate-resilient varieties: To minimize the impacts of climate and other environmental changes, it will be crucial to breed new varieties for improved resistance to abiotic and biotic stresses. Considering late onset and/ or shorter duration of winter, there is chance of delaying and shortening the growing seasons for certain Rabi/ cold season crops. Hence, we should concentrate on breeding varieties suitable for late planting and those can sustain adverse climatic conditions and pest and disease incidences.

2. Alternation in sowing dates of crops: Global climate change would cause alternation in sowing dates of crops which alter host-pest synchrony. There is need to explore changes in host plant interaction under early, normal and late sown conditions in order to recommend optimum sowing dates for reduced pest pressure and increased yield.

3. Rescheduling of crop calendars: As such, certain effective cultural practices like crop rotation and planting dates will be less or non-effective in controlling crop pests with changed climate. Hence there is need to change the crop calendars according to the changing crop environment. The growers of the crops have to change insect management strategies in accordance with the projected changes in pest incidence and extent of crop losses in view of the changing climate.

4. GIS based risk mapping of crop pests: Geographic Information System (GIS) is an enabling technology for entomologists, which help in relating insect-pest outbreaks to biographic and physiographic features of the landscape, hence can best be utilized in area wide pest management programmes. How climatic changes will affect development, incidence, and population dynamics of insect-pests can be studied through GIS by predicting and mapping trends of potential changes in geographical distribution of agro-ecological hotspots and future areas of pest risk.

5. Screening of pesticides with novel mode of actions: It has been reported that, application of neonicotinoid insecticides for controlling sucking pests induces salicylic acid associated plant defence responses which enhance plant vigour and abiotic stress tolerance, independent of their insecticidal action. This gives an insight into investigating role of insecticides in enhancing stress tolerance in plants. Such more compounds need to be identified for use in future crop pest management.

In addition to the strategies discussed above, we need to decide the future line of research and devise policies for combating the pest problems under climate change regimes. Some of these are:
1. Evolve temperature tolerance strains of natural enemies.
2. Development of Weather and pest forecasting models.
3. Developing early warning systems/decision support systems.
4. Awareness regarding impacts of climate change.
5. Adoption of mitigation and adaptation measures.
6. Sensitization of stakeholders about climate change and its impacts.
7. Farmers' participatory research for enhancing adaptive capacity.
8. Promotion of resource conservation technologies.

Conclusion

In India, pest damage varies in different agro-climatic regions across the country mainly due to differential impacts of abiotic factors such as temperature, humidity and rainfall. This entails the intensification of yield losses due to potential changes in crop diversity and increased incidence of insect-pests due to changing climate. It will have serious environmental and socio-economic impacts on rural farmers whose livelihoods depend directly on the agriculture and other climate sensitive sectors. Dealing with the climate change is really tedious task owing to its complexity, uncertainty, unpredictability and differential impacts over time and place. Understanding abiotic stress responses in crop plants, insect-pests and their natural enemies is an important and challenging topic ahead in agricultural research. Impacts of climate change on crop production mediated through changes in populations of serious insect-pests need to be given careful attention for planning and devising adaptation and mitigation strategies for future pest management programmes.

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Agriculture: Impact of covid-19 on Agriculture sector

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Abstract

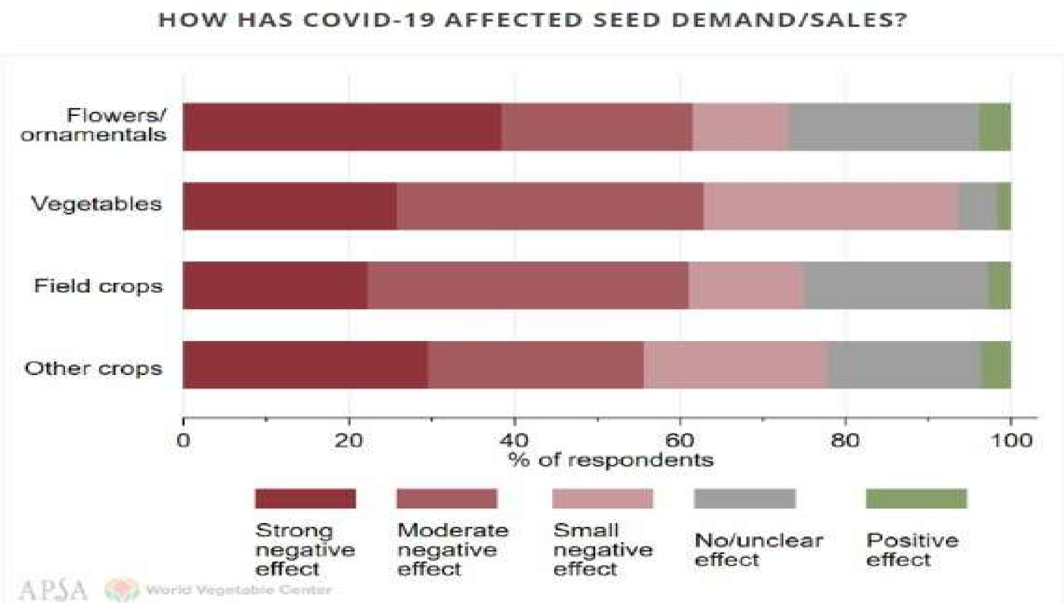
The ongoing health crisis COVID-19 has affected all walks of life. Protecting lives of people suffering from the disease as well as frontline health responders have been the priority of nations. Governments have swung into actions since the Corona virus attack created an unprecedented situation. India has declared a lockdown for achieving satisfactory containment of the virus spread. During these challenging times, how does Indian Agriculture respond to the crisis and how do government measures affect 140 million farm households across the country and thereafter impact the economy of a very important country in the developing world? We assess the immediate challenges that COVID19 has posed to the farm sector and suggest mitigation measures to ensure a sustainable food system in the post-crisis period.

Introduction

A novel corona virus, designated as covid-19,emerged in Wuhan, China, at the end of 2019.The World Health Organisation (WHO) has declared outbreak of COVID-19 as a public health emergency of international concern. Coronavirus disease (COVID-19) is an infectious disease caused by a newly discovered coronavirus. Most people infected with the COVID-19 virus will experience mild to moderate respiratory illness and recover without requiring special treatment. Older people, and those with underlying medical problems like cardiovascular disease, diabetes, chronic respiratory disease, and cancer are more likely to develop serious illness. The COVID-19 virus spreads primarily through droplets of saliva or discharge from the nose when an infected person coughs or sneezes, so it's important that you also practice respiratory etiquette (for example, by coughing into a flexed elbow). As public life shut down around world and health system week under the strain of the COVID-19 pandemic, affecting food system, food security and agricultural livelihoods.

Impact on Agriculture and its Allied Sector

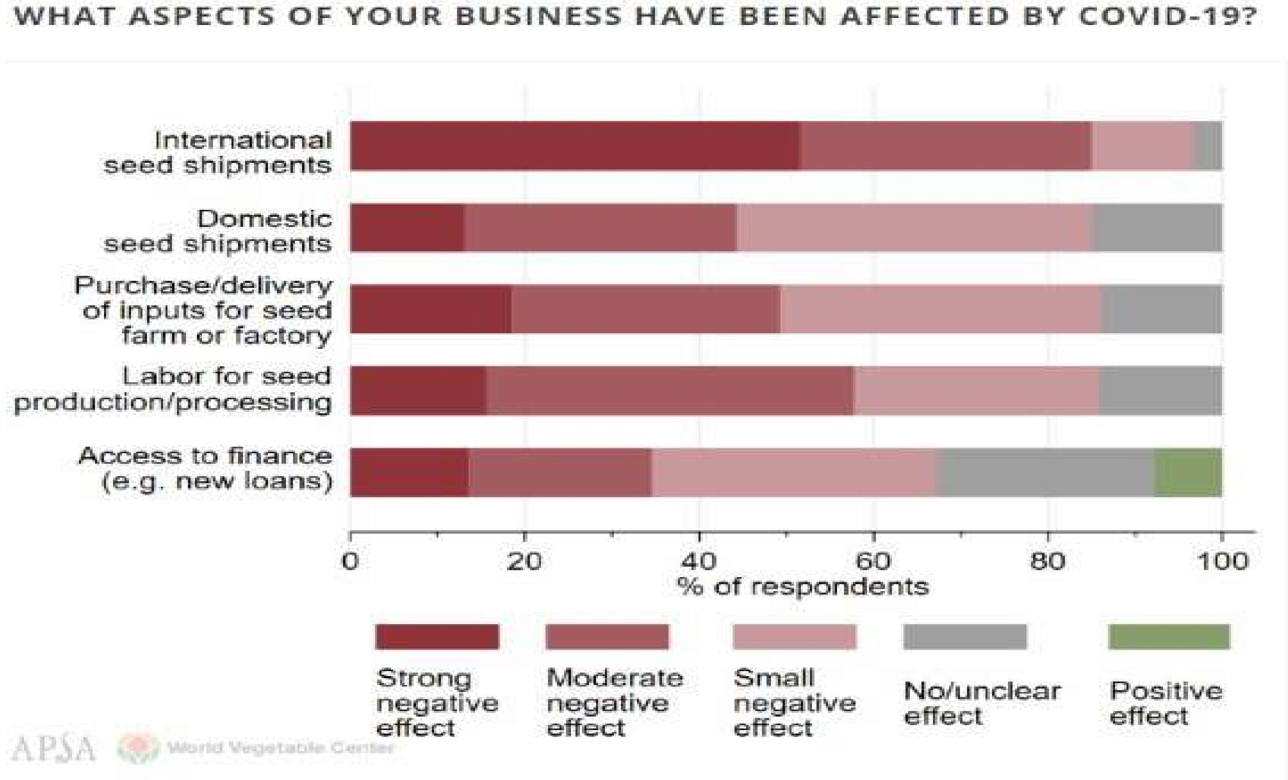
1. Seed business widely affected: With the coronavirus affecting India, China, the USA, Germany, France, the Netherlands, Italy, Spain, Brazil and other major countries involved in seed production , the import and export of seed is likely to be affected badly in the next planting/sowing season as there is the possibility of huge gap between the demand and supply.



Source: https://www.apsaseed.org/asia-pacific-seed-trade-reeling-from-covid-19-lockdown-survey/

The demand-supply gap would be much higher for high value seeds, particularly those of some vegetables and fruits varieties that are produced in the European countries. Of the 62 respondents involved in the vegetable seed trade, 58 (93%) reported a negative effect on the demand for vegetable seed, of which 26% reported a strong negative effect (see the graph below). Fewer respondents were active in flowers and field crops, and about 75% of them reported a negative effect on seed demand with 38% reporting a strong negative effect on the demand for flower seed.

The second graph shows that nearly all aspects of the seed business are negatively affected with more than 85% of respondents reporting negative effects on international and domestic seed shipments, difficulties in getting inputs, and difficulties getting labor for seed production and processing. Reduced access to finance was also reported by 64% of the respondents. Yet, international seed shipments clearly appear as the most severely affected aspect of the seed industry with 52% of the respondents reporting a strong negative effect.



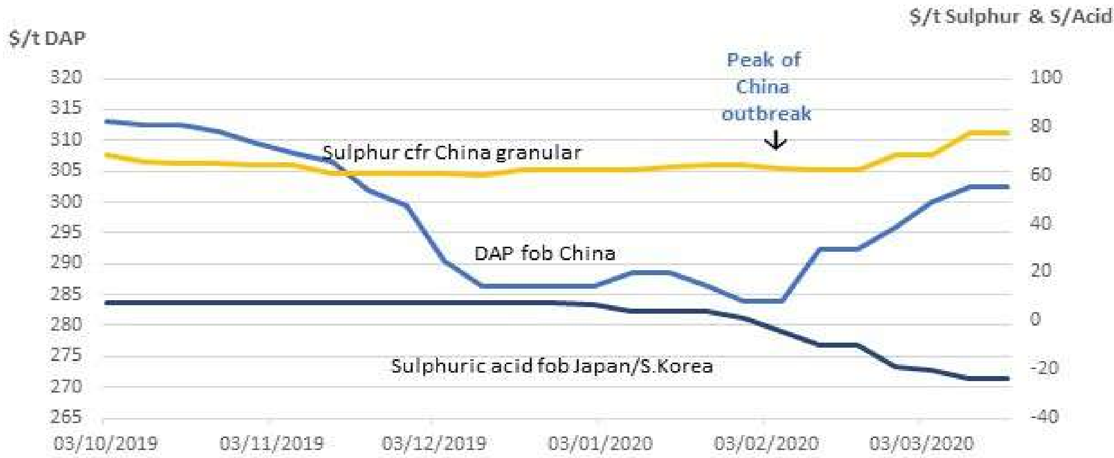
Source: https://www.apsaseed.org/asia-pacific-seed-trade-reeling-from-covid-19-lockdown-survey/

2. Covid-19 hit prices, Dairy and Poultry sector: The dairy farmers are also facing losses due to the lockdown. Nationwide lockdown has been imposed in backdrop of COVID-19 outbreak. Milk price dipped to almost half amid pandemic and farmers are forced to sell the milk at low prices.

The poultry industry in different parts of the India has been hit hard amid rumors that the novel coronavirus can transmitted through consumption of chicken, the prices of which have fallen considerably as a result. About two crore people employed in the poultry industry across India have been impacted. People were avoiding consumption of meat, fish, chicken, and egg etc. Due to the fall in demand, wholesale price of chicken had dropped by as much as 70 per cent.

3. Decline production on fertilizer industry: The fertilizer sector has been affected since the outset, primarily in China, the most significant producer and consumer for phosphates, Sulphur and sulphuric acid. Due novel corona virus Chinese fertilizer sector, affecting the movement of both, the supply of fertilizer and raw material has been decreased, while going forward it could hit the Brazil and India fertilizer industry.

The reaction on prices however has been mixed with tighter supply of phosphates, due to the production constraints in China, prompting a reversal in the downward trend while the price of sulphuric acid, already weak, has all but collapsed. In response to the increase in domestic phosphate prices to prevent the "unreasonable increase of prices".



Source: https://ihsmarkit.com/research-analysis/report-covid19-effects-on-the-fertilizer-industry.html

4. Mitigation measures: Covid-19 pandemic has deeply caused the agriculture sector as it slows down supply chains, delays logistics, and reduces workers in farmlands. At these situation automation and Artificial Intelligence technologies can play a significant role. They are able to make the monitoring of crops, soil and the entire farmland and can also provide data of the land to farmers that can help them predict the condition of crop and soil. AI systems can also help improve the harvest quality and accuracy by detecting the diseases in plants, pests, poor plant nutrition, and more. Several tech giants as well as startups are trying to fight agricultural issues by creating farming, irrigation and weather technology solutions. Microsoft precision agriculture, for instance, attempts to democratizing artificial intelligence for farmers worldwide.

The small and medium enterprises, running with raw materials from the agriculture and allied sector need special attention so that the rural economy doesn't collapse.

To obviate the immediate concerns of scarcity of farm labor, policies must facilitate easy availability of machinery through state entities, Farmer Producer Organizations (FPOs) or custom hiring centers (CHCs) with suitable incentives.

Relaxation of the norms by Agricultural Produce Market Committees (APMCs) allowing farmers to sell their produce beyond the designated mandis will certainly ease the burdens of farmers. State Governments must gear up their machineries for smooth procurement operations of farmers' marketable surpluses at MSP (minimum support price) or through other price support schemes.

With a burgeoning population, there is a corresponding rise in food demand in India. However, the negative externalities of the Green Revolution, particularly the environmental trade-offs and staple cereals fundamentalism, have since been realized. It is thus desirable to switch over to a suitable model with a far stronger nutrition focus where diets are more diverse. A post-COVID situation offers that unique opportunity to repurpose the existing food and agriculture policies for a healthier population.

Conclusion

The post-pandemic phase may result in major reviews of food systems, with special emphasis on resilience. This also affords opportunities for changes in agri-food systems that may make better use of locally produced foods. Development of safe and effective foods to promote immune function should be a priority for the food industry and governments. This may include foods for medical use by the elderly population, as well as other vulnerable groups.

The food science and technology community should contribute to the recovery of the food sector along with other sectors and disciplines. Food scientists and technologists should have a stronger role in government policy and contingency planning to ensure the resilience of the food supply chain in responding to future pandemics, including other civil emergencies.

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Headway in Agriculture

Article ID: 30508

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A technological revolution in farming led by advances in robotics and sensing technologies looks set to disrupt modern practice.

Farmers have adopted more innovative technology for get maximum profit in farming, and advances in robotics and sensing technologies are threatening to disrupt today's agribusiness model. Twenty-first century robotics and sensing technologies have the potential to solve problems as old as farming itself. "I believe, by moving to a robotic agricultural system, we can make crop production significantly more efficient and more sustainable," .In green- houses devoted to fruit and vegetable production, engineers are exploring automation as a way to reduce costs and boost quality. Devices to monitor vegetable growth, as well as robotic pickers, are currently being tested. For livestock farmers, sensing technologies can help to manage the health and welfare of their animals. And work is underway to improve monitoring and maintenance of soil quality, and to eliminate pests and disease without resorting to indiscriminate use of agrichemicals.

Drones with precision sprayers (insert) apply agrochemicals only where they are needed.

Although some of these technologies are already available, most are at the research stage in labs and spin-off companies. If they succeed, we can use technology to double food production.

Eliminating Enemies

The Food and Agriculture Organization of the United Nations estimates that 20–40% of global crop yields are lost each year to pests and diseases, despite the application of around two-million tonnes of pesticide. Intelligent devices, such as robots and drones, could allow farmers to slash agrichemical use by spotting crop enemies earlier to allow precise chemical application or pest removal.

"We predict drones, mounted with multispectral cameras, will take off every morning before the farmer gets up, and identify where within the field there is a pest or a problem," As well as visible light, these cameras would be able to collect data from the invisible parts of the electromagnetic spectrum that could allow farmers to pinpoint a fungal disease, Scientists from Carnegie Mellon have begun to test the theory in sorghum *(Sorghum bicolor).*

Agribotix, an agriculture data-analysis company supplies drones and software that use near-infrared images to map patches of unhealthy vegetation in large fields. Images can also reveal potential causes, such as pests or problems with irrigation. The company processes drone data from crop fields in more than 50 countries. It is now using machine learning to train its systems to differentiate between crops and weeds, and hopes to have this capability ready for the 2017 growing season. "We will be able to alert saying you have weeds growing in your field, here and here," says crop scientist Jason Barton, an executive at Agribotix.

Modern technology that can autonomously eliminate pests and target agrichemicals better will reduce collateral damage to wildlife, lower resistance and reduce costs. Rather than spraying a whole field, the pesticide could be delivered to the right spot in the quantity needed. The potential reductions in pesticide use are impressive.

Animal Tracker

Smart collars a bit like the wearable devices designed to track human health and fitness — have been used to monitor cows in Scotland since 2010. Developed by Glasgow start-up Silent Herdsman, the collar monitors fertility by tracking activity — cows move around more when they are fertile — and uses this to alert farmers to when a cow is ready to mate, sending a message to his or her laptop or smartphone. Cameras are also improving the detection of threats to cow health. The inflammatory condition mastitis — often the result of a bacterial infection — is one of the biggest costs to the dairy industry, causing declines in milk production or even death. Thermal-imaging cameras installed in cow sheds can spot hot, inflamed udders, allowing animals to be treated early.

Now working on downsizing a stress monitor designed for people so that it will attach to a cow's ear tag. "The more you stress an animal, the less energy is available from food for growth". The monitor takes 200 physiological measurements a second, alerting farmers through a smartphone when there is a problem.

Silicon Soil Saviours

The richest resource for arable farmers is soil. But large harvesters damage and compact soil, and overuse of agrichemicals such as nitrogen fertilizer are bad for both the environment and a farmer's bottom line. Robotics and autonomous machines could help.

Data from drones are being used for smarter application of nitrogen fertilizer. "Healthy vegetation reflects more near-infrared light than unhealthy vegetation". The ratio of red to near-infrared bands on a multispectral image can be used to estimate chlorophyll concentration and, therefore, to map biomass and see where interventions such as fertilization are needed after weather or pest damage. When French agricultural technology company Airinov, which offers this type of drone survey, they found that over a period of 3 years, in 627 fields of oilseed rape *(Brassica napus)*, farmers used on average 34 kilograms less nitrogen fertilizer per hectare than they would without the survey data.

Soil mapping opens the door to sowing different crop varieties in one field to better match shifting soil properties such as water availability. You could differentially seed a field, for example, planting deep-rooting barley or wheat varieties in more sandy parts, growing multiple crops together could also lead to smarter use of agrichemicals. Nature is strongly against monoculture, which is one reason we have to use massive amounts of herbicide and pesticides. "It is about making the best use of resources."

Mixed sowing would challenge an accepted pillar of agricultural wisdom: that economies of scale and the bulkiness of farm machinery mean vast fields of a single crop is the most-efficient way to farm, and the bigger the machine, the more-efficient the process. Some of the heaviest harvesters weigh 60 tonnes, cost more than a top-end sports car and leave a trail of soil compaction in their wake that can last for years. But if there is no need for the farmer to drive the machine, then one large vehicle that covers as much area as possible is no longer needed. As soon as you remove the human component, size is irrelevant. Small, autonomous robots make mixed planting feasible and would not crush the soil. Experiment with a hectare of barley. We plan to grow and harvest the entire crop from start to finish with no humans entering the field. The experiment will use existing machinery, such as tractors, that have been made autonomous, rather than new robots, but their goal is to use the software developed during this trial as the brains of purpose-built robots in the future. "Robots can facilitate a new way of doing agriculture''. Many of these disruptive technologies may not be ready for the prime time just yet, but the revolution is coming.

Plastic Mulching: Increase Vegetable and Fruit Productivity

Article ID: 30509

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Introduction

Weeds become the biggest problems for farmers. To save the crop from them, farmers make weeding but there is a lot of expenditure on this. At this time mulching can be quite effective for farmers. Many farmers face the problem that the productivity of crops in their fields is gradually decreasing, such farmers can increase the productivity of farming by using plastic mulching. Plastic mulching is the system of covering the ground of the plants in the field properly by plastic film. This film comes in many types and many colours.

Selection of Plastic Mulch Film

The color of plastic mulch film can be black, transparent, milky, mirrored, blue, red etc and selection also based on width and thickness of film.

1. Black film: Black film helps in conserving moisture in the soil, preventing weeds and controlling the temperature of the land. Mostly black colored plastic mulch film is used in gardening.

2. Reflective film containing milky or silver color: This film preserves moisture in the soil, weeds control as well as lowers the temperature of the land.

3. Transparent film: This film is mostly used in solarization of land. It can also be used for farming in cold climates.

4. Width of the film: While choosing the film used in plastic mulching, special attention should be paid to its width so that it can be very helpful in agricultural operations. Generally, 90 cm only films with width ranging from 180 cm are used.

5. Film thickness: In plastic mulching, the thickness of the film should be according to the type and age of the crop.

What is the Benefit of This Technique?

With this technique, the water moisture in the field is maintained and evaporation is prevented. This technique also prevents soil erosion in the field. And weeds in the field are prevented from happening. It is very helpful in controlling weeds in horticulture and keeping plants safe for a long time. It can be saved from hardening of the soil and the growth of the roots of the plants is good.

How to Use it in Vegetable Crops?

In the field where the vegetable crop is to be planted, first plow it well and then gets a suitable amount of cow dung and testing of soil must be there for better output. Then make a raised bed in the field. And lay a drip irrigation pipeline on them. Then lay a 25 to 30-micron plastic mulch film which is better for the vegetables and both sides of the film are pressed with a layer of soil. You can also press it with a tractor driven machine. Then, in the rounding on that film, make a distance of the pods from the pods by punching them. Plant seedlings in prepared holes or seedlings prepared in nursery.

Its Use in Fruit Crop

Its use for fruit plants as far as the shade of that plant is concerned. It is advisable to do so. For this, cut the film by cutting the length and width of the mulch. After that, clean the uprooted grass and weeds under the seedlings thoroughly and then set the irrigation tube properly. After doing 100-micron plastic film mulch which is suitable for fruit growing plants.

It has to be well placed around the trunk of the plant with hands. Then its four corners have to be covered with a layer of soil from 6 to 8 inches.

Precautions While Doing Plastic Mulching in the Field

1. Plastic film should always be applied in the morning or evening.
2. There should not be too much tension in the film.
3. Whatever stress happened in the film, only after removing that we move further.
4. Carefully take care of the irrigation tube while making holes in the film.
5. Make the holes the same and take care of the film not torn.
6. Keep both sides the same in mounting soil.
7. Always make a hole in round shape in the film.
8. Protects the film from bursting so that it can be used for a second time and protects it after use.

How Much Does the Cost of Plastic Mulching Come?

The cost of mulching can be less as it is due to the making of the beds in the field. Because the beds are of different sizes according to different crops and the price of plastic film in the market is also low. It can cost around 8000 rupees per bigha, and if you use instruments in the soil, then it is also added into cost.

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Cyantraniliprole - A New Potent Insecticide to Mitigate Resistance in Insects

Article ID: 30510

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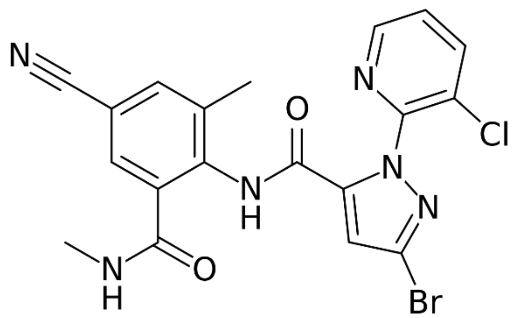
DuPont Cyazypyr (DPX-HGW86, cyantraniliprole 10.26% OD) is the second generation anthranilic diamide compound (IRAC Group 28 insecticides) to be commercialized. It has excellent cross-spectrum efficacy on both sucking and chewing pests of agronomic crops throughout the world, including rice. It is worth noting that the product shows the unique pest control with little to no adverse impact on beneficial arthropods in rice agro-ecosystems. Cyazypyr controls important rice pests including the brown plant hopper, green leafhopper, leaf rollers, stem borers, whorl maggots, leaf beetles, thrips and rice water weevil, while still preserving important predators and parasitoids that augment pest controls. Therefore, the product will be an important aspect of IPM programs. Cyazypyr also provides superior plant protection from hopperburn and other types of pest feeding damage. Remarkably the product also causes significant reductions in pest-vectored rice plant diseases including the rice grassy stunt virus (RGSV) and the rice ragged stunt virus (RRSV) by plant hoppers, and the rice tungro virus by leafhoppers. Further to the superb pest control and plant protection features, Cyazypyr also controls insect populations that are resistant to other insecticides. So, there is no known cross resistance between Cyazypyr and other existing products, thus making it a valuable rotational partner in IRM programs.



Forensic Entomology

Article ID: 30511

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Forensic entomology is the application and study of insects and other arthropods biology to legal issues, especially in a court of law. Flies and beetles follow a life cycle that allow scientists to estimate how long a body has been deceased.

First Forensic Entomology Case Recorded

A murder by slashing occurred in a village, and the local death investigator was ordered to solve the crime. The investigator had all villagers bring their sickles to one spot and lay them out before the crowd. Flies were attracted to one of the sickles, probably because of invisible remnants of tissue still remaining on it, and the owner subsequently broke down and confessed to the crime.

What Do Forensic-Then Entomologists Do?

Forensic Entomologists apply their knowledge of entomology to provide information for criminal investigations.
A forensic entomologist's job may include:
1. Identification of insects at various stages of their life cycle, such as eggs, larva, and adults.
2. Collection and preservation of insects as evidence.
3. Determining an estimate for the post-mortem interval or PMI (the time between death and the discovery of the body) using factors such as insect evidence, weather conditions, location and condition of the body, etc.
4. Testifying in court to explain insect-related evidence found at a crime scene.

Insects as Evidence

Most insects used in investigations are in two major orders Flies (Diptera) and Beetles (Coleoptera).

Five Stages of Decomposition Fuelled by Insect Activity

1. Fresh Stage:

a. Begins at death.
b. Flesh flies, blow flies, ants eating fly eggs and predatory wasps.
c. First sign of bloating due to putrefaction by anaerobic bacteria.
d. Autolysis, the degradation of complex protein and carbohydrate molecules, occurs.

2. Bloat: Swells due to gases produced by bacteria. Flies still present adult and larval blowflies attracted to seepage and soil fauna moves away due to wetness of earth.

3. Decay: Gases subside, decomposition fluids seep from body. Bacteria and maggots break through the skin. Predatory beetles such as rove and blister beetles are attracted. Larvae beginning to pupate.

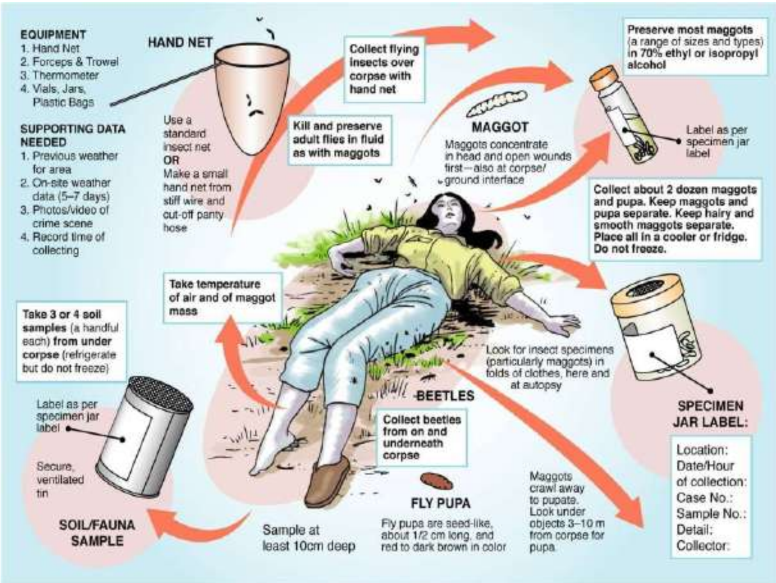
4. Post decay: In dry habitats - remains consist of dry skin, cartilage and bones; site for dermestid beetles, histerids, fly pupae, immature and adult rove beetles.

In wet habitats – large quantities of wet, viscous material (by products of decomposition) found in soil under the remains; site for adult and immature moth flies, rove beetles

5. Dry (Skeletal): Some dermestids, fly pupae, immature and adult rove beetles, normal soil fauna consisting of mites, etc. start to return; this stage could last for several months to years.

Collection of Entomological Evidence

1. Camera & video, to fix the evidence site.
2. Net to catch fly, etc. Sticky traps are also used instead.
3. Collection of paraphernalia: Live specimen containers, killed creature's container jar, forceps, spoon, small paint-brushes.
4. Preservation usually 98% alcohol (ethanol) is used.
5. Recording materials like labels, pencil, ruler, crime scene from, if any, prescribed by authorities.
6. Gloves and hand towels are usually taken along to maintain hygiene.



Detectors Used in Gas Chromatography

Article ID: 30512

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Detectors

1. It is the brain of any chromatography technique.
2. The choice of the detector depends upon the type of analysis being performed.

Requirement of an Ideal Detector

1. High sensitivity
2. Good stability and reproducibility
3. A linear response to solutes
4. Physically suitable
5. Capable of operable up to maximum column temperature (4000c)
6. No response to undesirable compounds
7. Respond to the compounds for which analysis is required
8. Inexpensive
9. Non-destructive to sample.

Detectors Used in GC

1. Concentration flow detectors:

a. Thermal conductivity detector.
b. Electron capture detector.
c. Flame ionisation detector.

2. Mass flow detectors:

a. Flame photometric detector.
b. Nitrogen-phosphorous detector or Flame thermo ionic detector.

3. Thermal conductivity detector: It is also known as katharometer and hot wire detector. Principle in TCD is change in thermal conductivity of gas stream. Thermal conductivity of most of the samples is lesser than most commonly used carrier gases like H, and He. Since the detector response depends upon the difference in thermal conduction between sample and carrier gas, a large difference is essential. An increase in temperature of the detector causes a change in the resistance of thermistor and this resistance gives a measure a measure of thermal conductivity of gas. TCD consists of a temperature-controlled metal block in which two cylindrical chambers are present, which consists of two filaments made up of platinum or tungsten. Both the filaments are connected to the arms of Wheat stone bridge arrangement. Resistance of filaments are constant as only the carrier gas is passed through them, once the effluent passes through them the change in conductivity is seen and is recorded.

4. Flame ionisation detector:

a. The effluent from the column is mixed with hydrogen & air, & ignited at a small jet. Organic compounds burning in the flame produce ions & electrons which can conduct electricity through the flame. Surrounding the flame is a cylindrical electrode & a relatively high voltage is applied between the jet & the electrode to collect the ions that are formed in the flame.

b. The current resulting from the Pyrolysis of any organic compounds is amplified by a high impedance amplifier & the output fed to a data acquisition system or a potentiometric recorder.

5. Electron capture detector: It is most widely used detector for environmental samples because it selectively responds to halogen containing organic compounds like pesticides, polychlorinated biphenyls. In ECD, the sample eluate from a column is passed over a radioactive β emitter, usually nickel-63 that gives off electrons. The ECD is selective in its response. When organic molecules that contain electronegative functional groups, such as halogens, phosphorous, & nitro groups pass by the detector, they capture some of the electrons & reduce the current measured between the electrodes.

Advantages

1. Simple and reliable.
2. Sensitive to electro-negative groups.
3. Non-destructive.
4. Disadvantages.

Disadvantages

1. Insensitive to amine, alcohol & hydrocarbons.
2. Limited dynamic range.
3. Compounds which have more electron affinity groups.

Flame Photometric Detector

The determination of sulphur or phosphorus containing compounds is the job of the flame photometric detector (FPD). This device uses the chemiluminescent reactions of these compounds in a Hydrogen/Air flame as a source of analytical information that is relatively specific for substances containing these two kinds of atoms. In order to selectively detect one or the other family of compounds as it elutes from the GC column, an interference filter is used between the flame & the photomultiplier tube (PMT) to isolate the appropriate emission beam.

The final component necessary for this instrument is a thermal filter to isolate only the visible & UV radiation emitted by the flame. compounds with a higher ionization potential do not absorb the energy and thus they are not detected. The ions and electrons produced by Photoionization are then collected at pair of biased electrodes. The detector is most sensitive for aromatic hydrocarbons and organosulfur or organophosphorus.

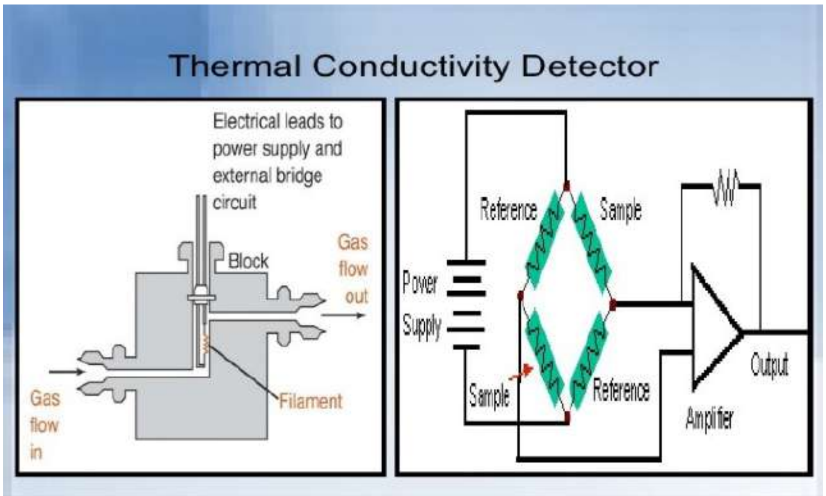
Nitrogen-Phosphorous Detector

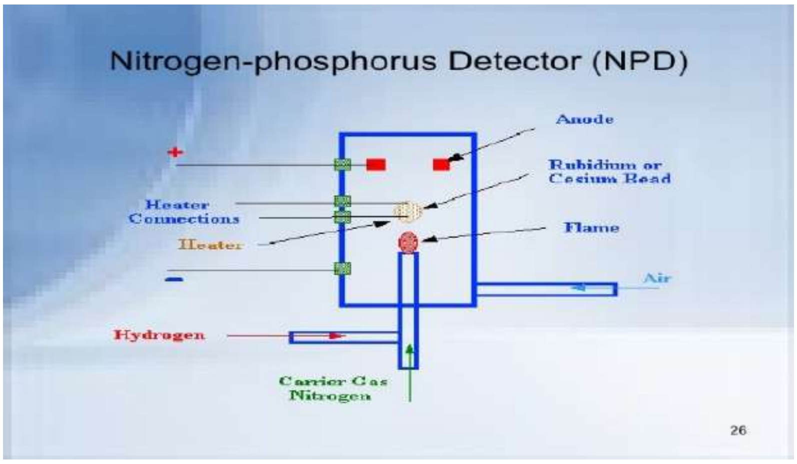
Compounds are burned in a plasma surrounding a rubidium bead supplied with hydrogen and air. Nitrogen and phosphorous containing compounds produce ions that are attracted to the collector. The number of ions hitting the collector is measured and a signal is generated.

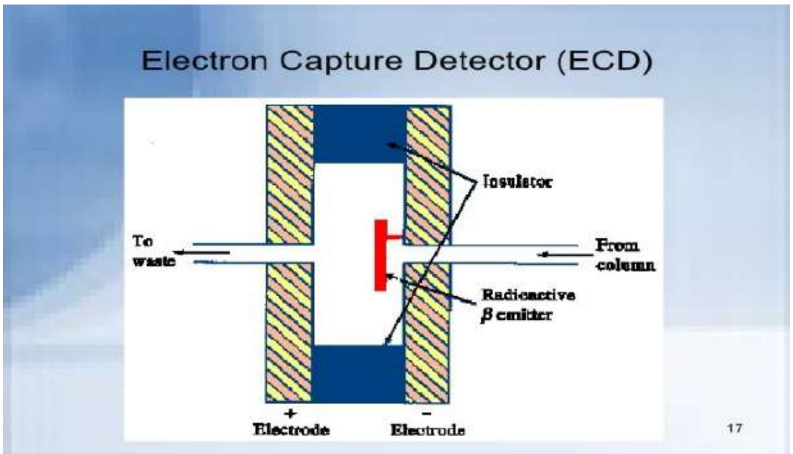
Selectivity: Nitrogen and phosphorous containing compounds

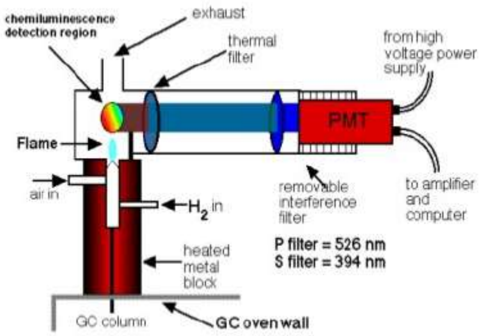
Gases: Combustion - hydrogen and air and Makeup - helium

Temperature:250-300°C.









Flame photometric detector

E-ISSN: 2581 - 8317

Ecological Succession

Article ID: 30513

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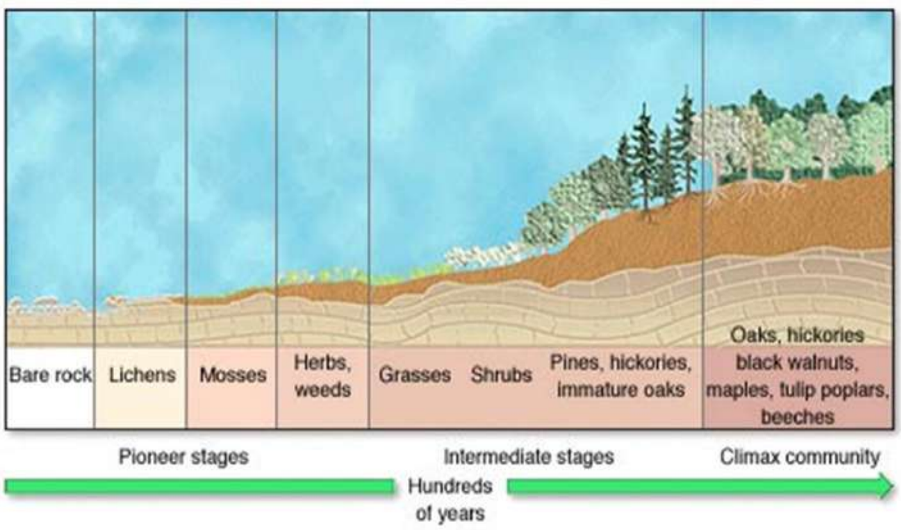
1. The cumulative unidirectional change in community occurring at site is known as SUCCESSION.
2. It is a law of nature and could be represented by the progressive changes in the species composition of community.
3. The term Succession was firstly used by Hult.

What is Ecological Succession?

1. Natural areas are subject to disturbances of many kinds. Humans and natural disturbances such as storms and fires, hurricane, earthquake etc.,
2. Such disturbances have existed so long that animals and plants have adapted to them and benefit from their occurrence
3. The Ecosystem undergo series of patterns of development called ecological succession.
4. There are two types of succession
   a. Primary succession
   b. Secondary succession

Primary Succession

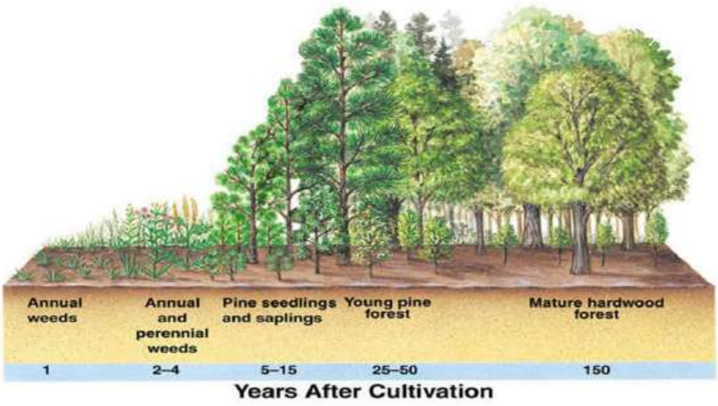
1. The establishment and development of an ecosystem in an area that was previously uninhabited. Begins in a place without any soil:
   a. Sides of volcanoes.
   b. Landslides.
   c. Flooding.
2. First, lichens that do not need soil to survive grow on rocks.
3. Next, mosses grow to hold newly made soil known as PIONEER SPECIES.
4. Soil starts to form as lichens and the forces of weather and erosion help break down rocks into smaller pieces.
5. When lichens die, they decompose, adding small amounts of organic matter to the rock to make soil.



Primary Succession

Secondary Succession

1. Begins in a place that already has soil and was once the home of living organisms.
2. Occurs faster and has different pioneer species than primary succession.
3. Example: After forest fires.



Characters of Succession

1. There is a progressive increase in the total matter of community.
2. There is tendency for increased nutrient conservation as slow loss of nutrients.
3. Nutrient becomes increasingly bound with the organism rather than being tree.
4. Decomposer component becomes dominant and significant.
5. Community become more diverse in terms of number of species and their balance.
6. The community become more diversified and heterogeneous.
7. Simple food chains will be replaced by complex food chains.

Primary succession	Secondary Succession
Begins with no life	Follows removal of existing biota
No soil present	Soil is already present
New area (e.g. Volcanic island)	Old area (e.g. Bush fire)
Lichens and moss come first	Seeds and roots already present
Biomass is low	Biomass is higher

How Do Humans Affect Ecological Succession?

1. Clearing the land for garden and preparing the soil for planting is a type of major external event that radically re-structure and disrupt a previously stabilized ecosystem.
2. This disturbance may immediately begin a process of ecological succession.

Does Ecological Succession Ever Stop?

1. We must recognize that any ecosystem, no matter how inherently stable and persistent, could be subject to massive external disruptive forces (like fires and storms) that could re-set and re-trigger the success ional process.
2. As long as these random and potentially catastrophic events are possible, it is not absolutely accurate to say that succession has stopped.

Detectors Used in High-Performance Liquid Chromatography

Article ID: 30514

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Detectors

1. It is the brain of any chromatography technique.
2. The choice of the detector depends upon the type of analysis being performed.

Requirement of an Ideal Detector

1. High sensitivity
2. Good stability and reproducibility
3. A linear response to solutes
4. Physically suitable
5. Capable of operable up to maximum column temperature (4000c)
6. No response to undesirable compounds
7. Respond to the compounds for which analysis is required
8. Inexpensive.
9. Non-destructive to sample.

HPLC Detectors

1. UV-Visible-spectrophotometer: Any chemical compound could interact with the electromagnetic field. Beam of the electromagnetic radiation passed through the detector flow-cell will experience some change in its intensity due to this interaction. Measurement of this changes is the basis of the most optical HPLC detectors. Radiation absorbance depends on the radiation wavelength and the functional groups of the chemical compound. Electromagnetic field depending on its energy (frequency) can interact with electrons causing their excitation and transfer onto the higher energetical level, or it can excite molecular bonds causing their vibration or rotation of the functional group. The intensity of the beam which energy corresponds to the possible transitions will decrease while it is passing through the flow-cell. According to the Lambert-Bear law absorbance of the radiation is proportional to the compound concentration in the cell and the length of the cell.

Three major regions (IR, visible, and UV) are used in the spectroscopy. In liquid chromatography, IR spectrophotometers have found only limited use. There are few transparent polar liquids which can be used as the mobile phase. On the other hand, spectrophotometers working in the range (200 - 600 nm) are used widely as LC detectors.
UV and visible region of the electromagnetic radiation corresponds to the excitation of the relatively low energy electrons such as pi-electrons, or non-paired electrons of some functional groups.

The majority of organic compounds can be analysed by UV/VIS detectors. Almost 70% of published HPLC analyses were performed with UV/VIS detectors. This fact, plus the relative ease of its operation, makes the UV detector the most useful and the most widely used LC detector.

2. Diode-array-detector: It is also a UV detector. it has two light sources tungsten lamp which is a source of visible light and Deuterium lamp which is a source of UV light. The UV lights is in the path of visible light. The flow cell is positioned before the grating so by the time light arrives at the grating, the intensity of the light at certain wavelengths has been attenuated. The amount of attenuation is dependent on the type and amount of compound eluting through the cell as well as the length of the cell(10mm). Light from the broad emission source is collimated by an achromatic lens system so that the total light passes through the detector cell onto a holographic grating. In this way the sample is subjected to light of all wavelengths generated by the lamp. The dispersed light from the grating is allowed to fall onto a diode array. The array may contain many hundreds of diodes and the output from each diode is regularly sampled by a computer and stored on a hard disc. At the end of the run, the output from any diode can be selected and a chromatogram produced using the UV wavelength that was falling on that particular diode. During chromatographic development, the output of one diode is recorded in real time producing a real time chromatogram.

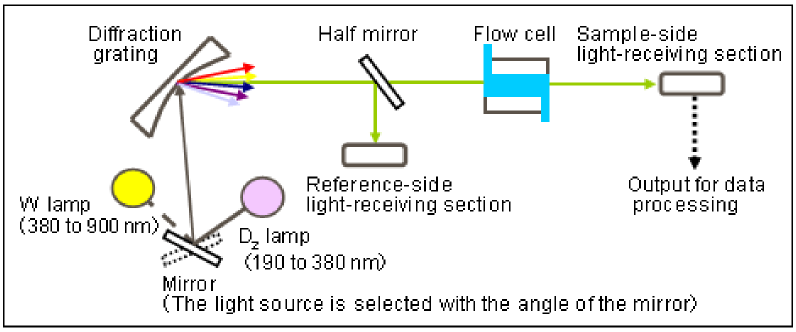
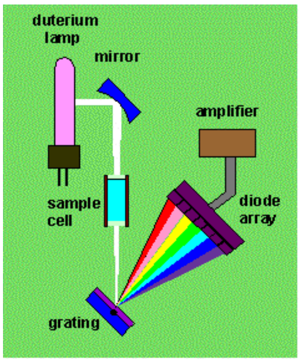


Figure 1. Diagrammatic illustration of a UV-VIS detector optical system



Organic Management of Stem Gall of Coriander

Article ID: 30515

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Abstract

Stem gall disease is a very important disease in all coriander growing area of Madhya Pradesh, Bihar, Uttar Pradesh and adjoining district of Rajasthan. The disease caused on stems, branches, leaves, petioles and fruits, causes 15-20 per cent yield loss. This disease was mange by organic because eco-friendly for environmental safety. Panchagavya is a mixed culture of naturally occurring beneficial microbe's mostly lactic acid bacteria, yeast, actinomycetes, photosynthetic bacteria and certain fungi. Which promote the growth of plants and providing resistance against pest and diseases. It has an excellent germicidal power, antibiotic and antimicrobial activity.

The role of cow product increasing concern for which are easily biodegradable and do not leave any harmful toxic residues besides conserving nature. So, it is necessary to use natural products like Panchagavya, Cow urine and Cow dung to produce chemical residue free food crops and hence product can play a major role in organic farming.

Introduction

Coriander is one of the earliest known spices to mankind and is native of Mediterranean and east regions. It is a crop of tropics and extensively grown in India, Morocco, Canada, Pakistan, Romania and Russia. Coriander is grown for its seeds, leaves and stem having a pleasant aromatic odour and fragrant. The pleasant aroma is due to an essential element called dlinalol or coriandrol ($C_{10}H_{17}OH$) a terpentiartiary alcohol (Purthi, 1976 and Lewis 1984). Coriander was cultivated on 447.1 thousand ha with an annual production of 313.6 thousand tonnes and productivity 701.4 kg/ha in India during 2013-014 (Anandraj, 2016). The main coriander growing states are Rajasthan, Gujarat, Andra Pradesh, Madhya Pradesh, Tamil Nadu, Chhatisgarh, Uttar Pradesh, Bihar, Orissa and Punjab. Uttar Pradesh is producing 3.68 thousand metric tonnes from 6.7 thousand ha with 547 kg/ha productivity (Anonymous, 2014).

The disease manifests itself in the form of galls on stems, branches, leaves, petioles and fruits, causes 15-20 per cent yield loss (Pandey and Dange, 1998) and deteriorates quality of seeds (Lakra, 1993). The chlamydospores (resting spores) released from the decayed host tissues after the monsoon rain and provide the primary inoculum. The possibility of survival of free chlamydospores in the soil has not been indicated due to high temperature prevailing during the summer months (May to June) in this region (Pavgi and Mukhopadhyay 1969a).

The studies on complete management of disease in the field are still lacking (Saxena et al, 2002). Application of fungicides like organo mercurials, copper fungicides, antibiotics, Bavistin, Thiram, Cusixin, Capton, Blitox-50 and Propiconazole have gave better results for controlling the disease. Over dose application of chemicals caused hazardous effects and residual problems in leaves as well as seed grains. Thus, situation triggered interest in searching alternates for disease control. Panchagavya is an organic formulation, which is obtained from five products (cow milk, ghee, curd, dung and urine). It has potential to play the role for promoting growth and providing immunity to plant system. It is also used as fertilizers and pesticides in agricultural operations (Galindo et al 2007).

Panchagavya is used as a seed treatment, foliar spray as well as soil application alone or with irrigation (Natarajan, 2002). Cow urine is one of the ingredients of 'Panchagavya' (Urine, dung, milk, curd and ghee) which is capable of treating many diseases and has several medicinal properties (Pathak and Kumar, 2003). Thus, it is the best remedy to cure fungal and bacterial diseases.

Healthy Plant

Infected Plant

Preparation of Panchagavya

Fresh cow urine and cow dung were collected in a sterile container from a local variety of cow, college of veterinary & Animal husbandry at Narendra Deva University of Agriculture & Technology, Kumarganj, Ayodhya. The urine was filtered through Whatman No. 1 filter paper to get rid of debris and precipitated material was stored in airtight container at 4°C before use. Cow dung slurry was prepared with adding equal amount of water (w/v).

Fresh five products of cow such as Cow dung = 1kg, Cow urine = 3L, Cow milk = 2L, Curd = 2kg, Cow ghee = 1kg were collected for making panchgavya. Required quantities of five ingredients were thoroughly mixed in a plastic container and allowed to ferment for 7 days with twice stirring per day (Chadha et al. 2012).

Applications

1. After field preparation, soil of each plots was treated separately with Cow urine and Cow dung slurry at concentration on 10, 20 and 30% as well as Panchgavya @ 30%.

2. The untreated soil maintained as control. Before sowing seeds were treated with Cow urine, Cow dung slurry at 10, 20 and 30% and Panchgavya @ 30% concentration for 30 min.

3. The treated seeds were dried in air under shade to remove excess moisture and then sown in field.

Properties of Panchagavya

Panchagavya contains several nutrients i.e. macronutrients like nitrogen, phosphorus, potassium and micronutrients which are required for the growth and development of plants and also contains various amino acids, vitamins, growth regulators like Auxins, Gibberellins and also beneficial micro-organisms like pseudomonas, azatobacter and phosphor bacteria etc.

Results

1. The stem gall symptoms were observed as small tumour-like swellings on all herbaceous parts of the affected plants, namely, stems, petioles, flower stalks and leaves. The symptoms were most prominent on stem followed by leaves, inflorescence and seeds. The fungus is restricted to galls only.

2. Treatments were significantly reduced the disease intensity in the field. The reduction was disease by panchagavya, cow urine and cow dung slurry @ 30% concentration.

3. The suppressive effect of panchagavya was maximum 49.60%, 49.57% followed by 48.76%, 44.45% in cow urine @ 30% concentration and 40.58% , 43.19% cow dung slurry @ 30% concentration at flowering and maturity stage, respectively.

4. Minimum disease severity was recorded in leaves 17.66% treated with panchagavya @ 30 % concentration and maximum in stem 29.33% treated with cow dung slurry @ 10% concentration. In control the disease severity was 55.0% in stem, 34.66% in Leaves, 36.66% in Inflorescence and 29.0% in seed.

5. Organic treatments were found to stimulate plant growth and yield. The maximum increase of plant height, number of branch's/plant, umbel/plant, umblet/plant, seed weight/plant and straw weight of coriander were obtained in Seed treatment + soil drenching with panchagavya @ 30% concentration and minimum increase plant height, no. of branch/plant, umbel/plant umblet/plant, seed weight/plant and straw weight of coriander were recorded in seed treatment + soil drenching with cow dung @ 10 % concentration.

Advantages

1. Application on soil plants habitually produces healthy leaves and branching is relatively high.
2. The plants produce healthy roots and healthy seeds were also observed.
3. Improves fertility status in soils by increasing macronutrients, micronutrients and beneficial microorganisms thus increase soil health.
4. It improves water holding capacity of soils because it acts as an organic manure.
5. It encourages growth and reproduction of beneficial soil microorganisms
6. It increases nutrient uptake in plants and enhances plant growth.
7. It increases immunity power in plants thereby confers resistance against diseases.
8. Various beneficial metabolites produced by microorganisms such as organic acids, hydrogen peroxide and antibiotics, which are effective against various pathogenic microorganisms.

Conclusion

The role of cow product increasing concern for environmental safety and using eco-friendly products for disease management which are easily biodegradable and do not leave any harmful toxic residues besides conserving nature. So, it is necessary to use natural products like Panchagavya, Cow urine and Cow dung to produce chemical residue free food crops and hence product can play a major role in organic farming.

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Review of Sustainable Agriculture: A Must Adopt Concept for Environment Sustainability

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Introduction

Agriculture is the process that produces food, fodder, fibre and other things desired by cultivation of some plants and rearing of domestic animals. The nature of agriculture has changed after the second world war. The production of food grains and fibres has increased manifold, through the use of machines in the use of new techniques, increased use of fertilizers and pesticides, and more use of irrigation systems, etc. Due to these changes, the farmers now started to meet the demand of most food grains and fibres, despite less effort. The role of agricultural experts has been criticized over the last two decades by which these social problems have increased. Seeing the negative consequences of modern agricultural methods, the demand for 'sustainable agriculture' is now rising. The sustainable Agro system, along with the systems for preserving the environment, as well as providing innovative and economically good opportunities for farmers, laborers, consumers, etc., policy-makers and others for the entire food system.

Human Needs and Excessive Exploitation of Environment

Due to the ever-increasing urban population around the world, many cities in developing countries have become centres of poverty. About half of the world's population now lives in urban areas. Rural people are constantly migrating towards urban areas in search of jobs, food, shelter, entertainment and a better lifestyle.

The Need to Improve the Quality of the Environment

Our huge population is under great pressure on available resources. Consuming resources at a high rate leads to a large amount of wastes. The competition to provide housing, food, water, transport energy, minerals and other means to urban citizens leads to excessive exploitation and degradation of forests and large tracts of agricultural land.

Sustainable Agriculture

Sustainable agriculture is a type of agricultural system that can provide adequate food and benefits to the population of the present day without destroying the productivity of the land or causing great harm to the environment. Sustainable farming systems are those that are least toxic, that handle energy properly and still maintain exports and profit levels, i.e. low energy agriculture or organic agriculture.

Therefore, sustainable agriculture is that:
1. Supports beneficial productivity.
2. The environment preserves quality.
3. Uses natural wealth efficiently.
4. Provides consumers with reasonably priced, good quality products.
5. Depends less on non-depleting assets.
6. Improves the standard of living of farmers and rural societies.
7. And sustainable agriculture will be effective for the coming generations.

Long-Term Farming Methods

The methods of long-term production include a variety of methods. At the level of its planning, it is necessary that we keep in mind the local geographical topography, soil condition and nature, local weather, pests, local investment and farmers' goals. Farmers (crop growers) will have to use their intelligence in choosing appropriate methods for long-term agriculture (sustainable agriculture).

Some of the following methods are used in long-term agriculture:
1. Selection of tillage methods that promote biological and economic stability.
2. Selecting improved varieties as required.
3. Proper management and use of soil by proper methods of irrigation.

Growing Mixed Crops or Diverting Agriculture

It is an old practice of agriculture in our country. At the same time, two or more varieties of plants are grown in the same field. If, for some reason, one type of crop is not prepared properly, then the other type of crop saves the risk of complete failure. The leguminous plants increase the fertility of the land by stabilizing atmospheric 'nitrogen'. This saves on expenditure on chemical fertilizers.

Many schemes are used to grow a mixed crop or to grow crops through a changed agricultural method:

1. Polyvarietal multi-varieties type of agriculture: in which crops of many different varieties of the same type of plant are grown.

2. Intercropping method: in which two or more varieties of plants are grown at the same time on a plot. For example, grains containing carbohydrate elements that use the nitrogen of the soil and leguminous plants (nitrogen stabilizers) transmit it back to the soil.

3. Poly culture: In this system different types of plants maturing at different time periods are sown together. The main advantage of this method is that water and fertilizer requirements of different plants vary.

Crop Rotation of Crops

In this system different types of plants are grown one by one in the same field. Bite through this system and diseases are controlled, soil fertility is increased and soil erosion decreases. Often, the soil cannot bear the burden of a consistent yield of a high-yielding sole plant because of the process where some nutrients are completely depleted on the one hand, but on the other, some other nutrients are not used at all. Due to this, the balance of nutrients in the land gets disturbed and many types of diseases and pests also develop.

The rotation of crops takes into account the following factors:
1. Legume crops should be sown only after non-legume crops.
3. Varieties of plants which require less water (irrigation) should be sown after plants requiring more irrigation (water).
4. Plant varieties with high fertilizer demand should be sown before crops requiring less manure.

Main patterns of plant rotations:
1. Green gram - Wheat – Moong.
2. Peanuts - Wheat – Moong.
3. Arhar - Sugarcane - Wheat – Moong.
4. Paddy - Wheat – Moong.

Soil Management

A healthy soil is a key component of long-term agriculture, that is, when sufficient amount of water and nutrients are found in a clean land (soil), then as a result, plants produce themselves to a large extent by pests. And can prevent diseases. Therefore, to achieve long-term productivity and stability, it is necessary to conserve and nurture the land. Following are some of the methods of conservation of land in which use of cover crops, use of manure, ploughing Reduction, preservation of water vapor found in the soil, dead mulches, all these methods increase the water holding capacity of the land.

Organic Fertilizers and their Use in Agriculture

For a sustainable farming system, it is imperative to use renewed investments (fertilizers, disinfectants, water, etc.), including those that benefit the plant without destroying the environment or doing the least harm. Minimum use of chemical fertilizers and pesticides is one possible way of achieving this goal. It is a method of energy efficient and non-polluting method that uses the capabilities of some microorganisms such as bacteria, algae and fungi to stabilize atmospheric nitrogen, in the soil, to dissolve phosphorus, dissolve organic matter or to oxidize sulphur.

Important Organic Fertilizers (Bio-Fertilizer)

1. Rhizobium Bio-fertilizer: Rhizobium is a type of symbiotic bacteria found in the roots (glands) of leguminous plants. These glands serve as very small size nitrogen producing factories in the fields.

2. Azotobacter Biofertilizer: Azato bacter are nitrogenous bacteria of independent GVs that inhabit the air. They grow around the rhizosphere root and make atmospheric nitrogen irreversibly stable and are present in special grains.

3. Azospirillium biofertilizer: These are pneumatic independent nitrogen fixative bacteria that live together as symbiotic. In this type of relationship, these bacteria live in the roots of the plant and do not make any glands.

4. Blue-green algae: Blue-green algae (Blue Green Algal, BGA or cyanobacteria) such as 'Nostock' and 'Anabaena' are independent photosynthetic organisms that stabilize atmospheric nitrogen. In paddy fields filled with water, these blue-green algae act as nitrogen biofertilizers.

Vermicompost

Vermicompost (vermicompost) is a technique for efficient scavenging of animal waste (sewage), residues of crops and agro-industrial litter. The process of converting organic matter into compost is mainly of microbial level. Earthworms have an important role in the conversion of organic wastes to vermicompost. Vermicompost (vermicompost) can be prepared from all types of organic residues. Example: dried leaves, sewage etc

Sustainable Development

It has become very important that we humans control our greed and curb our aspirations and needs. The need of the hour is that we respect our environment and stop the unlimited exploitation of natural wealth. There is a demand for long-term development that the use and consumption of natural wealth should be coordinated. A rate in which these resources can either be an alternative or can be replaced. Economic and industrial development should take place in such a way that there is no damage to the environment that cannot be rectified. The World Commission for Environment and Development has given the following definition of long-term development - Sustainable development is a development that not only fulfils the needs of the present but also maintains the capacity to meet the needs of the coming generations.

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An Introduction of Quantitative Trait Loci and their Mapping

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Introduction

In agriculturally important crop plants, many valuable traits such as yield and disease resistance are governed by number of genes thus, called quantitative traits. Quantitative traits show continuous variation due to their polygenic inheritance and environmental influences. These traits do not fall into any discrete classes and can be measured. Polygenes produce small, individual and cumulative action on the phenotype of trait. Dividing the genetic architecture of these quantitative traits is an ongoing issue for geneticists, since classical Mendelian methods of inheritance of oligogenes cannot be used in the case of polygenes. In 1906, Yule hypothesized the presence of genes with cumulative effects, and the experimental confirmation for their existence was given by Nilsson-Ehle in 1908. Afterwards, between 1910 and 1916, East and Emerson present extensive data in aid of polygenic inheritance in maize and tobacco. Thus, the outcomes from these and succeeding studies elucidate that the continuous variation characteristic of quantitative traits controlled by large number of polygenes and the environmental influences on their phenotypic expression (Singh 2009). It was initially suggested that polygenes were supposed to produce only additive gene effects, but now they are known to show dominance and epistatic effects as well. A number of statistical tools have been developed to understand the inheritance of these characters and science is called quantitative genetics. With the introduction of the linkage concept led to the construction of linkage map thus allow localization of various oligogenes to distinct locus/position on the specific chromosomes of the genome for different species. However, mapping of polygenes was not as straightforward as that of oligogenes. Sax (1923) reported linkage between qualitative and quantitative traits i.e., seed coat colour and seed size respectively, in common bean (*Phaseolus vulgaris*). In this way, the efforts for physical localization of quantitative traits began. His work displayed the key principle for mapping of polygenes based on the detection of genomic regions which shows the linkage between a genetic marker and a quantitative trait phenotype. Such a genomic region is referred to as quantitative trait locus (QTL), term given by Geldeman (1975). So, basically QTL is a locus on the genome that controls the phenotypic expression of quantitative trait in the population of organisms. The gene included in each QTL exists in more than one form, or allele, and can differ between individuals in a population (Grisel and Crabbe 1995). A QTL may contain one gene or cluster of linked genes affecting the concerned quantitative trait. The development of DNA markers has incredibly simplified the mapping of QTLs. The first use of DNA markers for QTL mapping was done by Paterson et al. (1988) for the mapping of QTLs governing fruit size, pH, and soluble solids in tomato.

Aims of QTL Mapping

1. The fundamental aim is to identify QTL, while minimizing the occurrence of Type-I error i.e., acknowledging the presence of linkage between a marker and QTL which does not exist in reality).
2. Identification of genomic region that affects the concerned trait.
3. Provide the detail for the effect of QTL on the trait under study.
4. Assessment of the amount of variation for the trait is caused by specific region.
5. Identification of the allele which is associated with the favourable effects.
6. Type of gene action possess by the concerned QTL.

Major Preconditions for QTL Mapping

1. An appropriate mapping population,
2. A dense marker linkage map for the species under study,
3. Reliable phenotypic evaluation for the target trait, and
4. Suitable software packages for QTL detection and mapping.

QTL mapping is generally based on biparental populations like doubled haplod, recombinant inbred line, F_2 or F_3. On the other hand, natural populations, germplasm collections, and breeding lines can be used for linkage disequilibrium-based association mapping of QTLs. Phenotypic evaluation of the mapping population for QTL analysis should be performed at different locations because evaluation at a single location may misjudge the total number of QTLs associated in the control of the traits under study.

The General Procedure for QTL Mapping

The general procedure for QTL mapping is shortly outlined below:
1. Two homozygous lines having contrasting phenotypes for the trait(s) of interest are selected and crossed to develop a suitable mapping population. The lines used as parents should be different from each other for the trait(s) of interest.

2. The mapping population is preferably evaluated for the target trait in replicated trials conducted over several locations and for many years. Thus, the process is known as phenotyping.

3. The parents involved in the mapping population are tested with a huge number of markers covering the entire genome at sufficient density of the parents led to the identification of polymorphic markers.

4. All the individuals/lines of the mapping population are then scanned using these polymorphic markers, this is known as genotyping.

5. The data developed through the marker genotyping are used to develop a framework of linkage map for the mapping population, which illustrate the order of the markers and the genetic distances between marker pairs with regard to centimorgans (cM).

6. Ultimately, the marker genotype and the trait phenotype data are analysed to detect relationship between marker genotypes and the trait phenotype. Simply stated, the plants are split into separate groups on the basis of their marker genotype. For each of these groups, mean and variance for the trait phenotype are estimated and used for the differentiation between the groups. If, the genotype groups for a marker differ remarkably for the trait of interest overall, it may be said that the concerned marker is linked with the trait under study.

Methods to Detect QTLs

1. Single-Marker Analysis (SMA): This method is also called as single- point analysis, which is an easy method for the discovery of QTLs associated with single markers. Complete linkage map does not require in this method and can be performed with basic statistical software programs. The statistical procedures utilized in this encompass student t-tests, analysis of variance (ANOVA) and linear regression. Among these routines linear regression is most frequently utilized as the coefficient of determination (R2) from the marker explains the phenotypic variation arising from the QTL linked to the marker.

2. Simple Interval Mapping (SIM): It was suggested by Lander and Botstein in 1989. The concept behind interval mapping is to test a model for the existence of a QTL at several locations between two mapped loci and linkage maps are being utilized in this method. It assesses the target association between the trait values and the genotype of a presumed QTL at different analysis points between pair of adjoining marker loci. Existence of an assumed QTL is approximated if the log of odds ratio surpasses the critical threshold. Utilization of linked markers for scanning remunerate for recombination between the markers and the QTL, and is regarded statistically more robust as compared to single-marker analysis. Tools such as MapMaker/QTL and QGene are used to conduct it.

3. Composite Interval Mapping (CIM): Jansen and Stam in the year 1994 developed this method of QTL mapping. It is the combination of interval mapping for a single QTL in a given interval with multiple regression analysis on marker associated with other QTL. It is more accurate as well as effective when linked QTLs are involved. It considers marker interval and a few other skilfully chosen single markers in each analysis, so that n-1 tests for interval-QTL associations are performed on a chromosome with n markers.

4. Multiple Interval Mapping (MIM): This method is based on Cockerham's model for the interpretation of genetic parameters and is a modification of SIM. It uses multiple marker intervals simultaneously to fit multiple assumed QTL straight in the model for mapping QTL. It gives information regarding number and location of QTL covering entire genome, as well detect interaction of important QTLs and their contribution to the genetic variability.

5. Bayesian Interval Mapping (BIM): Satagopan et al. in 1996 gave this method of QTL mapping. It is able to estimate QTL effect and position separately. It discloses the information regarding number and location of QTL and their consequences thoroughly. Its estimates should match with MIM estimates and must alike to CIM estimates. It gave rear estimates of multiple QTL in the intervals.

Merits of QTL Mapping

1. It accelerates the identification of novel genes.

2. When mutational approach fails to disclose genes coupled with their phenotypic roles, as well screening of this approach is laborious and costly, QTL mapping is a good alternative e.g. circadium rhythm screens.

3. It also helps in the identification of new functional alleles of known function genes can also be identified with QTL-mapping e.g. Flowering time QTL, EDI was the CRY2 gene.

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Methods of Extraction in Pesticide Residue Analysis

Article ID: 30518

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Extraction is the process by which toxicant is transferred from the treated bulky biological material in to a solvent. This is a fundamental process in pesticide residue analysis because no in-situ technique has yet been invented.

There are several extraction approaches employed such as:
1. Pressurized liquid extraction(PLE).
2. Supercritical fluid extraction (SFE).
3. Aqueous extraction.
4. Microwave-assisted extraction(MAE).
5. Solid-phase extraction (SPE).
6. Solid-phase microextraction (SPME).
7. Matrix solid-phase dispersion (MSPD).

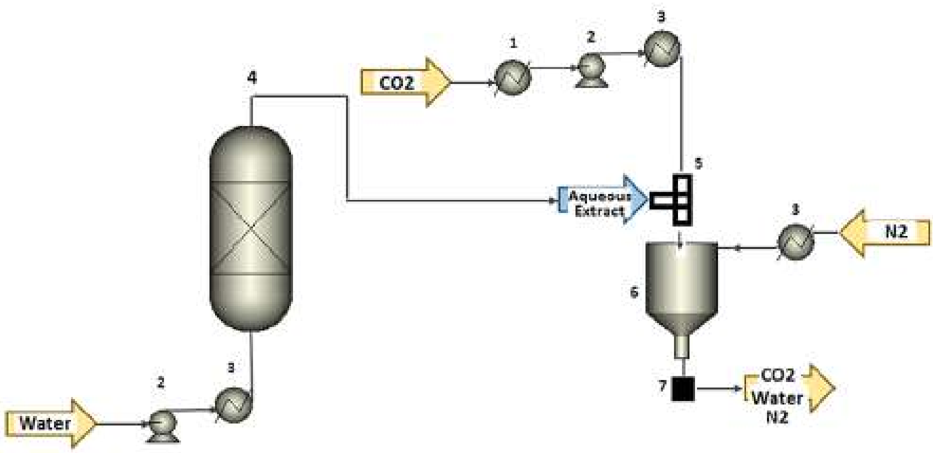
The main important extraction methods are in detailed below.

Pressurized Liquid Extraction (PLE)

1. PLE Is an accelerated solvent extraction.
2. Uses liquid for extraction.
3. Samples are loaded into vessels, which require a dispersant/drying agent to aid solvent flow.
4. Extraction occur at elevated temperature I.e. room temp to 40-200 and pressure 1000-3000 psi to improve recoveries.
5. Static extraction mode is used to equilibrate the sample to extraction conditions and dissolve the analytes in liquid.
6. Vessel is flushed with solvent rapidly, rather than a controlled dynamic flow in Superficial Fluid Extraction using a restrictor thus making PLE faster than SFE.

Solid-Phase Extraction (SPE)

1. Solid-phase extraction is a separation process by which compounds that are dissolved or suspended in a liquid mixture are separated from other.
2. Compounds in the mixture according to their physical and chemical properties.
3. SPE consists of four steps: column preparation (prewash), sample loading (retention or sorption), column post wash, and sample desorption (elution or desorption).
4. Compounds of interest are retained on the sorbent while interferences are washed away.
5. Analytes are recovered via an elution solvent.



Pressurized liquid extraction(PLE)

Solid-phase extraction (SPE)

Varietal Evaluation of Gerbera Cultivation Inside Poly House Under North Bihar Agro-Climatic Condition

Article ID: 30519

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Introduction

Flowers are heart, soul and ornamentation of nature; it is really hard to explain the beauty and essence of flower, which is adored by everyone, even the God himself. Flowers convey us the feeling of truthfulness simplicity, purity and piousness, flowers seem to be intended for the solace of ordinary humanity and mankind. One of such flowers, out valuing all utilities of the world through its magnificent beauty, varying hues and colours is pride of nature- '*Gerbera'.* Gerbera belongs to family Asteraceae. This group at present comprises 45 species, native to tropical Asia and Africa. About seven species were recorded in India distributed in temperate Himalayas from Kashmir to Nepal. Gerbera species of Indian origin are *Gerbera andria, G. kunzeana.* Gerbera produces attractive flowers known as 'head' or 'capitulum'. The plant is dwarf herbaceous perennial and grows in clump with solitary flower heads on a long slender stalk, which grows well above the foliage. The leaves are petioled, entire or pinnatilo bed, coarse or sometimes tubular and two lipped. Achenes are beaked; pappus or rough bristles in two or more rows. The daisy like flowers are available in wide range of colours including yellow, red, orange, cream, white, pink, brick red, scarlet, salmon peach, maroon and various other intermediate shades.

The ideal temperature for Gerbera flower initiation is 23°C and for leaf unfolding is 25-27°C. The flowering of Gerbera is harmed below 12°C and above 35°C. The optimum humidity inside the greenhouse should be 70-75%, which will maintain the health of the plants. Humidity is one of the key factors in greenhouse climate control. The relative humidity of air should not exceed 90-92 per cent, as it will lead to deformity of flowers. High humidity in a greenhouse can be maintained by using a fog cooling system, which was originally designed for temperature control.

Climatic Parameters

The thermal environment inside greenhouse is influenced by local weather parameters. Hence weather parameters like maximum and minimum ambient air temperatures, relative humidity (RH) inside and outside the polyhouse was recorded at 8:00 AM, 2:00 PM and 5:00 PM respectively.

Air Temperature

The temperature directly affects the crop growth due to variation in photosynthesis, respiration, absorption of water and nutrient etc. Biological reaction of most of the plants takes place between 0°C to 50°C. The plants can't sustain below 0°C due to freezing of water and above 50°C due to denaturation of proteins. Hence, temperature is the most important factor for growing the crops under protected cultivation. Maximum and minimum daily air temperatures inside and outside of polyhouse were recorded with the help of a digital thermometer. The least count of the digital thermometer was 0.1°C. The temp required for gerbera under polyhouse during day hour is 20-24°C and in night hour is 18-21°C.

Relative Humidity

The relative humidity is the environmental factor, which should be in a suitable range for growing the crops effectively. Relative humidity (RH) inside and outside of polyhouse was measured with the help of temperature –RH digital meter with 1% least count. Range of reading of the instrument was 0 to 100%. The RH required for gerbera under poly house is 60-65%.

Bed Preparation

Gerbera had been grown on six raised beds to assist in easier movement and better drainage. The dimensions of the bed were, Bed height: 45 cm, Width of bed: 80 cm and Pathways between beds was 30 cm. Regarding nutrient application 4 Kg FYM (Farm Yard Manure), 0.5 kg castor cake and 10 gm Thimate per sqm was applied before bed preparation and 10 kg vermi compost per sqm was applied during bed preparation. Two rows where planted on one bed at 37.5 cm distance between the rows and 27 cm distance between the plants in one row.

Fertigation Scheduled

N: P: K was applied on raised bed of soluble fertilizer @ 20:10:24 gm/sqm during vegetative growth and @ 10:12:25 gm/sqm/month during flowering period. Fertigation was done at weekly interval. Besides, micronutrient like Zn, Fe &Ca etc. was applied at fortnightly interval on the basis of soil analysis. The soil is deficient in Fe and Zn.

Planting

Six varieties of tissue cultured plant of Gerbera namely Palm beach, Debora, Orosis, Avemaria, Esmaria, and Vivian were planted in polyhouse, on Dated 16 December 2011 maintaining a plant density of 10 plant per sqm. It was planted on raised bed of size (18m×0.8m×0.45m). The information regarding Date of planting was obtained from staff working in Hi-Tech Horticulture.

Palm beach

Debora

Avemaria

Esmaria

Orosis

Vivian

Fig: Flowers of different variety of gerbera

Cost Economics

The economics of gerbera cultivation in polyhouse worked out with the help of cultivation cost and present market price of flowers. Cost of cultivation include cost of FYM, cost of castor cake, cost of planting material, cost of bed preparation and plantation, cost of fertilizers, pesticides and irrigation and cost of labour charge. While total income was calculated on the basis of total production of flowers and average market rate per flower.

Cost of cultivation = Cost of FYM, Castor cake and Thiamate + Cost of planting material + Cost of bed preparation and plantation + Cost of fertilizers, pesticides and irrigation + Cost of labour charge.

Total number of flowers = Total number of flowers per plant × Number of plants.
Gross income = Total number of flowers × Average market rate per flower.
Net benefit = Gross income – Cost of cultivation

$$\text{Benefit-Cost Ratio} = \frac{\text{Net Benefit}}{\text{Total Cost}}$$

Conclusions

Studies on the varietal evaluation of gerbera (viz., Palm beach, Debora, Orosis, Esmaria, Vivian and Avemaria) cultivation under polyhouse conditions was carried out the salient findings of the investigations are summarized hereunder.

1. The highest number of quality cut flowers per plant was produced by Palm beach (31.36) followed by Vivian (25.34), Avemaria (23.88), Orosis (23.42) and Debora (20.18). While Esmaria registered least (19.00) number of flowers per plant in 6-month-old crop.

2. Among the different genotypes studied, Avemaria (56.80) was produced largest number of leafs per plants compared to another genotype Vivian (54.75), Orosis (46.10), Debora (43.08), Esmaria (39.20) and Palm beach (37.15).

3. Among the different genotypes studied, Vivian (70.46) was found to be superior over Avemaria (68.20), Debora (65.26), Esmaria (62.05). Orosis (61.94) and Palm beach (60.12) with respect to plant spread.

4. Flower diameter was larger in Palm beach (12.85 cm) followed by Avemaria (12.15 cm), Debora (11.90 cm),Orosis (11.24 cm),Vivian (11.05 cm) and Esmaria (10.95 cm).

5. Esmaria (12-13 days) recorded maximum vase life compared to other cultivar studied viz. Palm beach (11-12 days), Debora (11-12 days), Vivian (11-12 days), Orosis (10-11 days) and Avemaria (9-10 days) in tap water.

6. The maximum net return was given by Palm beach followed by Debora, Orosis, Esmaria, Vivian, and Avemaria.

Impact of COVID-19 on Agriculture and Dairy Sector in Telangana

Article ID: 30520

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Introduction

The Coronavirus will adversely affect the agriculture sector and farmers in India. The sector is facing a lot of trouble with labourers and movement of the farm produced goods. Recently due to heavy rain, India's agriculture sector faced disruptions and crop damage and a present it is facing another hit due to disruptions created by the Coronavirus.

According to Food and agriculture organization of United Nations (FAO), "Agriculture, with its allied sectors, is the largest source of livelihoods in India. Agriculture contributes some 16% to the country's GDP. Seeing the above information, it is very clear that the damage caused by the Covid-19 pandemic will drop the country's struggling rural economy that supports nearly half its population into further distress.

Normally the farm activity is at its peak between April and June. During this period, majority of crops like wheat, pulses are harvested and sold in the market and also farmers begin to sow especially rain-fed crops like paddy, cotton, sugarcane and pulses, etc. Majority of 60% of India's food supply and farmer's income are dependent on the kharif season.

Another major problem faced by the agriculture sector in the lockdown is fleeing of farmers to their homes due to the fear of Coronavirus. Our food production also depends on availability of human resources, farm inputs and free movement of agricultural produce and all these are restricted at this time due to lockdown. These problems will lead to weak food production and high food price inflation also, if this continues for more days, food production would decrease later this year.

India's food grain output is projected to be at 292 million tonnes in 2019-20, up by 2.4 per cent from 2018-19 (RBI). According to reports, the stocks of wheat and rice with the Food Corporation of India (FCI), as on March 1, 2020 was 77.6 MMT. Between 2014-15 and 2018-19, NAFED has made an unprecedented record procurement of 91.1 lakh MT of oilseeds and pulses (61.3 lakh MT of pulses and 30.3 lakh MT of oilseeds) under the Price Support Scheme, up by 1205 per cent from the 7 lakh MT procured between 2009-10 and 2013-14. Here again, the inflow of rabi pulses into the market in April 2020 is expected to ease the situation further.

In other words, the overall supply situation of essential food items does not appear to be too worrisome in India at this point. However, if the lockdown proceeds beyond a month, the supply situation will become tighter. Coupled with supply bottlenecks, prices may begin to rise. Here, the price curve may begin to look like a U-shaped curve, with a sharp fall in prices in the initial days of the lockdown replaced by a sharp upturn in prices in the later days.

Regardless of the apparently comfortable situation with respect to overall supply, it is important that we underline some concerns that exist at the ground level, particularly with regard to the supply chain and the smooth organization of farm operations.

First, harvesting and marketing crops at the farm level is in crisis across the country, because of the following reasons:
1. Disruptions in the procurement of food grains by government agencies
2. Disruptions in the collection of harvests from the farms by private traders
3. Shortage of workers to harvest the rabi crop
4. Shortage of drivers in the transportation sector
5. Blockades in the movement of agricultural commodities across the major highways and
6. Shutdowns in the retail agricultural markets.

These factors have led to a crisis in a range of crops too wheat, grapes, watermelons, bananas, muskmelon, chana, cotton, chilies, turmeric, cumin, coriander, onion, and potato.

Secondly, these bottlenecks have led to a fall in the farm prices of a range of commodities in agriculture. Tomato growers in Maharashtra are reported to be receiving not even Rs 2 per kg. For many crops, these prices are also below the Minimum Support Prices announced. In Punjab, vegetables that were sold at Rs 15/kg are repeatedly being sold at a mere Rs 1/kg.

As the lockdown proceeds, these prices can be expected to rise, just as in the Western economies, the rise driven by panic buying and supply bottlenecks. Despite such price rises, farmers are unlikely to be the beneficiaries, most benefits are expected to flow to wholesale and retail traders as well as other middlemen.

Thirdly, the return of many migrant workers to their homes has meant that harvest operations are not taking place smoothly, and many farmers are being forced to leave the crop in the field. Losses to farmers will be the highest in such cases. While mechanical harvesters can be used, lockdown regulations disrupt their free movement. Further, in some places, a shortage of drivers/operators for these harvesters has also been reported. In the rice mills of Kerala, reports indicate a shortage of migrant workers, which has led to these mills not procuring adequate supplies of paddy from farmers. Farmers have either not harvested at all, or have harvested and left the product near the fields. Labour shortages are also being experienced in most milk processing plants, cold storage units, and warehouses. According to the Chairperson of AMUL, most milk processing plants are currently operating with half of the labour force. Many workers are not reporting for work or have returned home also because of the fear of police atrocities.

Fourthly, supply chains have been disrupted across the country for a range of commodities. The first official notification on lockdowns appears to have been ill-thought out, leading to the exclusion of a number of activities from the list of essential items. A second notification has corrected this, at least partially. Yet, major highways and entry points to States are seeing a pile up of trucks unable to move forward. Lorry transport is in major shortage at many places, leading to the extremely slow movement of goods across the country. APMC mandis are not functioning every day, while some have closed down, others are operating only twice or thrice a week.

Problems Faced by Telangana Farmers Due to Covid-19

1. Non-availability of labour.
2. Inability to access to market for produce due to lack of transportation.
3. Improper operation of markets.

Non-Availability of Labour

Some crops like paddy, wheat does not depend mostly on manual labour due to increase in the use of mechanical harvesters for paddy which has helped in the present situations but commercial crops are drastically hit as they tend to be more dependent on migrant labour. Consequently, the shortage of migrant labour has resulted in a sharp increase in daily wages for harvesting crops.

Inability to Access to Market for Produce Due to Lack of Transportation

About 50% of producers faced unremunerative prices for their produce since prices have collapsed due to either lack of market access including the stoppage of transportation and closure of borders. This is in contrast to areas where migrant labourers have returned home from urban areas and this has led to a sharp decline in agricultural wages.

Improper Operation of Markets

Due to the shortage of labour there is no proper handling of the produce to the markets and majority of losses had been faced while entering in to the market.

The dairy farmers in Telangana are facing losses due to the lockdown. Nationwide lockdown has been imposed in backdrop of COVID-19 outbreak. Milk price dipped to almost half amid pandemic and farmers are forced to sell the milk at low prices.

As milk prices drops drastically and the world-wide coronavirus crisis disrupts workforces as well as buying patterns, dairy has responded with a coordinated response. That includes informational resources quickly made available to farmers and an organized effort to gain needed relief for producers and the entire supply chain. Among agricultural commodities, the novel coronavirus holds special frustration for dairy. That's because dairy had just begun to emerge from a half-decade price slump, only to plunge into another major hit to farmer finances.

A COVID-19 Dairy Resource Site

The National Milk Producers Federation formally began its coronavirus response efforts by creating an informational web page on March 6, roughly one week before a nationwide wave of closures and cancellations arrived in full force. Since then, the site, www.nmpf.org/coronavirus, has been continually updated with sections devoted to farmers, employers, and processors.

Dairy's Proactive Approach

Dairy cooperative and industry leaders are consulted NMPF bringing out policy proposals to protect all of dairy. As store shelves emptied and supply chains began to show signs of strain, NMPF held a special conference call of its executive committee of cooperative leaders, discussing strategies to help manage the unfolding crisis, and is regularly consulting that body as situations evolve.

Dairy farmers and farm workers, despite the health concerns, continue to work around the clock. Milk haulers continue moving milk to processors; the farm feed, supply, and veterinary systems keep providing for animals; and manufacturing plants continue processing milk into wholesome, nutritious products. Dairy industry must be united in case of crisis. That unity will be necessary in the months and weeks ahead, as the entire dairy community faces a challenging outlook together. On an average Indian dairy cooperative procure around 508 lakh kg of milk every day.

Conclusions

Thus, the dairy industry in Telangana is facing a piquant situation following the lockdown imposed to contain the spread of the Coronavirus (COVID-19). Though there are no constraints faced in respect of production and ensuring supply of milk, the industry is finding it difficult to dispatch the products to all the localities, especially gated communities, where people are not allowing the delivery boys into their premises.

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Mitigation of Climate Change Through Agronomic Practices

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According to IPCC (2007) "Climate change refers to a statistically significant variation in either the mean state of the climate or in its variability, persisting for an extended period (typically decades or longer)". Rainfall variability, high temperature in tropical regions, low temperature in cold regions, occurrence of floods & droughts etc. are due to climate change which will impact the crop productivity all over the world. Agriculture is directly dependent on climate since temperature, sunlight and water are the main drivers of crop growth. In the long run, the climatic change could affect agriculture in several ways such as quantity and quality of crops in terms of productivity, growth rates, photosynthesis and transpiration rates, moisture availability etc.

Why Agriculture is Vulnerable to Climate Change?

1. Highly diverse nature.
2. High rainfall dependency (2/3rd area rain dependent).
3. Inadequate infrastructure facilities for supply of quality inputs.
4. Rapid degradation of soil and loss of soil fertility and nutrient levels.
5. Poor resources base of the farmers.
6. Poor technology penetration.

Researchers have proposed some strategies to address this climate change issue.

Agroforestry

Agroforestry, the practice of introducing trees in farming has played a significant role in enhancing land productivity and improving livelihoods in both developed and developing countries (Murthy et al., 2013). Although carbon sequestration through afforestation and reforestation of degraded natural forests has long been considered useful in climate change mitigation, agroforestry offers some distinct advantages. The planting of trees along with crops improves soil fertility, controls and prevents soil erosion, controls water logging, checks acidification and eutrophication of streams and rivers, increases local biodiversity, decreases pressure on natural forests for fuel and provides fodder for livestock.

Conservation Tillage

Conventional tillage has many advantages but one disadvantage is that it causes much soil disturbance which leads to the emission of greenhouse gases from soil environment into atmosphere. But conservation tillage causes less disturbance to the soil and it results in less emission of greenhouse gases comparatively. There is significant increase in soil organic carbon compared to conventional tillage in maize-green gram cropping system (Yadav et al., 2015).

Site Specific Nutrient Management

Generally, farmers go for the blanket application of fertilizers which results in low nutrient efficiency and loss nutrients into soil & atmosphere.

Site-specific nutrient management could be the best management option to avoid excessive and untimely fertilizer applications especially nitrogen fertilizers (Singh et al., 2017). It makes farmers to apply fertilizers according to the need of crop and increases the fertilizer use efficiency & decreases the fertilizer losses into atmosphere which leads to less emission greenhouse gases.

Adjustment of Sowing Dates

Time of sowing is very important factor which determines the crop yield. Farmers have to adjust the date of sowing according to the prevalent climatic conditions like rainfall, temperature and humidity. For example, prevailing of high temperature, which is due to climate change, at the maturity stage, might affect the grain quality in many crops. In that case farmers should go for early sowing to avoid the high temperatures at maturity stage of the crop. Dar et al., (2018) reported that early sowing of rainfed wheat has resulted in significantly higher yield.

Proper Choice of Varieties

The need for stress tolerant cultivars has become vital in the current context of climate change. Agricultural universities and research stations all over the country are working to develop varieties which are tolerant to calamities like drought, flood, cold etc. One main characteristic of these cultivars is that they are location specific. These varieties can play an important role in coping with climate variability as well as enhancing the productivity

Water Harvesting

It means capturing rain where it falls or capturing the run off in your own village or town and taking measures to keep that water clean by not allowing polluting activities to take place in the catchment. It helps the farmers to give supplemental irrigation to crops in water scarcity areas. Farm ponds can be used for rain water harvesting to increase productivity in water deficit areas. If an efficient rainwater harvesting system is adopted then it is assured that there would be a water reserve in case of water shortage which improves the crop as well as water productivity.

Alternate Rice Production Systems Like SRI and DSR

Generally, rice requires a large amount of water which is approximately 1200-1500 mm. Water scarcity is increasing in our country as well as world, thanks to climate change. So, scientists are recommending farmers to go for rice production systems which require less water like aerobic rice, system of rice intensification, direct seeded rice etc. Direct seeded rice reduces not only cost of cultivation but also water usage and gives almost same yield as transplanted rice. Aerobic rice cultivation where field remain unsaturated throughout the season like an upland crop offers an opportunity to produce rice with less water (Bouman et al. 2002). SRI is a viable rice cultivation method under a water limited wetland ecosystem and its productivity is also very high comparatively (Geethalakshmi et al., 2011).

Efficient Irrigation Systems

Energy efficient irrigation systems are moisture stress-based sprinkler and drip irrigation, which apply the proper amount of water as per the need of soil& plant environment. Water use efficiency of these systems is very high and water saving is 30-70% as compared to conventional flood irrigation method. Adoption of these irrigation systems would reduce 30-70% GHG emissions during the irrigation of crops in India.

Climate Smart Villages

Climate Smart Villages are sites where farmers, scientists, local government agencies and the private sector come together to develop climate smart agriculture practices which are location specific. Proper management practices will be followed which increase farmers' incomes through higher productivity, while building their resilience to extreme and variable climatic events. Main aim of these villages is to reduce greenhouse gas emissions with sustainable use of local resources. The location of a Climate-Smart Village is selected based on its climate risk profile and the willingness of farmers and local governments to participate.

Conclusions

India has set a target of halving greenhouse gas emissions by 2050 (Gautam and Sharma, 2012). Climate change is a reality and its impact on agriculture is extravagant. Agriculture sector is the most vulnerable sector to climate change as it will have a direct bearing on the living of 130 crore people in our country. Our main focus is on sustaining crop productivity under this climate change scenario. It can be achieved through practices like agroforestry, conservation tillage, site specific nutrient management using of stress tolerant cultivars, adjustment of sowing dates, alternate rice production technologies, adopting climate smart villages and efficient irrigation systems which reduce the emission of greenhouse gases into atmosphere.

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Application of Ozone in the Food Processing

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Introduction

Ozone, first discovered in 1840, being utilized as a disinfection agent in the production of potable water in France in the early 1900's. The majority of early development was limited to Europe where it became more widely used in drinking water treatment. The potential utility of ozone to the food industry lies in the fact that ozone is 52% stronger than chlorine and has been shown to be effective over a much wider spectrum of microorganisms than chlorine and other disinfectants. The preservation of food has been a challenge for mankind throughout the ages. Preservation of food can be defined as the extension of shelf-life of raw materials or prepared foods beyond their natural decay times. The food industry has generally concentrated on inactivating or killing of microorganisms and enzymes as a means of preservation by using a number of physical methods, mostly involving heat (Jakob and Hensen, 2005). Heat, particularly through cooking, has long been the principle method of eliminating pathogens. New technologies, including steam pasteurization, steam vacuuming, flash pasteurization and others continue to rely on heat to control or reduce harmful microorganisms in food. Many of the products resulting from these processes have become established in the diet throughout the world for decades and are important in own right. However, the application of heat results in products that are radically changed from their fresh counter parts (Leadley and Williams, 2006). Also, the effectiveness of heat processing is dependent on treatment temperature and time. Though thermal treatment helps kill vegetative organisms and some spores, however, the magnitude of treatment-time and process temperature is also proportional to the amount of nutrient loss, development of undesirable flavours and deterioration of functional properties of the food products. Non-thermal technologies, such as chemical rinsing and others work without heat, affects the composition and cellular activity of pathogens and ultimately killing them but, the consumers demand for safe and fresh-like products. The food industry is therefore currently in need of innovative processing technologies in order to meet the consumer's needs and demands. This has given impetus to research and led to studies for development of alternative processing methods. Hence, a wide range of novel processes have been studied over the last 100 years. Attention is now focused on ozone which is a powerful sanitizer that may meet expectations of the industry, approval of the regulatory agencies and acceptance of the consumer (Khadre et al., 2001). Sanitizers have been used in food processing facilities to control contaminant microorganisms, particularly those causing food borne diseases. However, use of some sanitizers has been limited or banned because of the potential health hazards. On the other hand, the need for potent antimicrobial agent has increased in recent years due to increasing outbreaks and emergence of new food pathogens. Therefore, the food industry is in search of disinfectants that are effective against food borne pathogens and safe to use in many specific applications of food processing. One such compound is ozone (Kim et al., 1999).

What is Ozone?

Ozone (O_3) is an allotropic form of oxygen (O_2), i.e. it is made up of same atoms, but they are combined in different form. The difference is the presence of three oxygen atoms, whereas "common oxygen" has only two. It has low molecular weight (MW = 48) whose three oxygen atoms chemically are arranged in chain. Ozone is then enriched oxygen (O_3). Ozone is a gaseous compound which is naturally present in the atmosphere and formed as a result of lightning or high energy UV radiation. Ozone has high potential applications in the food industry. Food preservation through ozone is a non-thermal processing technology which helps in enhancing food safety without compromising quality and desirability of food products. Ozone acts as a potential oxidizing agent and helps in eliminating pathogens due to its antimicrobial properties without leaving any residue in the treated food. Aqueous ozone may have a good potential for short-time surface treatment (decontamination) of fruit and vegetables and as a disinfectant for process water in food producing plants. When used in industry, ozone is usually generated at the point of application and in closed systems. Ultraviolet radiation (188 nm wave length) and corona discharge methods can be used to initiate free radical oxygen formation and thereby generate ozone. In order to generate commercial levels of ozone, the corona discharge method is usually used (Gonçalves, 2009).

Application of Ozone in the Food Industry

Today, the use of ozone is steadily replacing conventional sanitation techniques such as chlorine, steam or hot water. It's gaining momentum in the food processing industry as the safest, most cost-effective and chemical-free way of dealing with food safety management. Ozone has been used in the food processing industry, both as gaseous ozone and dissolved in water to reduce bacteria on a wide range of food products and contact surfaces.

Fruits and Vegetables

The fresh produce typically contains a complex mix of bacteria, fungi and yeast whose population and kinds are highly variable. Chlorine is the primary sanitizing agent used in fruits and vegetables washing but it produces residual by-product such as trihalomethanes which are potential carcinogens. Ozone is shown to be a good alternative sanitizer for fresh fruits and vegetables. Ozone processing within the food industry has been carried out for fresh fruits and vegetables either by gaseous treatment or washing with ozonated water. Two types of washing systems: spray and fume can be used to reduce microbial counts on the surface of produce

Dried Fruits

Najafi and Khodaparast, showed that when ozone was applied in gas form at three concentrations (1, 3, and 5 ppm) for four different periods (15, 30, 45 and 60 min) on Iranian date fruit, there is a reduction in the total count of mesophilic microorganisms, coliforms, *S. aureus* and yeast/mould. The results also suggested that a minimum of one-hour ozone treatment at 5 ppm could be successfully used for reducing the coliform and S. aureus of date fruits but longer exposure times are required for elimination of the total mesophilic bacteria as well as yeast/mould counts which were statistically lower than those of untreated control samples

Liquid Foods

Ozonation of liquid foods is mainly carried out in bubble columns. Bubble columns are utilized as multiphase contactors and reactors in various food, chemical, petrochemical, biochemical and metallurgical industries A typical bubble column reactor is a cylindrical vessel with a gas diffuser to spurge ozone in a gaseous state into either a liquid phase or liquid solid dispersion. When gaseous ozone is spurge into a liquid phase, agitation occur inducing turbulent shear stresses. This causes the liquid film to become thinner. Consequently, higher rates of diffusion through the liquid film occur, resulting in an increased local mass transfer coefficient (kL). In a bubble column ozone gas interacts with liquid food, where ozone is consumed followed by a chemical reaction involving oxidation. The overall reaction rate is governed by two steps first is the mass transfer from the gas phase to the liquid phase and then the chemical reaction in the liquid phase.

Spices

Ozone has been used experimentally as a substitute for ethylene oxide for the decontamination of whole and ground black peppercorns. Ozone treatment of ground black pepper resulted in slight oxidation of volatile oil constituents but ozone had no significant effect on the volatile oils of whole peppercorns. Because ozonation successfully reduced microbial loads and did not cause significant oxidation of the volatile oils in whole black peppercorns, this method was recommended for industrial treatment of the spice.

Sea Foods

Ozone pre-treatment (6 ppm) of tilapais helps to increase shelf life of the product by 12 days. The combination of ozone pre-treatment with storage at 0°C appears to be a feasible means of prolonging the storage life of fish. Ozonated water was used for dipping and washing fish or fish fillets showed an effective reduction of microbiological flora and had no effect on the product. The catfish showed highly statistically significant reductions in plate counts when live fish and fillets were washed in ozonated water ozonated water technology can be successfully used as a germicidal agent in seafood processing to extend the shelf life and quality of wild shrimp in a time when efforts are been made to eliminate the use of commonly used chlorine due to its ability to form potential carcinogens on reacting with organic matter.

Advantages

1. Ozone can be generated on-site.
2. Ozone is one of the most active, readily available oxidizing agents.
3. Ozone rapidly decomposes to oxygen leaving no traces.
4. Reactions do not produce toxic halogenated compounds.

4. Ozone acts more rapidly and completely than other common disinfecting agents.
5. Ozone reacts swiftly and effectively on all strains of all kinds of microorganisms.

Disadvantages

1. The major operating cost of producing ozone is the electrical energy.
2. Ozone is a potent oxidant and can reduce bacterial levels in pure culture; the use in food processing operations where bacteria exist within organic material is more difficult.
3. Ozone is the most powerful oxidizing agent available; it is also potentially the most dangerous of oxidants. This danger was recognized in the early stages of ozone research and techniques have been developed to insure the absence of ozone accidents

Future Perspective

As we can see above, ozone has found applications in various sectors in the food industry. It's potential to warrantee microbial quality of the various products as well as a potent sanitizer for plant equipments clearly predicts that this technology has a bright future and potential in the industry. The effectiveness of ozone being influenced by many factors, such as, method of the use, temperature and pH, besides the quality of used water.

Conclusions

There is great potential for using the reactive, antimicrobial properties of a natural environmentally friendly compound such as ozone when synthesized in a controlled system for food-based applications. Although ozone technology has existed for over a hundred years, its recent acceptance fuelled by environmental and health concerns now poises this technology for future longevity and increased successful usage, whether based on water purification, water recycling, air quality improvement, product extended storage and/or equipment surface sanitation.

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Hyperspectral Imaging: A Novel Technology in Food Industry

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Introduction

Hyperspectral imaging (HSI) is an emerging and innovative technique, which has advantages, that it is rapid, non-invasive, reliable for quality inspection, but compared to NIR spectroscopy, it also integrates traditional spectroscopy and digital imaging into one system, making it possible for providing spectral and spatial information of a certain object simultaneously (Zheng et al. 2006). The outstanding advantages of HSI make it possible to accomplish the evaluation of external features such as size, appearance, colour, defects, and so on, and estimation of internal properties that moisture, protein, fat, carbohydrates, etc., concurrently. These days, HSI has been widely applied to provide good results on the assessment of quality properties of foods, such as grain and oil, fruits and vegetables, animal and aquatic products, and others. In the field of grain and oil, the existing research is concerned with products' quality (component determination, germination test, variety classification and safety (fungal detection, pest detection).

Principle of Working

Hyperspectral imaging, like other spectral imaging, collects and processes information from across the electromagnetic spectrum. The goal of hyperspectral imaging is to obtain the spectrum for each pixel in the image of a scene, with the purpose of finding objects, identifying materials, or detecting processes. In hyperspectral imaging, the recorded spectra have fine wavelength resolution and cover a wide range of wavelengths.

Data Acquisition and Processing

Application and data acquisition techniques vary among different groups of investigators. In practice, there are five different NIRS measurement modes fitting different applications. These modes are transmittance, interactance, transflectance, diffuse transmittance and diffuse reflectance (Huang et al. 2008). Before spectroscopic analysis, the spectra are first extracted from regions of interest (ROIs), which are mostly determined by thresholding an image at a single waveband or at a ratio and/or difference image.While, for image processing, limited number of images (preferably less than 10) should be chosen from the massive images available to facilitate fast computation.

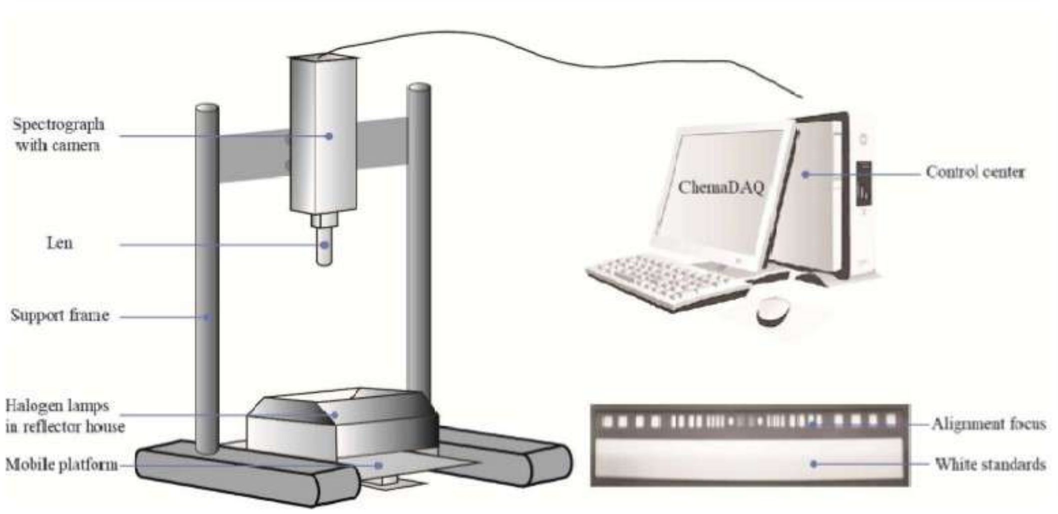

Fig.1. Sketch of hyperspectral imaging system

To reach the same goal, chemometric methods, such as principal component analysis (PCA) and partial least square regression (PLSR), can be employed where the loadings and importance in projection (VIP) scores can be examined to find out vital wavelengths (ElMasry et al., 2008).

Applications of Hyperspectral Imaging

1. Physical contamination and defects.
2. Detection of foreign materials.
3. Detection of defects in fruits and vegetables.
4. Detection of chemical contamination.
5. Adulteration of melamine.
6. Microbiological contamination.

Advantages

The main advantages of these techniques are related with the possibility of acquiring either single or multiple images as needed, at selected wavelengths in the NIR, MIR, and Vis range, providing with the ability to detect individual traits or properties directly associated with quality, in an extensive range of raw materials and products used in the manufacturing of foods. However, the potential of these techniques to obtain spatial, spectral, and multi-constituent information about the sample being analysed is the most attractive advantages in food analysis. The main advantages that these techniques that are present over the traditional chemical and chromatographic methods are the timeliness and the simplicity of use in routine operations.

Disadvantages

Cost of the device is very high. Issues that are related with the availability of commercial and robust instrumentation, the large amount of data generated during the analysis, the need to complex data analysis and algorithms, the small number of samples in most of the applications reported in the literature are still a drawback on the use of this technology in the food industry. However, the lack of academic training is still a barrier for the worldwide application of these technologies in research and by the industry.

Conclusions

Hyperspectral imaging integrates two popular technologies, that is, spectroscopy and computer vision, to present both spectral and image information of food products at the same time. Such richness in information provides a broad platform for applying various chemometric algorithms and multivariate data analyses to reveal quality and safety parameters in the food commodities. Furthermore, this platform can be widened by introducing different spectral profiles, that is, NIR, Raman, and fluorescence spectra, and its effectiveness has been preliminarily confirmed in some aspects of food safety.

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An Overview of Nutritional Value of Okra (Abelmoschus esculentus (L.) Moench)

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Introduction

Okra (*Abelmoschus esculentus* (L.) Moench), commonly known as lady's fingers and *bhindi* in India, belongs to family Malvaceae. Its place of origin is still disputed, said to have originated from West Africa, while some others claim South Asia or Ethiopia. One of the earliest accounts of okra is from Egypt, 1216 when Spanish Moor described the plant as eaten by locals for its tender, green, young pods. In 1658, the plant was introduced in Brazil by ships in commute of Alantic slave trade. By early 18th century, it was introduced to North America from Africa. It is distributed and has significance in many parts of the world. It is produced in subtropical, tropical and even in warm temperate regions around the globe. Okra commercially cultivated in many countries such as India, Myanmar, Turkey, Western Africa, Japan, Pakistan, Bangladesh, Afghanistan, Iran, Malaysia, Thailand, Brazil, Cyprus, Ethiopia and United States. In 2018-2019, total area under cultivation of okra in India was 513 ha with production of 6170 thousand tonnes (Anonymous, 2019).

Physiology and Cytogenetic Relationship

Initially, okra was included in the genus *Hibiscus*, later on the section *Abelmoschus* was considered as the distinct genus. The latest classification of okra was adopted at the International Okra Workshop held at National Bureau of Plant Genetic Resources (NBPGR) in 1990. Out of 50 known species only nine are most widely accepted with chromosome number varying from 56 to 196. The cultivated species has originated by interspecific hybridization of *A. tuberculatus* (n=29) with other species *viz*., *A. ficulnues*, *A. pungens*, *A. tertaphyllus*, *A. manihot* and *A. moshchatus* (n=36) and has a chromosome number of 2n=130 (Selvakumar, 2014). Okra bears solitary, yellow colored, pentamerous, hermaphrodite flowers with superior ovary. The plant is known for its fibrous fruits, known as pods or capsule which is green or red in color and contains white seeds. It is heat and drought tolerant vegetable species but frost can damage the pods. Okra can be grown on different types of soil, but well drained, high organic matter containing fertile soils are best suited for an efficient crop production (Akinyele and Temikotan, 2007). The seeds should be soaked overnight before sowing to a depth of 12 cm. Germination occurs six days after sowing or may take up to three weeks. Seedlings should be irrigated regularly. For the purpose of consumption, capsules are harvested at immature stage *i.e*., within a week of pollination, as they become more fibrous and woodier at maturity.

Nutritional Value of Okra

Okra is considered among vegetable of high export value for its high nutritive value and prolonged shelf life. It is rich in nutrients and commonly consumed as fried vegetable in India. The 100 g immature edible okra pods comprise of water 88.6 g, protein 2.10 g, dietary fibre 1.70 g, carbohydrate 8.20 g, energy 144.00 kJ (36 kcal) and low fat 0.20 g. It is also a rich source of β-carotene 185.00 µg, P 90.00 mg, Ca 84.00 mg, ascorbic acid 47.00 mg, riboflavin 0.08 mg, niacin 0.60 mg and thiamine 0.04 mg that plays a crucial role in human diet (Saifullah et al., 2009). The okra is also important source of iodine, iron, zinc, manganese and nickel but it is low in sodium saturated fat and cholesterol. The young immature okra pods contain mucilaginous substance (slime) which is good source of soluble fibre and they are cooked to deslime them for fresh consumption.

Many developing countries around the world are lacking in proper diet of vitamins and mineral matters. Okra being good source of potassium, calcium, iron, vitamins and mineral can play role in enhancing the world food security. It is proved that a week-old fresh okra fruits have the highest concentration of nutrients (Agbo et al., 2008). The other parts of plant like leaf buds and flowers are also consumable (Doijode, 2001). Also, its seeds provide about 20% proteins and 20% greenish-yellow edible oil which is provides unsaturated fats like linoleic acid and oleic acid. The oil is consumed for its pleasant odor and taste and it a study revealed its use as biofuel (Farooq et al., 2010). The cultivation of okra also offers seed flour and oil cake. The nutritive quality of cereal flour can be enhanced by addition of okra seed flour. For example, supplementing corn flour with okra meal improves the protein, oil and fiber content (Akingbala et al., 2003). and the dough quality. The roots of okra plant are used in clearing cane juice for preparation of jaggery or brown sugar. The crude fibre content of mature fruits and stems makes them usable in the paper industry.

Medicinal Properties of Okra

The galactomannan present in the seeds has many health benefits and used in preparation of gum having medicinal properties. The addition of okra in balanced diet boost the immune system, improves digestion, control diabetes, chronic dysentery, spermatorrhoea and genitourinary disorders. It is also reported in curing ulcers, lower blood cholesterol and provide relief from haemorrhoids. Its consumption prevents heart against clotting and atherosclerosis. It has high anti-oxidant property, rich in vitamin-A and protects eyes against macular degeneration and lower the risk of cataract. It should not be consumed by patients of kidney stone and gallstone. It also helps in reducing weight, prevents anaemia and support colon health. It promotes healthy skin by preventing wrinkles, scare and acne.

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An Overview of Nutritional Value of Okra (Abelmoschus esculentus (L.) Moench)

Article ID: 30525

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Processing of Cashew Nut and its By Products

Article ID: 30526

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Introduction

Cashew nut (*Anacardium occidentale* L.) is a tropical evergreen fruit tree belonging to Anacardiaceae family. It is widely cultivated in tropics for its nut and is a native of Brazil. In India it was introduced in Goa from where its cultivation spreaded to other parts of country. Cashew is a versatile tree nut and its kernel contains fats, proteins, carbohydrates, minerals and vitamins. Cashew has become number one crop in the world over almond. India provides around 55% supply of cashew kernels in world. The important commercial products of this crop are nuts and apple. The cashew kernels are used in confectionary and deserts. Cashew apple is eaten fresh or mixed in salads and even a drink is prepared from its juice. Cashew can be distilled to produce alcoholic drink called as Fenny. The cashew shell contains oil known as cashew nut shell liquid (CNSL) which has wide industrial uses. In India, the cashew processing is done manually, which consists of moisture conditioning, roasting, shelling, kernel drying, peeling, grading and packing.

Processing of Cashew Nut

The nuts used for processing are dried again to reduce moisture level to 7-8%. The steps involved in processing of raw nuts are as under:

1. Cleaning and grading of nuts: The nuts are cleaned and graded into three sizes, *viz*, small, medium and large. The grading of nuts is done on basis of nut thickness and not on the basis of its length. It helps in reducing the kernel breakage.

2. Roasting of nuts: Roasting of raw nuts is done to separate the adhering shell from kernel. There are three types of roasting *viz*; drum roasting, oil bath roasting and steam roasting.

a. Drum roasting: This is one of the oldest and more widely used methods. The nuts are fed into red hot rotating drum which will ignite the shell by maintaining its temperature because of burning of shell liquid. The drum is kept in rotation for 3-4 minutes and roasted nuts are discharged from lower end of drum and immediately covered by ash after sprayed with a little water, to absorb oil on surface. This facilitates removal of remaining oil on shell.

b. Oil bath roasting: The conditioned nuts are passed through CNSL (cashew nut shell liquid) bath heated to 170-200 °C by conveyer buckets for 1-2 minutes. During this period the shells get sheated thus rupturing the wall and releasing oil into bath. The roasted nuts are then centrifuged to remove adhering oil, cooled and shelled by hand or leg operated shelling machines. The kernel with adhering testa is scooped out using a sharp needle. The method is followed traditionally in Kerala and Karnataka

c. Steam roasting (autoclaving): The raw nuts are steam cooked at about 120-140 psi pressure to loosen the kernels from shells. Shell oil can be extracted in later stages by crushing. The nuts are shelled by hand or leg operated shelling machines. The steamed nuts are spread on floor under natural air for 12-24 hrs for cooling.

3. Shelling of nuts (decortications): Cashew nut after roasting and cooling are shelled to remove kernels. Care should be taken to protect hands from Cashew Nut Shell Liquid (CNSL) which is highly corrosive. Hand gloves can be used while shelling. Nuts are knocked 2-3 times on long edge of wooden mallet or light hammer to release the whole kernels without any damage.

Foot operated shell cutter can be used for shelling. This device consists of a pair of blades (knives) shaped in counter of half a nut. The blade cut through the shell all around the nut, leaving the kernel untouched. A hand lever is pressed to open shell into two parts. The kernel is then scooped out manually.

4. Separation of kernels: After shelling, the kernel and shell pieces are separated manually and the separated kernels are collected into containers.

5. Pre-grading: Pre-grading can be done before and after drying kernels. It can be done mechanically for large scale processing; whole kernels are separated from the broken. Sometimes the whole kernels are also separated and graded according to the kernel size.

6. Drying of kernels: After removal from the shell, the kernels are dried at about 70-80 ºC imperforated trays for about 6-8 hrs for reducing the moisture level to 4-5 percent. Drying of these kernels is necessary to prevent fungus. In order to ensure uniform drying, the position of tray may be changed frequently. Excessive drying may result in scorched kernel. After drying kernels are kept in the moist chamber for 24 hours which facilitates easy removal of testa and minimizes broken kernels.

7. Peeling: It is done by using a sharp knife or bamboo piece to remove testa (seed coat) from the kernels.

8. Grading of kernels: Kernels are graded according to the size manually. 25 different grades of cashew nut kernels are approved by Government of India. Standard specification for Indian cashew kernels is:

- **a. Wholes:** White wholes(WW)/scorched wholes(SW)/ dessert wholes (SWS)
- **b. Broken :** White broken/scorched broken/dessert broken
- **c. Lower grades:** Rejection etc.

Further, the classification refers to broken kernels, splits, pieces, small pieces and whether kernels are white or scorched. The cashew kernels are sold as WW 180, WW210, WW240, WW450 and WW500 which means white whole with number of kernels per pound weight. ThusWW210 means white whole with 210 kernels/ lb weight. Similarly, scorched wholes are numbered as SW180-SW500. Dessert wholes (DW), white pieces as B (Butts), S (Splits), LWP(Large white pieces), SWP (Small white pieces), BB (Baby bits), Scorched pieces as SB(Scorched butts), SS (Scorched splits), Dessert pieces as SPS (Scorched pieces seconds), DP(Dessert pieces).

9. Packaging of kernels: The import trade requires packaging of kernels in 11.34 kg capacity (25 lbs) tins/airtight cans in which the kernels are kept. After filling and weighing, the tins are evacuated and filled with CO_2 with help of vita pack process. This consists of removing all air from can and substituting it with CO_2 and the holes in the cans are then sealed. Cashew should be packed in impermeable packages, as they become rancid and go stale quickly.

Fig 1: Processing of cashew nut

By-Products from Cashew

1. Cashew apple: Cashew apple is a swollen peduncle to which nut is attached. It is very juicy and sweet; it is not eaten raw because of its astringent and acidic taste. It is very rich in vitamin C and can be used for juice extraction.

2. Cashew juice: The juice can be extracted with screw press, basket press or hand press. Straining of extracted juice is done through muslin cloth which is then clarified by adding 1.4 g of PVP (Poly vinyl pyrolidine) per litre of juice; the mixture is stirred and again strains through muslin cloth. Add sugar to improve the taste and boil the juice. Fill hot in pre-sterilized bottles, crown cork and process on boiling water for 20-25 minutes. On cooling, keep in cool and dry place. Sodium benzoate can be used as preservative.

3. Cashew kernels peel tannin: Kernel peel are a rich source of tannin (25%), which is in great demand by leather industry.

4. Cashew Nut Shell Liquid (CNSL): It is a byproduct obtained during separation of cashew kernel. It is viscous dark liquid and is extremely corrosive. It is used as raw material for phenolic resins and friction powder in automobile industry. It is also used as moulding acid resistant paints, found in any resins, varnishes and as insecticide/ fungicides etc.

5. Cashew kernels oil: Low grade kernels are processed in to kernel oil (30-40%) which is of high quality.

6. Cashew kernel butter: Kernel residue after extraction of kernel oil used to produce cashew kernel butter which is similar to peanut butter.


Cashew apple


Cashew juice


Cashew kernels oil


Cashew Nut Shell Liquid

Fig 2: Byproducts of cashew

Post-Harvest Handling of Nutmeg

Article ID: 30527

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Introduction

Nutmeg known botanically *Myristica fragrans* belonging to the family Myrsticaceae and is native to Moluccas in East Indonesia, known as the Spice Islands. The first commercial plantations were in Granada. The Tree yields two spices, nutmeg which is the kernel of the seed, and mace which is the net like crimson coloured leathery outer growth (aril) covering the shell of the seed, hence this spice is popularly known as "Twin Spice". Nutmeg is known for its unique aroma and fragrance, invariably used for preparation of Indian dishes particularly in South Indian dishes. Mace contains several chemical compounds that are known to have antioxidant, disease-preventing and health-promoting properties. Nutmeg also has many therapeutic applications in various traditional medicines for its anti-fungal, anti-depressant, digestive and carminative properties. Quality of nutmeg is largely depending on the proper post-harvest handling.

Nutritional Composition

Nut contains fixed oil trimyristin and many essential volatile oils like myristicin, elemicin, eugenol and safrole. These oils give a sweet aromatic flavour to Nutmeg. The other volatile oils are tineme, camphene, dipentene, cineoil, linalool, sabinene, safrole, terpeniol. Fixed oil content in the nutmeg varies from 25-40% and that of mace varies from 20-30%. The nutritional composition of Mace and Nutmeg as per ASTA (American Spice Trade Association) are given in the below table;

Composition	Mace per 100g	Kernel per 100 g
Water	4.50	4
Food energy (Kcal)	565	565
Protein (g)	8	7
Fat (g)	38.8	38.9
Carbohydrates (g)	46.10	47.3
Calcium (g)	0.20	0.20
Phosphorous (mg)	110	200
Sodium (mg)	70	10
Potassium (mg)	500	400
Iron (mg)	11.30	2.20
Riboflavin (mg)	0.56	0.25
Niacin (mg)	1.20	9.40
Vit-A	80	10

Harvesting

Fruits are available throughout the year, but the peak period of harvest is from June to July. When fruits are fully ripe, the nut split open. These are either plucked from the tree or allowed to drop.

Post-Harvest Handling

Market value of nutmeg mace is fixed based on the colour and nutritional composition. Even though post-harvest processing includes decortication, husk removal, separation of nut and mace, the most important processing with respect to colour of mace is drying. The harvest season of nutmeg coincides with heavy rain in Kerala. Hence, nuts should be dried within 24 hours of harvest and moisture level should not exceed 10 per cent.

The most important methods of drying in nutmeg are:

1. Conventional drying: Nutmeg and mace are dried separately as the moisture content of wet nutmeg is higher than that of mace and time required for drying is different. Mace takes four to five days for drying and nutmeg takes 10 to 12 days depending upon the intensity of the sunlight. In sun drying, the disadvantages are the products are exposed to direct sunlight, no uniformity in drying, presence of mould and infections (Aflatoxin) and contamination. In the processing of mace, the red coloured aril is removed from the nutmeg that it envelops and is flattened out and dried for 10 to 14 days under shade; its colour changes to pale yellow, orange, or tan. The mace is detached, flattened and dried in sun on mats for 3-5 days.

2. Mechanical drying: Mechanical drying is the solution to tide over the aflatoxin problem in nutmeg and mace. Mechanical and firewood-based driers can be used for drying both nutmeg and mace. In case of nutmeg drying, a temperature of 40°C may be adopted for about 6 to 8 hours for three days. Mace will take only 5 hours to dry at 40°C, but the colour will be yellowish which is not desirable. Maintenance of better quality, drying even in unfavourable climatic conditions at reduce drying time is the main advantages of mechanical drying.

Both nutmeg and mace need to be dried to a maximum moisture level of 10 per cent. Artificial drying of nutmeg at 50°C, which takes 28 hours to reduce moisture content from 36 per cent to 9 per cent showed "case hardening" effect after drying. Hence slow drying is preferable in case of mechanical drying.

3. Pulsed Microwave Assisted Hot Air Drying of Mace: Since nutmeg is a spice of high commercial value due to its importance in many fields like food and medicine, the processing is very important. The drying of nutmeg in quick time with colour retention is still a challenge. Conventional methods of drying nutmeg are associated with many disadvantages. Normal sun drying or mechanical drying takes several hours to weeks for attaining the desired moisture content. Implementation of novel methods of drying and processing will lead to the production and processing of nutmeg with better quality attributes at a lower cost.

Microwave-assisted convective hot air drying reduces drying time compared to convective drying and improves product quality compared to simple microwave drying. Pulsed microwave assisted hot air drying of mace takes two to three hours on an average. Application of novel processing methods, such as pulsed microwave assisted hot air drying may be having the potential to solve this problem. More research should be done in this field to optimize a best drying method for nutmeg which will overcome all the disadvantages of the conventional drying systems.

Grading

The dried nutmeg is graded by hand according to their weight, shape and colour. After grading, the nutmegs are fumigated with methyl bromide to protect them from storage pests.

The following classifications have been made in nutmeg trade:
1. Whole and sound nutmeg: this is used in spice trade as; (a) large (b) medium and (c) small.
2. Sound shrivels: these are employed for grading, but are usually too expensive for oil distillation.
3. Rejection: Considerably low-priced, this grade can be used for the distillation of oil.
4. Broken and warmy: this grade is also suitable for oil distillation, this grade includes Banda mace, Java estate mace, Siavw mace and West Indian mace among these Banda maces is considered to be superior in quality by the trade.

Packaging and Storage

The dried mace can be well packed and stored in air tight containers or polybags which are approved for organic products with protection from sunlight so as to protect the red colored pigment lycopene which is highly susceptible to oxidation in light. According to Agmark, nutmeg whole shall be packed in clean, sound and dry jute and cotton bags or in pouches made of food grade plastic. Nutmeg powder shall be packed in new, clean sound and dry containers made of tin, glass or in pouches made of laminated, extrusioned and metallised multilayer food grade plastic materials. The net weight of the nutmeg whole and nutmeg powder packed in a container shall be 25-gram, 50 gram, 100 gram, 500 gram, 1 kg and thereafter in multiples of 500 gram. Well packed nutmeg and mace can be stored normal temperatures in dry place. Moisture should be avoided so as to avoid mould attack and contamination with aflatoxin.

Adulterants

Nutmegs are sometimes adulterated with 'false' nutmeg *(M. malbarica)* or 'Bombay nutmeg', which are odourless and tasteless. The oil sometimes adulterated by the addition of turpentine oil or pinene. Mace is also sometimes adulterated with 'Wild mace' *(M. malbarica)*, which is of inferior quality.

Value Added Products

Nutmeg oil, Mace oil, nutmeg oleoresin, mace oleoresin, myristicin, nutmeg butter, the volatile oil of the bark and flowers are the value-added products of nutmeg.

Fig. a) ripened nutmeg fruit b) Aril surrounding the seed c) Separation of mace from seed

d) Dried nutmeg kernel e) Dried mace

Viral Diseases are; Menace to Capsicum (Bell Pepper) Under Protected Cultivation in Karnataka

Article ID: 30528

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Karnataka has diverse agro climatic zones and each of these zones offer a great potential for cultivation of wide range of crops. Among all crops, vegetables form major and important part of our dietary requirements, which are widely grown in rural and peri-urban areas. Of late, due to the population pressure, fragmentation of land holdings and urbanization has led to the decline in cultivable area. Hence, production of vegetables under protected cultivation system results in effective use of the land resources, besides being able to increase the production of quality vegetables both for the export and domestic markets by offsetting biotic and abiotic stresses to a greater extent that otherwise is prevalent in open cultivation. Under protected cultivation, capsicum is widely grown due to higher productivity and economic feasibility (Anon., 2011). Capsicum (*Capsicum annuum* L. var. *grossum* Sendt.) a member of family *Solanaceae*, depending on place and type capsicum is named as, chilli pepper, capsicum, red, sweet and green pepper.

In India, capsicum is extensively cultivated in states of Karnataka, Andhra Pradesh, Maharashtra, Tamil Nadu, hilly areas of Uttar Pradesh and Himachal Pradesh. In Karnataka capsicum is grown in an area of about 4.13 thousand ha with a production of about 81.67 thousand tons (Anon., 2018). However, Belagavi, Bengaluru Rural, Chikkaballapur, Dharwad, Haveri, and Kolar, districts are the major capsicum growing areas under protected conditions in Karnataka. Though area under cultivation of capsicum has been increasing the production is decreasing because of viral diseases affecting the crop.

About sixty-eight viruses has been reported to be infecting capsicum from different parts of the world in terms of host range, frequency of distribution and damage (Pernezny *et al.*, 2003). Diseases of viral nature affect production significantly, both in terms of yield and quality for export and domestic market (Nono-Womdin and Atibalentjia, 1993). Majority of pepper viruses are reported to be transmitted by aphids, thrips, leafhoppers, beetles and fungi or by contact and through the soil and some are transmitted by nematodes (Green and Kim, 1991). Viruses infecting pepper are tobacco and cucumber mosaic, potato virus Y, tomato spotted wilt, alfalfa mosaic, pepper mottle, pepper veinal mottle and pepper ring spot (Sutic *et al.*, 1999; Hiskias *et al.*, 1999; Buzkan *et al.*, 2006 and Ryu *et al.*, 2009). In this article, we are highlighting the results of Ph.D. research work on capsicum viral diseases under protected cultivation in Karnataka state.

Survey was conducted during *rabi* 2017-18 to know the incidence of viral diseases and prevalence of vector populations in major capsicum growing areas of Karnataka under protected cultivations like Bagalkote, Belagavi, Bengaluru Rural, Chikkaballapur, Dharwad, Haveri and Kolar districts. The survey results revealed that highest mean incidence (27.92%) of leaf curl disease in Dharwad, mild mottle disease (27.61%) in Belagavi and mosaic disease (21.39%) in Chikkaballapur districts were recorded.

Symptomatology

During survey, the capsicum plants showed typical symptoms of different viral diseases (tomato leaf curl, cucumber mosaic and pepper mild mottle).

1. Leaf curl symptoms: It was observed that from early infected diseased plants noticed yellowing and mosaic in younger leaves followed by blistering of leaves, upward curling of leaf lamina, leaf distortion and crumpling. The secondary symptoms such as stunted growth of plant and shorter internodes together with epidermal roughness were observed in early infected plants. The infected plants had small and lesser fruits compared to the healthy ones. The severity in symptoms was witnessed in infected plants showing upward curling and puckering in capsicum fields (Fig. 1). In addition, insect vector silver whitefly (*Bemisia tabaci* Genn) was also noticed on abaxial surface of the infected leaves.

2. Mild mottle symptoms: Capsicum plants infected by pepper mild mottle disease showed mild mottling, deformed leaves, yellow or green mosaic and chlorosis of leaves. However, the symptoms were more prominent on younger leaves. The infected plants showed reduced height and developed small, distorted and crumpy fruits with variations in colour (Fig. 1).

3. Mosaic symptoms: Sweet pepper plants during survey showed, mixed symptoms of mosaic, mottling, yellow discoloration, vein clearing, deformed leaves and narrowed petioles, stunted, reduced fruit setting and colour variation, mottling, chlorotic rings on fruits. Further, aphids were invariably found on every infected pepper plant, which are natural vectors of CMV (Fig.1).

Detection and Diagnosis

Disease diagnosis is a key factor, as diseases could be managed only if they are diagnosed properly because many similar symptoms are produced by dissimilar causes. Viral diseases can be diagnosed quickly by visual examination of symptoms but virus identification based on symptoms is unreliable, as different viruses can cause similar symptoms. The improper diagnosis of these plant viruses will lead to heavy loss in terms of both quality and quantity of the product. Hence, capsicum plants showed characteristic symptoms of leaf curl, mosaic, mottling, upward curling, puckering, intervenial chlorosis and vein banding chlorotic rings on both leave and fruits, were collected during survey and subjected to PCR analysis. For DNA viruses, total DNA was isolated by using CTAB method. Later, PCR was done by using universal begomovirus primers to confirm the begomoviruses and further, coat protein (CP) gene specific primers of *Chilli leaf curl virus* was used. For RNA viruses, total RNA was isolated by using QUIAGEN mini plant RNA isolation kit, cDNA was synthesized from mRNA through M-MuLV RT-PCR kit. CP gene primers of PMMoV and CMV were used to amplify. PCR products were analyzed by using 1 per cent agarose gel electrophoresis and further confirmed through sequencing.

The relationships of a begomoviruses with the leaf curl symptomatic capsicum plants were confirmed by PCR using begomoF/BegomoR degenerate primers. The symptomatic samples gave band of the expected size ~200 bp. Upon PCR amplification with coat protein genes of chilli leaf curl and tomato leaf curl viruses were amplified at ~500 bp and ~510 bp respectively. Similarly, mosaic and mottling symptoms were associated with *Cucumber mosaic virus* (CMV), *Pepper mild mottle virus* (PMMoV), *Tobacco mosaic virus* (TMV) were confirmed through RT-PCR, which amplified the CP-gene of CMV ~381 bp, PMMoV ~730 bp and TMV ~481 bp respectively. Rings on leaves and fruits were associated with *Groundnut bud necrosis virus* (GBNV) amplified ~830 bp by PCR.

a. Leaf curl and Puckering | **b. Mosaic** | **c. Mild mottling** | **d. Concentric rings**

Figure 1. Symptoms of a) leaf curl viruses b) cucumber mosaic virus c) mild mottle virus d) groundnut bud necrosis virus

Conclusion

In the present investigation confirmed the occurrence of different viruses on capsicum under protected cultivation which results in the reduction of both quality and quantity for domestic market as well as export. Majority of pepper viruses are reported to be transmitted by aphids, thrips, leafhoppers, beetles and fungi or by contact and through the soil and some are transmitted by nematodes. Hence, management of vectors is always puzzle for minimizing the rate of infection.

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Yield of Late Sown Wheat as Affected by Growth Regulators

Article ID: 30529

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Abstract

Late Sowing is a main problem in wheat climatization in India. Which brings the crop to survive and yield under unfavourable environmental condition. It causes restrictions of plants growth and productivity. In the present approach, a pot experiment with twelve treatments and four replications of each treatments was conducted with Completely Randomised Design (CRD) in the department of Crop Physiology, Chandra Shekhar Azad University of Agriculture and Technology, Kanpur, (U.P) to explored new approach for yield enhancement under late sown condition. Results showed that GA3 and Kinetin, possessed significant a greater number of tillers. NAA and Thiourea resulted highest number of grain/ears, grain weight, Harvest Index (HI) and finally grain yield.

Introduction

Wheat (*Triticum aestivum* L.) is physiologically categorized as a C3 plant, being second most important staple food crop. Globally, it is the most important human food grain and ranks second in total production as a cereal crop behind maize; the third being rice. In U.P, the productivity of wheat is lower as compared to Punjab and Haryana. The main reason of low productivity of wheat in U.P is its delayed sowing on sizeable area which is grown after toria, early potato, late paddy, sugarcane rotation and early pigeon pea etc.

This shift in sowing date is likely to alter the environmental conditions particularly those of temperature and day length available to the growing crops at various stages of growth and their influence would further affect germination, growth and development processes and thereby influencing yield.

Delay in sowing pushes the crop to severe spring resulting in enforced drying of crop at premature stage. Regmi et al., (2002) reported a yield decline in wheat when it was sown after the third week of November. The inputs applied to the wheat crop were not efficiently utilized and resulted in reduced yield under late sowing (Hobbs and Gupta, 2002).

The reduction in the optimum growth period caused by a rise in temperature leads to leaf senescence resulting in low photosynthetic rate to meet plant carbon economy (Sharma-Natu et al., 2006). As a result, it affects two important yield parameters, i.e. the number of grains per spike and grain weight (Ugarte et al., 2007).

This reduction can be compensated by cultivating short-duration varieties that are thermo-sensitive and generally low yielding. The other effective approach is the exogenous application of plant growth regulators (PGRs) involved in promoting plant growth and development under normal and stressful conditions. Growth regulators have not only provided a useful tool to agriculturist but have also been helpful in overcoming practical agricultural problems as where genetic or other manipulations have not been possible.

Thus, these growth regulating substances when use even in very minute concentration, bring about marked effect on the growth pattern and behavior of plants by inducing morphological, histological and physiological changes even in the parts of the plants, distantly located from the site of application as compared to other breeding tools which generally take several years to generate this type of characters in an individual crop plant.

Methodology

The experiment was conducted during during *Rabi* season in pot in the department of Crop Physiology, Chandra Shekhar Azad university of agriculture and technology, Kanpur, aimed with to study the effect of Gibberellins (GA_3) (20,40 ppm), Cytokinin (Kinetin) (5,10,15 ppm) , Auxin (NAA) (20,40,60 ppm), and Thiourea (TU) (400,800,1200 ppm) on yield of wheat (*Triticum aestivum* L.) under late sown condition.

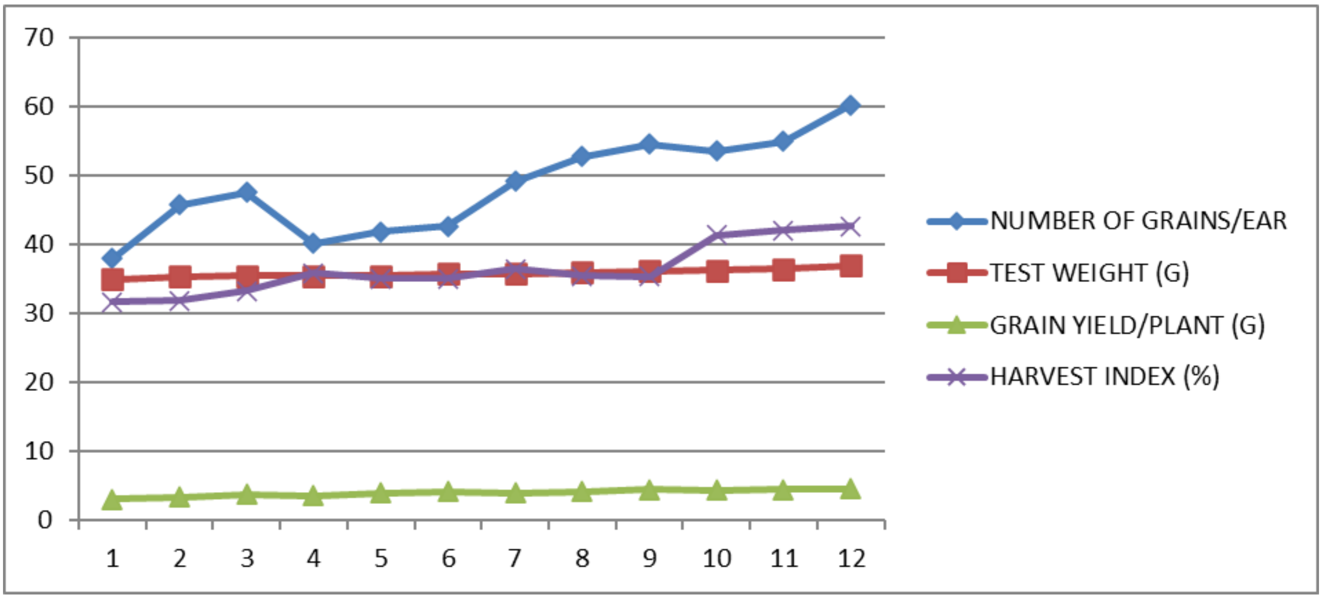
Result and Conclusion

According to the experiment, it may be inferred that the foliar application of Thiourea 1200 ppm significantly enhaced the Grain number/ear, Test Weight (G), Grain yield/plant (g) and Harvest Index (%) followed by NAA 60 ppm. The others treatments had also supporting influence (Nilesh, G. 2012 and Sahu, M.P. 1995, Sanaa et al. 2006, Amal Fadl Abdelkader et al. 2012 and Rukasz and Michalek, 2004).

Table-1 Influence of Growth Regulators on Yield Attributes of wheat under late sown condition.

S. No.	Treatments	Yield Attributes			
		No. of Grain/ear	Test Weight (g)	Grain Yield/Plant (g)	Harvest index (%)
1	Control	38.0	35.00	3.10	31.72
2	GA3 20 ppm	45.8	35.44	3.40	31.92
3	GA3 40 ppm	47.6	35.48	3.78	33.30
4	KN 5 ppm	40.2	35.46	3.65	35.88
5	KN 10 ppm	41.9	35.50	3.99	35.14
6	KN 15 ppm	42.7	35.75	4.18	35.06
7	NAA 20 ppm	49.2	35.80	3.97	36.48
8	NAA 40 ppm	52.8	36.00	4.21	35.49
9	NAA 60 ppm	54.6	36.20	4.56	35.43
10	TU 400 ppm	53.6	36.25	4.37	41.35
11	TU 800 ppm	55.0	36.50	4.54	42.08
12	TU 1200 ppm	60.3	37.00	4.66	42.67
	S.E(diff.)	0.606	0.304	0.070	0.0316
	C.D at 5% P	**1.230**	**0.616**	**0.143**	**0.0559**

Figure-1 Graph on influence of Growth Regulators on Yield Attributes of wheat under late sown condition.



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Zero Budget Natural Farming (ZBNF) – Going Back to Roots

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Summary

In order to feed the global population of 9.6 billion by 2050, as projected by a United Nations report, increasing food production with limited resources is important in creating a food-secure future. Zero budget natural farming (ZBNF) is a farming practice that believes in natural growth of crops without adding any chemical fertilizers and pesticides. The four pillars of ZBNF are Bijamrita, Jiwamrita, Mulching and Waaphasa. Farmers practising ZBNF gets higher yields, elimination of chemical pesticides, promotion of good agronomic practices, improve soil biodiversity and productivity thereby reducing the input cost.

Introduction

Zero Budget Natural Farming (ZBNF) is a farming practice that assumes in natural growth of crops excluding addition of fertilizers and pesticides or any other foreign elements. The word 'Zero budget' refers to the zero-net cost of production of all crops (inter crops, border crops, multi crops). Locally available inputs such as cow dung and urine for seed treatments and other inoculations. Since a ZBNF practicing farmer has lower cost of inputs and thus has better capacity to increase the incomes. At the same time, ZBNF crops helps in retaining soil fertility and is climate change resilient.

The founder of ZBNF and Padma Shri Awardee, Sri. Subash Palekar has provided four important non-negotiable guidelines based on 4 pillars:

1. Jeevamrutha: It is a mixture of fresh cow dung and aged cow urine (both from India's indigenous cow breed), jaggery, pulse flour, water and soil; to be applied on farmland.

2. Bijamrita: It is a mixture of neem leaves & pulp, tobacco and green chilies prepared for insect and pest management, that can be used to treat seeds.

3. Acchadana (Mulching): It protects topsoil during cultivation and does not destroy it by tilling.

4. Whapasa: It is the condition where there are both air molecules and water molecules present in the soil. Thereby helping in reducing irrigation requirement.

Features of Zero Budget Natural Farming

1. Zero budget natural farming is a method of chemical-free agriculture drawing from traditional Indian practices.
2. It is a unique model that relies on Agro-ecology.
3. It aims to bring down the cost of production to nearly zero and return to a pre-green revolution style of farming.
4. It states that there is no need for expensive external inputs such as fertilisers, pesticides and intensive irrigation.
5. The ZBNF method promotes soil aeration, minimal watering, intercropping, bunds and topsoil mulching and discourages intensive irrigation and deep ploughing.
6. It suits all crops in all agro-climatic zones.

Benefits of Zero Budget Natural Farming

1. No need to spend money or take loans for external inputs, which reduces the cost of production farming made into a "zero budget" exercise.
2. This breaks the debt cycle for many small farmers and help to foresee the doubling of farmer's income by 2022.
3. At a time when chemical-intensive farming is resulting in soil and environmental degradation, a zero-cost environmentally-friendly farming method is definitely a timely initiative.
4. Citing the benefits of ZBNF, in June 2018, Andhra Pradesh rolled out an ambitious plan to become India's first State to practise 100% natural farming by 2024.

Zero Budget Natural Farming in India

Zero Budget Natural Farming (ZBNF) has attained wide success in southern India. It was first started in state of Karnataka where it attained huge success. The movement in Karnataka state was started with the collaboration of Mr. Subhash Palekar and the state farmers association Karnataka Rajya Raitha Sangha (KRRS).

The population of India, which is currently 17.71 per cent of the total world population, is predicted to increase by 33 per cent from 1.2 billion in 2010 to 1.6 billion in 2050. Under 'business-as-usual' scenario, by 2050, 60 per cent of India's population, equivalent to over 10 per cent of the people on Earth, will experience severe deficiencies in calories, digestible protein and fat, the scientists have claimed in the paper. To meet increased demands for food on a diminishing area of agricultural land, efficiency of crop production must increase, but climate change, soil degradation and deforestration present further challenges to increasing the efficiency of Indian agriculture.

ZBNF is making ripples in Andhra Pradesh, where 5,23,000 farmers, about 13 per cent of farmers in the state, have already embraced the technique. Campaigners of ZBNF state that the soil already contains all the nutrients needed for plant growth and that the action of microbial cultures added to the soil releases these nutrients from the soil itself. However, if only nitrogen was provided by stimulating release from the topsoil, there would be an associated loss of organic matter, and all organic matter would be lost from the topsoil within 20 years. This would result in a sharp decline in crop production and make soils less resilient to droughts, argued the scientists.

Conclusion

Scientists in India have to rework their strategy so that farming is in accordance with nature. We need a global transition to a more climate resilient and sustainable agriculture which is less dependent on agrochemicals and draws more on natural biological and ecosystem processes.

Four pillars of Zero budget natural farming

Ground Water Recharging Through Agricultural Run-Off Water: Alluring or Threatening

Article ID: 30531

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Introduction

Seventy-one per cent of earth's surface is covered with water, however only 2.5% of this is considered as fresh water which is locked mainly in ice (68.7%) or as underground water (30.1%) in the deeper layers. Ground water acts as the prime source of drinking as well as other house hold activities in semi-urban and rural areas of India. A major proportion of agricultural and industrial sectors alone utilizes approx. 80 % of total extracted ground and conveniently made it the easiest option for fulfilling the increasing water requirements. The extent of groundwater usage can be taken into consideration by the fact that 230 billion cubic meters of ground water is drawn annually only for irrigation purposes in India. The Indo-Gangetic plain, north-western, central and western parts of India account for most intensive groundwater-based irrigation. Among these regions, western India and the Indo-Gangetic plain have more than 90% of the area irrigated using groundwater. Surprisingly, India extracts more ground water than the collective amount extracted by second and third largest extractors namely China and USA, thereby causing the groundwater depletion in the range of 122-199 billion cubic meters (https://www.downtoearth.org.in). The groundwater extraction is found to be more severe in north-western India where the total extraction exceeds the total recharge leading to progressive depletion. The situation is most grievous in Punjab where the ground water is depleting constantly at the rate of 91cm per year (CGWB 2019, The Hindu 2018). The fifth minor irrigation census has also declared that India has extracted 89% of water for irrigation and has suffered a decline of 61% in the ground water levels between 2007 and 2017.

Emerging Water Crises

Only around 9% of the total groundwater extracted finds usage in daily household activities which have further laid a tremendous amount of pressure on the ground water resources. The intensity of the problem can be further evaluated by the fact that 21 major cities of India would be running out of ground water by 2020 which would affect around 100 million people as stated by the Composite Water Management Index (CWMI) report of Niti Aayog in 2018. The per capita availability of water in India has declined from 5177 cubic meters in 1951 to 1545 cubic meters in 2011. Furthermore, the future projections of same report had also stated that by 2030, the country's water demand is projected to be twice the available supply which would imply severe water scarcity for millions of people eventually causing a 6% decline in the country's GDP

Ground Water Recharging

The ground water crises can be addressed, to some extent, by recharging it via various means. This practice of raising levels of groundwater can be done via natural as well as manmade procedures. The natural process of recharge is a hydrologic process which occurs as a result of downward movement of surface water to ground. The recharge mainly occurs during rainfall in monsoon season simply by gravimetric movement of water through finer pores between soil particles. The long distance travelled by water causes the removal of particulate matter and other impurities during its movement from earth surface to the water table. Since rainfall of past several years controls the existing groundwater storage levels, the dwindled state of monsoon might not be sufficient for natural recharge. The increasing human intervention has also led to a significant alteration in the monsoon patterns making the situation worse ever.

Hazards Related to Ground Water Recharging

Human interventions involving collection of rainwater in various catchments of buildings and its percolation into the ground can effectively recharge the underground water table. Some areas receiving a heavy and incessant rainfall have to face the problem water logging leading to a considerable decline the crop yield for the farming community. In some areas, the farmers are actively engaged in direct pumping of the agricultural runoff water into the groundwater by digging bores and wells. It should also be taken into consideration that the runoff water is never passed through any kind of filters in such practices. These efforts have even been praised by several government and non-government organizations, without any scientific evaluation. The agricultural runoff water contains an ample amount of cytotoxic and carcinogenic residual pesticides and other agrochemicals which are affecting humans by causing nerve and bone marrow disorders, infertility, respiratory problems and immunological issues. Some pesticides like organophosphates accrue in the animal bodies and an exposure to their higher concentration's scripts the accretion of acetylcholine, leading to fatal consequences. Furthermore, the agricultural runoff water also carries with it several microbial pathogens endowed with an even greater potential of deteriorating human health. Some of these pathogenic microbes are also opportunistic human pathogens and can form resting structures called spores which are found to be resistant to extreme environmental conditions. Some of these spores have the potential to rejuvenate even after a dormancy period of several years. Therefore, this process puts forward the possibility of groundwater as a possible sink and a future source of some deadly bacterial pathogens. The presence of phosphatic and nitrogen fertilizers in the agricultural runoff water may act as source of nutrient for their proliferation in the underground water table. Since, a major proportion of ground water is being utilized for irrigation purposes, the contamination and proliferation of groundwater with pathogenic microbes can increases the chances of their repeated attack to prone crops consequently the farming community may have to bear major economic losses. The dependence of major proportion of Indian population solely on ground water for drinking purposes makes the issue even more alarming. Charry on the top is the unavailability of the ground water to sunrays leading to almost negligible possibilities of its remediation.

Conclusion

The practice of groundwater recharge through rainwater harvesting must be scientifically supervised to make sure that the building catchments may not became the passage of transporting domestic polluted or untreated water to the readily depleting freshwater stock. Similarly, reverse boring of agricultural runoff water also needs a critical scientific evaluation before its dramatic glorification. More scientific efforts should be directed towards finding alternatives for management of runoff water and preventing the contamination of harmful agrochemicals, heavy metals and sporulating microbial pathogens into the groundwater.

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Agribusiness Opportunities of Production of Medicinal Plants Amid COVID-19 Pandemic

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Introduction

The demand for Ayurveda products with health care benefits has increasingly tremendously. Immunity building products are in greater demand in this time. The quality of raw-material of medicinal plants depends on the collection and cultivation practices used for procurement of medicinal plants. There is a huge gap between supply and demand for medicinal plants for manufacturing of Ayurveda medicines and products in the country (NMPB).

According WHO around 80 per cent of the world's population uses herbal medicines and its products for primary health care, particularly across Europe and South Asia country. Only 20-25 per cent is cultivated by farmers and rest of the collected from wild source. Sustainable cultivation and harvesting of medicinal plants should be promoted to get income benefits. Farmers should be ensured adequate income to encourage them to cultivate medicinal plants. The National Medicinal Plants Board in the country is promoting integrated cultivation of medicinal plants. The board is also promoting in situ cultivation and conservation of trees. There is a huge scope for export of raw materials of medicinal plants. But in term of quality, traceability, organic certification of materials is very important. Recently, WHO (World Health Organization) estimated that 80 percent of people worldwide trust on herbal medicines for some aspect of their primary cure and health care needs.

Around more than 30 per cent of the whole plant species, at one time or other were used for medicinal purposes. It has been estimated, that in developed countries such as United States, plant drugs constitute as much as 25 per cent of the total drugs, while in fast developing countries such as India and China, the contribution is as much as 80 percent. The medicinal plants are abundant more economic importance to countries such as India than to rest of the world. The medicinal plants are the basic source of raw-material for preparation of Ayurveda medicines. Therefore, the quality of Ayurveda products critically depends upon the quality of raw-material. By adopting good agro-technique of medicinal plants, the safety and quality of medicinal plant materials and finished products may well be help in assured.

Table 1: The Estimate of Consolidated Commercial Demand, Export and Consumption of Herbal Raw Drugs

S. No.	Particular	Year	Herbal raw drug
1	Demand	2014-15	5,12,000 MT
2	Export	2014-15	1,34,500 MT
3	Consumption	2014-15	1,95,000 MT

(Source: National Medicinal Plant Board, https://nmpb.nic.in/content/demand-and-supply-position-medicinal-plants)

Important Medicinal Plants for Cultivation

1. Ashwagandha
2. Aonla
3. Aloe vera
4. Giloy
5. Tulsi
6. Chiraita
7. Isabgol
8. Brahmi
9. Kalmegh

Cultivation of Tulsi

The cultivation of medicinal plants for farmers is very beneficial. Farmers of many states in India have opted to cultivate medicinal plant and make good income by it. The biggest advantage of growing Tulsi is that it gives good profits earning in short time and at low cost. Investing just ₹ 15000 to ₹ 20000 farmers can earn 3 to 4 lakhs in three months of its cultivation. After harvesting post-harvest management required to maintain quality of the product and fetching good price in the market drying of leaves should be done. Then steam distillation is done to get Basil or Tulsi oil. For transportation of Tulsi it is packed in airtight bags. Leaves should be stored in dry places. From herb several value-added products and medicinal products like Panch Tulsi oil, Tulsi Ginger, Tulsi Powder, Tulsi Tea and Tulsi Capsules are made after processing.

Industry estimates put the market for herbal products at ₹ 50,000 crore, growing at a fast-annual clip of 15 per cent. Acreage devoted to herbs and aromatic plants is still very small 6.34 lakh hectares out of the total currently cropped area of 1,058.1 lakh hectares but growing at 10 per cent annually, according to government data (ET, 2018).

Cultivation of Ashwagandha

Ashwagandha is widely grown in dry parts of sub-tropical regions. Madhya Pradesh, Rajasthan, Uttar Pradesh, Haryana, Gujarat are major Ashwagandha growing states in India. In Ashwagandha roots are the major economic part. Thus, land should be prepared in such a way that it should not have any constraints in the development of roots and get more length and width for better quality. Jawahar Asgand-20 is important cultivator variety dry roots yield 5-6 quintals per hectare (Jat et al. 2015).

Cultivation of Giloy

The plant is cultivated by stem cutting in the month of May-June. It requires some support preferably Neem etc. It grows well in almost any type of soils and under varying climatic conditions. Mature plant collected and dried stem used for making Giloy tablets. It is used as immunity booster. Giloy is cultivated by stem cutting obtained from older stem in the month of May-June.

Table 2: Medicinal Plants Cultivation Return and Industry Buyer

S. No.	Crop	Return/acre (₹)	Industry buyer
1	Atish	2.50,000	Dabur, Himalaya
2	Lavender	1,00,000	Himalaya, export house
3	Ashwagandha	1,00,000	Patanjali, Dabur, Organic India,
4	Tulsi	1,00,000	Tata tea, Dabur, Himalaya
5	Brahmi	90,000	Hamdard, Tata tea, export houses

(Source: Economics Times, 2018)

Conclusion

The National Medicinal Plants Board is promoting integrated cultivation of medicinal plants in the country. The board is also promoting in situ cultivation and conservation of trees. There is a huge scope for export and consumption of raw materials of medicinal plants for production of Ayurveda medicine. The demand for medicinal plants like Tulsi, Ashwagandha, Giloy, Brahmi, etc. increasing tremendously. In the country many industries engaged in buying medicinal plants as a raw material for production of herbal and medicinal products.

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BioClay: RNAi Based Topical Spray for Crop Protection

Article ID: 30533

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Plant viruses, bacteria, fungi and pests are difficult to control and decrease production & productivity of agricultural crops. RNA interference (RNAi), a conserved eukaryotic mechanism, shows an important role in growth, development and host defence against viruses, pest and various pathogens. RNAi is post-translational regulation which regulates transcript expression in a sequence specific manner, can be co-opted for defence against exogenous RNA resistance. The silencing of a gene is a consequence of degradation of large RNA into small RNAs that activate ribonucleases to target homologous mRNA. Double-stranded RNA (dsRNA) is the main activating molecule of RNAi, has been shown to provide protection without the need for integration of dsRNA-expressing constructs as transgenes of adverse impacts.

Introduction

In the world 30–40% per year losses in agricultural crop yield due to various biotic stresses like viruses, bacteria, plant pests and pathogens. From green revolution era resistant or tolerant cultivars, pesticides, chemicals, fertilizers are the most common plant protection management practices to respond against biotic stresses, but these have negative impacts on human and environmental health. So, there is need to develop or innovate environmentally sustainable approaches for plant protection. An RNAi technique is a conserved eukaryotic mechanism helpful to regulating RNA transcript abundance. Main feature of RNAi in plants is processing of dsRNA into small interfering (si) RNAs by the activity of DICER LIKE (DCL) enzymes. The siRNAs are then incorporated into an RNA-induced silencing complex, ensuring that it specifically degrades any RNA sharing sequence similarity with the inducing dsRNA. dsRNA loaded into degradable, layered double hydroxide (LDH) clay nanosheets and formed dsRNA–LDH complexes named as BioClay. When this BioClay sprayed on the levees of the plants, there is degradation of LDH and dsRNA uptake in plant cells and silencing of homologous RNA on topical application.

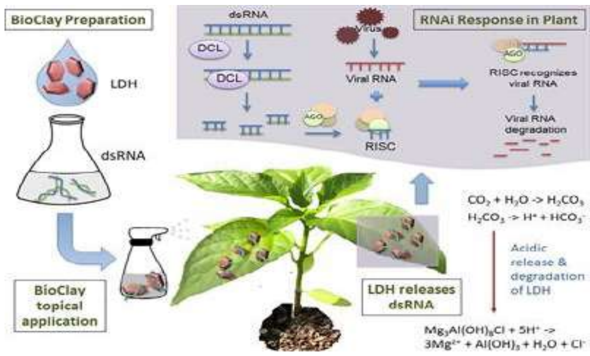

Fig: BioClay application and RNAi-mediated protection from Biotic Stresses (Fletcher et. al., 2020)

BioClay and Resistance to Pathogen

RNAi is a novel spray application for crop protection, as compared to conventional transgenic approaches. After foliar spray of dsRNA on the leaves of plants, dsRNA enters into plant and spreads systemically to whole plant via the phloem. Degradable BioClay acts like a vaccine for plant, it uses the sequence from the virus itself, ds RNA enters into the plant and plant shows defense against fungi or viruses. Miguel *and Scott, 2016* found that coleopteran Colorado potato beetle was highly susceptible to foliar-applied dsRNA on potato leaves. Currently topically-applied RNAi technologies focuses in two ways by selecting mortality-maximizing target genes specific to a given species and ensuring topically-applied dsRNAs are sufficiently stable for an optimum protection window. After spraying of dsRNA using clay nanoparticles as carriers, dsRNA associated to target NIb and CP coding regions (BCMVNIb-dsRNA and BCMVCP-dsRNA, respectively) to inhibit aphid-mediated transmission spread of BCMV (Worrall *et. al., 2019*) Mitter *et. al., (2017)* concluded that single spray of BioClay on *N. tabacum* plants shows effective virus protection for 20 days or more days. LDH degrades in the presence of mildly acidic conditions, so there is minimum risk of persistence of dsRNA in the environment.

Cultivation of Ashwagandha

Ashwagandha is widely grown in dry parts of sub-tropical regions. Madhya Pradesh, Rajasthan, Uttar Pradesh, Haryana, Gujarat are major Ashwagandha growing states in India. In Ashwagandha roots are the major economic part. Thus, land should be prepared in such a way that it should not have any constraints in the development of roots and get more length and width for better quality. Jawahar Asgand-20 is important cultivator variety dry roots yield 5-6 quintals per hectare (Jat et al. 2015).

Risk and Mitigation

All novel technologies are always associated some generalize risks to human health and environment; these can be mitigated by planning and monitoring. Sometime topically applies dsRNA caused problem in inhalation and indigestion, but human have innate immunity to recognize this dsRNA and degrade it in sequence specific manner. Due to genetic divergency of the target to dsRNA sometime off-target organism can come into contact with an applied dsRNA is the crop itself, to mitigate this parallel analysis of RNA ends technique can be used for identification of endogenous mRNA targets in dsRNA-expressing plants (Casacuberta et al., 2015).

Conclusion

BioClay can be residue free alternative approach for sustainable crop protection against various pathogens. BioClay can provide effective protection against virus transmission under field conditions without any harmful effect on human health and environment.

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Impact of COVID–19 On Demand of Organic and Sustainable Food

Article ID: 30534

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Introduction

As Covid-19 continues to spread, however, consumer purchasing patterns and, more importantly, priorities are changing, some farmers are seeing an uptick in demand for certain products, while others are having to dump their agricultural outputs due to a glut of demand. At a time when many consumers are taking a closer look at their health and thinking about how they want to feed themselves and their families through the pandemic, organic products may have more appeal.The World Organic Agriculture report of 2018 notes that a third of all organic food producers in the world live and cultivate in India. But at the same time, organic food cultivation makes up only 2.59% or 1.5 million hectares of the total global organic cultivation area of 57.8 million hectares.

The size of the Indian organic food market remains relatively small, at around $1.5 billion of the approximately $250 billion global organic food market. The cultivation of organic agriculture is growing around the world, rising to 50.9 million hectares in 2015 from around 11 million hectares in 1999. Some Indian states like Sikkim have taken the lead in converting their entire produce to organic cultivation, and while still unorganised, estimates suggest that Indian organic agriculture is growing at 25% a year. The coronavirus pandemic has led to surging demand for organic and sustanable foods. We are set to firmly exit the third era of globalisation.

What is Driving Interest in Organic Food?

1. Current purchasing patterns indicate strong consumer interest in organics.
2. The three main reasons that consumers purchase organic foods, to avoid pesticides, to avoid GMOs, and due to a belief that organic products are more nutritious.
3. Covid-19 is raising consumer awareness of the relationship between nutrition and health.
4. This has resulted in a surge in interest in products that benefit from a "health halo" including functional foods and fruit and vegetables. Because organic food products are a global commodity.

Challenges of Post COVID-19

1. Food safety is more important in food supply chain (Production, processing, delivery and safe handling).
2. Social distancing in human and animal food & feed sector as a part of the essential critical infrastructure workforce.
3. Preventive controls and food supplier verification.
4. Nutritional labelling of package food for restaurant and other business.
5. Sanitisation factors/potential transmission of Covid-19 via food insecurity for poors (Food shortage/price hike, decrease in purchasing power).
6. To provide nutritious food to enhance immunity and quality with minimum price.

Opportunities & Strategies for Re-Orienting Agriculture in Post COVID-19 (Preparedness & Response Actions)

1. Training for safety of farmers, food workers and food production systems, White glove service
2. Adoption of GMP/GAP/GBP
3. Re-orientation of concept of health, ecology, care & share
4. Strengthening of local food system
5. Family Farming
6. Quality food consumption & healthy diet for better immunity (Modified menus for immunity)
7. Tech-driven solution (Greater Technology for no sharing)
8. Honest food/Green food/Organic food.

Future Trend

1. Looking into the future, Covid-19 will likely impact the organic market into 2021 and beyond. The largest long-term disrupter to the organic sector is the potential for lasting economic depression through reduced income and a likely recession.

2. M. S. Swaminathan, the father of India's Green Revolution, once told me that the wars of the future will be won by those with food, and not by those with guns.

3. The democratic destruction that the coronavirus has unleashed shows us the power of that statement consumers' transitioning to purchasing more organic products either for health reasons or But the organic market is not without risks, if consumer incomes decline, layoffs persist and the world goes into a long-term recession, consumers may have less income to spend on premium products and have to choose the conventional counterparts to the organic produce they typically purchase to cut costs cause they are eating at home.

Conclusion

Overall, the COVID-19 pandemic is a crucial juncture in the Indian history. The evident trails from the rest of the world were helpful for the Indian officials to take preparedness and response measures at the right time to tackle the pandemic. Evidently, the Indian government has taken huge steps to feed the entire nation and protect their lives and livelihoods amid the coronavirus outbreak. Hoping that this cloud also has a silver lining, in reshaping the society's potential for greater food security and food sovereignty, thus paving the way to efficient food systems.

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Spectrophotometer: A Short Detail

Article ID: 30535

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Introduction

Every atom of any element has the maximum absorption at a different and specific wavelength. Basically,

$$\text{Concentration} = \frac{\text{Amount of solute}}{\text{Known amount of solution}}$$

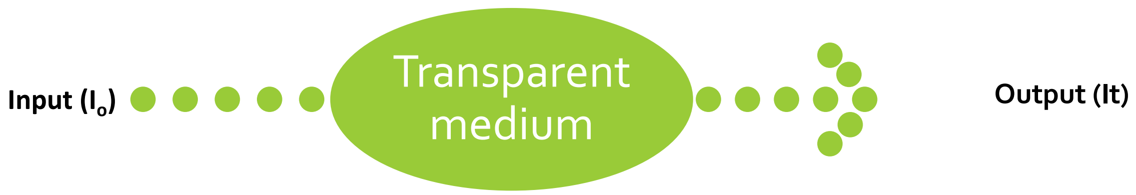
Concentration is an expression for a relative amount of solute per unit volume or mass of solution.

All atoms absorb maximum light at certain different wavelength according to energy requirement of the particular atom. For Na it is 2.2 eV.

In spectrophotometer, a light source of specific wavelength is passed through a test sample for specific element analysis. For a newly installed instrument we calibrate it using a known sample of Potassium permanganate ($KMnO_4$) with spectra grade standard (100.00+02).

Principle

It works on the principle of Beer- Lambert law.



Input = Output + absorbed or lost
Or
Output = Input – absorbed or lost

According to Lambert's law:

1. When a light is passed through a transparent medium, a portion of light absorbed in that medium is independent of the intensity(I) of the incidence light.

2. Each successive unit of thickness of medium absorb an equal fraction of light
Transmittance (T) is the fraction of the incident light which is transmitted through the medium. Transmittance (T) = It / Iowhere It is intensity of transmitted light and Io is for incident light.

$$I_o / I_t = 1/T$$
$$\log(1/T) = abc = \text{Absorbance or Optical density}$$
$$A = \log(1/T)$$

According to Beer's law:

1. Light absorption in the medium is directly proportional to number of absorbing atoms in sample i.e concentration of that specific atom of an element.

2. Absorbance or Optical density (A) is the fraction of incident light which is absorbed by medium. It is a function of absorption co-efficient, b length or thickness of absorption medium path, c concentration of absorbing material.

Hence A is directly proportional to concentration of element atom for a given path length at any given wavelength.

$$A = abc$$

where a is absorption co-efficient or absorptivity depends on wavelength of light (λ) and nature of sample medium, b is length of absorption or optical path, c is concentration of absorbing material.

After combining both laws, we get
Output = Input – Absorbed or loss
Similarly,
It = Io – (abc)
After taking log we get
log10 Io/It = abc = Absorbance
where a & b are constant in practice.
Therefore, result is directly related to concentrations of atoms.

Essential Parts

1.Halogen or deuterium bulb (light source)
2. Monochromator (for separating the continuous spectrum into different colours –diffraction grating or prism)
3. Wavelength selector
4. Slot
5. Test tube (measuring cuvette for a sample solution)
6. Photodetector.
7. Digital display.

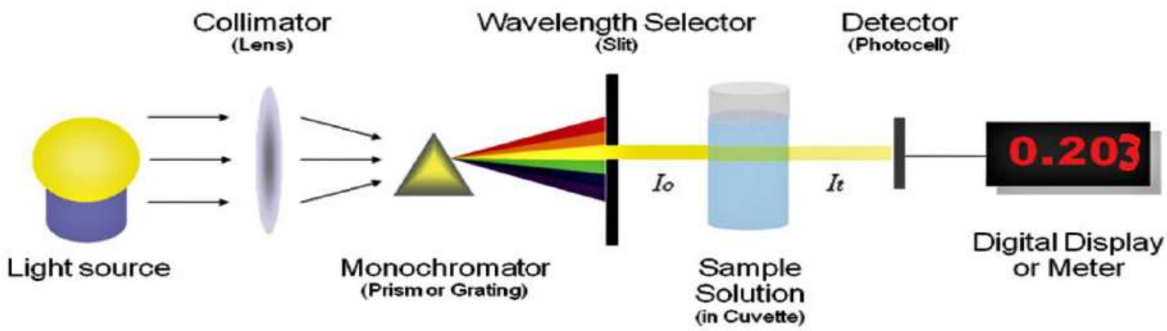
Types

1. Atomic absorption spectrophotometer.
2. Lateralization spectrophotometer.
3. Near infrared(NIR) spectrophotometer.
4. Tunable Diode laser (TDLS) spectrophotometer.
5. Beckman flame spectrophotometer.
6. 3-D excitation emission fluorescence spectrophotometer.
7. Flameless spectrophotometer.
8. Perkin – Elmer atomic absorption spectrophotometer.
9. Visible near infrared (VIS-NIR) SPECTROPHOTOMETER.
10. On-line real time Soil spectrophotometer.
11. Fourier transform infrared spectrophotometer(FTIR).
12. Graphite furnace AAS.
13. Inductively coupled plasma optical emission spectrophotometry (ICP-OES).
14. ICP-MS(Inductively coupled plasma optical emission mass spectrophotometry).
15. UV-VIS AAS.
16. Dobson Spectrophotometer.
17. Brewer Spectrophotometer.

The Working Process is as Follows

A beam of light passes through a monochromator. The appropriate wavelength is selected by passing the stray light through narrow aperture. Then the light passes through the sample solution in the cuvette and falls on the optical radiation detector.

Spectrophotometer should produce different wavelengths because each compound has the maximum absorption at a different wavelength. The quantity of photons falling on the detector depends on the length of the cuvette and the concentration of the atom in sample. Knowing the intensity of light after passing the cuvette, one could compute transmittance (T).



Applications

1. Determination of P and micronutrients analysis by AAS in soil.
2. Heavy metal analysis in soil and water.
3. Mineral composition and clay component of soil.
4. Monitoring dissolved oxygen content in freshwater and marine ecosystems.
5. Determination of As, Sb, Bi, Si, Te in streams and soil.
6. Detection of functional groups.
7. Estimation of exchangeable cations in soil by Beckman- flame spectrophotometer.
8. For identifying & quantifying gypsum concentration in soil.
9. Quantifying determination of bacterial DNA in soil enzymes from soil.
10. Respiratory gas analysis in hospitals.
11. Molecular weight determination of compounds.
12. For total Ozone measurements.

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Mexican Beetle as a Weed Feeder Insect

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Introduction

Generally, an unwanted plant in unwanted place is called as a weed. Some economic losses occur due to the weed. Weed is killing or control by using the herbicide which is available in the market due to high price so all farmer is not use, also it causes the environmental problem as well as residue problem in the soil. Reduce the all problem by using some biotic agent which feed on this unwanted plant without any side effects.

What is Parthenium?

Parthenium hysterophorus L. commonly known as carrot weed or congress grass in India, is an herbaceous, erect and annual plant belonging to the family Asteracae. It originates from the Mexico. In 1955, noticeable occurrences of carrot weed in Pune (Maharashtra) and spread as a wild fire in whorl india. At present it covers the 35 million hectares of land in India. It is creating nuisance on road sides, wastelands, railway tracks, industrial areas also on the side of open drainage system and irrigation canals. Its occurrence observed in agricultural crops, orchards and forest area, it mainly spreads through seeds which is small in size and light in weight.

Why Congress Grass is Dangerous Weed?

It is a poisonous, pernicious, problematic, allergic and aggressive weed posing a serious threat to human beings and his livestock. In India and also Australia, this weed has been considered as one of the greatest sources of dermatitis, asthma, nasal-dermal and nasal-bronchial types of diseases. Besides ill effects, it also causes several other problems like blockage of common pathways and reduces the aesthetic value of parks, gardens and residential area.

Biological Control by Mexican Beetle *(Zygogramma bicolorata)* in India

Zygogramma bicolorata, variously referred to as the Parthenium beetle or Mexican beetle, is a species of leaf beetle in the subfamily Chrysomelinae, native to Mexico.

Biology of Mexican Beetle

Beetles are off-white or light reddish in colour having dark brown marking on the elytra, measuring about 6 mm. in length. Eggs are light yellow generally laid on the ventral side of the leaves and hatch within 4-7 days. There are four in stars. The grubs feed on the leaves for 10-15 days and on maturity enter into soil and pupate below up to 15 cm depth. Adults emerge after 8-12 days. The beetle competes its life cycle within the 27-32 days and 4-5 generation from June to October. Fecundity of the female is up to 2500 eggs. During the rainy season between June to October beetle remain most active in the field.

How Beetles Kill the Parthenium?

Both adult and larvae are feed on the parthenium leaves. After hatching the larvae start the feed on soft growing leaves, first attacking the terminal and axillary buds and later the leaf blades, thus checking completely the plant growth and flower production. Adult voraciously feed on the plant. Beetle cut the immature flower an effort to chew soft tissues bneath the flowers. Dia back symptoms start to show and gradually get killed the plant. Small and succulents' plants are more attract the larvae and beetles for attack. In many states of India, beetle has establishment and contributing to control several hundred hectares of land which fully covered by parthenium. Also, beetle control the many places in the crop fields where instead searched the parthenium amidst the crop and devoured it. There are no chances or harming other crops because it is host specific. It cannot survive on food other than Parthenium.

Since the first release in the field in1984 at Bangalore, the beetle has well established in most of the south India and many parts of central and north India. In a very conservative estimate, it is calculated that the beetle has already spread in about 7 million hectares of land which amounts to be about 20 % area of the estimated 35 million hectares land infested with the parthenium. Initially it was feared that beetle will not be able to survive in the extreme low and high temperature of north and central India but it has betrayed this assumption and beetle has established well in many parts of Haryana, Punjab, Uttar Pradesh, Uttaranchal, Madhya Pradesh, Tamil Nadu, Karnataka, Andhra Pradesh, Himachal Pradesh and Maharashtra.

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Pandemic Followed by Epidemic: Locust

Article ID: 30537

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Introduction

Emerging pandemic show that humans or not infallible and communities need to be prepared. Corona virus was first reported at the end of 2019 and now it has been reported as pandemic by World Health Organization. Worldwide countries are responding differently to this virus outbreak which led to an overburdening of local health systems. On other hand some other nations have put in place effective strategies to contain the infection and have recorded a very low numbers of cases since the beginning this pandemic. As of now there is meagre hope in getting recovered fully from this Covid-19, another natural disaster phenomenon called "Swarming of Locust".

Some insect is useful and some are highly harmful to mankind, one of which is Desert locust, the notorious insect in the world. Locust crisis has affected so far 23 countries. They are highly migratory in habit, marked as polymorphism and great devastative polyphagous by nature. Ten important species of locust were reported in the World out of which only four species *viz*. Desert locust (*Schistocerca gregaria*), Migratory locust (*Locusta migratoria*), Bombay Locust (*Nomadacris succincta*) and Tree locust (*Anacridium sp.*) were reported in India. An average small locust swarm eats as much food in one day as about 10 elephants, 25 camels or 2500 people. With such aggressive growth, one square kilometre of land could hold up to 40-80 million of these insects. They also travel great distances, covering up to 150 kilometres daily depending on the wind direction and speed. Desert locust covers about 30 million sq. km this includes countries like North West and East African countries, Arabian Peninsula, the Southern Republic of USSR, Iran, Afghanistan, the Indian sub-continent. The last locusts-cycles damage was estimated at Rs. 7.18 lakh in India in 1993.

Biology of Locust

The life cycle of locust is complete usually 3 to 6 months. A female laid 20 to 200 eggs in group in soil at a time, which hatches within 10 to 20 days. Locust has solitary phase and gregarious phase in which gregarious phase is most active and exterminator in nature. They always fed and swarm in group. Adults rosy pink on fledging, darkens with age to greyish or brownish red then to yellow on sexual maturation. Males are brighter. Adults of solitary phase are pale greyish brown, buffer peach coloured. Males change to pale yellow on sexual maturation whereas female show no colour change on maturation at low density. Locusts breed in three seasons' viz., winter breeding from November to December, spring breeding from January to June and summer breeding from July to October. India has only summer breeding season but in Pakistan has both spring and summer breeding.

In India, Locust Control and Research (LC&R) is responsible for control of Desert Locust and is being implemented through Organization known as "Locust Warning Organisation (LWO)" established in 1939 at Jodhpur and later amalgamated with the Directorate of Plant Protection Quarantine and Storage in 1946. Locust Warning organization (LWO) is responsible to monitor and control the locust situation in Scheduled Desert Area (SDA) mainly in the States of Rajasthan and Gujarat while partly in the States of Punjab and Haryana by way of intensive survey , surveillance, monitoring and control operations where required. In India, a total of desert area is 2,05,785.45 square kilometres out of which under Rajasthan possess the maximum area (1,79,250.64 sq.km) followed by Gujarat (23,077.58) and Haryana (3,457.20).

During the first fortnight of January, 2020, Immature/maturing adults/swarms were observed in the Jaisalmer, Barmer, Bikaner, Jalore, Jodhpur, Pali, Sirohi, Sriganganagar of Rajasthan and Banaskantha and Bhuj-Kutch of Gujarat. According to FAO update on 13th May, 2020 the current situation remains extremely alarming in East Africa. At this time, there is a risk that swarms will migrate to the summer breeding areas along both sides of the Indo-Pakistan border as well as to Sudan and perhaps West Africa. According to the Global Committee, some adult teams were expected to come to India for spring breeding. Hence, vigilance was issued against the expected attack of locust in the upcoming days.

According to figures estimated form the most horrific attack of locust parties after 26 years, in the six states of the country since December last year, about 10 to 15 million acres of crop has been damaged, while according to the government figures so far the yield of one lakh acres of cotton, pulses, oilseeds and vegetables and fruits produced in summer has been affected by the locust attack. The April attack did not have much impact on the crops because most places had been harvested and there was no sowing in the fields.

The locust invasions join hands with the COVID-19 pandemic, creating a much burden to the farmers who were waiting for the harvest. Local agri-food supply chains are already experiencing disruptions, including reduced access to inputs and services, labour movement, transport and roadblocks, and credit or liquidity due to COVID-19. Particularly, the pandemic is disrupting the supply chains for pesticides and other equipment necessary to control the spread of locusts is again a new challenge for the farming communities.

Conclusion

Addressing the locust crisis there is significant constrains in all aspects of farming. Border closures and delays posed by quarantine measures are imposing restrictions on the movement of personnel and equipment to aid in the locust response. Even in those countries where the government is making locust response an essential activity and allowing teams to move, special care needs to be taken to reduce the threats that hinder workers and control officers spread the two remote rural locations where locust control operations are required. In this scenario, these two crises have the potential to generate the conditions for famine, disease and increased poverty unless and until proper quarantine measures is ensured. India will also use drones and specialist equipment to monitor the movement of locusts and spray insecticides to ward off a new outbreak. This comes even as officials and experts noticed a change in the locusts' attack strategy.

Banded Leaf and Sheath Blight (BLSB): A Menacing Disease for Maize Production

Article ID: 30538

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Introduction

Maize (*Zea mays* L.) is one of the worlds' leading crop and is widely cultivated as cereal, that was first domesticated in Central America. Maize was introduced for the first time to India from America during 17th century. It is one of the most versatile crops having wider adaptability under varied agro-climatic conditions. It is known as 'Queen of cereals' because it has the highest yield potential among the cereals. Despite of maize having very high yield potential, one of the major deterrents to high grain yield is its sensitivity to multitude of diseases, which is detrimental for the production and productivity. From different parts of the world, about 112 diseases of maize have been reported, of these 65 are known to occur in India. Among different fungal diseases affecting maize production, banded leaf and sheath blight (BLSB) caused by *Rhizoctonia solani* f. sp. *sasakii* causes significant grain yield loss from 11 per cent to 40 per cent, even upto 100 per cent on some cultivars in warm and humid regions. It was first reported by Bertus (1927) in Sri Lanka as Sclerotia disease. Since, it infects leaf and sheath, the symptoms appear in concentric spots that cover large area of infected leaf and husk. The pathogen spreads from the basal sheath to the developing ear under favourable environmental conditions *viz*., high relative humidity (90 %), an optimum temperature of 28° C and rainfall during first week of infection were favourable for the pathogen.

The Pathogen

Thanatephorus sasakii (Shirai) Tu and Kimbrough (St. Imp. *Rhizoctoniz solani* Kuhn f. sp. *sasakii* Exner) is the causal agent of banded leaf and sheath blight (BLSB). This pathogen is one of the most destructive and wide spread in most parts of the world and infecting a vast range of host plants, including maize (Ogoshi, 1987). *R. solani* f. sp. *sasakii* is morphologically characterized by pale to brown colour of mycelium, branching near the distal septum in young growing hyphae, presence of a constriction and formation of a septum in branch near the point of origin, absence of clamp connections, sclerotia of undifferentiated texture, young multinucleate hyphal cells with a prominent septal pore apparatus and rapid growth rate. The colonies produced by the pathogen are fast growing and form silky white colonies on PDA medium at 28 ± 1 °C losing their luster gradually and becoming dull in appearance (Fig.1).

Fig. 1. Cultural and microscopic view of R. solani f sp. sasakii under 10x and 40x magnification

Symptoms, Disease Development and Epidemiology

Fig. 2. a). Initial symptoms with large discoloured areas on leaf sheath. (b and c). Alternate bands on leaf and cob. (d). Sclerotial bodies on the sheath and cob.

The BLSB disease appears at pre-flowering stage on 30 to 40-day-old maize plants, but infection can also occur on young plants which may subsequently result in severe blighting and death of apical region of growing plant. The pathogen affects all aerial parts of the maize plant except tassel. The disease manifests itself on leaf, leaf sheaths, stalks and ears as leaf blight, stalk lesion or rind spotting and stalk breakage etc. The disease symptoms on leaves appeared as irregularly globular to elongated lesions which turns to water-soaked areas. The affected areas appear bleached; soon they become straw coloured and necrotic (Ahuja and Payak, 1982). The lesions enlarge rapidly resulting in discoloured areas alternating with dark bands, apparent on lower leaves after 7-8 days (Rani et al., 2013).

Disease Development

The symptoms are more common on sheaths than leaves. A short of wave pattern of disease advancement can be seen not only on leaves but also on sheaths and husk leaves. The disease manifests itself on leaf, leaf sheath, stalks and ears as leaf and sheath blight, stalk lesions or rind spotting and stalks breakage, clumping and cracking of styles and horseshoe shaped lesions with banding of caryopses resulting in ear rots. In early stages marginal chlorosis and rooting of laminae proceed inwardly, later as the infection becomes older numerous sclerotial bodies are also seen (Fig.2.). Buddemeyer *et al.* (2004), observed that *R. solani* caused round to elliptical, yellow to tan or black lesions on seminal crown and brace roots of maize cultivars. Depending on disease severity, crown roots of maize plants were completely rotten and affected plants lodged. Typical BLSB symptoms were observed as small purplish brown lesion or greenish olive brown large continuous patches on leaf sheath and pale olive brown lesions on stalk as well as rotting of ears.

Epidemiology

The fungus is capable of infecting maize plants in all the stages of crop growth right from seedling to maturity. *R. solani* survive in the soil and on infected crop debris as sclerotia or mycelium. Sclerotium serves as primary inoculum. The fungi spread by irrigation, movement of contaminated soil and infected plant debris. At the onset of growing season, in response to favourable humidity and temperature (15 to 35°C), the fungal growth is attracted to rapidly growing seedlings and water-soaked seed coats by chemotropic stimulants released by growing plant cells and decomposing plant residue. Secondary spread of this disease occurs by contact of diseased leaves or sheath with healthy plants. High relative humidity (90 %), an optimum temperature about 28°C, and rain fall in the first week of infection significantly favours the development and spread of disease. Disease development and spread becomes slow, if the relative humidity goes below 70 per cent (Sharma, 2005). Crop damage is caused by loss of photosynthetic leaf area due to foliar infection and stalk rot which lead to crop lodging (Lu *et al*., 2012). Sheath blight reduced the breaking resistance of lower internodes and consequently resulted in poor lodging resistance (Wu *et al.*, 2012).

Economic Importance

The disease causes a considerable reduction of high yielding maize varieties, resulting in premature death, stalk breakage and ear rot. In India, Singh and Sharma (1976), have estimated 40.5% reduction in maize grain yield with 71 per cent of BLSB disease index, whereas Lal et al. (1980) estimated loss in grain yield ranging from 23.9 to 31.9 per cent at disease score levels ranging from 3.0 to 5.0 in ten cultivars. Lal et al. (1985) suggested that due to BLSB disease of maize, grain yield loss vary to the extent of over 90 per cent. In Guangxi province in South China, maize yield losses of 87.5 and 57.8 per cent have been determined under natural conditions in the hybrids Luya 13 and Guiding planted at Bao Qiao and Chen Xiang countries (Sharma, 2005). Tang et al. (2004) reported that BLSB caused 0-60 per cent loss in maize grain yield under natural conditions. If the ear rot phase of the disease predominated, the magnitude of grain loss may reach cent percent (Huang et al., 2007).

Host Range

The pathogen infects plants belonging to 32 families in 188 genera and hence it has wide host range. Isolates of *R. solani* causing BLSB disease in maize infected members of Gramineae (*Cynodon dactylon*, *Oryza sativa*, *Saccharum officinarum* and *Sorghum bicolor*), Leguminosae (*Arachis hypogaea, Glycine max*, *Pisum sativam* and *Vigna radiate*) and Solanaceae (*Lycopersicum esculentum* and *Solanum tuberosum*). In artificial inoculations it infects a number of crop plants belonging to families Poaceae, Papilionaceae and Solanaceae: *Paspalum serobiculatum*, *Pennisetum americanum*, *P. purpureum*, *Setaria italica*, *Panicum miliaceum*, *Coix lachrymal-jobi*, *Echinochloa frumentacea*, *Zea mays*, *Zea Mexicana*, *O. sativa*, *S. officinarun*, *S. bicolor*). Maize has also been infected by strain of *R. solani* from rice, sugarcane, arrow root and some grasses.

Management

Cultural practices like stripping of the second and third leaf sheaths from the ground level at the age of 35-40 days old maize crop is effective in checking further BLSB development. Treating seeds with fungicides like (Bavistin 50WP @ 2.5

g/kg of seed, Vitavax Power (Carboxin 37.5% + Thiram 37.5% DS) @ 2g/kg of seed and Thiram 50 WP @ 2.5 g/kg of seed) against BLSB pathogen. Seed treatment @ 0.4% and soil application @ 2-5 kg/acre of *Trichoderma viridae* and will manage the disease. Foliar application of carbendazim @2g/ lt of water or Propiconazole 250 EC @1ml/ lt of water or Tebuconazole 250 EC @1ml/lt of water @ 30-45 days after sowing will control the disease.

Conclusion

The management of maize pathogens is considered very important in the present scenario because the BLSB caused by *R. solani* is most prevalent and serious limiting factors for the successful cultivation of maize worldwide. The integrated management approaches evolved particularly in the present changing climate would provide sustainable management of BLSB. Moreover, inheritance pattern of BLSB resistance in maize varieties/hybrids through conventional and/or biotechnological approaches. Additionally, progresses made in the "omics" field will revolutionize the possibilities for improving pathogen identification and investigating host-pathogen interaction, epidemiology and development of novel disease management practices. All this information should lead to more efficient management of this menacing disease.

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COVID-19 Impact on the Agriculture Sector and its Mitigation

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Abstract
The ongoing problem will greatly affect each sector but agriculture in this situation affected the worst with gap in the demand and supply and transportation problem. The crisis during this global pandemic is difficult to recover easily but with the sustained effort of central and state government measures this problem can be resolved.

Introduction
The impact of COVID-19 on the economy is no doubt devastating. No sector has escaped its impact. Its impact on agriculture is complex and varied across diverse segments that form the agricultural value chain. Even among the different segments, its impact varies widely among different regions and among producers and agricultural wage labourers. This impact will reverberate across the larger economy and will linger longer than a few months. The problems in agriculture at the moment are primarily related to labour availability and in ability to access markets for produce due to issues in transportation as well operation of markets. However, commercial crops are drastically hit as they tend to be more dependent on migrant labour. Consequently, the shortage of migrant labour has resulted in a sharp increase in daily wages for harvesting crops. In many areas, the rise is as high as 50 percent, making it unremunerative for producers since prices have collapsed due to either lack of market access including the stoppage of transportation and closure of borders. This is in contrast to areas where migrant labourers have returned home from urban areas and this has led to a sharp decline in agricultural wages.

Immediate Challenges in Ag Sector
1. In spite of all these measures and in view of continuing restrictions on movements of people and vehicular traffic, concerns have been raised regarding negative implications of COVID19 pandemic on the farm economy. This is the peak of rabi season in India and crops like wheat, gram, lentil, mustard, etc. (including paddy in irrigated tracts) are at harvestable stage or almost reaching maturity.

2. This is also the time when the farm harvests reach the mandis (market yards) for assured procurement operations by designated government agencies. Moreover, any severe disruption to the supply of perishable fruits and vegetables, dairy products, fish, etc. having mobilized to meet the increasing demand from a bulging middle class as well as urban and rural consumers, may create irreparable damage to all actors in the supply chain.

3. The migration of workers from few parts to their native places has also triggered panic buttons, as they are crucial for both harvesting operations and post-harvest handling of produce in storage and marketing centres.

4. The Union Home Ministry, in a very significant move, has notified to exclude movement of farmers, farm labourers and harvesting and sowing-related machines from the purview of lockdown. Making the food grains, fruits and vegetables and other essential items available to consumers, both in rural and urban areas, is the most critical challenge for Government machinery during the lockdown period.

Mitigation Measures to Tackle the Crisis
1. To sustain the demand for agricultural commodities, investments in key logistics must be enhanced. Moreover, e-commerce and delivery companies and start-ups need to be encouraged with suitable policies and incentives.

2. The small and medium enterprises, running with raw materials from the agriculture and allied sector or otherwise, also need special attention so that the rural economy doesn't collapse for this.

3. Relaxation of the norms by Agricultural Produce Market Committees (APMCs) allowing farmers to sell their produce beyond the designated mandis will certainly ease the burdens of farmers. State Governments must gear up their

machineries for smooth procurement operations of farmers' marketable surpluses at MSP (minimum support price) or through other price support schemes.

4. Structural reforms such as land leasing, contract farming and private agricultural markets, etc. have long been advocated to bring enhanced investments into the agriculture sector and to push its growth. However, there has not been uniform implementation of these legislations by State Governments and so the full potential of the sector is unrealized.

Conclusion

The crisis during this global pandemic is difficult to recover easily but with the sustained effort of central and state government measures this problem can be resolved .By way of implementing the policies effectively in the agriculture sector with introduction of new scheme like Atma Nirbar Bharat and increase MSP price will help in resolving the problem to some extent. But other efforts depend upon how this crisis will end.

Artificial Intelligence – A Tool for Modern Agriculture

Article ID: 30540

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Abstract

AI or Artificial intelligence the ability of a digital computer or computer-controlled robots to perform task commonly associated with intelligent beings. AI is helping the farmers to monitor their crops without the need to invigilate personally into the farm. AI is redefining the traditional pattern of agriculture. The future of AI in agriculture is way ahead in offering radical transformation with advanced approaches.

Introduction

AI or Artificial intelligence the ability of a digital computer or computer-controlled robots to perform task commonly associated with intelligent beings. The term is frequently applied to the project of developing systems endowed with the intellectual processes characteristics of human such as the ability to reason, discover meaning or learning from past experiences. AI in agriculture is helping farmers to improve their efficiency and reduce environmental hostile impacts. The agriculture industry strongly and openly embraced AI into their practice to change the overall outcome. AI is shifting the way our food is produced where the agricultural sector's emissions have decreased by 20%. Adapting AI technology is helping to control and manage any uninvited natural condition. Today, the majority of start-ups in agriculture are adapting AI-enabled approach to increase the efficiency of agricultural production. The businesses in agriculture with the help of AI are processing the agricultural data to reduce the adverse outcomes.

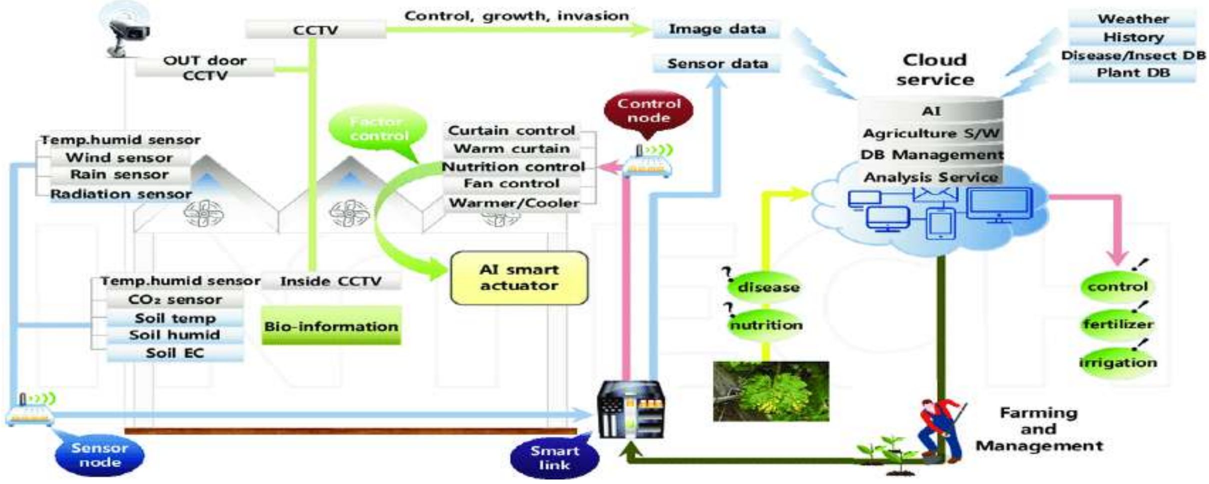
Merit of AI in the Agriculture

1. Forecasted Weather data: AI in an advanced way is helping the farmer to remain updated with the data related to weather forecasting. The forecasted/ predicted data help farmers increase yields and profits without risking the crop. The analysis of the data generated helps the farmer to take the precaution by understanding and learning with AI. By implementing such practice helps to make a smart decision on time.

2. Monitoring Crop and Soil Health: Utilizing AI is an efficient way to conduct or monitor identifies possible defects and nutrient deficiencies in the soil. With the image recognition approach, AI identifies possible defects through images captured by the camera. With the help of AI deep learning application are developed to analysis flora patterns in agriculture. Such AI-enabled applications are supportive in understanding soil defects, plant pests, and diseases.

3. Decrease pesticide usage: Farmer can use AI to manage weeds by implementing computer vision, robotics and machine learning. With the help of AI data are gathered to keep a check on weed which help the farmers to spray chemicals only where the weeds are. This directly reduced the usage of the chemical spraying an entire field.

Application of AI in the Agriculture



1. Agricultural Robots: Companies are developing and programming autonomous robots to handle essential agricultural tasks such as harvesting crops at a higher volume and faster pace than human laborers.

2. Crop and Soil Monitoring: Companies are leveraging computer vision and deep-learning algorithms to process data captured by drones and/or software-based technology to monitor crop and soil health.

3. Predictive Analytics: Machine learning models are being developed to track and predict various environmental impacts on crop yield such as weather changes.

Artificial Intelligence Use in The Agriculture

Conclusion

Today AI are used for solving several industries' purposes. AI is helping the farmers to monitor their crops without the need to invigilate personally into the farm. AI is redefining the traditional pattern of agriculture. The future of AI in agriculture is way ahead in offering radical transformation with advanced approaches.

Utilization of Fly Ash in Agriculture: A Better Way to Manage Industrial Solid Waste

Article ID: 30541

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Introduction

Being a developing country, India is becoming industrialized to fulfill the needs of the increasing population. To develop industries huge amount of power generation is required which heavily rely on coal-based thermal power plants. About 70% of India's total installed capacity of power generation is thermal, of which coal-based generation is 90% (Annual Report of Ministry of Power Govt. of India, New Delhi).

The Indian coal is of low grade with 10-40% of ash content (Narayana et al, 1986), releasing a larger quantity of ash at coal based thermal power plants, which requires huge areas for its disposal. Fly-ash is a powdery material, produced as a by-product during coal-based power generation process. Fly-ash contains silica, aluminium, oxides of iron, calcium, magnesium, arsenic, chromium, lead, zinc and other toxic metals. Fly-ash has a low bulk density, high surface area and light texture (Asokan et al., 2005). Fly-ash leads to air pollution due to its persistence over a long period of time and also causes health hazards.

It degrades the environment by clogging natural drainage, reducing pH and portability of water, interfering with the photosynthesis of aquatic plants and disturbing the food chain. Therefore, it is very much essential to overcome these problems not only by safe disposal but also through conversion of these materials to value-added products.

Use of Fly Ash in Agriculture

Realizing the severity of the situation and the urgent need for bulk utilization of fly ash, many works have already done in which fly ash is used to ameliorate the agricultural soil, through changing the Physico-chemical properties of soil and making it productive. This in consequence may lead to increase in crop yield, better crop quality with higher nutrient content (Chakrabarty and Thetwart, 2000).

It is very essential to note that the Physico-chemical properties of soil and fly ash are similar in many respects, fly ash is, in fact, superior in many respects. Alkaline fly ash will help in neutralizing the acidic soil (red and lateritic type, pH 5.5), making them more productive, and suitable for cultivation and in doing so, it makes some of the plant nutrients in available form due to adjustment of soil pH. As the total physical properties such as bulk density of fly ash is seen to be much less than those of soil, whereas, hydraulic conductivity, water holding capacity, lime reactivity and presence of finer particles are higher than soil, these characteristics coupled with its podzzolanic properties, make fly ash an ideal soil conditioner and amending agent, to improve physical properties of the soil.

A comparison of the fly ash with the normal soil suggested that fly ash has all the growth supporting elements for plants like the normal soil excepting organic carbon and nitrogen. So fly ash is blended with different organic wastes, to supplement the organic carbon and nitrogen content of the soil to make the soil more fertile.

Use of Fly ash in agriculture provides a feasible alternative for its safe disposal to improve the soil environment and enhance the crop productivity. However, a judicious amendment strategy has to be developed to abate the land pollution from the heavy metals present in it (Sikka & kansal, 1995). Fly ash contains essential nutrients for plant growth and it can be used as a fertilizer to complete the deficiency of several elements in the crop field.

The ashes are good sources of available secondary nutrients (Ca, Mg and S) and micronutrients (Zn, Fe, Cu and Mn) and the texture being sandy silt to silty loam improves water holding capacity and percolation in sandy as well as clay soils for beneficial effects (Kumar & Jha, 2014). Fly-ash has therefore great potentiality in agriculture due to its efficacy in modification of soil health and crop performance (Kishor et al., 2010).

The Indian Fly Ash is alkaline and as such improves soil quality. CPRI Bengaluru has developed porous and hollow globules from Fly Ash. These globules if buried around crop, absorbs the water and retain it for longer period by resisting evaporation. This application helps to widen the gap between two watering cycles. It can also be used as insecticide and if used along with bio-waste, it significantly supplements the utility of chemical fertilizers (Murugan and Vijayarangam, 2013). Mahale et al. (2006) found that the application of fly ash improves seed germination in case of wheat, mung bean and urad bean, whereas in the absence of fly ash the seed germination rate was very slow. In case of Brinjal (*Solanum melongena*) the plants growth was better in the fly ash amendments when compared to control and the maximum yield at 180t/ha fly ash amended soil (Gond et al., 2013). Fly ash addition generally increases plant growth and nutrient uptake (Aitken et al., 1984). Weinstein et al., (1989) reported that fly ash increased crop yield of alfalfa, barley, Bermuda grass and white clover.

Merajul et al. (2010) conducted a study on Fly ash application in soil using *Solanum nigrum*. They founded up to concentrations of 30% fly ash, there was improvement in the growth of *Solanum nigrum* plant. But further increase in the fly ash concentration caused deleterious effects on the plant growth, biomass, and leaf area, number of leaf per plant and leaf photosynthetic pigments.

To solve these problems, fly ash can be blended with different organic substances like cow dung or any bio wastes to make it more and more suitable to be used in agriculture. Since Fly ash is devoid of organic carbon and nitrogen, whereas organic waste/compost or cow dung being rich in organic carbon and nitrogen, if blended with it, can bring sufficient amount of organic carbon and nitrogen in amended soil. In order to modify the composition of fly ash to be similar to that of soil, cow dung is added at various ratios to the fly ash to enhance the wt% composition of P, N, K in fly ash (Sugnanam et al., 2016).

They found in their study that the application of fly ash in combination with cow dung was beneficial for the plant growth and yield and their investigation concluded that fly ash in combination with the cow dung can be a promising material to substitute for artificial fertilizers. In order to increase the nitrogen content in the fly ash cow dung is used as an additive to increase the property of nitrogen fixation by the plants, which make this a novel method for the utilization of fly ash for agriculture.

Conclusion

Fly ash can be used as a potential nutrient enhancer for degraded soils hence can solve the solid waste disposal problem up to a certain extent. However, the bioaccumulation of toxic heavy metals and their bio magnification in higher trophic levels and soil should be taken into consideration. So, the ultimate goal is to utilize fly ash in degrade soils in such a way so that soil quality cannot be altered and also accumulation of toxic metals in plants should be in below critical levels for human health.

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Entomology: Insecticide Mixtures and Their Use in Present Scenario

Article ID: 30542

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Introduction

Insecticide mixtures involve combinations of two or more insecticides in the right concentration into a single spray solution (Cloyd, 2009). Insecticide mixtures are widely used to deal with the array of arthropod pests encountered in greenhouse and field production systems due to the savings in labor costs. Pesticide mixtures may be more effective against certain life stages including eggs, larvae, nymphs, and adults of arthropod pests than individual applications although this may vary depending on the rates used and formulation of the pesticides mixed together (Blumel and Gross, 2001).

The primary intention for the use of an insecticide mixture (tank-mix or pre formulated mixture) is, in most cases, not resistance management, but pest management. Those mixtures may be developed for a variety of reasons, including synergistic effects, improving efficacy against one pest or a range of pests, and other desirable properties such as flexibility of application.

Advantages of Insecticide Mixture Formulations (Compared to Solo Active Products)

1. The mixture may enhance the overall target spectra, allowing the control of a broad range of pests when they are present on the crop at the same time.

2. It is less time consuming, costly and labour intensive to mix two or more pesticides and spray once.

3. Insecticide mixtures may be more effective on certain types and developmental stages of arthropod pests.

4. Synergism is when the combined toxicity of two compounds is greater than the sum of the toxicities of each individual compound; Potentiation occurs when the activity of one compound enhances the activity of another

5. Mixing insecticides with different modes of action can delay resistance within a pest population because the mechanisms required to resist the pesticide mixture may not be widespread or exist in the population.

Disadvantages of Insecticide Mixture Formulation

1. Insecticide mixtures is targeting different pests, the timing may not be optimal for all, resulting in reduced effectiveness.

2. Sometimes, antagonism (reduction in efficacy) may also occur due to mixing two (or more) pesticides together.

3. Another issue with tank mixing is incompatibility. This is a physical condition that prevents pesticides from mixing properly in a spray solution. It can reduce effectiveness or damage plants.

4. Insecticide mixtures are formulated to broaden the spectrum of activity; this may increase the potential detrimental effects on non-target organisms (natural enemies) and may do more overall harm than using single active products in sequence.

Mode of Application

Sometimes, product manufacturers combine pesticides with other pesticides or fertilizers for sale as premixes. However, when premixes are not available (or are not offered in the desired combination) you may combine products (tank mixing) at the time of application.

Tank mixing combining two or more crop-production products (pesticides and/or fertilizers) and applying them at the same time-is convenient and cost-effective. This practice can save the time, labour, fuel and equipment wear involved in multiple applications. Tank mixing also reduces soil compaction and the risk of mechanical damage to crops or treated areas.

Conclusion

The combination insecticides will have broad spectrum insecticidal activities and may be used for controlling insects on large number of crops, tank mixing has positive and negative aspects. Although producers routinely mix pesticides to reduce labor costs associated with multiple spray applications and to improve control of arthropod pests. Higher doses and repeated applications of solo active formulations lead to accumulate pesticide residues in vegetable commodities along with environmental pollution. With the increasing awareness of toxic effects of conventional formulations, there is a significant trend towards switching over from such pesticide formulations using insecticide mixtures. These formulations would not only replace toxic, non-degradable ingredients/adjuvants of the solo active formulations but also increase the bio-efficacy of the products and also caution is advised to avoid problems associated with antagonism, incompatibility, phytotoxicity and resistance. Pesticide mixtures will continue to be an integral component of pest management programs due to the continual need to deal with a multitude of arthropod pests associated with ornamental cropping systems.

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Some Insecticide Mixtures Available Formulation in Market with Trade Names and Target Pests

S. No	Technical name	Trade name	Target pests
1.	Acephate 50% + Imidachloprid 1.8% SP	Lancer gold, Star gold	Various sucking pest and bollworms in cotton
2.	Chlorantraniliprole 9.3% + Lambda cyhalothrin 4.6% ZC	Ampligo	Pink boll worm and army worm in cotton Heliothis in chick pea
3.	Chlorpyrifos 16% + Alphamethrin 1% EC	Legend plus, Chlorthrin	sucking as well as chewing pest
4.	Chlorpyrifos 21% + Fenobucarb (BPMC) 10.5% EC	Perfek 31.5 EC (Bio stadt)	Flying insect pests, chewing & boring insect pests, hoppers and bugs.
5.	Deltamethrin 0.27% + Buprofezin 5.65% EC	Devikey, Tusker	For the control of mealy bug and sucking pest
6.	Deltamethrin 1% + Triazophos 35% EC	Tiger, Truzo super, Tricada,	Bollworms
7.	Ethion 40% + Cypermethrin 5% EC	Nagata, Colfos, Jashn	Heliothis, spotted bollworm & pink bollworm in cotton; whiteflies on cotton and vegetables.
8.	Imidachloprid 40% + Ethiprole 40% WG	Glamore	Brown plant hopper in rice
09.	Imidachloprid 40% + Fipronil 40% WG	Lesenta	White grubs in sugarcane
10.	Flubendiamide 19.92% + Thiachloprid 19.92% SC	Belt expert	Thrips and fruit borer in chili
11.	Indoxacarb 14.5% + Acetamiprid 7.7% SC	Caesar, Indoprid	Jassids, whitefly, and bollworm on cotton and thrips and fruit borer on chilles

12.	Profenophos 40% + Cypermethrin 4% EC	Polytrin C, Kriphos super	Bollworm of cotton Aphids, jassids, thrips, whiteflies etc.
13.	Thiamethoxam 1% + Chlorantraniliprole 0.5% GR	Virtako	Stem borer and leaf folder in Paddy
14.	Thiamethoxam 12.6% + Lambda cyhalothrin 9.5% ZC	Alika	For all sucking pest
15.	Thiamethoxam 17.5% + Chlorantraniliprole 8.8% GR	Voliam flexi	Lepidoptera pests, aphids, jassids and mirids in cotton

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Biotechnology: Molecular Farming - The Next Destination for Agricultural Biotechnology

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Introduction

Molecular farming can be elucidated as the use of plants to produce recombinant protein products. The technology is now greater than 30 years old. The initial promise of molecular farming was based on three perceived advantages: the low costs of growing plants, the immense scalability of agricultural production, and the inherent safety of plants as hosts for the production of pharmaceuticals. Current developments mean that pharmaceutical molecular farming is now climbing the slope of enlightenment and can soon emerge as a mature technology.

Definition

The use of whole organisms, organs, tissues or cells or cell cultures, as bioreactors for production of commercially valuable products via recombinant DNA techniques. Molecular farming is an application of genetic modified (GM) technology. It is also called "gene pharming or biopharming".

Why Molecular Farming?

An important advantage of transgenic plants for molecular cultivation is the relatively low cost of large-scale production. Recombinant proteins are estimated to be produced in plants at 2–10% of the cost of microbial fermentation systems and 0.1% of the cost of mammalian cell culture (Richard et al., 2003). Another advantage of molecular pharming is well-established technology for gene transfer and expression, high biomass yield, prolific seed production, and also the existence of large-scale processing infrastructure.

Plant Molecular Farming

Plant molecular farming (PMF) is that the use of genetically modified plants to produce pharmaceuticals or industrial chemicals. If plants are used not just for food or animal feed, but also as "bio factories" for the production of specific active ingredients, like antibodies, vaccines, recombinant proteins or pharmaceuticals, the term "molecular farming" is used.

In principle, genetic engineering can be used to introduce any proteins into plants as needed. A wide range of plant species used for PMF including alfalfa, Arabidopsis, banana, carrot, maize, rice, potato, sugar cane, tomato, tobacco, wheat etc. Human growth hormone was the primary pharmaceutically important protein to be expressed in transgenic tobacco (Barta et al. 1986). Then transgenic plants expressing vaccines, therapeutics, industrial enzymes, anti-bodies, nutraceuticals, and other pharmaceutical proteins have been produced (Ma et al. 2005).

Molecular Farming Strategy

Clone a gene of interest, transform the host platform species, cultivate the host species, recover biomass, process biomass, purify the product of interest and deliver the product of interest.

Molecular Farming Hosts

Bacteria, yeasts, unicellular fungi, mammalian, insect, plant and filamentous fungal cell cultures, whole plants (corn, barley, rice, duckweed, moss protonema), whole animals (insects, birds, fish, mammals).

Different Plant Based Expression Systems

1. Stable nuclear transformation:

a. Most typical method.
b. Employed in a species with a long generation cycle, foreign genes are transferred via *Agrobacterium tumefaciens* or particle bombardment.
c. Genes are taken up and incorporated in a stable manner.
d. Large acres are often utilized with very cheap cost- grains.

e. Long-term non-refrigerated storage of the seed up to 2 years.
f. Manual labour required
g. Lower yield and out-crossing.

2. Plant cell suspension culture:
a. Culture derived from transgenic explants: transformation after desegregation.
b. The location of the recombinant proteins depends on the presence of targeted / leader peptides in the recombinant protein.
c. Permeability of the plant cell wall to macromolecules
d. Containment and production under a modified genetic procedure.
e. Low rescale capacity.

3. Plastid transformation (Transplastomic plants):
a. First described by Svab *et al*. (1990).
b. No transgenic pollen is generated.
c. Very high expression levels may be achieved.
d. Protein: up to 70% in dry weight but relatively stable
e. No out-crossing.
f. Protein unstable.
g. Extraction and purification at specific time.
h. The edible vaccine is not feasible since tobacco is highly regulated.

4. Transient transformation system:
a. Recombinant plant viruses to infect host plants, such as TMV, CaMV, PVX.
b. Agro infiltration through recombinant *A. tumefaciens.*
c. Small amounts of target protein are obtained in weeks.
d. The infection process is rapid.
e. The protein accumulates within the space's interstitials.
f. The target protein is temporarily expressed in the plant.
g. It is not stored long term due to tissue damage.
h. Stable transgenic plants don't seem to be generated.
i. Scalability and low levels of expression.

5. Hydroponic cultures:
a. Transgenic plants are grown on hydroponic medium.
b. Desired products are released as a part of root fluid into a hydroponic medium.
c. Plants are contained in greenhouse.
d. Easier purification but expensive to operate.
e. Not suitable for large scale production.

Applications
Production and use of bioplastics and biopolymers in post-harvest containers of horticultural crops for long transport. Production of secondary plant metabolites (Jasmonic acid, salicylic acid etc.) in plants at triggered levels for disease resistance. Biofuel production and over production of starch content in maize for production of sugar syrup. Production of edible vaccines or extraction of non-edible vaccines from plants. Production of enzymes and other proteins in crop plants for clinical use, which might be alternative use of agricultural crops other than food. Excessive production of vitamins which are deficient in crop plants can be used to reduce vitamin deficiency in target population groups.

Conclusion
Plants are effective and efficient bioreactors for the production of pharmaceutically valuable recombinant proteins. Variety of plant species that are being explored to serve as green bioreactors, each with its own advantages and disadvantages. The transgenic plant shows low production cost, high productivity, no risk of contamination and simple storage compared to transgenic animals. Therefore, it serves as an alternative to conventional fermentation systems

using bacteria, yeast, or mammalian cells. Plant-based pharmaceuticals (PMP) have already achieved preclinical validation in a variety of disease models such as hepatitis B, rabies, etc.

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Soil Quality & Soil Health Indicators for Sustainable Agriculture

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Soil degradation due to non-judicious use of agricultural inputs and over exploitation of natural resources has emerged as a great threat to sustain crop productivity and soil quality. The most important soil degradation processes are decline in nutrient supplying capacity, fertility depletion and loss of soil organic carbon. The decline in organic matter level due to continuous cropping without recycling enough crop or animal residue, coupled with nutrient imbalances has led to negative nutrient balance, impaired soil health and declining productivity.

Soil Quality

The capacity of soil to function within natural or managed ecosystem boundaries, to sustain plant and animal productivity, maintain or enhance water and air quality, and support human health and habitation.

Soil Health

Soil health may be considered as the state of soil at a particular time, equivalent to the dynamic soil properties that change in short term.

What are Indicators?

Soil health indicators are physical, chemical and biological properties, processes, and characteristics that can be measured to monitor changes in the soil. The types of indicators that are the most useful depend on the function of soil for which soil quality is being evaluated.

These functions include:
1. Providing a physical, chemical, and biological setting for living organisms;
2. Regulating and partitioning water flow, storing and cycling nutrients and other elements;
3. Supporting biological activity and diversity for plant and animal productivity;
4. Filtering, buffering, degrading, immobilizing, and detoxifying organic and inorganic materials;
5. Providing mechanical support for living organisms and their structures.

Soil Quality Indicators are Important to

Focus conservation efforts on maintaining and improving the condition of the soil, evaluate soil management practices and techniques, relate soil quality to that of other resources, Collect the necessary information to determine trends, Determine trends in the health of the Nation's soils, Guide land manager decisions.

What are Some Indicators?

Indicators of soil quality can be categorized into four general groups: visual, physical, chemical, and biological. Indicators of soil quality can be categorized into four general groups: visual, physical, chemical, and biological.

1. Visual indicators may be obtained from observation or photographic interpretation. Exposure of subsoil, change in soil colour, ephemeral gullies, ponding, runoff, plant response, weed species, blowing soil, and deposition are only a few examples of potential locally determined indicators. Visual evidence can be a clear indication that soil quality is threatened or changing.

2. Physical indicators are related to the arrangement of solid particles and pores. Examples include topsoil depth, bulk density, porosity, aggregate stability, texture, crusting, and compaction. Physical indicators primarily reflect limitations to root growth, seedling emergence, infiltration, or movement of water within the soil profile.

3. Chemical indicators include measurements of pH, salinity, organic matter, phosphorus concentrations, cation-exchange capacity, nutrient cycling, and concentrations of elements that may be potential contaminants (heavy metals,

radioactive compounds, etc.) or those that are needed for plant growth and development. The soil's chemical condition affects soil-plant relations, water quality, buffering capacities, availability of nutrients and water to plants and other organisms, mobility of contaminants, and some physical conditions, such as the tendency for crust to form.

4. Biological indicators include measurements of micro and macro-organisms, their activity, or by-products. Earthworm, nematode, or termite populations have been suggested for use in some parts of the country. Respiration rate can be used to detect microbial activity, specifically microbial decomposition of organic matter in the soil.

Ergosterol, a fungal by-product, has been used to measure the activity of organisms that play an important role in the formation and stability of soil aggregates. Measurement of decomposition rates of plant residue in bags or measurements of weed seed numbers, or pathogen populations can also serve as biological indicators of soil quality.

Indicators Should

1. Correlate well with ecosystem processes (this also increases their utility in process-oriented modelling).

2. Integrate soil physical, chemical, and biological properties and processes and serve as basic inputs needed for estimation of soil properties or functions which are more difficult to measure directly.

3. Be relatively easy to use under field conditions and be assessable by both specialists and producers.

4. Be sensitive to variations in management and climate. The indicators should be sensitive enough to reflect the influence of management and climate on long-term changes in soil quality but not be so sensitive as to be influenced by short term weather patterns. Be components of existing soil data bases where possible.

Biological Indicators

1. Soil Microbial Biomass:
2. Soil Enzyme Activities.
3. Soil Microorganisms.
4. Soil Microflora.
5. Plant Root Pathogens.
6. Soil Microfauna.
7. Soil Arthropods.
8. Activity of soil microfauna.

Microbial Biomass Indicators of Soil Health

Vast numbers of microorganisms naturally reside in soil and perform a wide range of functions which are essential for a normal and healthy soil. Soil microbes decompose organic matter, release nutrients into plant-available forms, and degrade toxic residues. They also form symbiotic associations with roots, act as antagonists to pathogens, influence the weathering and solubilization of minerals, and contribute to soil structure and aggregation.

Microorganism as Indicators of Soil Health

The biological activity in soil is largely concentrated in the topsoil, the depth of which may vary from a few to 30 cm. In the topsoil, the biological components occupy a tiny fraction (<0.5%) of the total soil volume and make up less than 10% of the total organic matter in the soil.

These biological components consist mainly of soil organisms, especially microorganisms. Despite of their small volume in soil, microorganisms are key players in the cycling of nitrogen, sulphur, and phosphorus, and the decomposition of organic residues. Thereby they affect nutrient and carbon cycling on a global scale.

Soil Microflora as Bioindicators of Soil Health

Soil microflora including bacteria (eubacteria and archae bacteria), fungi and algae have the potential to be important indicators of soil quality health. There is a large variety of microorganisms in the soil, possibly millions of species.

Decomposition of carbon compounds such as cellulose, hemicellulose, polysaccharides, hydrocarbons and lignin provide energy to heterotrophic microorganisms responsible for other nutrient transformations, e.g. asymbiotic nitrogen fixation, protein and amino acid decomposition, mineralization and immobilization of nitrogen, and mineral transformations.

Conclusion

Changing soil health Conditions need to give a new look to the Biological Indicator of Soil and improved by adopting the suitable crops and cropping pattern that sequester more carbon. Improve nutrient management practices for better soil health through integrated nutrient management. Assessment of soil health biological indicators have prime importance and protect the soil from degradation.

Overview of Breeding Objectives and Methods in Garden Pea

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Garden pea (Pisum sativum L. var. hortense) belongs to the family Leguminosae (Fabaceae) is also called sweet pea is a choice vegetable grown for its fresh shelled green seeds rich in protein (7.2 %), vitamins and minerals. The green seeds are used as vegetable or can be used after processing (canning, freezing and dehydration). India is ranking second next to China both in terms of area and production (FAO, 2012). In India, it is grown in an area of 0.42 million ha with the production of 4.01 million metric tonnes and productivity is 9.5 t/ha. Garden pea is a cool season crop mainly grown during winter season in plains and during summer season in hills.In recent years, there has been an increase in demand for varieties suited to kharif and early summer seasons, with resistance to powdery mildew, rust, Fusarium root wilt/rot and stem fly and also for processing and export. Therefore, future thrust in the improvement of garden pea would be on developing varieties tolerant to biotic and abiotic stresses (mainly high temperature), and also for processing and export. Breeding objectives and Breeding methods are the first step towards any crop improvement programme.

Introduction

The improvement of garden pea in India started in around the year 1940.Initially the main emphasis in pea improvement has been on early maturity, yield, and quality. Later on, the focus has shifted to the midseason varieties with resistance to diseases. Intensive work has been undertaken on breeding for resistance to diseases. Pea being a self-pollinated crop can very well be improved through methods commonly practice in the improvement of self-pollinated crops. These breeding methods tend to follow the systematic sequence of steps developed for utilization to their best advantages. Breeding objectives deals with the improvement of various characters. while implying breeding methods breeder always considers multiple characters, even in conditions where any single character is dominant. Characters are considered depending on various factors like crop, growing area etc.

Breeding Objectives

In India, most of the organizations which work for the improvement of garden pea are targeting to develop high yielding varieties (in early, midseason and tall group) with resistance to biotic and abiotic stresses. Presently, there is also demand for varieties and suitable for processing qualities like freezing, dehydration, canning and export.

Thus, the chief breeding objectives in peas are as follows:
1. Breeding for earliness
2. Breeding for high yield
3. Breeding for disease resistance.
4. Breeding for insect resistance.
5. Breeding for higher nutritive quality.
6. High protein content.
7. Breeding for processing quality.
8. Breeding for abiotic stress: Breeding for tolerance to high temperature and resistance to frost.
9. Multiple resistances.
10. Breeding for resistance to viral diseases.
11. Breeding for resistance to wilt and root rot
12. Breeding for resistance to powdery mildew.

Breeding Methods

1. Introduction: Most cultivated pea varieties in India have been introduced from various European countries and the U.S.A. Arkel, Meteor, Early Badger Perfection Newline, little Marvel and Superb are introductions (Kumar et. al., 2006). Introduction was the main method of improvement followed in earlier days. Cultivar Bonneville still occupies large area. Earlier T 19 was grown for a short duration. Yet another line NP 29 once grown is hardly seen but Lincolin continues to be grown by farmers even today, although at a very few places. The other entries which are grown in small pockets are Early Giant, Greater Progress, Early Superb, Early Badger, Little Marvel, Khapadkheda, Perfection New Line and Wisconsin (Peter and Kumar, 2008).

2. Hybridization: Most of the pea cultivars have been developed by hybridization between an Indian variety and an exotic variety (Amin et. al., 2010). Hybridization system results in new recombinants and variability in crop plants. Breeding work has led to development, testing, identification, release and notification of many improved garden peas varieties. For evolving varieties through hybridization in pea following procedures are used:

a. Single seed descent (SSD) method: Single seed descent method is now becoming common in peas. This is particularly useful in those situations where selected better lines are intercrossed. Hybrid (F1) plants are grown to produce 500 or more F 2 seeds. One seed is harvested from each F2 plant and the harvested seeds are bulked to plant F3. This procedure continues till F5 and F6 in which phenotypically uniform, superior and stable individual plants with distinct traits are selected for further evaluation for yield and quality. A major advantage of this method is to improve this crop with less resources and the rapid advancement of generation is possible in field and glass house / off season nurse. (Kumar et.al., 2006).

b. Pedigree method: This is a system of breeding in which individual plants are selected in the segregating generations (F2) from a cross on the basis of their desirability judged individually and on the basis of a pedigree record. Jawahar Mattar series 1, 2, 3, 4, 54 and 83 have been evolved through this method (Peter and Kumar, 2008). Several improved varieties like Arka Priya, Arka Pramodh and Arka Apoorva have been developed through this method at IIHR, Bangalore. Similarly, Vivek Matar 3, 6, 11, Kashi Samridhi, Narendra Sabji Matar 6, Matar Ageta 6 and Jawahar Matar 1 and 2 were developed through this method.

c. Bulk method: This method was developed by Nilsson Ehle of Sweden in 1908 in a wheat breeding programme. The growing of genetically diverse population of self-pollinated crops in a bulk plot with or without mass selection followed by single plant selection in F /F 5 6 generation is known as bulk breeding.

3. Following are the advantages of this method (Newman, 1912):

a. Large populations could be grown in each generation, thereby increasing the probability of more gene combinations.
b. Little work is required to handle anyone cross permitting several crosses to be carried forward.
c. Selection from later generations would breed true as in any other comparable method of breeding.
d. More generations could be grown each year involving off season nurseries since there is greater role of natural selection. (Kumar et. al., 2006).

Mutation Breeding

Mutation breeding is an alternative to conventional breeding for crop improvement. Exposing plant genetic material to mutagens enhances the possibility of isolating genotypes with desirable traits. Induced mutations can create variability in inherited traits in crop plants (Kumar et. al., 2007b). Two mutants with short internodes were isolated in 'Azad P-1' treated with 15 kR dose of gamma rays and 0.3% dose of EMS.

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Applications of Drones in Agriculture

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Natural resources are available to us in a very limited quantity and the world population is increasing day by day. With increasing number of people to feed pressure on agriculture sector to grow enough food for everyone's consumption will also increase. Agriculture sector is very important sector for ensuring food security for all, it is dealing with the lot of problems like unavailability labour or high cost of labour for farming, extreme weather events, inadequate amount and inefficient application of fertilizer, infection, diseases, and health problems due to chemical application (fungicide, pesticide, insecticide etc.) or insect/ animal bite. The use of advanced technologies like as drone in agriculture offer great potential for overcoming such challenges. The main applications of drone in agriculture are for the purpose irrigating crops, crop monitoring, fertilizer and chemical application, soil and field analysis. Drones industry has global market of $127.3 billion (904.3 Crores Rupees) worldwide of which contribution of agriculture is at $32.4 billion (230.2 Crores Rupees) and it is expected to grow further in the future. Drone-based solutions in agriculture have great significance in terms of managing adverse weather conditions, productivity gains, precision farming and yield management. These are some significant areas in agriculture to provide drone-based solutions along with use of Artificial Intelligence and computer vision technology.

Figure 1: Drone Flying in Field

Applications of Drones in Agriculture

1. Drones can be used for surveying and produce a 3-D field map with detailed terrain, drainage, soil and irrigation.
2. Nitrogen-level management can also be done by drone solutions
3. Aerial spraying nutrients and chemicals.
4. Crop Monitoring and Health assessment.
5. Yield mapping
6. Disease monitoring.

General India Drone Laws

Drone use is allowed in India, but there are several drone laws that need to be followed when flying in the country. Operators must ensure that they follow the following drone laws when flying a drone that weighs over 250 grams in India,

1. Do not fly your drone over densely populated areas or large crowds.
2. Respect others privacy when flying your drone.
3. Do not fly your drone within 5km of airports or in areas where aircraft are operating.
4. You must fly during daylight hours and only fly in good weather conditions.
5. Do not fly your drone in sensitive areas including government or military facilities. Uses of drones or camera drones in these areas are prohibited.

6. You must be at least 18 years old and have completed a training course.
7. All drones must be equipped with a license plate identifying the operator, and how to contact them.
8. You must only fly your drone within visual line of sight.
9. You cannot fly more than one UAV at a time.
10. Do not fly your drone within 50km of a border.
11. Do not fly your drone more than 500 meters into the sea, from the coastline.
12. Do not fly within 5km of Vijay Chowk in Delhi.
13. Do not fly over national parks or wildlife sanctuaries.
14. All drones must have liability insurance.

Conclusion

The use of agriculture drones can take care of a lot of problems that currently plagues the sector, including crop health monitoring, crop treatment and crop scouting, and the importance of these unmanned aerial vehicles (UAVs) has been recognised by both governments and start-ups. On the one hand, the central government has launched an online platform called Digital Sky Platform for the registration of drones and their operators and on the other, there are 35 drone start-ups in the country that are working to raise the technological capabilities and reduce the prices of agriculture drones, aka agri-drones.

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CRISPR/CAS - A Versatile Tool for Gemone Editing

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Introduction

On the earth, construction manual of all living beings is the De-oxy Ribonucleic Acid (DNA). Genome of an organism have billions of base pairs or thousands of genes. In the field of molecular genetics scientist already founded genome sequencing of several organisms and many genes, govern important characters. Researchers use genome editing tools to found out how genes work and to control their expression. It allows to researchers to make desirable modification in the genome of an organism through add, alter or delete nucleotides in the gemone of an organism. Any change in the genome is reflected in the phenotype of organism. To conduct experiment on genome editing mainly nucleases, an enzyme can make specific cuts in DNA needed. Several types of nucleases enzymes have been discovered i.e. CRISPER/cas, TALENS, ZNF and mega-nucleases. CRISPER/cas is most recent find of nuclease enzyme which widely used in genome editing experiment. In the year 1987 CRISPER first observed in bacterial repeats, CRISPER elements and associated genes identified and named in 2002. In the year 2007, it was founded that CRISPER is a bacterial adaptive immune system and in the year 2012 CRISPER/cas9 developed as genome editing tool. In 2013 CRISPER first time used in Plants and in the year 2016 USDA determines CRISPER/cas9 edited crops will not be regulated as GMOs.

CRISPR - A Defence System in Bacteria

The majority of life on the earth constitute by archea and bacteria. Viruses are a common threat to cellular organisms. Over the years of development various defence mechanisms against viruses has evolved in the organisms. In prokaryotic organisms a defence system called CRISPER/cas discovered recently. This system helps in understanding of virus-host interaction and provide sequence- specific adaptive immunity. It acts by integrating sequence of virus in the cell's CRISPER locus, allow the cell to remember, recognize and clear infections.

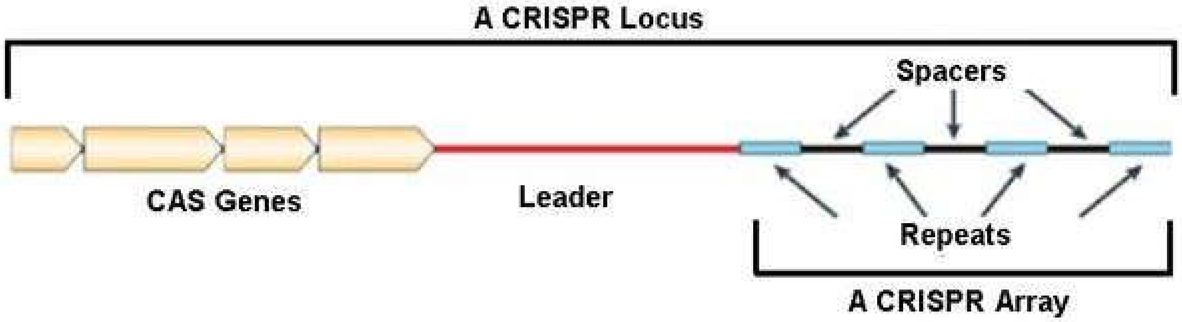

Fig 1. Structure of CRISPER locus

What is the CRISPR?

CRISPR (Clustered Regularly Interspaced Palindromic Repeats): An array of short repeated sequences separated by spacers, unique sequences (Fig.1). It found on chromosomal DNA as well as plasmid DNA (Torre et. al., 2015). The spacers are often derived from genetic material of infectious agents (viruses and plasmids). Spacers are an observation that gave rise to the idea that CRISPRs are part of an anti-virus system (Barrangou et. al., 2007). So, by increasing number of spacers immune system against new viruses can be developed.

New spacers are usually added at one side of the CRISPR, making the CRISPR a chronological record of the viruses the cell and its ancestors have encountered. It works as recognition elements to find matching virus genomes and destroy them. CRISPR activity regulates by a set of CRISPR associated (cas) genes, code for proteins essential to the immune response usually found adjacent to the CRISPR(16). Since in the process of spacer acquisition the genome gets modified but inherit the protection in the offspring.

How Crispr Works?

The CRISPR-Cas mediated defence process can be divided into three stages (Adaptation, Expression and Interference). Adaptation, leads to insertion of new spacers in the CRISPR locus. This stage associated with Cas1 and Cas2 proteins, virtually universal for CRISPER-Cas system. The second stage is associated with action of defence system by expressing the cas genes and transcribing the CRISPR into a long precursor CRISPR RNA (pre-crRNA), further processed into mature crRNA under control of Cas proteins and accessory factors. In the last stage (interference), target nucleic acid is recognized, later destroyed by the combined action of crRNA and Cas proteins (Fig.2). The Cas proteins, a highly diverse group are predicted or identified to interact with nucleic acids as RNA-binding proteins, nucleases and helicases. On the basis of Presence of multiple CRISPER loci, frequent horizontal transfer of CRISPER-Cas systems and the diversity of Cas Proteins, CRISPER-Cas system is classified into 3 categories i.e. Type1, 2, and 3 CRISPER-Cas system.

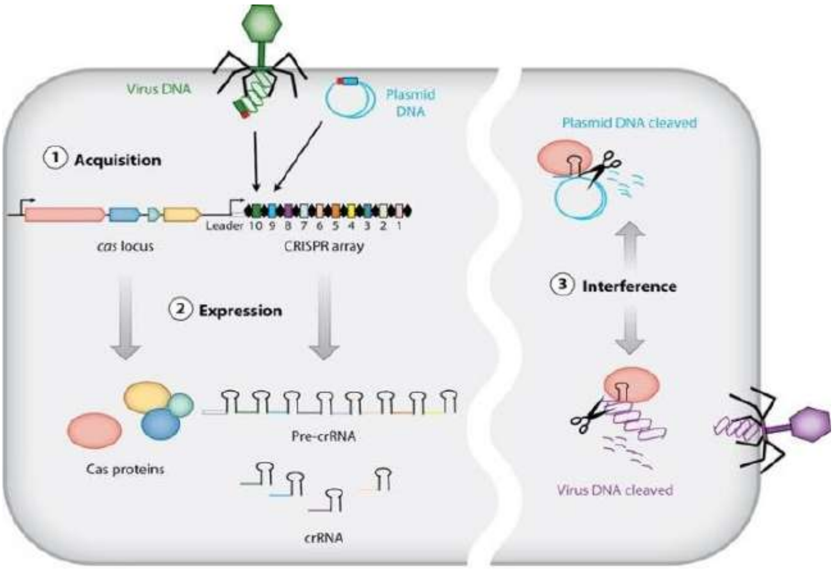

Fig.2. Mechanism of CRISPER/cas defence system in Bacteria

CRISPR - CAS 9

The Type II system is identified the powerful genetics tool for eukaryotic cells, because of its simplicity and efficiency. Cas9 proteins (from *Streptococcus pyogenes*) are widely used for genome editing, which produces a break in the double-strand DNA (Jinek et. al., 2012). This phenomenon makes use of DNA repair pathways in eukaryotic cells provide two ways to make genetic modifications, Non-Homologous End Joining (NHEJ) and Homology Directed Repair (HDR). The crRNA and tracrRNA combined into a single guide RNA (sgRNA) paved the way for this development. CRISPR-Cas systems have also been developed for programmable gene regulation. A new type of genome-editing tool CRISPR-Cpf1/Cas12 similar to the type II CRISPR-Cas system. A single Cpf1 protein functions in crRNA processing, target-site recognition and DNA cleavage. The Cpf1 differs from Cas9 because it recognizes T-rich (such as 50-TTTN-30) PAM sequences, PAM sequence is located at the 50-end of a target DNA sequence, upstream of a protospacer sequence, guided by a single crRNA and no trans-acting crRNA is required.

Recently, the newly identified class II type VI CRISPR/Cas13 systems were found. Cas13 proteins contain two higher eukaryotic and prokaryotic nucleotide-binding RNase domains that mediate target RNA cleavage. Aman et al. used CRISPR/Lsh Cas13a to confer modest resistance against an RNA virus in plants.

Scenario of CRISPR System in Field of Agriculture

The CRISPR associated nuclease Cas9 system has been widely used as mutagenic agent in targeted mutations in plants, help in studying function of gene (a new path for crop improvement) and in genome modification through site-specific DNA double-strand breaks, in DNA repair process. Multiple guide RNAs at various genomic sites used for multiple genomes editing. Three guide RNAs were introduced in rice genomic loci at distinct places and analysed the mutation efficiency of 3–8% . CRISPER has been used in maize (Liang et al., 2014), wheat and sorghum for genome editing. CRISPER cas9 used for the genetic engineered of waxy corn for amylopectin (branched polysaccharide) and amylose (long chain polysaccharide) content by knocking out the Wx1 gene, encodes the endosperm's granule-bound starch synthase enzyme results in shut down the production of amylose. CRISPER/cas system are used in developing climate resilient crops. Unlike the ZFN's and TALEN's, in CRISPR-Cas9 technology DNA target specificity can easily be changed by programming the sgRNA sequence and multiple sgRNAs can work simultaneously with the same Cas9 protein on different targets (Wu et al., 2014). In human cells KRAB (Kruppel Associated Box) domain could be used for repression of gene by fusing with the dCas9 (catalytically inactive Cas9).

Conclusion

Climate change around the globe challenge food and nutritional security. Molecular breeding associated with transgenics advanced novel crop cultivars, tolerate to various stress help in release the global hunger. But use of conventional approaches for improving concerned characters restrict due to high G×E interaction and complex polygenic inheritance. Effect of climatic changes on the crops could be minimized using genome editing tool i.e. CRISPER/ cas system through transforming crop breeding approaches and pave the way for next generation breeding. Therefore, CRISPER/cas may be the efficient approach to maintain the food security.

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Humic Substances – Booster to Crop Growth

Article ID: 30548

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Summary
The complexed humic substance is organic or synthetically formed compound which have consisted around 80% of the SOM (Soil Organic Matter) and considered as a store house of the nutrients such as carbon, nitrogen, phosphorus and sulphur. Though it is not even a primary fertilizer but also stimulates the seed emergence, plant growth, root growth, dry matter production, increase the mineral matter content in the plants and also reduces the amount of fertilization by substituting the fertilizers. Overall, the soil fertility has been maintained very well with the help of humic substances.

Introduction
Humic substances (HS) are the polymeric compound which is produced from the decomposition of the plant material, animal and debris. It occurred naturally and distributed widely in soil, sediments and water ecosystem. It consists of varying degrees of organic molecules including carbohydrates, amino acids, protein and fatty acid with aliphatic chain and aromatic ring structure held together by the hydrogen bond, vander waals forces, ion dipole interaction. The complex natures of it, has been attracted by the researchers to do the research on its structure and their formation. It accounts more of the soil organic matter that will act as the sources of nutrients and plays a crucial role in plant growth by ensuring the nutrient availability, alleviating an abiotic stress and reducing the heavy metal toxicity etc.

Characteristic Nature of the HS
Humic substances are broadly classified into three groups such as humic acid, fulvic acid and humin based on their solubility in varied range of pH. Fulvic acids are the low molecular weight yellow colored substance which is soluble in water at all pH condition. Humic acids are the brown colored substance that have higher molecular weight than the fulvic and lower than the humin. These humic acids are soluble only in the alkaline condition. Black colored high molecular weight HS is known as humin which is highly resistant to microbial degradation. In HS, the percentage composition of C, O, H and N are C (45-60); O (25-45); H (4-7); N (2-5).

Formation of HS
HS are complexed in nature that makes itself as not completely understood. There are several HS formation theories that are been proposed by several scientists. Since from earlier to modern theories, four pathways had been considered as major. An account of the different pathways, humic substances are formed from the lignin (Waksman, 1932), quinones (Stevenson, 1982) that are derived from the enzymatic oxidation of polyphenols by the microorganism and sugar-amine condensation (Mriaillard, 1913). All these processes are exercised at a time but in some cases based on the prevailing environment conditions, the dominance of HS formation pathway may get varied. For example, in swampy areas predominantly HS are formed under a lignin pathway but whereas in the forest areas polyphenol condensation will take place.

Available Forms of HS in the Market
Commercial, granular and liquid forms of the humic substances are extracted from the composting, coal and peat (Quilty, 2011). It can be either incorporated into the soil or sprayed upon the leaves and both. The mode of application will be varying based on the persisting environmental condition and purpose of application.

Role of HS in Plant Growth
1. Soil application: Humic substances are negatively charged. The functional groups like carboxylic, hydroxyl etc., present in the HS are the primary reason for its negativity. These negative charges attract the positively charged ions that will increase the cation exchange capacity of the soil. Application of HS in soil enhances the plant root and shoots growth with increasing the bioavailability of nutrients. Under the unfavourable environmental condition, ultimately the nutrients exist as an unavailable form particularly the micronutrients that will be combat by the process of its chelation.

Moreover, HS thickens the root, increase the dry weight, enhance the secondary roots, enhance the seed germination and also it triggers the auxin bioavailability. Humic acid acts as a catalyst in enhancing the microorganism that is present in the soil.

The application of HS also mitigates the heavy metal toxicity through the production of Reactive Oxygen Species (ROS) that destroy the lipid, nucleic acid and protein. The main role of Humic substances is concern to their association with glutathion biosynthesis that protect the DNA against the ROS.

2. Foliar application: Humic acids are not only beneficial in soil application but also to the foliar application. The main advantage of fulvic acids are their low molecular weight and its water solubility nature that enable it to enter into the plants easily by enhancing the cell wall membrane permeability. In addition to that complexation or chelation properties of a fulvic acid helps to increase the nutrient use efficiency mainly micronutrients.

Conclusion

Finally, concluded that humic substances, showed a promising and positive effect towards the plant growth and yield. However, the magnitude of its effects depends on the method of application, source of the humic substances and the soil type. The researchers are still working on to reveal the unknown side of HS. Thus, the proper integrating application of humic substances with the fertilizer would increase the food production and also the sustenance of soil quality.

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A Sight on the Benefits and Utility of Single Super Phosphate (SSP) for Farmers

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Introduction

Phosphorus (P) is an essential element for any living being that exists on Earth. It plays a primary role in the formation of vital biomolecules such as deoxyribonucleic acid (DNA) and nucleotide forms adenosine triphosphate and adenosine diphosphate (ADP and ATP), which store energy and are extremely important for cellular respiration and photosynthesis. Together with nitrogen (N) and potassium (K), P belongs to the class of the three essential macronutrients for development of any kind of plant.

Single Super Phosphate (SSP) is the oldest chemical fertilizer manufactured in India with multi-nutrient as it contains 16% P_2O_5 as prime content with additional nutrients of 11% Sulphur, 21% Calcium and Minerals in Traces. The main attraction and utility of SSP is that it is cheaper in cost and available at 1/4th price of DAP & MAP and 2/3rd price of MOP without compromising on overall input value. It is more suited for crops like oil seeds, pulses, horticulture, vegetables, sugarcane, paddy etc. Single Super Phosphate (SSP) fertilizer is mainly used for improving root growth and chlorophyll synthesis and thus improves product quality.

Chemical Properties

Ingredient	Quantity
Phosphorus content	7 to 9% (16 to 20% P_2O_5)
Calcium (Ca) content	18 to 21%
S content	11 to 12%
Ph	<2

Use in Agriculture

SSP is an excellent source of plant nutrients. The P component reacts in soil similar to other soluble fertilizers. The presence of both P and sulphur (S) in SSP may provide an agronomic advantage where both of these nutrients are deficient. In agronomic studies where SSP has been shown to be superior to other P fertilizers, it is usually due to S, Ca (or both).

When available locally, SSP has found widespread use in pastry fertilization where both P and S are low. As a source of P alone, SSP often costs more than other, more concentrated fertilizers; Therefore, it has declined in popularity.

How it Helps in Crop Nutrition

1. Contains 16% phosphorus, which is 100% soluble in water.
2. Strongly promotes root development.
3. Improves soil texture.
4. SSP contains 11% sulphur which increases the oil content in oilseed crops.
5. Contains 21% calcium, which increases the hardness of the straw, which increases pest resistance in the crop.
6. Helps form knots on the roots of legume crops.
7. Improves growth of white roots.

How do farmers benefit:

1. Increased use efficiency of nutrients, hence reduction in cost on fertilizers
2. Less fall of flowers and increase in fruit bearing.
3. Increases oil content in oilseed crops, hence higher marketing value.
4. Reduction in pest incidence, hence reduction in pest control cost.
5. Improvement in crop quality, yield and income of farmers.

Non-Agricultural Use

SSP is mainly used as crop nutrient source. However, MCP and gypsum (the two primary ingredients in SSP) appear in many products. For example, MCP is commonly added to enrich animal diet, and bakers routinely use it as a leavening agent. Gypsum is widely used in the construction industry, as well as in food and pharmaceuticals.

Advantages

1. Single super phosphate can be used by mixing with all types of manure.
2. Mixing and giving with concentrated fertilizer is useful for a good crop.
3. At the time of sugarcane sowing, making Single super phosphate (powder) flow, keeping the sugarcane pieces in it for some time is beneficial.
4. Single super phosphate also helps in the development of roots.
5. It transports the ground essential elements and prevents phosphorus from perishing in the ground.
6. Single super phosphate has countless benefits.
7. Single super phosphate is a special requirement of the present time.
8. The cost of farming of farmer friends decreases and farmers gets maximum benefit.
9. Due to the availability of air in the ground, the inauspicious element changes into a beautiful tone.
10. Nitrogen desiccant enhances the gland above the bud.
11. Increases the immunity power of plants.
12. Paddy crop is good and the grains of the crop are found in excess in weight.
13. Increase the amount of protein in the category of paddy.
14. In oilseed crop, oil increases the percentage.
15. Single super phosphate is also functional as a ground reformer.
16. Single super phosphate reduces the cost of capital of farmer friends, which exposes the broad prospects of progress of the farmer and makes the land strong and the farmer rich.

Management Practice

No special agronomic or handling precautions are required for SSP. Its agronomic effectiveness is similar to other dried or liquid phosphate fertilizers.

The loss of P in surface runoff from fertilized fields can contribute to water quality problems. Producers should implement agricultural practices that minimize this loss.

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Vegetable Cultivation In River Bed of Dhab Area for Remunerative Returns

Article ID: 30550

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River bed commonly known as diara land is a basin or bank area or area between two or more streams of river and known as Khadar, Kachhar, Doab, Dariyari, Kochar, Nad, Tali and Nadiari by several local names. River bed cultivation is a kind of vegetable forcing, facilitating off season production of mainly cucurbitaceous vegetables. In India, cultivation of cucurbits like watermelon, muskmelon, longmelon, pumpkin, ridge gourd, bitter gourd and bottle gourd occurs mostly in North and Central India,; bitter gourd, snake gourd etc. in some areas of Kerala and cultivation of pointed gourd in Eastern U.P., Bihar and West Bengal is more common under river bed conditions to catch early market and fetches more profit.

Presently not only in India, but in other south East Asian countries cucurbits are also commercially cultivated in the river bed areas. In survey it was observed that out of total area under cucurbits cultivation, 60% area is under river bed and during summer season around 75-80% of total cucurbits production is being produced in diara land area, which is available in the market from February of June. The area under diara agro-ecosystem in Bihar is reported to be 11.57 lakh ha distributed among Ganga, Burhi Gandak, Gandak, Kosi and some rivers (Wadhwani and Singh, 2008). The river bed cultivation is done by the farmers using their own seeds of land races, as well as old aged indigenous production technology which results low productivity. Hence, there is urgent need for screening of the existing varieties and advanced lines of cucurbitaceous vegetables under riverbed condition. Till day no technology is standardized for riverbed or diara land based on research.

Climate change has induced direct impacts on natural and human systems altering productivity, biodiversity and functions of many ecosystems and livelihoods. The agriculture sector is adversely affected by climate change and the rural poor are the most vulnerable groups to climate change impacts leading to unsustainable livelihoods (Rai, 2007; NAPA, 2010). In this context, development efforts that diversify livelihoods options based on local knowledge and resources, and that also enhance innovative capacity of people for better management of natural resources in the changing context are the dire need of the day for adaptation to climate change.

Flash flood in the terai region of Bihar is increasing day by day. Due to the deforestation there is the loss of water sources in different parts of the country. The cutting of land due to the heavy rainfall and flash flood is also increasing which leads to the farmers to become landless and poor. The volume of the flow of river cannot be imagined in rainy season (July-Sept) and possess a severe threat to those marginal people living near the river bank. The agriculture land is fully deposited by the sand and alluvial soil. This condition remains just for three months of rainy season but rest of nine months of winter and spring (Oct-June) remain as such fallow and wastage. Moreover, the situation of the people leaving near the river bed is very desperate. Farming in those areas which is made marginal or sandy by the flood in the rainy season in the winter, spring and summer season for rehabilitation of that marginal land is referred as river bed farming.

Heavy floods during the rainy season have converted a large area of lands as riverbeds and riverbanks in many parts of Terai Bihar. Those lands are remains fallow and wastage since long period of the time. During the autumn and spring season i.e. period of high wind the environment is also highly polluted (sandy wind). The wind carries sand from these banks and makes environment muddy. It has not been reported exactly but there are significant areas of land in Bihar under riverbeds and flood affected, and the area is increasing every year. Thousands of families have been displaced from their farming profession to the landless situation, and in Tarai area 25% of the families are landless (Helvetas, 2010). Riverbed vegetable farming is a pro-poor focused intervention for the rural community. Out of 12 months in a year only 3 months of the rainy season there is risk of flood. Nine months of the year it remains as it fallows. The primary objective of this intervention is to raise household incomes of landless and land poor families through employment generation at local level. The secondary objective is to improve the environment with green enterprise by utilizing wastelands. The landless and land poor families residing in the vicinity of rivers have large family size (5 to 8 members per family) aggravated by acute food and nutritional insecurity problem. They lack appropriate means of livelihoods and are compelled to depend on share cropping and wage labouring. They also go to different parts of India for seasonal wage labouring.

The cultivation practices on the riverbeds are of different nature and face a large number of problems, related to irrigation, fertilization, and seed problem etc. Due to long spell of droughts in recent years, there is need for irrigation on riverbed farming which further increases the cost of production. Mostly the farmers manually collect water in buckets from river and irrigate the crops which suffers from numerous problems such as considerable seepage, conveyance and evaporation loss; higher energy cost; lower water productivity; leaching of costly agricultural inputs causing sub-surface water pollution.

River Bed Soil

A well-drained soil of loamy type is preferred for cucurbits. Lighter soils which warm quickly in springs are usually utilized for early yields, and in heavier soils vine growth will be more and fruits late maturing. In sandy river-beds alluvial substrate and sub-terranean moisture of river streams support the cucurbits. In fact, a long tap root system is adapted to the growth of cucurbits in river-beds. All the cucurbits are sensitive to acid soils. Below pH of 5.5 no cucurbits can be successfully grown and most of the cucurbits prefer a soil pH between 6.0 to 7.0. Musk melon is slightly tolerant to soil acidity, while other cucurbits 'prefer intermediate or normal pH. Similarly, alkaline soils with heavy salt deposition are unsuitable for cucurbits and water melon is the only cucurbit which is slightly tolerant to salts. Soil temperature is also a determining factor for quick germination, early maturity and production. The minimum temperature should not go below 10°C and maximum 25°C. The optimum range is around 18-22°C. In river-beds the sand remains comparatively warmer and does not cool quickly. Further, sandy river-beds have moisture beneath and warm up quickly in spring. That is the reason why cucurbits in river-beds survive low temperature periods of winter months and produce early crops in spring. Soil moisture is important for rapid growth and it should be at least 10% to 15% above the wilting point. Rainy season cucurbits are mostly unirrigated. Depth of the soil is also an important consideration in case of perennial cucurbits.

Methods of Seed Germination

In case of cucurbits they used to make plastic tunnel for seed germination in the first week of December to take harvest earlier. While some farmers do direct sowing of seed in February in the pits. While in others crops like cowpea, beans direct sowing is practiced. In case of chilli and tomato nursery bed is prepared and after seedling is ready to transplant in the field. Transplanting is done slightly closer than normal condition.

Methods of Seed Sowing

Methods of seed sowing depend upon the water table. If the water table is below 0.6m then farmer used to sow seeds by making slight deep bed. If the water table is 0.6m then they make bed on the level of the surface and sow the crops and if the water table is less than 0.6m then they sow seeds by making ridge beds.

Selection of Crops

All vegetable crops are not suitable for the river bed cultivation. Cucurbit species are more suitable crops to be grown on river beds areas. Water melon, Cucumber, Bottle gourd, Musk melon, Bitter gourd, Pumpkin, pointed gourd, long melon, etc are important cucurbits grown by farmers.

Manures and Fertilizers

Generally, manures and fertilizers on the basis of soil test and nutrient content of soil are used. But in case of river bed farming sandy soil don't have good fertility so prime concern should be given for good harvest. Farmer used to dig pits and all manures and fertilizers are applied in that pits rather than spreading in the whole field. The basal dose of manure and fertilizers used by the farmers in each pit are FYM: 3-4 kg / pit and Urea: 20g/pit.

Irrigation

As the source of water is near the field people experience more dryness in the field. Farmers used to irrigate the land once in week. To overcome this problem, RPCAU, Pusa, has developed solar based boat irrigation system in which water is collected in a tank which is placed at top of the field and through drip-irrigation system water is supplied to the plant. These technologies particularly drip irrigation not only uses water efficiently (90 to 95 %) but also minimize the other problem associated with the traditional irrigation system. The drip irrigation is a method of applying water to the root zone of plant at slow speed under varied level of pressure depending upon the quantity of water and area under single point source.

Harvesting

Harvesting of cucurbits starts from the onset of February month who do off season production and earn good profit. Those who directly sow their cucurbits seeds on the main field then their harvest starts only after May and they do not get good price. Early harvested crops had high market demand and fetch good prices as offseason vegetables. February harvest gets Rs. 20 to 25 per kg while it starts decreasing in May to June harvest which fetches just 8 to 12 rupees only.

Conclusion

There is significant area of land under riverbed and it is increasing every year. Among vegetables, cucurbits are commonly grown on riverbeds. The productivity and production of vegetables on riverbed is lower due to poor inherent soil fertility compared to conventional farming in permanently cultivated fertile lands. Riverbed area is regarded as wasteland but riverbed vegetable farming is the major source of income of many landless and land poor families residing in the vicinity of rivers. Riverbed vegetable farming has been emerged as a niche based on farm income generation activity for landless and land poor families and well accepted by farmers and agricultural organization.

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Mango Malformation: Causes and Symptomatology

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Abstract

Mango (*Mangifera indica* L.), the king of fruits is one of the most important fruit crops of India and belongs to family Anacardiaceae. Epidemiology of mango malformation was not well understood and described till today, yet many studies have proven that *Fusarium mangiferae* is the pathogen responsible for mango malformation disease and Koch's postulates have been completed successfully with this fungus in various places around the world.

Introduction

Mango (*Mangifera indica* L.), the king of fruits is one of the most important fruit crops of India and belongs to family Anacardiaceae. It has been cultivated for past 4,000 years having great cultural and religious significance. It is the fifth largest cultivated fruit crop globally with yields of approximately 40 million tonnes, second only to banana among the tropical fruit species. Mango malformation is one of the most important and destructive diseases of this crop worldwide (Veldman et al., 2017).

Causes

Epidemiology of mango malformation was not well understood and described, still many studies have proven that *Fusarium mangiferae* is the pathogen responsible for mango malformation disease and Koch's postulates have been completed successfully with this fungus in various places around the world. Although the cause of malformation has been controversial, but fungus is one of the major possibility causes.

Symptomology

Broadly three distinct types of symptoms were described by various workers. These are bunchy top of seedlings, vegetative malformation and floral malformation. Later, these were grouped under two broad categories i.e., vegetative and floral malformation.

Vegetative Malformation

It is more commonly found on young seedlings that is characterized by disrupting of apical growth resulting in several small flushes with quite short internodes at the apical ends of various branches. Symptoms of vegetative malformation include hypertrophied, tightly bunched young shoots, with swollen apical and lateral buds. Vegetative mango growth occurs in several intermittent flushes, separated by resting periods with no apparent growth. It may appear even in nursery stages on the main stem of the plants. These shoots bear small leafy structures appearing as if a crowded unhealthy and ugly looking mass. The multi-branching of shoot apex with scaly leaves is known as "Bunchy Top", also referred to as "Witche's Broom". The seedlings, which become malformed early, remain stunted and die while, those getting infected later resume normal growth above the malformed areas. Vegetative malformation seriously affects seedlings and small plants in nurseries.

Floral Malformation

It is the malformation of panicles and is more serious problem than vegetative malformation (Chakrabarti, 2011). Floral malformation appeared in the panicles significantly impacts fruit production since affected inflorescences usually do not set fruit. The primary, secondary and tertiary rachises become short, thickened and hypertrophied. Such panicles are greener and heavier with increased crowded branching. These panicles have numerous flowers that remain unopened and are predominantly male and rarely bisexual. The ovary of malformed bisexual flowers is exceptionally enlarged and non-functional with poor pollen viability. Both healthy and malformed flowers appear on the same panicle or on the same shoot. The severity of malformation may vary on the same shoot from light to medium or heavy malformation of panicles. The heavily malformed panicles are compact and overcrowded due to larger flowers. They continue to grow and remain as black masses of dry tissue during summer but some of them continue to grow till the next season. They bear flowers after fruit set has taken place in normal panicles and contain brownish fluid.

Conclusion

The scientist has been continuously working to tackle the mysterious malady till today from the very first beginning of the disease incidence reported. Century-long researches were being conducted seeking the reason behind this malady and its control measures. In the long run of research work, different sciences like Microbiology, Biochemistry, and Genetics were being developed together and that has facilitated the researcher to dive into the depth of its causative agent, possible management practices and reduction in disease incidence. The most efficient method to manage mango malformation starts with the traditional principle of disease control i.e. Avoidance and resistance before the infection. When the disease infection occurs, the control measure must be carefully followed.

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By-Products of Sericulture Industry

Article ID: 30552

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Abstract

Sericulture is an agro-industry based activity that creates a lot of wastes during the commercial production of its final product- the silk. Broadly, there are 3 types of wastes generated during the silk production- wastes from the host plants, wastes from the silkworm rearing and wastes from grainage operation. Sustainable use of such wastes creates many by-products, called as sericultural by-products, are of high value to human beings. The utilization and commercial exploitation of such by-products gives a possibility of extra income generation to the silkworm farmers and simultaneously, gains foreign exchange by promoting at global level. The scientific in-depth study and commercial promotion of such sericultural by-products are the need of the hour to give them a special recognition, thereby making silk industry more holistic and acceptable to sericultural entrepreneurs.

Introduction

India, the second largest silk producer in the world, is developing as a leading silk producing country. Not only for its silk producing ability but also, for the development of sericultural by-products, India is famous across the globe. Apart from producing many by-products, India is well known for its seri-products of medicinal value. Many sericultural by-products are evolving these days and holding a major share of market. Mainly these seri-products have been divided into 3 types based on their product origin (Singh, 2017; Ganga and Chetty, 2019).

These are:
1. By-products of moriculture.
2. By-products of silkworm rearing.
3. By-products of grainage operation.

By-Products of Moriculture

Mulberry is used as the host plant in sericulture. Mulberry leaves are only used as the feed in sericulture. Apart from used as a direct raw feed, the mulberry leaves are also used as a source of semi-synthetic artificial diet for the silkworm. The leaves are also having medicinal value that can be used for treatment of various diseases and disorders. During the offseason, mulberry plants are pruned. The matured pruned plant parts which is not used as a feed for silkworm, can be used as the cattle feed and manures. The leftover plant parts are used as the mulches in mulberry garden or as a fuel in domestic use. The rejected plant parts are conveniently used as the raw material for paper pulp industry. Mulberry tea, prepared from its leaves, is a very common drink because of its anti-diabetic and cholesterol reducing properties. The leaf juice of *Morus* species has refrigerant and laxative properties which can be used as febrifuge in diarrhoea, cold, endemic, malaria and amoebiasis.

Apart from the leaves, mulberry possess fruits of high quality. Botanically, mulberry fruit is a syncarp consisting of many drupes. The full-bodied flavour of this fruit is a good balance of sweetness and tastiness with nutrient elements of vital importance for human metabolism. Fruits can be used for making jam, jelly, fruit drink, pulp, fruit tea, fruit sauce, cake, fruit powder, fruit wine, food colorant, diabetes control agent and as ruminant livestock feed. It can also be used in the pharmaceutical industry. It opens a new vista for industrial exploitation of mulberry fruits throughout the world.

Mulberry twig branches and wood stem are used in cosmetics for hair lotions; moisture products for skin, wood processing – for furniture, as fuel, in the food industry – for natural colouring and in the textile industry–for making the so called "artificial cotton". The thick stem of mulberry can be used as materials for the preparation of pens and can be used as medium grade fuel wood in rural areas. The mulberry bark is digested with 14% caustic soda and 5% bleaching powder, that gives a product pulp obtained as white and soft fibre suitable for use in textile industry. Recent studies have been going on for biogas production from mulberry plant residues (Buhroo et al., 2018).

By-Products of Silkworm Rearing

During the silkworm rearing, excess amount of harvested leaves and unfed leaves, moulted skin of the larvae are the major wastes. These wastes are collected during the bed cleaning activities. Apart from these, the diseased and dead larvae also get collected.

Such types of wastes are exclusively used in the production of compost. Studies show that the amount of nitrogen, phosphorus and potassium in the left-over mulberry leaf is 3.1, 0.5 and 1.5% respectively and that present in the silkworm litter is 1.4, 0.4 and 0.8% respectively (Ganga and Chetty, 2019). Therefore, the mulberry leaves and the silkworm litters are the adequate materials for composting.

The rejected and the dead larvae are used as the poultry feed. It has been observed that the chicks fed on the deceased larvae lay bigger and a greater number of eggs. Silk glands of dead matured silkworm larvae is used for surgical suturing. Surgical suturing is done by treating the silk glands with acetic acid and drawing them into fine filament.

Silkworm pupae are often used as the delicious food in many south Asian countries like Korea, China, Japan, Thailand etc. In India, pupa is exclusively used for human consumption in North-eastern states. The use of silkworm pupae in chocolates, chili sauce has vast potential for commercializing the concept. Waste silkworm pupae are also used as livestock and poultry feed.

The vital residue of silkworm rearing composed of vegetable mulberry remnants and excreta can be used as organic fertilizer (as FYM or compost) or in biogas production or fodder for animals during winter. This method is exclusively used in Japan for feeding sheep, goats and cattle. This emphasizes the complete utilization of all type of residues in a comprehensive and sustainable way (Buhroo et al., 2018).

By-Products of Grainage Operation

Grainages are the organisations designed to produce commercial silkworm eggs for future generations. The eggs produced with an intention for multiplication of future generations is called seed cocoons. Many sericultural and non-sericultural wastes are generated during the production of silkworm seed cocoons.

The pierced cocoons are vital waste products in the grainage operation which is categorized as grade I waste. Pierced cocoons are the cocoons from which adult moths emerge by breaking the continuity of the silk thread. Hence, these types of cocoons are unfit for reeling. In silk industry, the pierced cocoons are used for spinning purpose. Generally, the hand-spinning industry uses the pierced cocoons to form silks like ghicha and katia which are used for producing fabrics like gents' chaddar, lady's scarves, curtains, table cloth etc.

Another important waste generated during the grainage operations is the unused adult silk moths. These dead, unused and deformed moths are often used for composting purpose. There is a chance of spread of pebrine spores during the process of composting, so special care is required to burn the infested seed lot. The moths are often used to produce a special type of medicinal wines in accordance with the ancient Chinese prescription. This liquid can be used to treat impotence, abnormal menstruation and menopausal symptoms (Ganga and Chetty, 2019).

There are various cosmetics developed in the market from the silkworm wastes. Silk lotion, silk hand creams, silk night creams, silk baby creams and silk toothpaste are the well-known products among them (Nazim et al., 2017).

Conclusion

Sericulture and silk industry are two inseparable parts of each other. Starting from silkworm egg production to the production of final product- silk, is a cumbersome process which creates a lot of waste materials on its way. The use of these waste materials to produce various by-products is the need of the hour. Moreover, this will facilitate an income generation and sustainable utilization of the seri-wastes simultaneously.

Commercial production of quality by-products from seri-waste may also add some remunerative income to the farmers by the product promotion and export generation to foreign countries, thereby gaining foreign exchanges for our country. However, there are many loopholes in the form of research needs, technical know-how, knowledge dissemination at the grass-root level etc which need to be gap filled in order to recognise sericulture by-products at the global level.

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Spun Silk: The Unsung Jewel of Sericulture Industry

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Abstract

Sericulture is an extensive study of silk producing creatures, more particularly the silkworms. It involves various processes starting from the raising of the host plants, rearing of silkworms and reeling of the silk. In between, there are a lot of silk wastes generated. It comprises of wastes from the host plants, rearing wastes and reeling wastes. Spun silk is the best example of silk waste management, by creating the short fine fibres, inferior although. Spun silk is directly or indirectly used for mixing with natural or manmade fibres. It not only creates employment generation but also helps in meeting the demand of silk in the market.

Introduction

Sericulture is an agro-based industry that deals with various processes, starting from rearing of silkworms to the production and marketing of its final product "The Silk". During the whole process, various types of waste materials are emerged; out of which the pierced and malformed cocoons are important so far as the rearing and grainage sectors are concerned. Apart from them, many other types of deformed silk materials are also observed viz., floss (outer part of cocoons brushed before reeling), friese (the coarse and uneven silk fibre at the beginning and end of each cocoon), scrap (the machine waste left over from reeling) etc. These all types of deformed and discontinuous silk filaments are used for the production of spun silk. So, spun silks are defined as the pure silk obtained by spinning the different types of reeling wastes and some unreelable cocoons. Spun silk can be directly used as spun silk yarn or indirectly as blended yarns by mixing with natural or manmade fibres.

Types of Spun Silk

Broadly, the spun silk is divided into two types based on the spinning activities (Ganga and Chetty, 2019). These are – Mill-spun silk and Hand-spun silk.

Mill-spun silk	Hand-spun silk
Made up off superior quality silk wastes	Made up off inferior quality of silk
Utilizes different silk wastes like filature wastes, cooker's waste, reeler's waste without pelade waste, throwster's waste etc.	Utilizes silk wastes from defective cocoon, boiled off cocoons and pelade wastes.
It is used for spinning fine yarn.	It is used for production of hand spun yarn. The pierced and cut cocoons are utilized for the production of hand-spun yarn which is called as Matka yarn.

Processes of Spun Silk Production

Broadly there are 5 major stages like, Degumming, Dressing or combing, Preparatory, Spinning and Finishing.

Degumming

Degumming is the process of removal of loose sericin layer of the wastes which binds them together in an entangled manner. There are 3 prominent ways of doing this:

1. Schapping: This is the oldest and traditional method of degumming where silk wastes are kept in alkaline solution for several days in order to ferment by natural microbes. Despite of being the easiest one, it is not performed for commercial purpose as of the foul smell emanating during the fermentation process which reduces the economic value. This process also creates problems in judging the complete removal of sericin.

2. Soda-boil method: Here, the wastes are treated with a mixture of alkaline soap solution in a boiling condition for 45 minutes. Then, they are washed with water to clean off the sericin layer of the wastes.

3. Enzymatic method: Here, enzymes are used to remove the sericin layer. Then they are dried in sunlight or in heated rooms.

Dressing or Combing

The main aim of this process is to yield the parallel filaments from that of the entangled ones. In this process, the dried-degummed silk filaments are converted into silvers by opening them up in an opening machine. Then, these are filled uniformly and combed to get the parallel filaments. During the dressing process, the short filaments are deposited which are not enough to be used for spinning into fine yarns. These short filaments are used to produce a coarse yarn called Noil yarn.

Preparatory

After the production of parallel filaments, in this process, dirt and other foreign matter are cleaned. The cleaned filaments are then subjected to carding into ribbons. The cards are then drawn in a drawing machine to extend the filaments.

Spinning

Here, the drawn threads are spun in a ring frame where various processes like the drafting, twisting and winding are done together. These processes are performed to see the strength and uniformity of the spun silk filament.

Finishing

This is the final process of the spun silk preparation, where the second twist is given followed by gassing to burn off any defects. Then, the final reeling is done to transform them into a standard hank form. Hanks are then dressed, folded and packed into bales and marketed.

Spun Silk Products

Spun silks can be used as the normal silk products. It can be used for manufacture of silk fibres which tend to be fuzzy after wearing as the yarn is made up off short staples. It is also used for pile fabrics, dress trimmings and linings, elastic webbing, sewing silk, summer wear silks, velvets, umbrella fabrics and insulation.

Conclusion

Pure silk production plays an important role in strengthening the economy of our country. It brings foreign exchanges back to our country through export in large quantities. Apart from the total production of silk in India, the waste generated thereby plays a vital role for silk industry as well. The total collection and utilization of silk wastes play an important role in effective resource management of all sericultural products available to farmers. Spun silk belongs to the most effective way of managing the silk wastes and brings out the maximum return for the sericulture farmers. Thus, creating an employment generation for many. The way forward is to look for extensive research and product development out of the spun silk. The newly developed spun silk products will pave the way for gaining momentum in textile industry of India.

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Rice Production in DPR Korea: Role of Improved Technologies

Article ID: 30554

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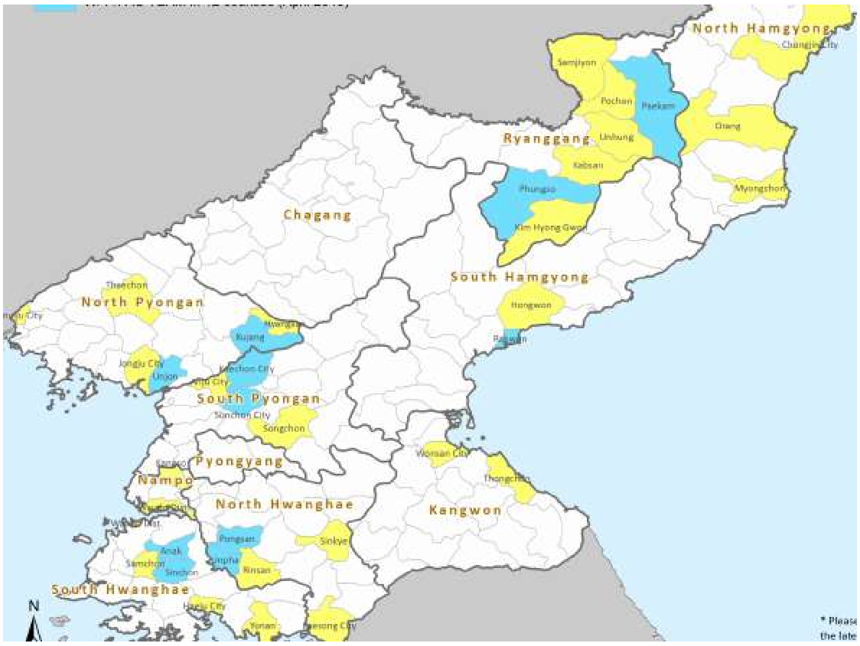
Introduction

Rice is staple food of the people of DPRK which provides most of the daily dietary energy supply. National food security in DPRK critically depends on annual harvests of the rice crop. Strengthening national food security by attaining self-sufficiency in rice and other cereals is a key priority of the DPRK Government. The crop is grown on average (2012-2019) 35.0 percent of the total farm cultivated area and contributes 45.0 percent to total production of food crops (in cereal equivalent). Rice cultivation is concentratedmainly in the central, south-western and south-eastern parts of the country, which include the lowland parts of the provinces of North and South Pyongan, North and South Hwanghae, Pyongyang, Nampo and Kaesong (collectively known as the "Cereal Bowl") and the narrow east coastal strip comprising parts of Kangwon, and North and South Hamgyong Provinces. Smaller areas are also cultivated in upland Chagang and Ryanggangprovincesas shown in the map below.



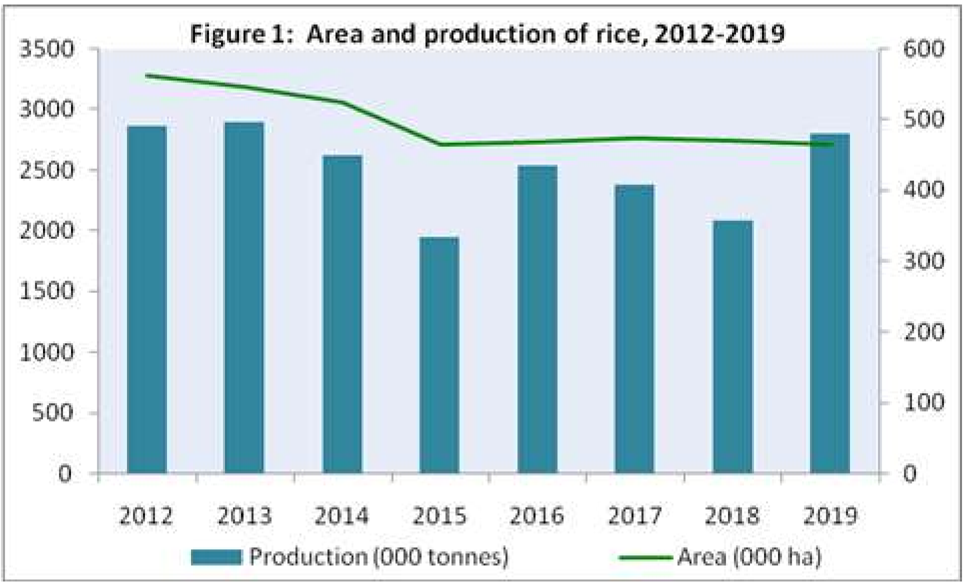
A key constraint to expanding agricultural production in DPRKorea is limited availability of arable land because of the country's mountainous terrain. The average elevation of land is 442m above the sea level. The highlands are 176 404sq km (78.7 percent of the whole territory) and the lowlands are 47 848 sq km (21.3 percent of the whole territory).Topographically, the land is high on the north and the east and gets lower southwards and westwards.

According to land use data of 2013, of the country's 12.3138 million hectares (mha) land, agricultural land amounts to 1.8956 mha which constitutes 15.4 percent of the total land area. In order to increase availability of arable land, the DPRK Government pursues the policy of land reclamation in tidally inundated lowland along the country's coastlines and through other land development projects. In 2019, DPRK secured more than 37 000 ha of cropland through reclamation of tideland, river improvement, straightening of roads and waterways, reclamation of idle land and relocation of public buildings. This paper provides an overview of rice production in DPR Korea focusing on the contribution of FAO's technical assistance in development and dissemination of improved technologies.

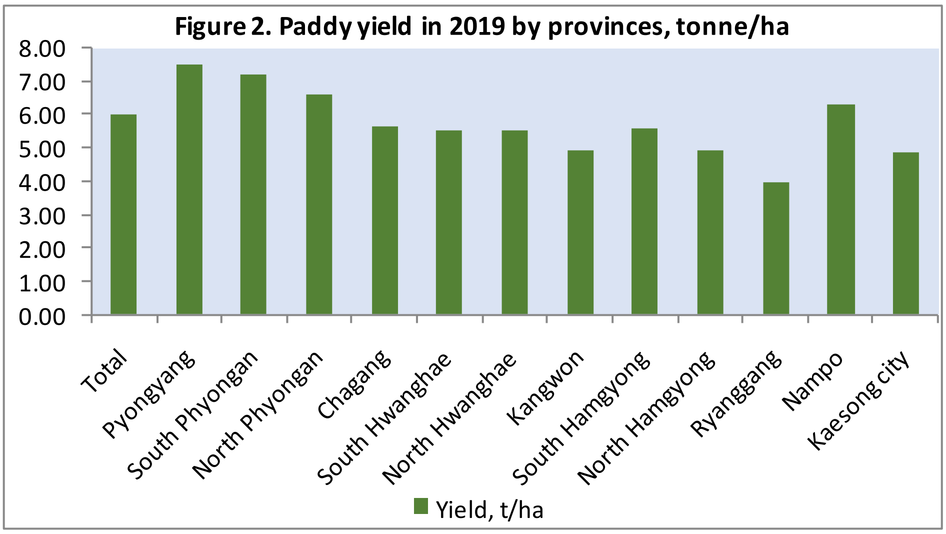
Rice Cultivation in DPRK

In DPRK, rice is cultivated in the main cropping season which typically starts in April with the arrival of spring rains and harvested between September and October. Because of low temperatures prevailing at the beginning of the season, farmers grow seedlings in seedbeds equipped with protective cover for subsequent transplanting in the field which begins in May. In DPRK, almost the entire paddy is grown under irrigated conditions. The availability of water for irrigation is critical in determining the yield of paddy.

During the period 2012–2019, rice area in DPRK declined from 563 000 ha in 2012 to 465 200 ha in 2015, followed by slight increases in subsequent period stabilizing at about 470 000 ha (Figure 1).



The 2019 paddy area was reported at 465 838.60 ha, a 1.2 percent decrease from the level of 2018, mostly due to shortages of irrigation water. Following a record harvest of 2.9 million tonnes in 2013, paddy production declined sharply to 1.94 million tonnes in 2015 because of severe drought, but rebounded in 2016. The recovery was short lived, continuing droughts in subsequent years led to rice production in DPRK falling close to the lowest level recorded in 2015. The declining trend was reversed in 2019 with a record 2 803 713.30 tonnes of paddy harvested, which exceeded the 2018 production by34.3 percent and 2017 production by 17.6 percent bouncing back close to the highest production level of 2013. The increase in rice production in 2019 was driven entirely by growth in paddy yield which increased to 6.02 tonnes/ha, a 35.9 percent increase from the level of 2018 (4.428 t/ha). Paddy yields varied significantly among the provinces in the range from 3.97 tonnes/ha in Ryanggang and 7.55 tonnes/ha in Pyongyang (Figure 2).



Development of Improved Rice Production Technologies in DPRK

Rice breeding in DPRK is based mostly on utilization of local germplasm with limited access to exotic rice genetic resources, stored principally in gene banks of China National Rice Research Institute and other Chinese rice research organizations. This imposes an inherent constraint on development of rice varieties combining high-yield potential with tolerance to various stress factors in rice growing environments; particularly drought, salinity and pests and diseases. Although DPRK is signatory to the International Treaty on Plant Genetic Resources for Food and Agriculture, its access to improved rice genetic resources from the global network of rice research and advanced germplasm testing is restricted because of existing international sanctions. In the wake of green revolution, rice research in most Asian rice growing countries tremendously benefitted from collaboration with the International Rice Research Institute (IRRI) and IRRI's various regional networks of testing advanced breeding lines. DPRK's collaboration with IRRI was limited in the past due to some unavoidable reasons.

Under these circumstances, FAO's technical collaboration played a significant role in development of improved rice production technologies through research and innovation. Among the technologies developed with FAO's assistance, two have been adopted and disseminated widely across the cooperative farms in DPRK: Improved rice production technology patterned on System of Rice Intensification (TCP/DRK/3404); Use of conservation agriculture and climate - smart agriculture practices supported through TCP Emergencies in the wake of 2017 and 2018 droughts. At present FAO is providing technical assistance to improve productivity of rice cultivation in reclaimed tidelands through development of rice varieties with tolerance to low and medium-level soil salinity and associated rice cultivation technology (TCP/DRK/3702).

Under the project TCP/DRK/3404 implemented over 2014-2015, standard SRI practices were evaluated under local context, modified and packaged into integrated rice cultivation technology. The key elements of modified SRI are: a) growing seedlings in upland nurseries with lower seed rate of 100-150g/m2; b) 30-day old seedlings at 4-5 leaf stages of growth; (c) planting density generally at 25 cm×20cm (or 20 plants per square meter), may vary according to the soil type, fertility, climate and other ecological factors; (d) 3 seedlings per hill; (e) intermittent irrigation; (f) application of about 20 tonnes of organic manure as basal along with other NPK chemical fertilizers; (g) weeding using chemicals but also combined with manual tools; and (h) machine harvesting with straw cutting device to return straw for incorporation into soil.

Farmers' Innovations: Non-Chemical Weed Cultivation Using Mud Snails

In accordance with government's policy to promote advanced farming methods including organic farming as stated in DPRK's five-year strategy for national economic development (2016–2020), efforts are focused on developing biological and organic methods for controlling insects' pests and weeds through research and innovation. Cooperative farmers in Yomju County, North Pyongan Province of DPR Korea introduced innovation in weed control by growing mud snails in rice fields.

Mud snail is a tropical mollusk, which feeds on grass in water. Back in 2014, encouraged by suggestion of researchers of Kim Il Sung University work teams of several cooperative farms in Yomju County set up experimental plots to validate this property of mud snails. The results were surprisingly astonishing. Rice paddies were free from weeds and yielded on average 0.8 tonne/ha more than did conventional plots. In some plot's yields exceeded by 1 tonne/ha. The soil turned black and oily. In the past herbicide use inhibited shooting and growth of rice in the later period. However, in absence of herbicide use, the rate of shooting increased water permeability and porosity of soil improved as mud snails did vertical movements around the roots of rice plants and their excrement increased the soil fertility. The county became confident of success and decided to introduce it into all farms.

A key constraint on the way of dissemination of this innovation was availability of mud snails in rice fields in sufficient numbers. It was overcome by allowing the snails to hibernate through drying rice fields. Farm technicians found that snails could safely spend the winter in a state of deep sleep for 200 days at the constant atmospheric temperature of 8-12 degrees centigrade and it is important to nourish them well and make them fully excrete before wintering.

Dry hibernation grounds and outdoor breeding grounds were built on all farms and at all work teams. It helped the Ryongbuk Cooperative Farm succeed in increasing the survival rate of mud snails to 98 percent, which was disseminated to all farms of the county. Next, they addressed the issue of feeding mud snails which led to increasing the survival rate of young mud snails. Soon the farmers were able to tackle all issues of outdoor breeding of mud snails. With the introduction of weed control by mud snails, Yomju County in 2019 exceeded the level of peak production year in 2014.

Non-Chemical Pest Control

Because of sanctions- related restrictions on import of agricultural inputs, the supply of chemical pest control products including pesticides, insecticides and germicides to DPRK's cooperative farms are limited. Farmers make up the shortages of chemical pesticides by producing self-made bio-pesticides using locally available plant materials, although their efficacy isn't high.

They also use other innovative control measures consistent with integrated pest management in rice cultivation. To reduce disease load of root rot, a common disease in the rainy season, many cooperative farmers pre-spray the growing crop with various antioxidants growth promoter, trace element fertilizer and disinfectant that are expected to contribute to strengthening growth of the crops under high temperatures and humidity. In some farms, water level is kept as shallow as possible.

Maintenance of Soil Fertility

Chemical fertilizer use in DPRK is imbalanced due to significant shortages of phosphorus and potassium fertilizers, which are mainly imported. Although the overall supply of chemical fertilizers in 2019 improved compared with the supply in preceding years, the actual amounts of phosphate and potash fertilizers was far below the requirements (Table 1).

Table 1. Fertilizer supply for 2017-2019 and five-year average (tonnes):

Type of fertilizer	2019	2018	2017	% Change 2019 from 2018
Ammonium sulphate equivalent, approx. 20.5 % N	931 212.2	624 086	599 017	49.2
Superphosphate equivalent, approx. 17% P_2O_5	6 433	4 174	10 776	54.1
KCI-muriate of potash, 48-62% K_2O	2 550	2 915	2 343	-12.5
Total	**940 195.2**	**631 175**	**612 136**	**48.9**

Source: DPRK Ministry of Agriculture

To compensate the shortages of chemical fertilizers, DPRK farmers resorted to production and utilization of large amounts of organic manures. Over the past few years DPRK cooperative farms expanded the scope of production of organic fertilizers using a variety of sources for making composts such as dunghill, peat, green manure, blue-green algae and muck.

Many farms produce organic fertilizers by blending microbial and hukposan fertilizers, humus, sullage and subsoil. Some farms also produce fermented compost using Sinyang No. 2 bacteria. Before the onset of spring, farmers transport self-produced organic manures to crop fields for spreading into soil. According to cooperative farm mangers and technicians, organic manures improve soil fertility and contribute to high yields.

About 600-800 kilograms of organic matters are removed from soil with a paddy yield of over 10 tonnes/ha in a year, and therefore 20 tonnes of good quality organic fertilizers should be applied per hectare.

Rice Planting in 2020

The crop growing season in DPRK in 2020 began in a different context as in many countries of the world. Following the outbreak of COVID-19 epidemic in China in December 2019, the DPRK took early decisive measures to prevent the epidemic from spilling over into its territory. They began with cancellation of all flights to and from China on 20 January 2020, three days before Wuhan city, the epicentre of the epidemic, was put under lockdown. Within days tourism was suspended and the land and maritime border with China was closed that brought DPRK's trade with China to a standstill.

The DPRK Government declared the threat of novel coronavirus as "national emergency" and swiftly established a State Emergency Anti-Epidemic System under the guidance of Non-Standing Central Public Health Leadership Committee to coordinate national response from the central to local levels to prevent the outbreak of the epidemic.

In implementing these restrictive measures significant roadblocks were created in movement of people and transportation of goods and supplies across the country. There were concerns with regard to timely access by cooperative farms to much needed inputs such as fertilizers, irrigation pumps, spare parts for machineries and fuel, which might affect early spring planting activities. However, as reported in the national media, cooperative farms in DPRK by and large succeeded in conforming to spring planting schedule.

Beginning in the middle of March, cooperative farmers across the country moved to establishment of nurseries for growing rice seedlings. Many farms prepared the seed beds, applied fertilizers and treated seeds for production of healthy seedlings. Some cooperative farms in South Pyongan province spread humus soil on seedbeds.

In South Hwanghae, cooperative farms in Yonan, Unnyul, Anak and other counties applied fertilizers and herbicides in seedbeds to increase sprouting rate of seeds. By the end of April, more than 85 percent of cooperative farms completed sowing of rice seeds in nurseries. To protect the growing seedlings from cold and low temperatures, seedbeds were covered with plastic/vinyl sheets.

Transplanting of Rice Seedlings

According to national media reports, despite unfavourable weather conditions rice transplanting began in early May 2020 at the Wonhwa Co-op Farm in Phyongwon County in South Pyongan province. The party daily RodongSinmun called on Emergency anti-epidemic headquarters at all levels to ensure preventive activities to manage the risk of COVID-19 were not interrupted while providing assistance to cooperative farms in rice transplanting.

By mid-May, rice seedlings were planted in more than ten thousand hectares of rice paddies in the provinces of South Hwanghae, North Phyongan, North Hwanghae, Kangwon, Pyongyang, Nampo, and South Hamgyong. Cooperative farmers introduced on a wide scale improved rice production technology, modified System of Rice Intensification (SRI), developed with FAO's technical assistance in 2015, in rice cultivation this year. The key elements of the technology they applied are: choosing of improved rice variety suited to local conditions, tall seedlings (aged about 30 days), number of clumps per unit area, number of seedlings per clump, intermittent irrigation, application of about 20 tonnes/ha of organic manure as basal dose. In addition, DPRK farmers refashioned rice transplanting machines to suit planting of tall seedlings at appropriate soil depth.

Conclusion

Food production in DPRK isn't sufficient to meet the demand. Even in 2019 with record increase in rice production, shortages in domestic food supply exist. The estimated food demand in 2019-2020 was 5,242,636.0 tonnes (in terms of milled cereal equivalent) against which 4 868 390.0 tonnes are available with an estimated food deficit of 374 246.0 tonnes. Significant gaps in national food security permeate all four pillars of the concept of food security – availability, access, utilization and stability. In this context, FAO's collaboration with DPR Korea is focused on strengthening national food security by attaining self-sufficiency in food supply.

Yield Gap Concept in Agriculture: In Brief

Article ID: 30555

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Introduction

Despite substantial advancement in the mechanization of crop production and breeding of high-yielding cultivars, the climate is most important factor that determines the crop yield. Yield is limited by many factors, including the limited length of growing period due to high and low temperatures, occurrence of drought, irregular in rainfall distribution, intensity of rainfall, genetic and management constraints. Many researchers are indicating that, there is need to increase crop yield through crop genetic improvement and enhanced crop management practices. Genetic and management constraints can be analyzed by using crop simulation model.

Yield Gap

Yield gap is the difference between potential yield and actual yields.

$$Yg = Yp - Ya$$

where, Yg: yield gap

Yp: potential yield (Yw in rainfed ecosystem)

Ya: actual yield.

Why Yield Gap Matters?

1. Demand for agricultural products (food, feed, and bio-fuels) increasing continuously and is expected to increase 60% by 2050.

2. Three broad options available to face the global food demand are:
   a. Expand the area of croplands at the expense of other ecosystems.
   b. Increase the yields on the existing croplands (i.e. closing the yield gaps).
   c. Reallocate current agricultural production to more productive uses.

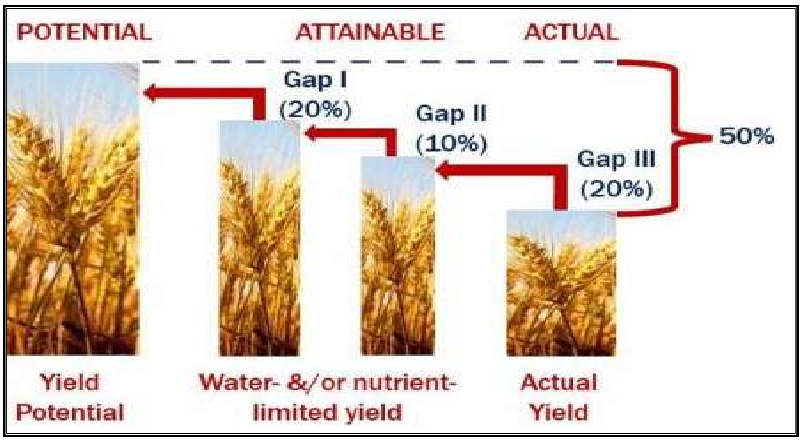

Figure 1: Structure of yield gap in Agriculture

Potential Yield (Yp)

Yp is the yield of a crop cultivar when grown in an environment to which it is adopted with non-limiting water and nutrient supplies with effective control of pests, diseases and weeds. In these optimal conditions, crop growth is determined by solar radiation, temperature, atmospheric CO_2 concentration and management practices which influence crop cycle duration and light interception, such as sowing date, cultivar maturity and plant density. In rainfed systems it is referred as water-limited potential yield (Yw).

In crop simulation models, maximum yield for a given level of resource availability and measured yields in highest-yielding farmer's fields have been used to estimate Yp and Yw (Sadras et al., 2015).

Actual Yield (Ya)

Ya reflects the current state of soils and climate, average skills of the farmers and their average use of technology. In order to represent both temporal and spacial variation in a defined geographical region, it is defined as the average yield achieved by the region under the most widely used management practices like sowing date, cultivar maturity and plant density, nutrient management, crop protection etc., by farmers.

The number of years utilized for estimating Ya must be a compromise between variability in yield and the necessity to avoid confounding effects of temporal yield trends due to technological or climate change.

Attainable Yield

It is the best yield achieved through skillful use of the best available technology. Some studies use attainable yield as an approximation to either potential yield or water-limited yield (Sadras et al., 2015).

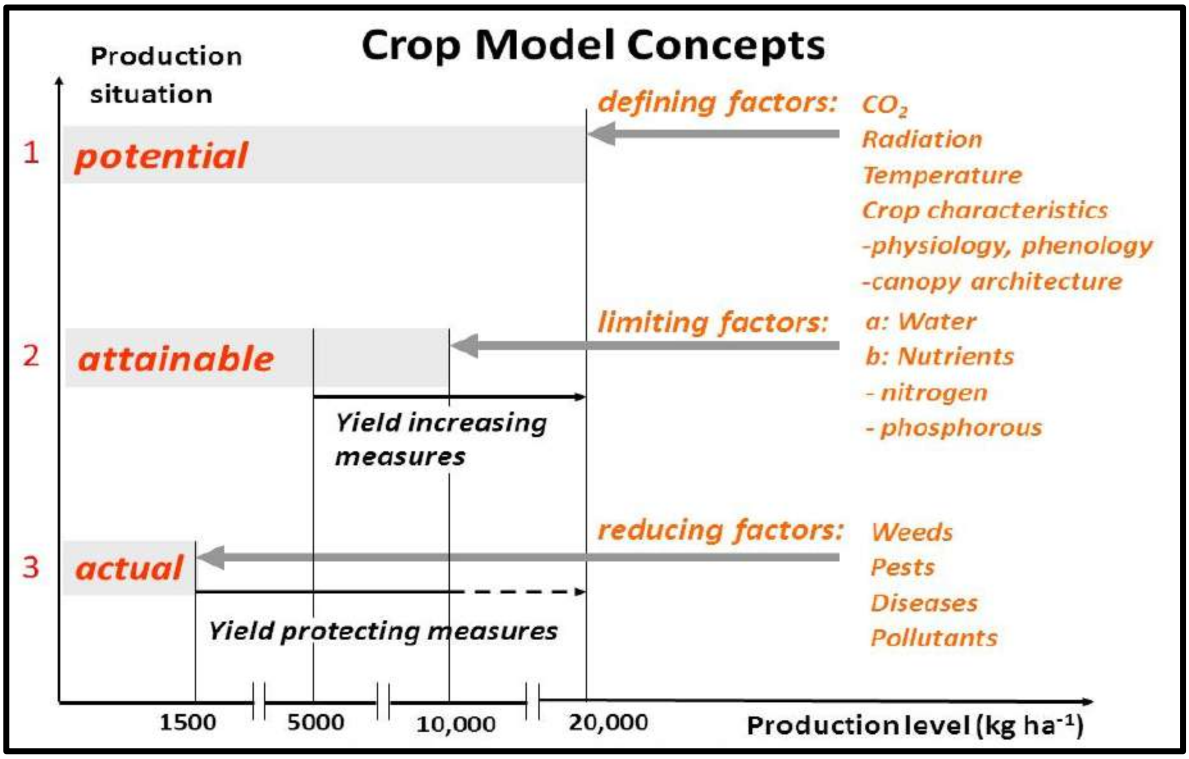

Figure 2: Crop model concepts of yield gap

Yield Gap Assessment

Yield gaps estimated at 2 levels: 1. Local focus (Site based approach), 2. Upscaling approach (region, national, globe). Assessment of Yp and Yg involves 3 methods (Lobell et al., 2009).

1. Models simulations
2. Field experiments and yield contests
3. A historical maximum farmer yields.

Attributes of Best Crop Models Used in Yg Analysis (Van Ittersum Et Al., 2013)

1. Daily step simulation
2. Flexibility to simulate management practices
3. Simulation of fundamental physiological processes
4. Crop specificity
5. Minimum requirement of crop "genetic" coefficients
6. Validation against data from field crops that approach Yp (Yw)
7. User friendly.

But the best assessment of Yg should be an integration of (Lobell et al., 2009):

1. Remote sensing
2. Geospatial analysis
3. Simulation models
4. Field experiments.
5. On-farm validation.

Conclusion

Yield gap studies provides clarity regarding their underpinning assumptions, models and parameters and include verification with measured data. Closing the yield gap through fine tuning of current management practices provides an opportunity to increase crop production on existing cropland.

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Heat Stress Management in Horses

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Introduction

As summer draws near, and the climate warms up, so does the serious season for horse shows, hustling and other equine occasions. This is the season that serious warmth related pressure happens in horses. With summer's bright days can come extraordinary warmth. Such circumstances can cause problems for owners as they battle to enable their horses to modify, remain sound, and stay healthy. However, with a well-thought-out management plan, horses can stay cool and comfy in the midst of summer. Summer management is very well required in horses to reduce the stress, maintain its health condition, to maintain its well-being and welfare standards. Horses often naturally adjust without help, but it is worth using caution and aiding in the process due to the fatal potential of heat-related illnesses should a horse overheat. Horses also rely to a significant extent on sweating to cool them off. Horses are more susceptible to heat as they are larger and have a higher percentage of active muscle than people do during exercise. When muscles are being used, they produce a lot of heat. Horses suffering excessive heat stress may experience hypotension, colic and renal failure.

What Causes Heat Stress in Horses?

Overheating and heat stress in horses may be caused due to various reasons but some of the factors that are mostly responsible are hot inclement weather, high humidity, poor barn ventilation, longer period of exposure to direct sunlight, excessive long duration of work, transportation for a longer period without a break and provision of water, and obesity. If a horse's body temperature shoots up from the normal 37 to 38 °C to 41 °C, temperatures within working muscles may be as high as 43 °C, a temperature at which proteins in muscle begin to denature. Combination of air temperature and relative humidity are important cause (Table 1).

Air temperature (F) + Relative humidity (%)	Horse cooling efficiency
Less than 130	Most effective
130-150	Decreased
Greater than 150	Greatly reduced
Greater than 180	Condition can be fatal if the horse is stressed

Table 1 Air temperature and relative humidity effect on horse cooling efficiency

Signs of Heat Stress

For proper management of horses, we should be aware of signs of heat stress. We have to keep a regular note on the signs of heat stress in horses. Some of the signs of heat stress in horses that are observable are heavy breathing/panting, fast pulse rate, excessive sweating, lethargy/restlessness, dark urine and reduced frequency of urination, rectal temperatures are higher than 103.5°F, reduced or poor performance and muscle spasms.

Skin fold test

Ways to Manage Heat Stress in Horses?

Being cautious on hot days is the most ideal approach to ensure safety of the horse. Best way to manage the heat stress is to prevent it before it occurs. There are various methods or techniques which can help in reducing the heat stress in horses. Some of the most important managemental methods are providing proper hydration, feeding, exercise, travel and competing time, shelter and artificial cooling. Observing for signs of heat stress.

Hydration

Horses can sweat 15 to 20 litres per hour in cool, dry conditions and up to 30 litres per hour in hot, humid conditions, but only 25 to 30 per cent of the sweat produced is effective in cooling the horse by evaporation, which shows that the requirement of water by horses in hot and humid condition is very high. So unlimited access to clean and cool water in the stable and field is required. Water requirement in horses is 25-55 litters in summer. As amount of sweat is very high in horses which shows that the loss of salt is also very high so, to counter that electrolytes should be fed (50g of a balanced electrolyte split between two feeds, or in water) and free-choice salt should be offered, either as loose salt or a salt block.

Feeding

Feed of horses to reduce heat stress should be well balanced. Adjustment of the energy sources feed should be done. Use highly digestible fibre sources and added fat feed sources. Feeding of small amounts throughout the day rather than two large feedings is beneficial as the heat produced by digestion can be spread out. Letting your horse roam the pasture will also help it get more water. Very high levels of protein should be avoided as the excess nitrogen increases fluid loss due to the higher urine output.

Yield Gap Assessment

Yield gaps estimated at 2 levels: 1. Local focus (Site based approach), 2. Upscaling approach (region, national, globe).
Assessment of Yp and Yg involves 3 methods (Lobell et al., 2009).

1. Models simulations
2. Field experiments and yield contests
3. A historical maximum farmer yields.

Exercise, Travel and Competing

During extreme hot and humid conditions, the exercise, travel and competitions should be avoided. No riding should be done during hottest hour of day. Riding should be done early in the morning or late in the evening. Keep the work of horses' light and include frequent breaks in between. Warm-up period should be short before competitions during hot and humid day. Offer water after warming up, before competing and immediately after competing. Rest intervals in between the travel should be given to avoid stress.

Shelter

Avoiding direct exposure of sun is one of the best ways to avoid heat stress. Shelter is a basic requirement during summer. Shade from trees or buildings can be given. Do not restrict horses in shade for longer periods. Pink skin horses' need more protection from UV-rays so should be taken of special care in summer. Shelter should have proper ventilation with fans/exhaust to improve airflow and should be free from dust. Regular cleaning of shelter and removal of manure regularly is must.

Artificial Cooling

When the normal managemental techniques cannot reduce heat stress, then artificial cooling should be provided to the horses. Cold water with the hose pipe or sprinkler is sprinkled to cool down hoses. Using cold water (15 degrees or less, 5 degrees is ideal), it is more important to continuously apply cold water all over the horse's body and it may be 10-15 mins

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before you may see any effect. Misting fans are even more effective at cooling. Other equipment's available are cooling collars, cooling blankets, cooling wraps and dry air cool pad saddle.

Cooling collar


Cooling wraps


Horse cooling blanket


Dry air cool pad saddle

Conclusion

Adjusting to the heat is no new task for horses or horse owners, but it's important to be sure you're prepared to help your barn sail through the summer easy breezy. Heat stress needs to be managed properly to maintain the performance of horses. Depending on the economics of combination of methods to reduce heat stress can be used. Feeding and hydration are basic to ameliorate heat stress. Other external managemental methods depend on severity of heat stress. So, combination of methods to reduce heat stress should be used.

Soil Health Card Scheme and Fertility Status in India

Article ID: 30557

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Introduction

The use of fertilisers for agriculture in India has risen astronomically in the last 60 years, resulting in deterioration of soil health in many parts of the country, particularly the intensively cultivated Indo-Gangetic plains, also known as the "Great Plains". In 1951-52, fertilizer usage in the country averaged less than one kg per hectare, which has now risen to 133 kg per hectare, according to information given on the Department of Fertilisers website. However, despite this increase, the consumption of fertilisers is still less in India than many developed countries. In view of the deterioration in soil health, the government had in 2008-09 launched a new scheme, namely the National Project on Management of Soil Health and Fertility, to promote soil test-based balanced and judicious use of chemical fertilisers in conjunction with organic manure.

National Mission for Sustainable Agriculture (NMSA)

The programme was implemented during 12th Plan with the objectives:
1. To make agriculture more productive, sustainable and climate resilient;
2. To conserve natural resources;
3. To adopt comprehensive soil health management practices; to optimize utilization of water resources; etc.

Soil Health Management (SHM) is one of the most important interventions under NMSA.SHM aims at promoting Integrated Nutrient Management (INM) through judicious use of chemical fertilizers including secondary and micro nutrients in conjunction with organic manures and bio-fertilizers for improving soil health and its productivity; strengthening of soil and fertilizer testing facilities to provide soil test based recommendations to farmers for improving soil fertility; ensuring quality control requirements of fertilizers, bio-fertilizers and organic fertilizers under Fertilizer Control Order, 1985; upgradation of skill and knowledge of soil testing laboratory staff, extension staff and farmers through training and demonstrations; promoting organic farming practices etc.

Fertiliser Consumption in India

Year	Fertiliser consumption in India
2011	180.748
2012	163.122
2013	156.496
2014	163.498
2015	170.984
2016	165.848

Pan-India Progress of the Scheme

The progress of the programme will help in the meaningful use of the fertilisers in the country.

State	No. of Samples Entered	No. of Farmers Entered	Test Results Entered	SHCs Entered on Portal
Andaman & Nicobar	14,287	14,291	12,148	10,512
Andhra Pradesh	3,158,341	11,831,618	2,990,549	9,375,946
Arunachal Pradesh	530,284	2,408,880	460,278	2,072,873
Bihar	488,312	2,068,084	379,445	56,206
Chhattisgarh	1,786,364	10,823,911	1,695,762	10,002,355
Dadra and Nagar Haveli	4,545	15,476	4,424	14,683
Daman and Diu	291	7,754	290	7,573
Delhi	1,244	1,248	1,211	1,211
Goa	48,728	50,003	42,854	43,48

Gujarat	5,215,179	15,571,532	4,672,145	12,221,884
Haryana	2,726,271	8,661,085	2,599,417	7,989,439
Himachal Pradesh	268,672	1,686,837	232,039	1,483,067
Jammu and Kashmir	371,325	1,824,725	342,598	1,726,829
Jharkhand	240,868	927,026	116,977	443,595
Karnataka	3,420,299	18,195,034	3,251,063	17,321,430
Kerala	486,347	4,449,342	328,069	3,375,203
Ladakh	8,466	37,689	7,833	36,487
Madhya Pradesh	3,226,642	10,009,469	2,919,398	8,651,329
Maharashtra	5,831,534	20,005,428	5,476,039	16,736,556
Manipur	2,755	4,374	2,362	2,844
Meghalaya	80,016	407,796	79,667	399,710
Mizoram	25,919	30,612	25,445	29,799
Nagaland	31,639	31,666	31,485	31,504
Odisha	1,212,524	4,084,453	962,864	3,364,961
Puducherry	11,323	16,706	10,980	15,809
Punjab	1,509,908	2,155,037	1,384,497	1,729,248
Rajasthan	6,885,823	16,119,103	5,846,192	382
Sikkim	23,055	85,255	21,279	72,492
Tamil Nadu	2,987,463	13,358,237	2,624,142	11,386,551
Telangana	2,222,101	8,174,925	1,543,290	5,578,141
Tripura	77,175	287,698	70,995	268,590
Uttar Pradesh	11,024,198	42,838,236	10,124,840	38,503,043
Uttarakhand	286,767	1,454,027	278,755	1,402,189
West Bengal	364,931	1,238,082	272,633	26,555

Conclusion

Soil is the most important and underrated asset of farming. Soil Health is essential for a healthy crop and health yielding farm products. National Mission for Sustainable Agriculture and Soil health Card scheme aimed to give shine to this important asset and thereby farmers achieving higher productivity of crops. Monitoring such programmes is the only way for better follow up of the aimed objectives.

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An Overview of Fruit Flies and Strategies to Control Fruit Flies in Fruit Crops

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Introduction

Global agricultural production includes a significant proportion of horticultural crops; and these crops are substantiated by high export value, high yield and returns per unit area (Ravichandra, 2014). Fruit flies (Diptera: Tephritidae) have emerged as one of the most serious insect pests of crops of horticultural importance across the globe. The tribe Dacini comprises 932 described species (Doorenweerd *et al*., 2018) and includes three economically important genera, *Bactrocera, Dacus* and *Zeugodacus*. Of these, about 60 are known to occur in India, mostly infesting edible host fruits and fleshy vegetables, resulting in fruit losses (Nair *et al.,* 2018). Many of which are highly polyphagous (White and Elson-Harris, 1992). In this subfamily, the genera *Dacus* and *Bactrocera* are important as they include economically important species such as *Bactrocera dorsalis* (Hendel) and *Bactrocera zonata* (Saunders). The subgenus Zeugodacus includes economically important species like *B. cucurbitae*.

Nearly 35 per cent of the known fruit fly species attack soft fruits like mango, guava, sapota, citrus, ber, peach, etc. and several cucurbitaceous vegetables (White and Harris, 1992). These losses can approach 100% in cucurbit species due to the melon fly, *B. cucurbitae* (Dhillon *et al*., 2005), on mango (12-60%), papaya (12-60%) and guava (40-90%). The oriental fruit fly, *B. dorsalis* (Hendel), is a major pestiferous tephritid which is known to have a species complex containing over 70 species (Clarke *et al*., 2005; Schutze *et al*., 2012) and is widely distributed in Asia, Australia and the Pacific islands.

Fruit flies often cause serious damage to mango; owing to their attack the highest damage observed in mango was 56.5% (Jose *et al.,* 2013). The mango fruit fly is believed to be the single largest crop damage in India. It accounts for about 27 per cent of harvesting loss.

Guava fruits are attacked by a number of fruit flies including *Bactrocera cucurbitae*, *B correcta, B dorsalis* and *B zonata*. These species are polyphagous and widely distributed in the country. Among many pestiferous tephritid species, *B. dorsalis* attacks on mango and causes serious loss ranging from 5 to 80%.

Bactrocera dorsalis

Bactrocera zonata

Species Composition of Fruit Flies on Different Hosts

Host	Fruit fly species	Authors
	Coreya arborea	Bezzi (1916)
	B. cucurbitae	Kapoor (2006)
	B. correcta	Kapoor (1993), Jhala et al. (1989) and Patel and Patel (2005)
Mango fruit fly/ oriental fruit fly	*B. dorsalis*	Kapoor (1993), Dwivedi et al. (2003), Kannan and Rao (2006), Patel and Patel (2005)
	B. zonata	Kapoor (1993), Kapoor (2006) and Madhura and Viraktamath (2001)
	B. affinis	Madhura and Viraktamath (2001)
	B. zonata	Patel and Patel (1995), Kappor (1993), Patel and Patel (2005)
	B. dorsalis	Patel and Patel (1995), Kappor (1993), Patel and Patel (2005)
Sapota	*B. correcta*	Patel and Patel (1995), Patel and Patel (2005)
	B. caudate	Kapoor (1993)
	B. distincta (Malloch)	
	B. dorsalis	Kappor (1993), Patel and Patel (2005)
Banana	*B. dorsalis*	Sukla and Prasad (1985), Kappor (1993), Dale (2002), Ranjitha and Viraktamath (2006), Patel and Patel (2005)
	B. diversa	Kappor (1993)
Guava	*B. zonata*	Sukla and Prasad (1985), Kappor (1993), Dale (2002), Ranjitha and Viraktamath (2006), Patel and Patel (2005)
	B. correcta	Jalaluddin et al. (1999)
	B. diversa and B. cucurbitae	Kapoor (1993)
	B. pyrifoliae Drew & Hancock	
Peach fruit fly	*B. (B.) zonata*	Saunders, 1842
Cucurbits	*B. cucurbitae*	Kabir et al. 1991

Indian Scenario

India is the world's largest producer of tropical and subtropical fruits and vegetables and also potential for export of fruits and vegetables hitherto remain largely unexploited because of less export of fruits and vegetable. To achieve the desired goal, production of fruits and vegetables both qualitatively and quantitatively should be increased by mitigating biotic and abiotic constraints.

In India, fruit flies have been identified as one of the ten most serious problems of horticulture because of their polyphagous nature and huge economic loss to fruits and vegetables, which varies from 2.5 - 100 per cent depending upon the crop and season (Dhillon et al., 2005). These pests cause direct damage to important export crops leading to losses up to 40% to 80%, depending on locality, variety and season (Kibira et al., 2010). Indirect losses can cause presence of these pest species limits access to international markets due to quarantine restrictions imposed by importing countries.

The management of fruit flies is becoming increasingly difficult in many countries, challenging because use of formerly effective broad-spectrum and systemic insecticides is not recommended against fruit flies because of consumers' reactions and also it difficult to manage because their life-stages occur at different sites and remains protected, e.g. eggs and larvae in the host, pupae in soil and adults are active flier.

Some of the Key Facts About the Fruit Fly Pest

1. Fruit flies have a greater impact on global agricultural fruit trade than almost any other pest.
2. About 70 species of tephritid fruit flies are key pests of fruits and vegetables, causing high losses every year.
3. The Mediterranean fruit fly (Ceratitis capitata) attacks over 250 species of fruits and vegetables.

Biology:

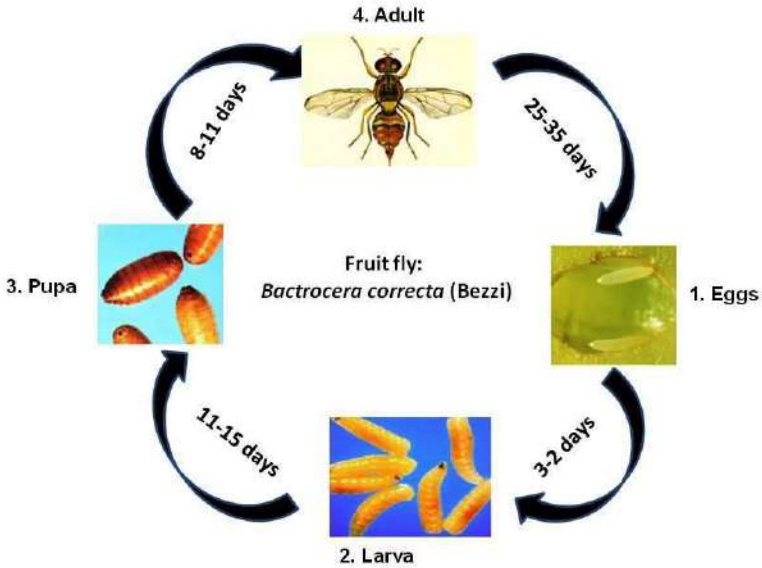
Egg: Under optimum conditions, a female can lay more than 3,000 eggs during her lifetime, but under field conditions from 1,200 to 1,500 eggs per female is considered to be the usual production. Development from egg to adult under summer conditions requires about 16 days.

Larva: The mature larva emerges from the fruit, drops to the ground, and forms a tan to dark brown puparium.

Pupa: Pupation occurs in the soil. About nine days are required for attainment of sexual maturity after the adult fly emerges.

Adult: Brown or dark brown with hyaline wings and yellow legs.

Life cycle:



Nature of Damage

Damage caused by fruit flies may be in the form of:

1 Plant injury: Female fruit flies most often lay their eggs in the fresh flesh of fruits, vegetables and other plant parts. The eggs hatch into larvae (maggots), which most often feed on the inside of the host and convert host tissues in a soft, spongy mess.

2. Economic injury: High population of fruit fly causes more severe damage and management practices need to be implemented. The flies attack semi ripe and mature fruits during the months of April and May. Other fruits like guava, citrus, plum, peach, sapota, loquot, etc are also susceptible to this pest attack.

The damage to crops caused by fruit flies result from:

1. Oviposition in fruit and soft tissues of vegetative/reproductive parts of certain plants.
2. Maggots destroy and convert pulp into a bad smelling.
3. Decomposition of plant tissue and is coloured semi liquid mass by invading secondary microorganisms.

Guava fruits attacked by fruit flies

The Major Steps in Fruit Fly Management

1. Report of infestation - detection system (trapping, rearing, inspection, sampling)
2. Collection of adult flies
3. Identification of pest species - diagnosis system (characters of pest species)
4. Host plants and their phenology
5. Ecology - nature of infestation, seasonal history, population studies
6. Biological studies
7. Behavioural studies (attraction to various lures, baits, etc.)
8. Programme of quality management (preventive, eradicative, management).

Various Methods for Control of Fruit Flies in Different Fruit Crops

In fruit fly management, more than one tactic is frequently required. Each of these tactics has different advantages and disadvantages, and its adoption may or not be available for every case (Suckling et al., 2016). For example, the Male Annihilation Technique (MAT) is applied for some *Bactrocera* species but not for other species, owing to the lack of suitable lures. Additionally, the Sterile Insect Technique (SIT) requires the mass rearing of the target pest and geographic isolation of the release zone (Suckling et al., 2016).

Among the various management strategies for fruit fly, trapping using lures found practical for detection and monitoring as well as proved most effective, eco-friendly and economical tactics.

1. Sanitation: Field sanitation is a technique that either prevents fruit fly larvae from developing or sequesters young emerging adult flies so that they cannot return to the crop to reproduce. Removal and disposal of infested or uninfected (cull) produce. While this can be laborious, it is a very effective fruit fly suppression method and a key component of an IPM program for fruit flies.

2. Wild host destruction: Elimination/destruction of such hosts would certainly reduce the reproductive potential of pest species.

3. Raking/ploughing of the Soil: The pupae of dacine flies can be easily destroyed by raking/ ploughing. During such operations some pupae are killed due to mechanical injury while others are exposed and became prey to natural enemies. In one study, Verghese et al. 2006 reported that three-weekly inter-tree ploughing and raking was used as part of an IPM package that included field sanitation and cover sprays of insecticide. The effectiveness of this package as implemented by mango producers in India was recorded over a nine-year period. Infestation reductions attributable to the IPM package were between 77% and 100% in different years.

4. Bagging of fruits: The technique of bagging of each fruit by a paper/ cloth/ plastic bag is being strongly encouraged in cases where a smaller number of fruits is to be protected against oviposition by the fruit fly. The method may also protect host fruits from other pests. This practice is extensively followed in many countries. However, implementation of technology on a large scale may pose problem like:

a. It is labour intensive.
b. Rain or storm may damage paper bags.
c. Difficult to wrap the fruits on large and old trees.

Mango with FF bags close up

5. Early harvesting: Some fruits like banana, papaya and some mango varieties remain free from fruit fly infestation at green mature stage or colour-break stage. The chances of infestation can be reduced substantially if such fruits are harvested at colour-break stage.

6. Wire netting: The small orchard may be covered with fine wire netting. Although it is costly; however, it may be effective in protecting fruits from fruit flies and birds.

7. Vapour heat treatment (VHT): Vapour heat treatment is a post-harvest treatment and performed to kill immature stages of fruit flies, if any present in the host(s). It is performed under a state of high temperature and saturated water vapours with the goal to kill the insects without injuries to the hosts. The thermal efficiency of VHT is better than dry heat treatment. Mango varieties, e.g. Alphnaos, Banganpally, Chausa, Dashehari, Kesar, Langra, Malika, Neelam and Totapari when treated at 500C resulted into 100 per cent mortality of eggs and mature larvae (Dutt, 1999). The APEDA (Agricultural Processed Export Development Authority) had already established a VHT Laboratory at Indian Agricultural research Institute, New Delhi.

8. Mechanical control: The mechanical control includes a number of tactics which assist in reduction of fruit fly population. Mass trapping is also one of the main tactics which has the potential to minimize or avoid the use of insecticides and has attracted interest due to their efficacy, specificity and low environmental impact. Mass trapping consists of the use of traps and baits that release specific volatile substances that attract insects to the trap, in which fruit flies are captured and killed (El-Sayed et al., 2009).

Mass Trapping

Mass trapping is a valuable tool for fruit fly population suppression. These techniques are effective when combined with bait spraying; however, the efficacy of both systems is highly dependent on pest density population.

One efficient and cost-effective pest control technology is the Sterile Insect Technique (SIT). The SIT is a biologically-based pest control method in use since the late 1950's that, unlike chemical control tactics, is friendly to the environment and does not pose any health concerns.

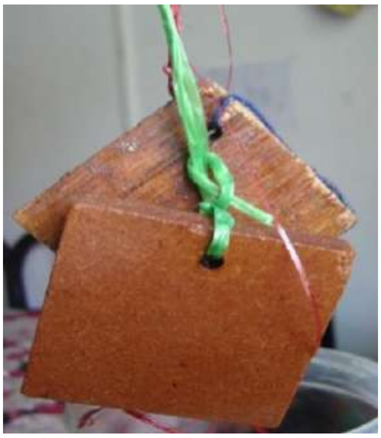
Sterile Insect Technique Features (SIT)

Repeated release of sterile males for suppressing wild populations of the same species was first proposed by E.F. Knipling (1955). This technique is well suited for the suppression or eradication of some dacine species.
1. Sterile insect techinique involves the mass-rearing and subsequent sterilization of large numbers of male insects of the target pest.
2. Sterile insects are not self-replicating and therefore cannot become established in the environment.
3. Sterile insect technique has been applied to eradicate fruit fly pest populations from whole areas or countries.

Male Annihilation Technique (MAT)

Use of combination consisting of ethanol + attractants like methyl eugenol or cue-lure + malathion 50 EC (or any other insecticide) (6:4:1 V/V) can be successfully used in annihilation of male flies from the environment. Such mixture should be soaked in ply wood blocks (5 x 5 x 1.2 cm) and suspended in self-made plastic bottle traps (made of 1 litre mineral water bottle). Methyl eugenol (4-allyl-1, 2-dimethoxybenzene) is a kairomone (Metcalf and Metcalf, 1992) that is attractive to many species of the Subfamily Dacinae (Tephritidae). Methyl eugenol was used for male annihilation or killing of sexually immature males before they were able to mate with females (Steiner, 1952) to eradicate established populations of Oriental fruit fly (*Bactrocera dorsalis* (Hendel)) Methyl eugenol especially attracts the males of *B. dorsalis*, *B. correcta* and *B.zonata* (Verghese *et al*., 2006).

Bottle trap



Plywood block

Farmer Friendly Fruit Fly Trap Developed

A simple, eco-friendly, cost-effective trap developed by the Indian Institute of Horticultural Research, Hessarghatta, Bangalore has come as a respite for mango exporters and growers across the country. The trap has resulted in increased yield and better returns to the mango growers. Field trials in mango orchards have shown encouraging results in the Integrated Pest Management (IPM) System.

The trap works on a simple Male Annihilation Technique (MAT). The trap consists of a small plastic container with a piece of plywood treated with methyl eugenol and dichlorvos which in hung on the tree. This trap attracts the male fruit fly. In the absence of males, females fail to procreate and hence the fruit will be free from infestation. Six to eight traps are required for each acre.

There is substantial decrease in losses consequent to adoption of this technology. This has facilitated export of mangoes to several countries like USA, Japan, New Zealand and Australia which had previously banned Indian Mangoes because of fruit fly. Indian Institute of Horticultural Research is in the process of patenting this farmer friendly technology.
(Source: NAIP sub project on Mass Media Mobilization, DIPA and IIHR, Bangalore).

Popularization of Low-Cost Traps and Lures for Fruit Fly Control

Area wide control of fruit flies is one of the important approaches in management. Though many types of commercial traps & lures are available in the market, they are not well accepted & adopted by large section of farmers.

NIPHM has developed a very low-cost trap & lures that a farmer or farmer association can prepare themselves at very low cost. This concept has been very well received by both Agricultural Extension officials as well as progressive farmers.

The above-mentioned lures are to be prepared in well ventilated room wearing disposable hand gloves. Separate containers and measuring jars are to be used while preparing the lure mixtures. Cost of ME and Cue lure is approximately Rs.35/- for one bottle trap. 6 to 10 traps are required per acre for best control. Lures are to be replaced once in 30 to 40 days.

Ripe Banana and Apple Traps for Control of Fruit Flies

1. Materials required:

a. Plastic jar 1 litre.

b. Ripe banana or apple or mango
c. Jaggery/Sugar solution
d. Wires/ropes for hanging the trap

2. Methodology: Cut fruit peels into small pieces and mix with sugar and water. Make circular holes randomly on the plastic jar. Place sugary water inside the container. Hang the bait/lure from the lid with the help of a wire/rope. Use wire/rope for hanging the trap close to the plant canopy. Change the lures once in 15- 20 days. Flush out the trapped insects periodically.

3. No. of traps per acre: 4-5.

Biological Control

The biological control of fruit flies is still in infancy state, though a number of efforts have been made to collect, rear and release of parasitoids. Some important parasitoids of *Bactrocera* species recorded in India are: *Fopius vandenboschi, F. persulcatus, Diachasmimorpha longicaudata* and *Fopius arisanus.*

Chemical Control

In case of fruit flies only adults are exposed to control measures while eggs, larvae and pupae remain protected from non-systematic insecticides. The use of systematic insecticides is not recommended due to consumers' reaction. For the control of fruit fly populations two techniques are commonly used, in one bait mixed with insecticide is sprayed and the technique has been termed 'Bait Application Technique' (BAT). The other technique is based on the use of attractant/insecticide system, in which males are annihilated from the environment and called 'Male Annihilation technique' (MAT).

1. Adopt male annihilation technique of using bait traps with 100 ml of 0.1per cent methyl eugenol (1ml/lit) and 0.05 per cent malathion 50EC (1ml/lit) taken in 250 ml capacity wide mouthed bottles fitted with hanging devices.

2. Another poison bait may be prepared by adding 100g of jaggery and 2ml of decamethrin 2.8EC in 1 lit of water and sprayed on the tree trunks at weekly interval. The bait could be sprayed on the nearby hedges and vegetation.

3. Spray deltamethrin 0.025 per cent thrice at least 15 days interval commencing 45 days after fruit set.

4. Spraying of 0.03 per cent dimethoate up to two weeks period to picking the fruits is also effective.

Conclusion

Fruit flies have been identified as one of the ten most serious problems of horticulture because of their polyphagous nature and huge economic loss to fruits and vegetables. In the present scenario main efforts are to be concentrated to keep a watch on the build-up on fruit flies in different fruit crops and to work for development of their integrated management so that these pests may be controlled in early stages. The strict quarantine measures should be taken to prevent their further spread and introduction to areas where they have not yet gained entry. Resistant source is an important lead in fruit fly resistance breeding and uses of resistant varieties are important tool for environment friendly pest control. It can be concluded that that Integrated Management and insecticide control will gives best results.

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Processing of Oil Palm

Article ID: 30559

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Introduction

Oil palm *(Elaeis guinensis)* is monoecious, cross pollinated plant placed in the Arecaceae family along with coconut and date palms. It is native to West Africa. Oil palm is the highest oil producer among all perennial oil yielding crops. Fruit of oil palm is drupe. It consists of exocarp, mesocarp and endocarp surrounding the kernel. The kernel has a testa, a solid endosperm and an embryo. It produces two distinct oils viz palm oil (extracted from mesocarp of fresh fruits) and palm kernel oil extracted from kernels. The yield of palm oil ranges between 20-30%.

Processing of Oil Palm

The palm oil processing consists of threshing of bunches, heating of fruit, digestion, pressing, clarification/ drying and storage. The unit operation used in processing of oil palm for extraction of oil explained as under:

1. Threshing: The fruit bunches consist of fruit embedded in spikelets growing on a main stem. For extraction of oil heating of fruit or bunches is necessary as it performs many functions. At small scale operation, bunches are threshed manually to separate the part from the spikelet's and threshed fruits are cooked. While at large scale operation, bunches are heated using high pressure sterilization system which helps in loosening of fruits.

2. Sterilization of bunches: Sterilization of bunches either by using hot water or steam under pressure serves the following operations:

a. To destroy oil splitting enzymes and to arrest hydrolysis and auto-oxidation.
b. To weaken fruit stem to help in removal of fruit from bunches on shaking or tumbling in threshing machine.
c. To solidify proteins to allow oil bearing cells to come together and flow more easily on application of pressure.
d. To weaken pulp structure in fruit to help in easy detachment of fibrous material and its contents during digestion process.
e. teaming breakdown gums and resins which are removed during oil clarification.
f. High pressure steam cause separation of moisture in nuts. When pressure is reduced, contraction of nuts leads to detachment of kernel from shell wall, thus loosening kernels within their cells. Detachment of kernel from the shell wall facilitates nut cracking.

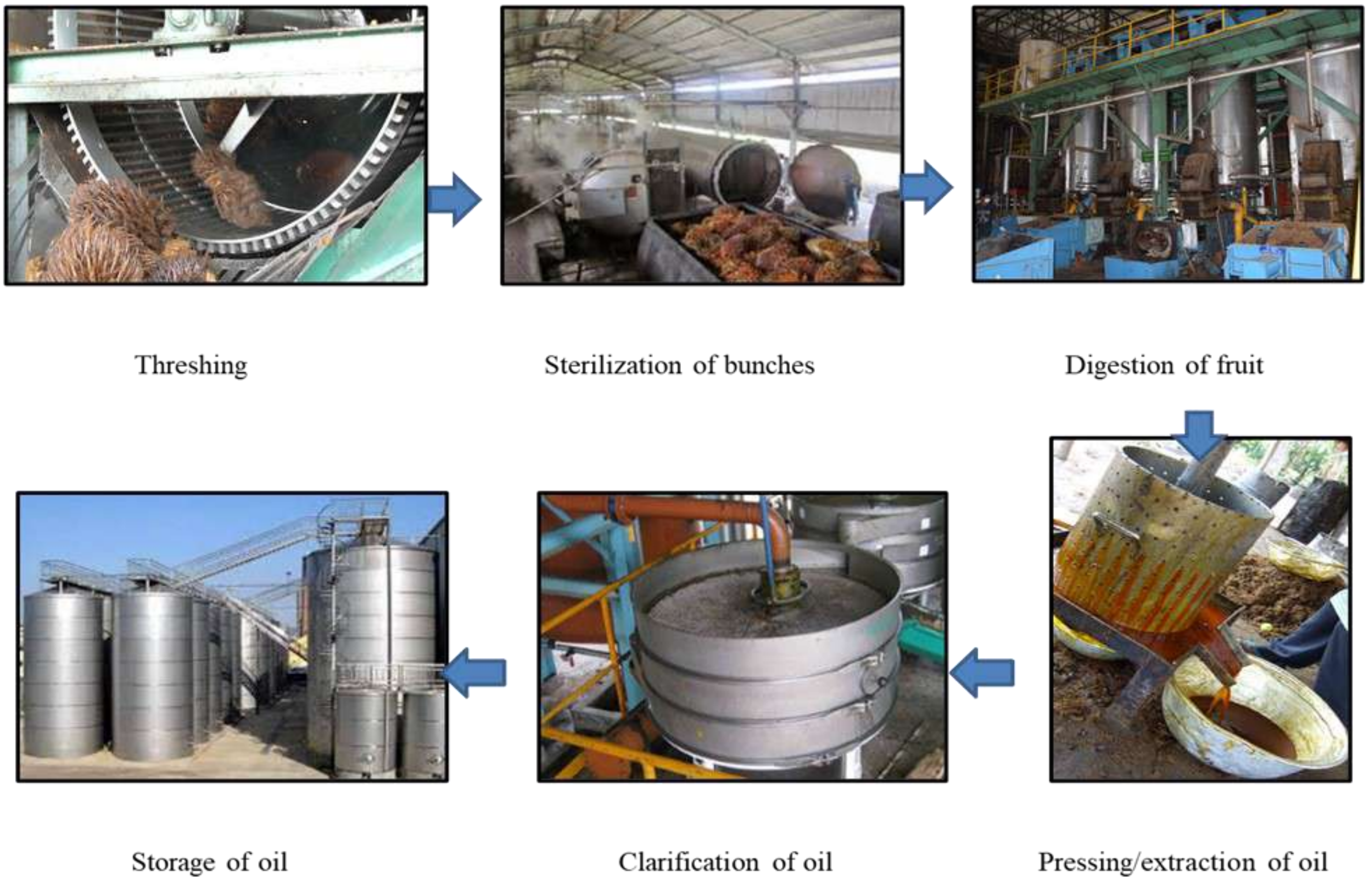
3. Digestion of fruit: It refers to the process of releasing palm oil in the fruit through rupture of oil-bearing cells. Digestion consists of steam heated cylindrical vessel fitted with central shaft carrying better arms for stirring. Through action of rotating beater arms, the fruit is pounded. Pounding or digesting fruit at high temperature, helps to reduce viscosity of oil, destroys out covering (exocarp) of fruit and cause disruption of oil cells.

4. Pressing/extraction of oil: Oil can be extracted either by dry method or wet method. In dry method oil is extracted by using mechanical press while in wet method hot water is used for leaching out the oil from the digested material. Either batch press or screw press can be used for oil extraction.

5. Clarification and drying of oil: Clarification is done to separate oil from impurities. The fluid coming out of press is a mixture of palm oil, water cell debris, fibrous material and non-oily solids. Presence of non-oily solid make the mixture very viscous (thick). The mixture is therefore, diluted by adding hot water in 3:1 proportion. The diluted mixture is passed through a screen to remove coarse fibre.

The screened mixture is boiled for 1-2 hours and then allowed to settle in large tanks. The clear oil is decanted and reheated in a cooking pot to reduce moisture content to 0.15-0.25%. Continuous clarifier consisting of three components heat the crude mixture, dry the decanted oil and hold the finished oil in an outer shell as a heat exchanger.

6. Storage of oil: The purified and dried oil is stored in plastic drums or in other suitable containers and stored at ambient temperature.



Processing of oil palm

7. Palm kernel oil extraction: The residue left after extraction of palm oil from fruits contain mixture of fibre and palm nuts. The nuts are separated manually or in depreciation. The nuts are then dried and cracked in centrifugal crackers to release the kernels. Breaking of kernels should be avoided as it increases the free fatty acids in the oil. The kernels are then separated from the shells using a combination of winnowing and hydro-cyclones. The kernels are dried in silos to a moisture content of 7% before packing and use for kernel oil extraction.

The palm kernel oil is extracted by using following three-unit operations:

a. Kernel pre-treatment
b. Screw pressing
c. Oil clarification.

Kernel Pre-Treatment

The kernels after cleaning are broken into small fragments by using either hammer grinder or breaker rolls or combination of both. The kernel fragments are flaked (0.25-0.4 mm thick) in a roller mill. The kernel flakes are then placed in stack cooker for steam conditioning which adjust the moisture content to optimum level, rupture cell wall, reduce viscosity of the oil and coagulates the protein in the meal to facilitate release of oil from pertinacious material. In palm kernel, the meal is cooked to a moisture content of 3% at 104-110 °C.

Screw-Pressing

Properly cooked meal is fed to screw-press, which consists of an interrupted helical thread (worm) which revolves within stationary perforated cylinder called cage or barrel. The meal is forced through the barrel by action of revolving worms. The expelled oil flows through the lining bars of barrel while de-oiled cake is discharged through annular orifice.

Oil Clarification

The expelled oil sometimes contains solid impurities thus the oil is drained to a reservoir. The oil is pumped to a decanter or revolving coarse screen to remove large part of impurities. After this, the oil is pumped to a filter press to remove remaining solids and fines to get clear oil. The cake from the press is collected separately. Palm oil, olein and stearin are used worldwide in making margarine, in shortening and confectionery and in snack foods frying. Palm oil is also used in the manufacturing of soaps, detergents and other surfactants. It is good raw material for production of oleo-chemicals, fatty acids, fatty alcohols, glycerol and other formulations for cosmetics, household and industrial products.

The Challenge of Disease Control During Rainy Spells by Using Natural Fungicides

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Expand periods of wet weather spell "feast" for fungal plant pathogens in rainy season since they are extremely dependent on moisture for spore distribution and plant infection. While cool temperatures may have slowed down fungal development to some extent, the wet conditions are very good for to disease development. So, it's better to go for organic fungicides spraying as this year government also plans to ban 27 widely used pesticides as it regards them to be dangerous for humans and animals, but it will first hear out the manufacturers who say their products are not so harmful. The overuse of chemical pesticides in horticulture has caused significant environmental problems. These problems dictate a demand for alternative, safe, and environmentally friendly fungicides. Although with the application of chemically made fungicides, plant diseases can be controlled but the hazardous impacts of such products in human health and environment are well known. Moreover, with their excess applications pest resistance may exist. Natural plant products have been found effective in plant disease managements and could be safely incorporated as suitable alternatives for synthetic fungicides. During last several decades researchers have evaluated plant extracts against plant pathogens, valuable results have been achieved and some commercially natural formulations have been prepared and marketed.

Introduction

Too much rainfall may cause fungicides to wash off crops for several reasons. Repeated or continuous wetting of infected tissues over several days will aid spore production as it allows thorough wetting of infected canes and promotes spore release. In addition, rains assist rain splash – dispersed pathogens in splashing the spores to susceptible plant tissues. Furthermore, extended wetness periods (12 to 48 hours) provide ample moisture for spore germination and leads to the infection of plant tissues.

Phomopsis and Botrytis diseases; Black rot, Downy mildew, and Anthracnose; leaf diseases; leaf spots and fruit rots and rust are the diseases in vegetable crops that are promoted by wet weather. While powdery mildew prefers warm, dry conditions, it does need rainfall in the spring and early summer to release ascospores from overwintered cleistothecia. Therefore, rainy springs will increase powdery mildew disease risk as well, particularly if rains are followed by warm dry weather which will promote successful establishment of the first colonies. The challenge is to apply sprays before rainfall events.

With as much rain as we have had it is difficult to keep the plants covered with fungicide. In addition, with rapid plant growth, new growth may not be covered or the fungicide residue is too diluted to be effective. This suggests that there is usually sufficient amount of active ingredients left after light rain events. But to achieve good to excellent control, one has to reapply the fungicide after a major rain event or when significant plant growth has occurred. A spreader sticker may help the fungicide adhere to the plant surface. During rainy periods, especially when followed or accompanied by windy conditions, it is difficult to get the fungicides on at the right time, e.g., before an infection period. This may be further complicated by fields being flooded, preventing access with spray equipment.

Natural Plant Products

These have a specific mode of action with narrow target range, therefore are suitable for a specific target, mostly nontoxic for antagonistic microorganisms, show limited field persistence and have a shorter shelf life and no residual threats.

Plant Extracts

1. Aloe vera: A new extract with potent antifungal properties is the extract obtained from *Aloe vera*, which has been found to have antifungal activity against four common postharvest pathogens: *Penicillium digitatum, penicillium expansum, Botrytis cinerea and Alternaria alternata* (Barkai-Golan, 2001).

2. Clove and cinnamon: The terpenes present of the essential oils are the primary antimicrobials. Many of the most active terpenes are eugenol, thymol and carvacrol. Essential oils may inhibit enzyme systems in yeasts, including those involved in energy production in cells and synthesis of their structural components. Eugenol is a substance obtained from clove, which contain 95% of eugenol as the main volatile oils. Cinnamic aldehyde is another antimicrobial substance obtained from cinnamon. This plant also contains eugenol (only 8% of volatile oil and 75% of the first one).

3. Allium: The Allium contains various compounds with resistance to fungal disease. Some are constitutive inhibitors, such as catechol that is present in onion cultivars (Link and Walker, 1933). Onion also produces a class of cyclopentane phytoalexin upon pathogen infection, designated tsibulins (Dmitriev et al., 1990), which accumulate in bulb scales at infection sites during incompatible interactions with *Botrytis cinerea*. The main compounds obtained from this extract are allicin. This has been suggested as a plant fungicide which undergoes thioldisulphide exchange reactions with free thiol groups in proteins and it is thought that this is the basis of its antimicrobial action. The antimicrobial sulphur compounds of onions contain phenolic compounds protocatechuic acid and catechol, which contribute to their antimicrobial activities. Garlic oil inhibits ethanol production by *Saccharomyces cerevisiae* and delay sporulation of *Hansenula anomala* and *Loderomyces elongisporus.*

4. Crucifers: Isothiocyanates derive from glucosinolates in cells of plants of the mustard family (cabbage, kohirabi, Brussels sprout, cauliflower, broccoli, kale, horseradish, mustard, turnips, rutabaga) are potent antifungal and antimicrobial agents (Davidson, 1997). These compounds are formed from the action of the enzyme myrosinase on the glucosinolates when plant tissues are injured. The mechanism by which isothiocyanates inhibit cells may involve enzymes by direct reaction with disulfide bond or through thiocyanate anion reaction to inactive sulphydryl enzymes.

5. Carrot: Purified metabolic extract of carrots is found to be antifungal activity. Dodecanoic and pentadanoic acids are the compounds responsible for inhibition. An extract of carrots inhibited sporulation and aflatoxin production by fungus. The inhibitor was not identified but was determined not to be 6-methoxymellein, p-hydroxybenzoic acid, or falcarindiol but rather to be part of the volatile carrot seed oil, a mixture of terpenoid compounds (Davidson, 1997).

6. Hops: Resin from the flowers of the hop vine which is used in the brewing industry is composed of bitter acids, including humulone, cohumulone and adhumulone and also bitter acids, including lupulone (lupulon), colupulone, xanthohumol and adlupulone (Davidson, 1997). Both types of bitter acids possess antimicrobial activity against fungi.

7. Neem oil: It is pressed from the fruit and seeds of the neem tree. At a 70 % concentration, neem oil kills powdery mildew spores, virus vectors (such as aphids and white fly), and the eggs of numerous insect pests.

8. Sesame oil: It was extracted from the seed of *Sesamum indicum.* The seed has a high oil percentage constituting 50% of its weight and made up of the fatty acids oleic and linoleic acid. It has been reported as having a multitude of antioxidant properties. Organocide, a fungicide that uses a 5.0% solution of sesame oil, showed no phytotoxic effects on plants. Organocide provided 85% control of powdery mildew on the upper surface of pumpkin cotyledons.

Fungicidal Properties of Some of Plant Products

Acacia, sapodilla, datura, eucalyptus and pomegranate extracts can control fungus (Satish *et. al*., 2007). Eucalyptus and lavender extracts control *Alternaria alternata* (Zaker and Mosallanejad, 2010). Clove bud, cinnamon, ginger, black pepper, garlic and onion extracts control *Aspergillus niger* (Avasthi *et. al*., 2010). Neem, garlic and turmeric extracts control *Fusarium oxysporum, Rhizoctonia solani (*Hadian, 2012). Indian beech, milk weed, oleander and turmeric extracts control *Aspergillus fumigatus*, *Alternaria solani* (Masih *et. al.,* 2014). Kokum, wild turmeric and jasmine extracts control *Rhizopus stolonifer, Colletotrichum coccodes* (Bhagwat and Datar, 2014). Grape seed, rosemary, mint, basil and sage essential oils control *Botrytis cinerea***.** Pepper and cassia extracts, neem, mustard and cinnamon essential oils also used as a fungicide (Bowers and Locke, 2004).

Conclusion

Due to hazardous impact of most of synthetic fungicides, in the near future the use of such chemicals must be strictly regulated by governments which may lead to a growing demand for naturally plant protection materials such as plant origin products. Based on approved data and scientific publications it seems evident that plant essential oils/extracts are biodegradable and do not cause similar environmental risks. The option of replacing fossil oil-based chemicals with plant product formulations fits well with food and agriculture policies directed to the future. If we are supposed to move toward production of safer horticultural products, more attention and effort are still needed for production of more commercially botanical fungicides in the near future.

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COVID-19 Era- Boost the Immune System and Minimize the Risk of Infection

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Covid-19 or Coronavirus was declared as a global pandemic by the World Health Organization. And while the countries are grappling with imminent dangers that this virus poses to humanity, there are few key measures that individuals can take to fight this pandemic. Follow the World Health Organization and the Government advice to protect against COVID-19 infection and transmission.

To protect yourself and others against COVID-19, physical distance of 1 meter (3 feet) and good respiratory hygiene means covering your mouth and nose with your bent elbow or tissue when you cough or sneeze.

Especially if you have travelled by public transport use an alcohol sanitizer, in case you are travelling to disinfect your hands, wearing a mask (cover your nose and mouth) and avoiding touching your hand or mouth. There are also certain methods to improve your immunity which is paramount at this intersection.

Individuals in certain pre-existing illnesses like diabetes, hypertension, cardio vascular disease, and respiratory issues are at a higher risk of having Covid-19 complications, it also aggravates with age as the general immunity reduces as you get older. In the younger generation with no underlying illnesses, Covid-19 can result in a minor infection, provided you have a robust immunity and do not engage in activities like smoking or vaping to combat the onslaught of the virus. Here is a list of measures you can take to improve your immunity.

Good Nutrition

Good nutrition is very important before during and after the infection. During infection body needs extra energy and nutrients. Therefore, maintaining a healthy diet is very important during the COVID-19 pandemic. The food you eat plays a key aspect in determining your overall health and immunity. Certain foods like mushrooms, tomato, bell pepper and green vegetables like broccoli, spinach and regularly consume vegetables and fruits rich in Beta carotene, Ascorbic acid & other essential vitamins are also good option to build immunity against infection.

You can also eat supplements rich in omega 3 & 6 fatty acids for your daily dose, if stepping out to buy groceries is not an option during social distancing. Some natural immunity supplements include ginger, gooseberries (amla) and turmeric. Some of these super foods are common ingredients in Indian dishes and snacks. There are several herbs that help in boosting immunity like garlic, Basel leaves and Black cumin. Certain seeds and nuts like sunflower seed, flax seeds, pumpkin seeds, and lemon seeds are good source of Vitamin E.

Probiotics like Yoghurt, Yakult and fermented food are also excellent sources to rejuvenate the composition of gut bacteria, which is important for nutrient absorption by the body. These are good option for older generation.

To Maintain Good Healthy Diets and Good Immunity, AYUSH Encourages Everyone to Follow

1. Don't Compromise on Sleep: Good sleep for 7-8 hours is the best way to help your body to build immunity. The lack of sleep will prevent the body from resting and this will impair other bodily functions that will have a direct impact on your immunity. Lack of sleep adversely affects the action of the flu vaccine.

2. Stay Hydrated: Drink up to 8-10 glasses of water every day, to stay hydrated. Hydration will help flush out the toxins from the body and lower the chances of flu. Other alternatives include juices made of citrus fruits and coconut water, to beat the heat.

3. Don't Skip on Exercise: A good diet should be followed by an exercise routine. Remember to exercise regularly; even light exercise will go a long way in releasing the toxins from your body. It is recommended to exercise for 30 to 45 minutes, depending on your stamina. Exercise produces changes in part of brain that regulate stress and anxiety. Regular exercise improves metabolism, which has a direct correlation with body immunity and minimize the risk of infection.

4. Destress Yourself: The growing anxiety around the pandemic is another concern that is affecting millions across the globe. While the uncertainty might be overwhelming, there are few steps we can follow regularly to help relieve our stress, stress is known to have an adverse effect on immunity.

5. Practice meditation: Too much stress releases the hormone known as cortisol, which impairs your response to immediate surroundings and makes your body susceptible to infections; you are left feeling constantly anxious. The best way to relieve stress is through meditation, it is a tried and tested activity to calm the nerves.

6.Avoid Smoking, alcohol and other addictive substances: Certain habits like smoking, vaping, alcohol consumption and substance abuse have a direct correlation between weakened body defences and respiratory illnesses. Engaging in smoking and vaping is proven to weaken your lung capacity and destroy the cells lining your respiratory tracts, these cells are crucial to fight viruses that enter through your nasal orifices. There is new research claiming that individuals who engage in heavy alcohol consumption tend to suffer from ARDS (Acute Respiratory distress syndrome) which is one of the conditions caused by Covid-19 infection. Practice moderation, if you are dependent on any of these, as sudden withdrawal can also prove to be risky.

7. Travelling: Avoid all kinds of non-essential travels. Most Covid-19 positive cases are imported cases, which later spread to the communities. Avoid being exposed to the public transport system and public places to avoid any likelihood of exposure. In case you have to travel, make sure to cover your nose and mouth with a mask and carry an alcohol-based hand sanitizer, at all times. Use your non-dominant hand while accessing the door knobs and handles, as these are frequently touched by many people.

8. Supplements and immunity boosting foods: While all the above-mentioned tips will definitely help, the need of the hour is a quick boost to your immunity system to keep it fighting fit. Here are a few common supplements and superfoods that can help.

9. Vitamin C: This particular vitamin is a crucial participant in the army of immunity. It helps prevent the common cold. It acts as a powerful antioxidant and protects against damage induced by oxidative stress. For severe infections, including sepsis and acute respiratory distress syndrome (ARDS), high dose intravenous vitamin C treatment has been shown to significantly improve symptoms in patients.

10. Vitamin D: Vitamin D supplements have a mild protective effect against respiratory tract infections. Most people are deficient in Vitamin-D, so it's best to consult with a doctor about taking a Vitamin D supplement to boost immune response.

11. Zinc: Zinc is a vital component to WBC (white blood corpuscles) which fights infections. Zinc deficiency often makes one more susceptible to flu, cold and other viral infections. It is advisable to take a zinc supplement, especially for older people.

12. Turmeric and Garlic: The bright yellow spice, Turmeric, contains a compound called curcumin, which boosts the immune function. Garlic has powerful anti-inflammatory and antiviral properties which enhances body immunity.

13. Ginger: Ginger is an antimicrobial, antibiotic, and anti-inflammatory compound. It is effective in soothing sore throat and dispel nausea. Due to its high antioxidant content ginger can enhance the immune response system.
Apart from maintaining a healthy lifestyle and taking supplements, the Indian health ministry is also suggesting few organic and natural ways to practise as preventive measures to fight COVID-19. The Ministry of AYUSH has recommended the following self-care guidelines as preventive measures and to boost immunity with special reference to respiratory health.

a. Drink warm water throughout the day.
b. Practice Meditation, Yogasana, and Pranayama.
c. Increase the intake of Turmeric, Cumin, Coriander and garlic.

d. Drink herbal tea or decoction of Holy basil, Cinnamon, Black pepper, Dry Ginger and Raisin.
e. Avoid sugar and replace it with jaggery if needed.
f. Apply Ghee (clarified butter), Sesame oil, or Coconut oil in both the nostrils to keep the nostrils clean.
g. Inhale steam with Mint leaves and Caraway seeds.

Conclusion

While the battle against the Covid-19 pandemic is fought by our health care workers, we can do our bit by limiting our exposure to the virus by staying indoors, social distancing, eating healthy, hydrating and following basic hygiene protocol.

Coccinellidae: Most Predaceous Family of Coleoptera

Article ID: 30562

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Coleopterans are well recognized due to their hard or leathery forewings, i.e. Elytra that often completely cover the more delicately the membranous hind wings. There are several species do not have any hind wings and are thus incapable to flight. All beetles have biting mouth parts and are able to penetrate the outer skin of most insects and mites. Beetles are typically active hunters with both adults and larvae showing rapid movement.

Predaceous Family

Coccinellids (Ladybird beetles).

Characterization of Coccinellids

1. Adult coccinellid beetles range from 0.8-18 mm in length and have an oval body with a convex dorsal surface and a flat ventral surface and biting mouth parts.
2. They have fully developed hind wings and many species are good flier.
3. Most commonly known coccinellids are predators of aphids in garden as well as orchards and arable crops.
4. Other species are also attack scale insects, mites, mealy bugs and whiteflies.
5. Some coccinellids are fungivores.

Different Species of Coccinellids

1. *Adalia bipunctata* (L.)- 2 Spotted ladybird:

a. It is commonly known as two spotted ladybird beetle and also a potential predator of aphids.
b. The legs and underside of the abdomen of *A. bipunctata* are black and the elytra are variable but usually a single black mark is present centrally on each elytron.
c. Elytra are mostly black with red marks.
d. It laid yellow eggs in hatches of 5-50 or more, stacked end on, usually to the lower surface of the leaves.
e. Larvae are state grey with orange marking and when nearly fully grown, they are more voracious than the adults.
f. Pupae are black and are found on leaves and stems.

2. *Chilocorus bipustulatus* (L.):

a. Adults and larvae of *Chilocorus bipustulatus* are predators of scale insects in fruit and citrus crops.
b. Its adult is small 3.3-4.5 mm in length, with a very shiny convex black body and characteristic red spots looking like an exclamation mark in the centre of each wing case.
c. Eggs are oval, 1-2 mm long, yellow to orange in colour and are laid singly near to the scale insects.
d. Larvae are covered with spines and tubercles and their sizes vary from 1 mm to 7 mm in length.

e. Chilocorus bipustulatus can consume 20-40 scale insects per day.

3. *Coccinella septempunctata* (L.) or 7-Spotted ladybird beetles:

a. Coccinella septempunctata are 5.5 mm in length or larger and nearly always have three black spots on each red elytron and a one central spot behind the thorax.
e. It is common in fields where aphid population is abundant.
c. Generally it has one generation per year.

4. *Cryptolaemus montrouzieri* (Mulsant):

a. It is the mealy bug predator and originated from Australia.
b. The adult is about 4 mm in length, has dark brown/black wing covers and orange head, prothorax, wing tips and abdomen.
c. Larvae are covered in mealy wax like projections making (the younger larvae) resemble to their host mealy bug and it can reach up to the length of 13 mm.
d. All stages of *Cryptolaemus montrouzieri* are predatory, while adults and young larvae prefer host eggs and young nymphs, but older larvae will consume all stages of mealy bugs.
e. Cryptolaemus montrouzieri are also polyphagous, feeding on aphids and scale insects also.

5. *Delphastus catalinae* (Horn):

a. Adults are small, shiny black beetles and of 1.3-1.4 mm in length.

b. This predator devours a large number of whiteflies, both at its adult and larvae stages.

c. The pale yellowish-white larvae are relatively immobile and can starve, if their food source runs out before they reach pupation.

d. Adult and larvae feed predominately on young whitefly nymphs.

e. Adult can consume 50-100 whiteflies/cm^2 before going for oviposition.

6. *Harmonia conglobata* (L.):

a. It is an aphid predator.

b. Adults are large (3.4-5 mm in length) and are recognized by the elytra which are coloured pale pink with eight black angular spots.

c. Larvae are grey with pink dorsal spots.

d. Adult and larva is voracious predator of aphids.

7. *Hippodamia convergens* (Guerin-Meneville) or 13-Spotted ladybird beetle:

a. *Hippodamia convergens* is a highly voracious predator and can capable of eating 50-60 aphids daily. It can also feed on another insect and mite prey.

b. Adult beetles size varies up to 7 mm in length and have up to 13 black spots on their red elytra.

c. They all have a set of white lines that converge behind the head, giving the common name convergent ladybird beetle.

d. The eggs are about 1 mm long, yellow to orange colour and spindle shaped.

e. After hatching the larvae are look like an alligator and immediately start feeding on their own egg cases followed by insect and mite prey.
f. They can feed on many other soft bodied insects, mites and their eggs, beetle larvae, psyllids, mealy bugs, scale insects, spider mites, thrips and whiteflies.

8. *Propylea* 14- *punctata* (L.) or 14- Spotted ladybird beetle:

a. *Propylea* 14- *punctata* has yellow elytra with more or less square shaped black marks, usually seven on each elytron but often fused so it is difficult to differentiate 14 clear spots. The pronotum has an irregular, single black mark. Legs are orange-yellow marking than does that of a similar sized 2 spot ladybirds.
b. It is rarely as abundant as 2-spotted and 7-spotted ladybird beetles.

9. *Stethorus punctillum* (Weise):

a. Adult of *Stethorus punctillum* are small (1.0-1.5 mm long), black lady bird beetle, hemispherical in shape with fine yellow hairs covering the elytra.
b. Larvae are dark brown to black and up to 2.5 mm in length with setae on the sides of each segment.
c. Both adults and larva are predators of *Panonychus ulmi.*
d. Eggs are oval and pale cream coloured.
e. Adults consume on an average 20 mites per day.

10. *Henosepilachna vigintioctopunctata* (Fabricius):

a. Body is hemispherical and convex, pubescence whitish, grey except black spots, head reddish brown, eyes black, pronotum reddish brown except for yellowish brown antero– lateral margins, antennae 11 segmented.
b. Females were bigger than males.
c. Adult body size in males 5.5-6.5 mm long and 4.0-5.0 mm wide and female's body size slightly larger, measuring 6.5-7.5 mm long and 4.5-5.5 mm wide.
d. It is phytophagous on the plants of family solanaceae.

11. *Menochilus sexmaculatus* (Fabricius):

a. Adult beetles are about 4.5 mm long and 3.5 mm wide across the middle elytra, head dark brown with a pair of black eyes and brown antennae.

b. Elytra colour of beetle's yellowish with two blank transverse wavy lines and one small round black spot. Polymorphic elytral ground colour varies within species.

c. It is predate on aphids, coccids, scale insects and mealy bugs in agro-forestry, orchards and forestry areas on tree species *Dalbergia sissoo, Tectona grandis, Mangifera indica* and *Morus alba.*

Conclusion

Almost all the coccinellid species are highly beneficial to agro-ecosystem due to their predatory potential, except one species i.e. *Henosepilachna vigintioctopunctata* which is phytophagous. The feeding nature varies in different species and was documented as either aphidophagous, phytophagous or mycophagous. Various insect pests can cause great loss to plant growth and development and the role of lady bird beetles in insect pest control has been recognized as important component of integrated pest management. After evaluation of predatory potential of coccinellid beetles they may be utilized as biocontrol agents.

Fungicidal Properties of Some of Plant Products

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Papaya

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Introduction

Botanical name: *Carica papaya*

Family: Caricaceae

Carica papaya is a plant belonging to family Caricaceae it is also called as pawpaw with potential medicinal values and has been cultivated in most of the tropical countries. It is also called as Fruit of a common man and Wonder fruit of tropics and sub tropics. Fruit Colour is responsible for Papaya caricaxanthin and anthocyanin pigments. Papaya have an enzyme called Papain - Proteolytic enzyme, act as a curative of several diseases like - piles, dyspepsia of spleen and liver, digestive disorders, diphtheria and skin blemishes, other than the fruit from papaya the leaves, seeds and milk of the papaya tree have medicinal properties. It is great for digestion and is widely eaten alone or forms part of fruit salads. It is also used in smoothies.

Digestion

Papayas contain digestive enzymes which help break down food quite rapidly, thus facilitating the digestion of proteins. They also have a high content of water and soluble fibre which further easy digestion. Papaya seeds are beneficial in treating intestinal worms in the body. The enzyme called papain in papayas helps prevent constipation and aids in digestion. The anti-amoebic and anti- parasitic characters in papaya control the bowel movements, thus curing indigestion, acid reflux, heart burn, irritable bowel syndrome, stomach ulcers and gastric problems.

Wound Healing

Papaya contains an active enzyme called fibrin which is also available in animal and human body. It aids in digestion and prevents blood clots as well as facilitates quick healing of external and internal wounds. It helps in preventing unnecessary clotting inside the body.

Cancer

Papaya contains flavonoids like beta carotene, lutein, zeaxanthin and cryptoxanthin. They act as antioxidants by fighting the oxygen free radicals, thus curing cancer. Beta –carotene provides protection against lung and oral cavity cancers. Papaya juice, through its anti-proliferative effect on liver cancer cells, stops or slows down the growth of cancer cells of liver, thus preventing liver cancer.

Kidney Disorders

In poison related disorder of kidneys, the aqueous seed extract of unripe papaya fruits has been found to induce antioxidant and oxidative free radical scavenging, thus enabling the kidneys to recover of stones.

Heart Health

The abundant amount of potassium in fresh papayas regulates the cell body fluids as well as controls the flow of blood to maintain normal blood pressure. It also regulates the harmful effects of sodium inside the body. Moreover, papaya contains zero cholesterol and high amount of fibre which help in lowering high cholesterol levels. In this way, this fruit protects against various heart diseases.

Menstrual Problems

Papaya is effective in controlling menstrual irregularities in women, easing menstrual cramps and promoting regular flow of menstruation. Papaya leaves are a natural remedy for menstrual pain. Taking papaya leaf with tamarind, salt and water can relieve frequent pain in women menstruation cycle.

Morning Sickness

Regular consumption of a small slice of papaya can relieve nausea and morning sickness in pregnant ladies.

Immunity

Being rich in vitamin A and C, papaya boosts the body's immunity and hence, helps in preventing cold, fever and flu.

Papaya Benefits for Skincare and Hair

The nutritional value of papaya makes it beneficial for treating acne, pimples and other skin infections. The fermented flesh of papaya called papain can dissolve the dead cells and open up the pores, thus providing you with fresh and glowing skin. It can also cure skin infections and wounds because of its healing qualities. Mashed papaya is effective in treating sore and cracked heels. This way papaya act as an Anti-ageing.

Papaya During Pregnancy

Ripe papaya is absolutely safe to eat during pregnancy as it is full of vitamins and nutrients. However, an unripe or semi ripe papaya should be avoided as it contains a concentrated form of latex that triggers uterine contraction which can lead to miscarriage. The papaya enzyme called papain is found in the fruit's latex and leaves. Unripe papaya latex acts like prostaglandin and oxytocin which the body makes to start labour. These are used in synthetic forms to start or strengthen labour contractions. Women trying to become pregnant should avoid eating papaya due to its contraceptive effects.

Papaya for Weight Loss and Diet

Being extremely low in calories and rich in vitamins and minerals, papaya can form part of a perfect healthy diet. Papayas are rich in vitamins C, E and A, and folate as well as dietary fibre. The antioxidants help burn calories and extra fat deposits, thus causing weight loss. You can have papaya at breakfast in the form of salads and juice. Papaya smoothies and cocktails are a nutritious punch providing several health benefits.

Papaya Leaf Benefits

Papaya leaf is known for its various medicinal properties, especially for curing dengue. These leaves contain powerful healing compounds that are effective in curing cancer, dengue and malarial fever. Dengue is a deadly disease characterized by a drastic drop in platelets, known as thrombocytes. No approved medicine has been discovered for this disease so far. Several studies have proved that the extract of raw papaya leaf helps to boost platelets and relieve symptoms of dengue like headache, joint ache, severe muscle pain and rashes on the body with itchiness.

Papaya Juice Benefits

Papaya juice can be a healthy and refreshing addition to your diet as it boasts of all the vitamin and mineral content of whole papayas. It should be distinguished from papaya nectar which is devoid of the nutritional value of the real papaya juice. It is advisable to prepare papaya juice at home with the help of juicer to ensure that it is pure and fresh.

Papaya Face Pack

Papaya literally works wonders for your skin. It is widely used in several face packs meant for different skin types along with other natural ingredients like honey, egg white, turmeric, sandalwood, lemon etc to provide you with a flawless glowing skin.
Given below are few of these face packs:

1. If you have dry skin, you can apply a mixture of mashed papaya, 2 tablespoons raw milk and 1 tablespoon honey on your face for 10-15 minutes to combat dryness and moisturize your skin.

2. You can prepare an anti-ageing mask by blending ripe papaya pieces with 1 tablespoon sandalwood powder and 1 tablespoon honey. Apply it on your face and allow it to dry for 20 minutes. Then wash off with cool water.

3. You can prepare a lightening face pack by making a smooth paste of mashed papaya, 2 tablespoons honey and 1 tablespoon lemon juice. Apply it all over your face and skin. This will cleanse the dirt and provide you with a naturally lighter complexion.

4. Applying a finely grounded paste of raw papaya on your face will help clear pimples and blemishes.

		
Papaya dry candy	Papaya juice	Papaya fruit
		
Papaya skin care		Good for pregnant ladies
		
Tutti frutti	Papain	Papaya leaf extract

Processing of Vanilla

Article ID: 30564

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Introduction

Vanilla fragrans is an only edible orchid belonging to the family Orchidaceae. It is commercially cultivated for its beans, which have a sweet scent, a pleasant aroma and flavour. Vanilla is the costliest spice in the spice horizon and the world's most expensive spice after saffron and cardamom; hence it is popularly known as 'Princes of Spices". Vanilla is the important source of vanillin, which is used to flavour ice-cream, chocolate, beverages, cakes, custards and other confectionery. It also finds use in perfumery and medicine. It is indigenous to South-eastern Mexico, Guatemala and parts of Central America, but is now being cultivated in other parts of the tropics. This crop was introduced to India 200 years ago. In India, it is grown in a few estates of Kerala, Tamil Nadu and Karnataka.

The chief constituents of vanilla beans are 'Vanillin and its content in the beans varies from 1.3 to 3.8 per cent. Apart from vanillin, beans are rich in resins, fat, glucose, fructose, about 26 numbers of volatile constituents as well as 144 numbers of other volatile compounds and moisture. Vanilla also contains water (35 %), sugars (25 %), fat (15 %), cellulose (15 to 30 %) and minerals (6 %).

Harvesting

Almost 9-11 months are required for the fruit to mature after successful pollination and fertilization, depending on the temperature and elevation. The pods or sticks are harvested rotationally when they become fully yellow. The immature pods produce an inferior product and if it is picked too late, it will split during curing.

Processing: Curing

There are different methods of curing the beans, such as Mexican process, Bourbon process, Peruvian process and Guyana process. Under Indian conditions, either the Mexican or Bourbon process can be followed. Every procedure of curing of vanilla beans is characterized by these four phases.

1. Killing or Wilting: The vegetative tissue of the vanilla pod is killed to stop the vegetative growth of the pods and disrupt the cells and tissue of the fruits, which initiates enzymatic reactions responsible for the aroma. The method of killing varies, but may be accomplished by heating in hot water, freezing, or scratching, or killing by heating in an oven or exposing the beans to direct sunlight. The different methods give different profiles of enzymatic activity. Hot-water killing may consist of dipping the pods in hot water (63–65 °C (145–149 °F)) for three minutes, or at 80 °C (176 °F) for 10 seconds. In scratch killing, fruits are scratched along their length. Frozen or quick-frozen fruits must be thawed again for the subsequent sweating stage. Tied in bundles and rolled in blankets, fruits may be placed in an oven at 60 °C (140 °F) for 36 to 48 hours. Exposing the fruits to sunlight until they turn brown, a method originating in Mexico, was practiced by the Aztecs.

2. Sweating of Fermentation: Sweating is a hydrolytic and oxidative process. Traditionally, it consists of keeping fruits, for 7 to 10 days, densely stacked and insulated in wool or other cloth. This retains a temperature of 45–65 °C (113–149 °F) and high humidity. Daily exposure to the sun may also be used, or dipping the fruits in hot water. The fruits are brown and have attained much of the characteristic vanilla flavour and aroma by the end of this process, but still retain 60-70% moisture content by weight

3. Slow drying: Reduction of the beans to 25–30 per cent moisture by weight, to prevent rotting and to lock the aroma in the pods, is always achieved by some exposure of the beans to air, and usually (and traditionally) intermittent shade and sunlight. Fruits may be laid out in the sun during the mornings and returned to their boxes in the afternoons, or spread on a wooden rack in a room for three to four weeks, sometimes with periods of sun exposure. Drying is the most problematic of the curing stages; unevenness in the drying process can lead to the loss of vanillin content of some fruits by the time the others are cured.

4. Conditioning or aging: Here, the beans are stored in closed boxes in bundles of 25-30 tied together from tip to top with cotton threads and these bundles according to their size are wrapped in tissue paper. These wrapped bundles are again wrapped in woollen blankets and kept for a period of three months or longer in closed wooden boxes to permit the full development of the desired aroma and flavour.

5. Grading: In India, the beans are graded into four groups. The first (best) grade beans consist of those above 16cm in length, soft to touch without any blemishes and containing 2.5 per cent vanillin. The second-grade beans consist of those of 12-15 cm length, without blemishes and with more than 1.8 per cent vanillin. The third-grade beans are shorter, with a length of 8-12 cm and with some blemishes. The rest of the beans are taken as fourth (last) grade and are of poor quality.

The grades or types of vanilla entering the trade are:
1. Mexican vanilla
2. Bourbon vanilla
3. Indonesian vanilla
4. Tahiti vanilla
5. Vanillons.

Products of Vanilla

The various types of vanilla products employed in flavouring are vanilla extract, vanilla flavouring, vanilla tincture, concentrated vanilla flavouring, vanilla oleoresin, vanilla-vanillin extract and flavouring, vanilla powder, vanilla-vanillin powder, perfumery vanilla, vanilla absolute etc.

Killing or wilting of vanilla pods

Sweating or Fermentation

Slow drying of vanilla pods

Aging process

Different grades of vanilla pods

Final dried beans/pods

Growing Food Insecurity: Effectiveness of Public Distribution System

Article ID: 30565

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Abstract

The major threat to any economy amid lockdown is the rising food insecurity. Farmers have given another year of record food production. The requirement of food grains would be just enough even if the PDS was universalised for next 6 months. However, the loopholes in the functioning of the PDS have limited the distribution of food grains. Poor storage conditions are leading to large amount non-issuable food grains. Further, the progress of food grains distribution, under the Pradhan Mantri Garib Kalyan Yojana has been way below the target. The slow progress of food grain distribution, the growing wastage in godowns is a clear indication of the growing food insecurity in the country.

Keyword: Food Security, PDS, Food Grain Distribution.

Section 1: Introduction

The Covid-19 pandemic has resulted in a deep crisis for the global and Indian economy. The most worrying concern for every economy today is that of food security. On the supply side, at an aggregate level, agriculture and food sector across the globe is likely to show more resilience to the pandemic crises as compared to other sectors.

However, the prolonged lock down, loss of jobs, mobility restrictions etc is having a far-reaching impact on food security at the household level, particularly, the marginal/poor households. Every economy is facing a threat of food security, although the degree of exposure may vary.

The Government of India's relief package announced several measures on free distribution of food grains and other essentials during the lockdown. However, we do not have the exact estimates of the number of daily wages earners who have lost job during the lock down, the number of migrants who have returned to villages and many more.

As a result, it is difficult to ascertain the exact need and identify the proper reach of food grains. In this context, many had been arguing for universalising the Public Distribution System (PDS). However, the feasibility of such a solution depends on the effective functioning of PDS. This paper aims to evaluate the effectiveness of PDS in handling the growing crisis of food insecurity.

The rest of the paper is organised as follows. In the following section, we look at the availability and requirement of food grains. Section 3 looks at the challenges in effective distribution of food grains and section 4 concludes the paper.

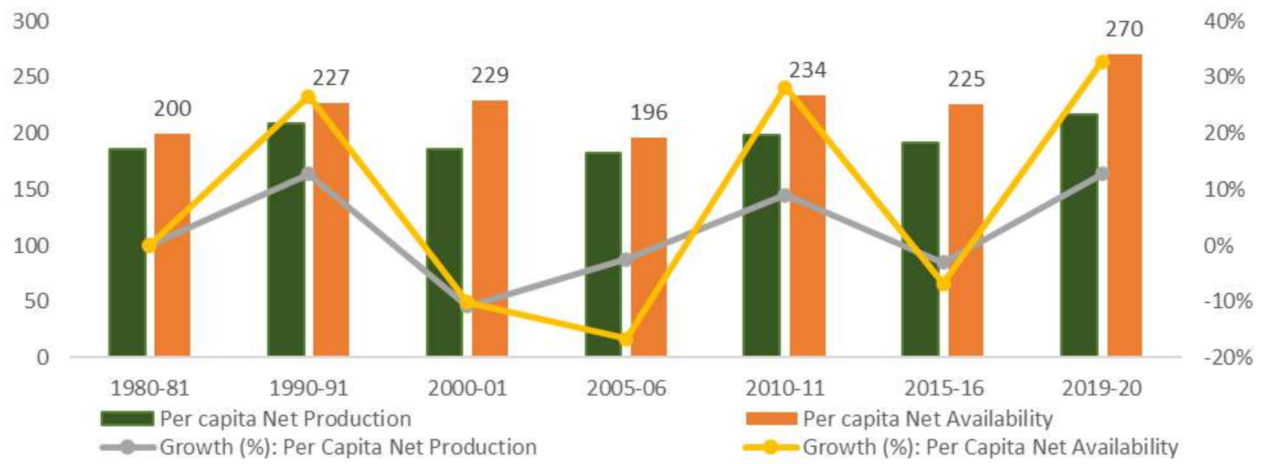
Section 2: Food Grains – Availability vs Demand

In India, the food production and management systems are characterised by a high degree of government involvement. India's buffer stocking policy worked on an insurance approach, the buffer stock is kept as an insurance against a reduction in supplies in times of falling production (Saini & Kozicka, 2014). In the mid -60s, with the increased production due to Green Revolution, government intervention intensified.

The economic revolution in the mid-60s, steered policy makers towards a preference for price stabilisation, elimination of hunger, and government involvement in grain markets to curb speculative trade. Both the Food Corporation of India (FCI) and Agriculture Prices Commission (APC) were set up in 1965 to secure a strategic and commanding position for the public sector in food grain trade

Food grain production in India in the last 40 years, have seen significant growth. The per capita availability of food grains increased from 200 tonnes per '000 persons in 1980-81 to 270 tonnes per '000 persons in 2019-20. During this period, while per capita net production increased by 1.2 times, per capita net availability of stock of food grains increased by almost 4 times. In the last 5 years, i.e. since 2015-16, food grain stock in godowns saw the sharpest increase, i.e., by 69%. During this period, per capita net availability of food grains increased by about 20%. Clearly, government intervention of stocking food grains intensified further in the recent years.

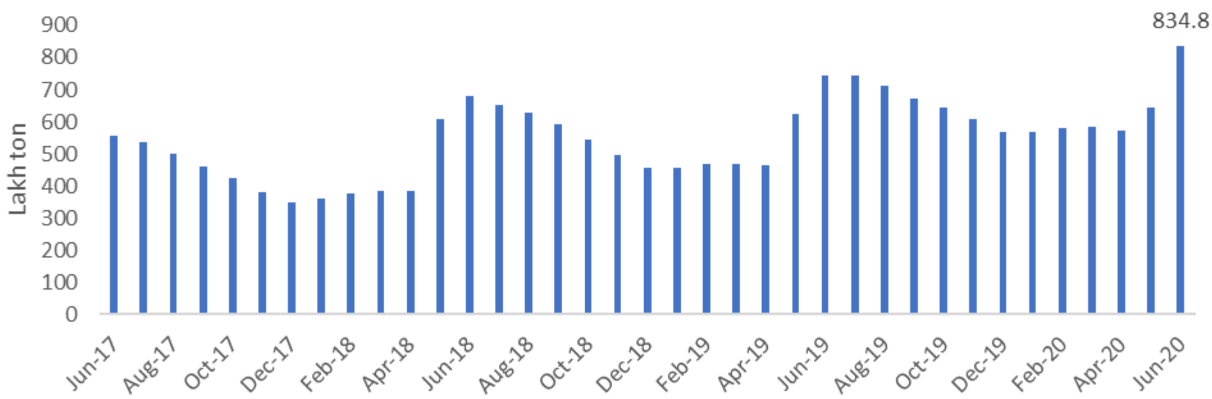
Fig 1: Per Capita Net Availability of Food Grain Production and Stock



Source: Ministry of Agriculture, Food Corporation of India

Food grain production in 2019-20 as per the 3rdAE of Ministry of Agriculture. is estimated to reach a record high of 295.67 million tonnes- the 4th consecutive year of record production. Government procures food grains directly from the farmers or open market at a Minimum Support Price (MSP) which is fixed by the Government on the recommendations of the Commissions for Agriculture Costs. Out of 1071 lakh MT harvest of wheat, government has procured 375.54 Lakh MT of wheat till now out of its targeted procurement of 407 Lakh MT which amounts to INR 7229.15 crs (as per MSP). With high production and procurement levels, existing stock of food grains have reached at its highest level in the last 3 years. The current level of stock of food grains, maintained and operated by FCI is close to 835 lakh tons as on 10th June, 2020 which is almost 4 times higher than the buffer stock norms.

Fig 2: Food Grain Stock: Current vs Buffer Norm



Source: Food Corporation of India

Given the high level of stock, if the PDS was universalised for 136 crore population, the food grains required would still exceed the existing stock. With, 10 kg of food grains per person distributed for 6 months, the requirement of food grains would be 82 million tonnes which is still lower than the existing stock. However, the additional reserves would go down to 1.4 million tonnes. Nonetheless, the additional reserves would be closer to the buffer norms if 75% of the population were brought under the PDS system.

Table 1: Food Grain Requirement with PDS Universalisation

Food grains Stock	84.4 Million Tonnes
Food grains required for universalisation of PDS (10 kg per person for 6 months)	82.0 Million Tonnes
Food grains required for 75% of population under PDS (10 kg per person for 6 months)	61.5 Million Tonnes
Additional Reserves with Universalisation of PDS	1.4 Million Tonnes

Additional Reserves with 80% of Population under PDS	21.9 Million Tonnes
Buffer Norm	21.4 Million Tonnes

Source: Authors own estimates using data from FCI.

Government's relief package of food distribution under Pradhan Mantri Garib Kalyan Yojana covered 0.8 bn population which is roughly 59% of the population and another 80 million migrant workers which was about 5% of the population. This implies that the government have targeted 64% of the population which is much lower than what it could have with the existing stock of food grains.

Section 3: Challenges in Effective Functioning of PDS

The Central government's relief measure of food grain distribution is not only limited by approach but also in terms of functioning. Stating below some of the challenges that have constrained the functioning of the PDS system.

One of the biggest challenges, is the absence of proper storage facilities for stocking. A large amount of excess grains has been stored in sub-optimal conditions leading to significant damage. As of May 1, 2020, 60.5 lakh tonnes of wheat and 11.3 lakh tonnes of rice held by government was not "readily issuable". This included grain that was sub-standard, partially spoilt (what the FCI considers as partially salvagable) or completely damaged (non-issuable). In just four months, between January 1 and May 1, the stock of rice and wheat that was not "readily issuable" increased from 7.2 lakh tonnes to 71.8 lakh tonnes.

Table 2: Grain in Central Pool that was Not Readily Issuable, Sept 1 2019 to May 1 2020 (Lakh Tonnes)

Date	Wheat	Rice	Total
1st Sept 2019	3.61	3.51	7.12
1st Nov 2019	2.47	3.91	6.38
1st Jan 2019	2.83	4.34	7.17
1st May 2020	60.48	11.33	71.81

Note: The grain that is not readily issuable includes grain that is below rejection limit (poor quality), grain from which a part can be segregated and salvaged for human consumption, and grain that is not fit for human consumption at all. Some grain may also be excluded from readily issuable stocks because of being in transit.
Source: Food Corporation of India and Department of Food and Public Distribution.

Secondly, as per the relief package announced, the 0.8 billion poor population were provided double their entitlement for food grains over the next 3 months for free of cost with a relief package of Rs. 400 bn. The 80 million migrant workers were entitled for 5kg of wheat/rice and 1 kg of Chana with a package of Rs. 35 bn. If the entitlements of the two thirds of India's population (which is the population covered under National Food Security Act (NFSA) were to be doubled, the government should have distributed as much grain through Pradhan Mantri Garib Kalyan Yojana (PMGKAY) as it does under NFSA (Rawal, et. al,2020). However, as per the latest data on distribution of food grains from the Dept of Food & Public Distribution shows that distribution under PMGKAY was far short of what was needed to double the distribution of grain through NFSA. In the PMGKAY, one of the most important components of the relief package, only 55.5 lakh tonnes of grain were distributed by the government. Taking distribution of grains under both PMGKAY and the National Food Security Act, in April and May only 132.7 lakh tonnes of grains were distributed by the government.

Table 3: Distribution of Food Grains Under NFSA and PMGKAY

Commodity	March		April		May		March+May
	NFSA	PMGKAY	NFSA	PMGKAY	NFSA	PMGKAY	NFSA+PMGKAY
Wheat	20.4	0.0	18.7	3.8	15.1	3.3	41.0
Rice	22.9	0.4	24.8	22.3	18.5	26.1	91.7
Coarse Grains	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total	**43.2**	**0.4**	**43.5**	**26.1**	**33.7**	**29.4**	**132.7**

Source: Food Corporation of India and Department of Food and Public Distribution

Clearly, distribution of food grains is far below the target. Several surveys conducted by researchers during this period also reflects the inadequacy of government machinery in food grain distribution. A survey conducted by the Dalberg Global Development Advisors in the second week of April found that 43 per cent of households with Antyodaya or BPL cards had not received free rations (Totapally, et. al. 2020). A survey of 1737 rural households in three States conducted by Mobile Vaani, a community radio service, found that 89 per cent of respondents in Bihar, 63 per cent in Jharkhand and 69 per cent in Madhya Pradesh had not received free rations (through PMGKAY or State-level schemes) (Gramvaani, 2020).

Section 4: Conclusion

The year 2019-20 is the 4th year in a row of record food grain production, yet there is a growing concern on the rising food insecurity. The increase in food grain production and the stock of foodgrains in godowns would have been just enough to universalise the PDS and reduce food insecurity. However, the progress of food grain distribution so far has been far below what has been announced. Besides, due to poor storage conditions, the excess food grains are under sub-optimal conditions and about 71 lakh tonnes of foodgrains are non-issuable. Although there are no national surveys available yet that could be used to make quantitative estimates, there is a growing concern on the increasing number of undernourished and food insecure people during the lockdown. Although most of these surveys are not nationally representative, stark findings of these surveys provide an indication of the rise in food insecurity.

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Biopharming, Strategies of Biopharming and its Current and Future Challenges

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Introduction

Biopharming is the production and use of transgenic plants and animals genetically engineered to produce pharmaceutical substances for use in humans or animals. It often involves the insertion of gene constructs derived from humans. Biopharming exists on a spectrum of activity and is not clearly demarcated from its nearest neighbours. For example, genetically modified yeast, bacteria, and animal cell cultures have for some time been used to produce pharmaceutical substances in enclosed bioreactor systems, but are generally not included in the definition of biopharming. On the other hand, plant cell cultures, a newer development but also involving enclosed bioreactors, are typically included together with whole-plant methods in plant biopharming.

Biopharming is also known as "molecular farming". The most common plants currently being researched for biopharming include corn, soybeans, rice, tobacco, and potatoes modified to produce the substance, usually a protein, vaccines, in their fruit, leaves, seeds or tubers etc. Internationally, no products derived from plant biopharming have yet reached the stage of commercial production. The plants are harvested and the drug is then extracted and purified.

Since the early 1990s, biotech companies have proposed using food and feed crops as miniature factories for producing pharmaceutical proteins and industrial chemicals that they do not make naturally. This technology, called "biopharming," involves the insertion into plant cells of foreign genes coding for medically important proteins, such as therapeutic proteins, monoclonal antibodies, and vaccines. To date, however, the FDA has yet to approve a single drug made by this method.

Production of biopharmaceuticals in transgenic plants may offer a cost-effective alternative to using engineered bacteria or mammalian cell culture. One advantage of biopharming is that plant cells possess the biochemical machinery needed to fold complex proteins and to perform the post-translational modifications (such as glycosylation, the addition of sugar molecules) required for full biological activity. Moreover, unlike mammalian cells, plants do not contain retroviruses and other infectious agents (such as prions) that cause disease in humans.

Strategies for Biopharming

The products of biopharming are variously termed plant-derived pharmaceuticals (PDPs), plant-made pharmaceuticals (PMPs) or plant-made biopharmaceuticals (PMBs) (DePalma, 2003). Potential biopharmed products range from very high-value compounds, such as human or veterinary vaccines or interferon to more modestly priced intermediates or nutraceuticals, including recombinant enzymes or ω-3 and ω -6 'fish oils.

Plant-based pharmaceuticals, in their broadest sense, can be divided into three categories, i.e. single-molecule drugs, botanicals and biologics (Fowler and Law, 2006). Singlemolecule drugs are plant-derived therapeutic compounds that can sometimes be obtained from either wild or cultivated species as an alternative to laboratory synthesis. Examples include the painkiller morphine (from the opium poppy, Papaversomniferum), the antimalarial medication artemisinin (from the herb Artemisia annua) and galanthamine (an Alzheimer's medication from daffodil bulbs, Narcissus spp.). Botanical drugs are plant extracts that contain a mixture of active molecules that may act synergistically in the treatment of specific conditions [see also Food and Drug Administration.

Industrial Importance

The biopharmaceutical industry is a maturing industry, now confronted with increasing generic competition and greater regulatory expectations. These drivers are motivating manufacturers to incorporate process modeling tools into their development and manufacturing practices to reduce development costs and shorten time-to-market. This is because the enhanced process understanding provided by modelling minimizes the number of experiments required to develop a process and reduces the risk of failure during scale-up.

Current Challenges

1. Improve yield of therapeutic molecules
2. Increase the stability of the molecules
3. Improves the downstream process
4. Improve & establish a more reliable biosafety system.

Future Direction

1. Science has developed genetically enhance crop and can develop plant – made industrial and pharmaceuticals crops
2. The extent to which these crops will be further developed for commercial and humanitarian use will ultimately depend on.

Conclusion

Biopharming is still a relatively new venture that is focused mainly on the generation of relatively high-value therapeutic products for the private sector. Containment at all stages, from the plant systems themselves to the processing and distribution of the end products, remains a major challenge. Over the past decade, there have been sufficiently numerous episodes of unexpected contamination of the food chain by poorly contained transgenic crops to warrant a rethink of the strategy of using major food crops as production vehicles in biopharming.

Induced Mutagenesis Breeding for Vegetative Propagated Ornamental Plant: Gladiolus *(Gladiolus grandiflorus)*

Article ID: 30567

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Introduction

Gladiolus *(Gladiolus grandiflorus)* is a monocotyledonous flowering bulbous plant, belonging to family Iridaceae. The major gladiolus-growing areas are West Bengal, New Delhi and Uttar Pradesh. It is an important flower crop and is very popular as cut flower both in domestic and international market. Gladiolus spikes are most popular in flower arrangements and for preparing high class bouquets.

Materials and Methods

Investigation was carried out at Department of Horticulture, Banaras Hindu University, Varanasi, Uttar Pradesh. Gladiolus corms of 7 varieties viz., Aldebaran, Jyotsana, Legend, Praha, Punjab Dawn, Pusa Kiran and Tiger Flame were exposed to gamma doses at 1.5 kR, 2.5 kR, 3.5 kR, 4.5 kR and 5.5kR.Flower colour of induced mutant was observed with flower colour chart. Another investigation was carried out at Model Floriculture Centre, G.B. Pant University of Agriculture and Technology, Pantnagar.

Uniform and healthy corms of gladiolus varieties viz. Yellow Golden, Nathan Red, White Friendship, American Beauty, Red Majesty, Purple Flora and Algarve were irradiated with different doses (0, 25, 40, 55 and 70 Gy) of gamma rays. Corms harvested from vM1 generation were stored and again planted as vM2 .Data was recorded on all the characters in both years.

Results and Discussion

Experiment which was conducted in Banaras Hindu University, to check the gladiolus mutagenesis ,yielded following results:

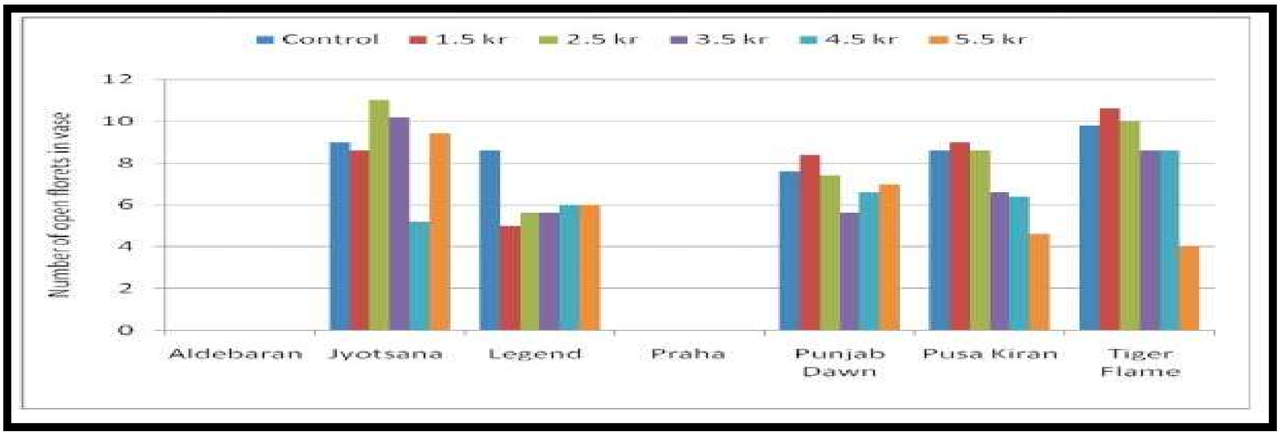

Fig 1: Number of open florets in vase as influenced by gamma doses and varieties in gladiolus

Table 1: Characteristic of gladiolus mutant(3.5kR gamma dose)along with parent Tiger Flame

Character	Parentage(Tiger Flame)	Mutant
Rachis length	58.6cm	60.3cm
Number of florets / spikes	16	17
Length of florets	10 cm	9.8 cm
Width of florets	8.25 cm	8.5 cm
Floret colour	Deep orange	Light orange upper petal, streaks formation

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Parent petals	**Mutant petals(This mutant was named and released as Shobha.)**

Fig 2: Stable mutant of variety Tiger Flame at 3.5 kR gamma dose

Another experiment which was conducted at Pantnagar, yielded the following results:

Fig 3: a)Change of stemen into tepal in Yellow Golden b)Twin floret in Golden Yellow c)Purple flora mutant without pistil d)Five tepals mutant in Algarve e)Purple flora mutant with increased number of floral organs f)Stemen changing into extra whorl of tepal in Nathan Red g) Increase in floral organ in Jester Gold

Conclusion

From the present study it is concluded that flower mutants can be induced by mutagen treatment in gladiolus, higher doses are deleterious and lethal. Chimerism and genetic variability play a key role in the variation observed in mutation treated population. Induced mutations through tissue culture are desirable for developing new cultivars for the floriculture industry and the cut flower trade to fulfil the demands of both domestic and international markets.

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Three Magical Leaves That Boost Our Immunity Against COVID-19

Article ID: 30568

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With the recent Corona Virus outbreak in India and with the fear about the severe virus spreading, still there are many things we can do to save and support our health and that of our family. None of us can totally get rid of the risk of getting Corona Virus and no food can cure us from Corona Virus but the least we can do is to have a healthy & well-balanced diet to support our immune health. Regrettably, with no vaccination and proper line of treatment, there is no correct way to stay safe from this virus attack. However, health experts believe that strong immunity can not only resist, but also combat the virus attack. Ever since, the lockdown began, the internet is flooded with immunity boosting food suggestions, and one of my recent claims are that immunity boosting foods like tomato, ginger, garlic, capsicum, peas and beans can help in building resistance against COVID-19, but did you know there are 3 magical leaves that has been boosting up your immune system? Well, this will surprise you, but from fruits - Papaya leaves, from vegetables - Moringa leaves and another from medicinal herb cum leafy vegetable *Alternanthera sessilis* (Joyweed) was a great immunity booster and can help in keeping several chronic diseases at bay.

Here, Humans have two kinds of immunity; they are innate immunity and adaptive immunity. Innate immunity is a natural immunity- the body's first defence system against all germs that enter the body. Adaptive immunity is a more specific body defence system that arises due to the stimulation of particular pathogens such as flu, pneumonia, and others. "Both become the most major part of the human body's immune system which protects it from pathogenic threats, that there were many possible things to enhance the body's immunity among them the three magical leaves are highly recommended to consume immune stimulant consumption. Let's go through it!

Papaya Leaves Extract (Multivitamin)

It is a tropical fruit, which has been often related with many medicinal properties. Its leaf juice is also getting importance in a world of nutrition having wonderful health benefits. The leaf extract of papaya, own many compounds, such as flavonoids and other plant phenols, and alkaloids for example carpaine, anthraquinone, saponins, and cardiac glycosides, such as carposide and tannins. Its juice can be beneficial for people with a weak immune system. It will make sure that your red blood cells (by protective role against hemolysis) and platelets increase. Red blood cells are required for oxygen supply to trillions of cells in the body. Better oxygen supply in the body can give a boost to our immune system.

Papaya leaf juice can also help in reducing fever. Recent studies have shown its beneficial effect as an anti-inflammatory agent as well as immune modulatory effects and as an antioxidant (Imaga et. al., 2010). Theses leaves also contain huge amounts of vitamins A, C, E, K, and B and minerals like calcium, magnesium, sodium magnesium and iron. The extract has nephro-protective and hepato-protective activity against toxins. A compound found in papaya leaf is acetogenin, which can help prevent dangerous disease like malaria and dengue. This extract is a natural source of the protein digesting enzyme papain and chymopapain which helps break down proteins, carbohydrates and fats to naturally speed up your metabolism. Papaya leaf extract contains the rare plant enzyme fibrin, an insoluble protein involved in blood support. Have papaya leaf juice before protein consumption to facilitate its better absorption in the body. The papaya leaves increase the activity of the macrophage (body defenders) so there will be more germs got devoured. In recent studies, it was reported that tannin content in the leaves reaches over 90%. This showed that papaya leaves have the more potential to be further developed as cheap alternatives to immune modulator.

How to Get Papaya Leaf Juice?

For preparing papaya leaf juice, we need to wash leaf thoroughly. We can also cut off the stem and need to cut the leaf (chopping). Add some boiled water that is cooled, to it. Add the leaves to a blender and juice these leaves. Finally, we will get a dark-green coloured liquid. The juice is likely to have a very bitter taste. We will have to prepare this juice, fresh, every day. You should not store it for more than 24 hours. Make sure you store the juice in the fridge in an airtight container. Store it in the lower part of the fridge to prevent it from getting too cold.

Moringa Leaves (Drum stick)

The micronutrients like Potassium (K), iron (Fe), calcium (Ca) and essential vitamins like Vitamins A, B, C and E are present in moringa leaves. It is known that iron and vitamin C play an important role in boosting the immune system. Also, crude protein and antioxidants are present in remarkable amounts which are beneficial to boost the immune system. Hence, incorporating these leaves in daily menu is a valuable addition among susceptible populations. It is also called a miracle tree as it is a treasure house of all essential nutrients that are needed to enhance our immunity. The leaves itself is known to contain 2 times more protein than yogurt, 4 times more vitamin A than carrots and 7 times more vitamin C than oranges. It is a storehouse of vitamin E and its utilization can satisfy the recommended intake of vitamin E. The amount of zinc found in leaves, pods and seeds are twice as found in beans. There were tons of recipes made with moringa leaves – stir fries, daal, sambar etc.

Ponnagamti Kurra

Alternanthera sessilis L. is a leafy vegetable used widely for its medicinal properties. It has been a part of Indian health care system including different streams of medicinal plant practices such as Ayurveda, ethnobotany and folklore medicine for treating different conditions. It was commonly called as sessile joyweed and dwarf copperleaf is native to tropical and subtropical regions of the world. The leaves, flowers and tender stems are consumed as vegetables. As an herbal medicine, the plant has diuretic, cooling, tonic and laxative properties. A lots of bioactive chemicals was identified in tissues of Alternanthera sessilis, including: triterpenes alpha-spinasterol, beta-spinasterol, stigmasterol, campesterol, lupeol, beta-sitosterol, oleanolic acid etc., It has many medicinal actions, it is named as : hepatoprotective, antioxidant, blood puryfing and detoxicating (potent radicals scavenging activity and metal ion chelating activity), anti-inflammatory, febrifuge (a medicine to reduce fever), galactogogue, antiulcer, hematinic (stimulate formation of new blood cells), anti-anemic, cholagogue, diuretic, antihyperglicemic, antibacterial, antiviral, antifungal, anti-allergic (histaminergic - regulate histamine level), lowering blood temperature, relaxing smooth muscles, in body, in bigger amounts laxative. Aqueous extracts of closely related Alternanthera philoxerioides have been proved to inhibit proliferation of the HIV and Haemorrhagical fever virus.

Conclusion

Since these three leaves are a natural source of phyto chemicals, therefore it should be further explored to develop an effective drug against the virus. Despite considerable research on the antiviral property of vegetables, many questions are still unanswered. Therefore, more detailed study should be conducted to elucidate a complete mechanism of action of these plants against the virus. Also, more clinical trials are needed to analyse the antiviral property of these plants. Considering numerous studies which corroborate antiviral effect, this paper recommends consumption of these plants as a safe alternative to prevent corona virus infection.

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Genetic Mechanism of Seed Dormancy in Rice (*Oryza sativa* L.)

Article ID: 30569

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Introduction

The failure of the fully mature and viable seed to germinate to an appreciable degree under favourable environmental conditions is termed as dormancy, and the rest period refers to the duration of dormancy. Rice varieties differ significantly in their degree of dormancy. The japonica subspecies generally have shorter periods of dormancy than the tropical indica subspecies. Most javanica varieties have a moderate degree of dormancy. The African cultivated rice *Oryza glaberrima* possesses strong seed dormancy. Seed dormancy in wild rice species, normally extends from 3 to 6 months. However, in the cultivated species this dormancy period can be totally absent or last as long as 4 months. Red rice has strong seed dormancy (Cohn and Hughes *et al.*,1981 ; Noldin *et al.*, 2006). Weedy rice has much stronger seed dormancy than cultivated rice. Previous studies of the genetic basis of seed dormancy showed that indica cultivar N22 exhibited stronger seed dormancy than many traditional rice cultivars. Although earlier observations indicated association of long growth duration or photoperiod sensitivity with higher degree of dormancy. Genotypic variation at multiple loci for seed dormancy (SD) contributes to plant adaptation to diverse ecosystems.

Table 1: Dormancy in 39 Rice Varieties Hooghly, West Bengal, India (H. P. Sikder et al., 1998)

Maturity group	Non dormant (10d)	Weak dormancy (40d)	Moderate dormancy (60d)	Strong dormancy(80-100d)
Early aus	Satika	-	Dular	-
Early aman	CR205	EMH3, CR201 AC517, Dudhkati, CR205	Badkalamkati 65, Chunakati, Malsira, Jhulur,	KXI-36, Sankarkalma, Dudhraj
Medium aman	-	Rupsail	Bhasamanik, Kalma 222, Dudhsar, Nagra	Latisail, Patnai, Jhingasail,
Medium-late and late aman	Boak	NC1281	Gabura, Oc1393	NC678, Kumargore, Tilkkachari,

Source: International Rice Research Newslatter Volume 11 Number 5 ,1998

Approaches for Discovering Dormancy Related Genes

1. Mutagenesis: The classical reverse genetic strategy involves mutagenesis. The study of mutants has provided evidence about the role of different factors like GA, ABA, light, temperature, nitrate and the seed coat in dormancy establishment or release, and also about the role of processes like epigenetic regulation, protein degradation and RNA modification in dormancy control. Some of the mutants showing dormancy phenotypes were related to defects in seed maturation. The key role of ABA in dormancy is strongly supported by mutation studies.

2. QTL Analysis: Quantitative trait loci (QTL) analysis is another technique for isolating genomic regions which contribute to grain dormancy. This approach has been useful in providing markers for breeding programs. Once a major QTL has been identified, molecular markers can be developed to assist the introduction of the QTL into breeding programs.

Table2: Quantitative Trait Loci for Seed Dormancy in Rice

Population	Chromosome (QTLs)	Marker linked to QTLs/Marker interval	Software used	References

RIL Plants Pei-kuh, non dormant (Oryza sativa L.) X Asian common wild rice(O. rufipogon Griff.)	Chr3(qDOR-3-1), Chr5(qDOR-5-1), Chr8(qDOR-8) Chr11(qDOR-11),	G144-BCD454 RZ296-BCD1072 RG181-Amp2 G24-RZ141	MAPMANA-GER	Cai et al., 2000
BC1 SS182(dormant)XEM931(nondo-rmant)	Chr4(qSDS-4), Chr7(qSD S-7-1), Chr7(qSDS-7-2), Chr8(qSDS-8), Chr12(qSD S-12)	RM252 RM180 RM346 RM135 RM270 (Nearest marker)	MAPMAKER/EXP v3.0	Gu et al., 2004
BC4F2 plant SS18-2xEM93-1(nondormant)	Chr 1(qSD1), Chr7 (qSD7-1) Chr 12(qSD12)	RM84-RM259 RM6338-RM5672 RM3331-RM35	MAPMAKER/EXP v3.0	Gu et al., 2006
CSSLs, Nona Bokra (strong dormancy)X Koshihikari (weak dormancy)	Chr 1(Sdr6) Chr 6 (Sdr9, Sdr10)	RM7228-RM6259 RM7488-RM7311 RM1161-RM3498	MAPMAK-ER/EXP	Marzougui et al., 2012
RIL Plants Daguandao (Oryza sativa L. subsp. japonica) X IR28 (O. sativa subsp. indica),deed seed dormancy	Chr1(qSD1.1) Chr 2(qSD1.2) Chr 3(qSD3.1) Chr 4(qSD4.1) Chr 6(qSD6.1) Chr 8(qSD8.1) Chr 9(qSD9.9)	RM3411-RM5389 RM3602-RM5410 RM8277-RM8275 RM16535-RM16550 RM3183-RM6298 RM284-RM7556 RM7038-RM524	QTL IciMapping	Cheng et al., 2014

Conclusion

Seed dormancy in rice (*Oryza sativa* L.) is both useful as well as disadvantageous depending upon the growing condition. A certain degree of dormancy is advantageous for a variety to avoid the crop loss during harvesting period. Seed dormancy in rice has been attributed to both embryo and hull factors. Dormancy is a quantitative trait controlled by nuclear and sometimes by maternal factors depending on the species and genotype. Environmental factors can have significant effects on the germination phenotype, and these factors are known to interact with the genotype. Rapid and uniform seed germination has been selected in crops, but a moderate degree of dormancy is desirable for cereals to resist preharvest sprouting (PHS). Phenotypic expression of dormancy is often affected by environmental conditions in particular, temperature as well as by genotype. A major approach to determine the genetic architecture for seed dormancy is to dissect it into quantitative trait loci (QTL) .The isolation of dormancy QTL is challenging because the trait is relatively complex and is also rather environmentally sensitive. Therefore, genetic manipulation of this trait is one of the major goals in rice breeding. In this regard, the broad gene pool of wild and indigenous rice for seed dormancy may be used efficiently, and there is a need for allele mining in indigenous rice of India to search for novel dormancy allele, if any.

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Digital Agriculture

Article ID: 30570

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Digital Agriculture is the useful technology which integrates agriculture production from Farmers (Producers) to the consumer efficiently.

The technologies used in this aspect can provide the agricultural industry with the tools and information to make more informed decisions and help in improving the agricultural productivity

Digital Agriculture includes aspects such as Robotics, satellite imagery, Mobile services, GIS and UAVs, Internet of things, Breeding Informatics etc

Why Digital Agriculture is Must in the Present Scenario?

There are many reasons to answer this question. As we all are aware about present scenario of agriculture production and productivity and need to enhance these to meet the food requirement of upcoming population, digital agriculture is the novel way of facilitating agriculture enhancement for future need.

Digital agriculture facilitates better adoption rate through collaborative and bidirectional feedback loops resulting in farmer preferred products and services. Along with this it also provides quick ,cheaper and stable low-cost solution of an individual farmers to increase his farm productivity.

Several of elements of digital agriculture are as follows:
1. Mobile Devices: Allows real time data gathering and information dissemination
2. Digital services: Promotes rapid solution to the farmers' problems and needs.
3. UAVs and GIS: Enables temporal and spatial dimension to gather more information and be specific in precision farming.
4. Internet of things: Networks and stitch wide information about various aspects of agriculture at single platform which enables easy and quick accessibility of required information.
5. Breeding informatics: Facilitates Young and energetic breeders and various agriculture scientist to go for accelerated R&D gain in Breeding aspect for higher productivity attributes

Conclusion

Digitalization of agriculture has certain challenges to overcome.

Issues such as cyber security and data protection, labour replacement and re-education and the risk of creating a digital divide between economies with differing abilities to adopt new technologies are hurdles. But efficient and precise use of digital platform in agriculture provides easy way to move one step ahead in achieving required goal in least amount of time.

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Public Private Partnership in Agriculture: New Trend to Double Farmers Income

Article ID: 30571

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Public private partnership is a cooperative arrangement between public and private sectors, typically involves between public a unit of government and a business entity that brings better services and improve economical capacity among communities.

When the Government is short of funds for much needed project, say, establishing food processing industry, a public-private partnership, which benefits from an injection of money from the private sector, is a promising option.

Need of PPP In Agriculture

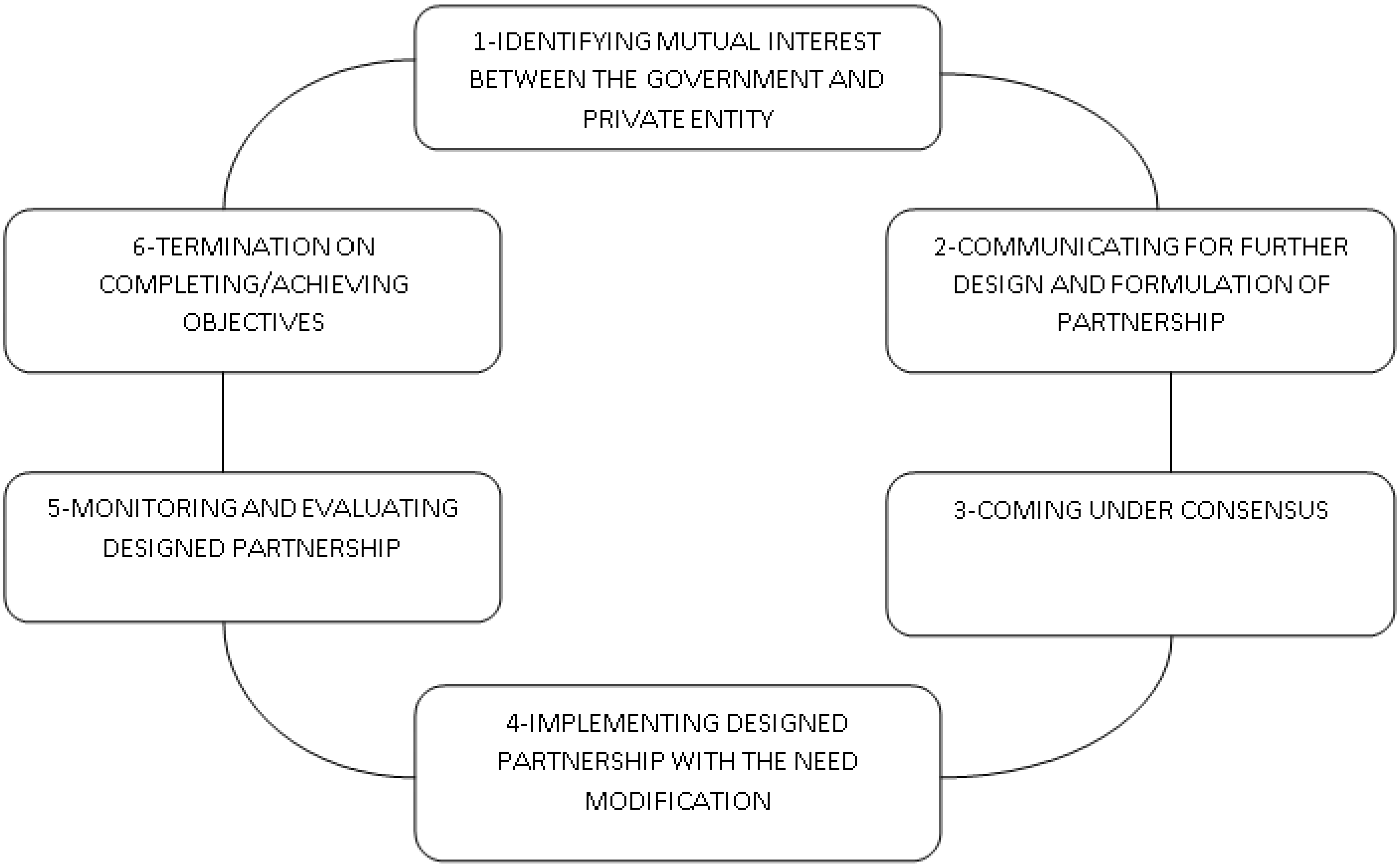
Slow growth rate of agriculture in India hinders in achieving target of doubling farmers income by 2022.

Most of farmers produce go in vain, as farmers are forced to sell what they produce without vslur addition process.

PPP in Agriculture can alter present trend by infusing funds and capacity building in agriculture sector such as by establishing value addition, processing centres with help of Government aid.

PPP Approach in Agriculture

PPP Approach in agriculture can be followed through below given cyclic approach



Some Recent Initiatives by Government of India to Form PPP in Agriculture

Recent union budget 2020 has announced to initiate new trends in agriculture through PPP. Kisan Rail caters the food chain requirements for perishable agri commodities KISAN RAIL will be set up by Indian Railways through the PPP arrangement.

Kisan Rail will comprise refrigerated coaches in express and freight trains. The budget also proposed the launch of Krishi Udan by Civil Aviation Ministry on international and national routes to transport perishable goods to less accessible areas such as the north east and tribal districts. This will also be developed under PPP arrangement.

Similarly, there is provision for funding viability gap for creation of efficient warehousing in PPP mode in rural areas.

Conclusion

68th round of NSSO survey on employment estimated about 48.9 percent workers major livelihood support comes from agriculture. Added to this approximate 70 percent of our population lives in rural areas (census 2011). According to estimation of NABARD ALL INDIA FINANCIAL SURVEY 2016-17 report cultivation and Livestock comprises about 43 percent income to average monthly income of Agri households. Backing up PPP in agriculture along with various schemes like NFSM,PMKISAN, e-NAM etc , farmers may add up more money in his pocket and this may fulfil honourable PM call for doubling farmers income by 2022.

Prospects on Development of Red Rot Resistance in Sugarcane

Article ID: 30572

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Cancer of Sugarcane (Red Rot Disease)

The sugar recovery and cane yield were drastically reduced in most of the agricultural zones due to fungal pathogen "*Colletotrichum falcatum*". It was commonly known as red rot disease after the name given by E.J. Butler in 1906. The reddened tissue with intermittent white spot is a characteristic feature of red rot infected canes. The severity of disease is highly influenced by rainfall pattern and temperature. Around 29 - 83 per cent reduction in cane weight was recorded at varied infection levels (Munir *et al*., 1986). The pathogen hydrolysis accumulated sucrose into other components *viz*., glucose and fructose by producing enzyme invertase which results in increased molasses (Sehtiya *et al*., 1993). Most of the commercial varieties *viz*., BO 3, BO 10, CO 213 and COC 617 were found highly susceptible to red rot disease. Planting of susceptible sugarcane cultivars on large scale resulted in rapid evolution of new *C. falcatum* virulent strains. Several red rot epiphytotics have been reported at global level in the past due to failure of high sucrose cultivars.

Pathogen Infection

1. It is a soil and sett borne fungal pathogen, perpetuated mainly through infected canes, diseased stubble / debris and by resting propagules in the soil.

2. The dissemination of fungal spores mainly depends on nature of infection, prevailing environment and time. Severity of disease can be observed during monsoon or post monsoon period.

3. The secondary transmission is mediated through rainfall, irrigation water and some extent by wind.

4. The pathogen infects cane primarily through cut end of setts, growth cracks in canes, leaf scar, growth ring, root primordia, and root lets.

Red Rot Resistance

Development of resistant varieties through breeding programme remains a challenging task for red rot disease. The improved resistant varieties become susceptible to new race of pathogen in a shorter time. Hence, screening of pre-release cultures for red rot resistance should be kept mandatory in order to avoid future epidemics.

Screening Criteria

Seedling selection can be implemented through spraying of spore suspension culture collected from different susceptible cultivars. Employing different races of pathogen would help to develop durable resistance for red rot. The promising cultures should be screened further at later stages by employing two common technique viz., plug method and nodal method to confirm the red rot resistance of the clones.

1. Plug method of inoculation: The *C. falcatum* culture grown on oat meal media was used to prepare spore suspension. A bore hole was punched in the centre of third internode from the bottom. Then, 0.5 ml of spore suspension was added into the bore hole. After dropping of suspension, the bore hole was sealed with clay or parafilm. The inoculated cane was split opened longitudinally after 60 days of incubation period to detect the severity of red rot symptoms.

2. Nodal method of inoculation: The top few leaf sheaths were slightly removed / pulled out to add 2 ml of spore suspension in between leaf sheath and stalk. The spore suspension comes in contact with the node. After 60 days of incubation period, the top leaves are stripped off to check the red rot symptoms in the inoculated and adjacent nodes. It is considered as natural method because the inoculum was applied without causing any injuries to the cane.

Breeding Methodologies

Development of varieties with horizontal resistance would be more promising in imparting tolerance to red rot incidence. Involvement of minor genes with additive effect would help to overcome several virulent pathotypes leading to long lasting resistance.

1. Germplasm characterization: Large scale germplasm characterization would be beneficial in identifying clones with different resistant genes for red rot. The identified resistant clones can be involved in polycross to evolve sugarcane varieties possessing race non-specific resistance.

2. In-vitro mutagenesis: Various explants of sugarcane viz., leaf, shoot apical meristem and parenchymatous pith can be utilized for callus induction. A 42-day old callus was subjected to irradiation (gamma rays) or treated with chemical mutagen (EMS & SA) to induce variants. The mutated callus was transferred to fresh medium for further proliferation. The somaclonal variants were screened for red rot resistance using a culture filtrate. The resistant callus was regenerated into plantlets. The obtained cultures were screened further at field level to confirm the presence of resistance for red rot.

3. Induced mutagenesis: The sets of high sucrose varieties were treated with different mutagens to induce novel variants. The treated setts were taken up sowing at field conditions. The population was screened to derive variants with new alleles imparting red rot resistance.

4. Transgenic approach: A red rot resistant transgenic clone was developed through expression of β-1, 3-glucanase gene from *Trichoderma* spp. The antifungal property of Trichoderma β-1,3-glucanase inhibited the growth of fungal pathogens and thereby found to exhibit direct association with resistance (Nayyar et al., 2017).

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Community Seed Bank: Combating Seed Crises in Pandemic

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Introduction

The world was living in peace and harmony, public gathering, exchanging greetings, laughing together was merely a simple and unnoticeable part of human lives. In 2019 mid-November, a contagious virus "COVID-19" emerged and soon declared as a pandemic by WHO. Out of serval heroes, two most important are medical doctors who are saving people from various and other is farmers who are at equal risk but producing enough food to feed the population of 1.3 billion, locked in homes after the declaration of lockdown.

Farmers with lots of difficulties and fear managed to complete the rabi harvesting, including harvest procurement and storage. As lockdown, period keeps on extending, and new worries such as the sowing of Kharif crops and procurement of inputs emerged boggling farmers. As it is a challenge to provide all inputs especially good quality seeds through formal seed chain amid pandemic, as the transportation system is badly hit.

From Informal Seed System to GI Tag

Although, globally India seed industry ranked 5th largest player with the robust growth, still the informal seed sector accounts for 65-70%. Many informal systems adopted by the of seed saver communities are operative, on the principle of sustainable conservation and uses of genetic resources.

One of these informal seeds systems is Community Seed Banks (CSBs) by providing the seeds to the farmers, as reaching to public seed outlets under the pandemic is difficult, especially from remote villages.

Since ages unique conservation and sharing practice of seeds in Chhattisgarh is done by tribes with a belief that their prosperity lies in conserving Land, Water, Forest and Seeds. A very unique local informal seed system called Charjhaniya, Char = four and Jhaniya = people.

In this system, the seed savers provide the seeds to those who promise to provide free seeds to next four people from their harvest, in this way the seeds of more varieties get multiplied and distributed among communities without any financial burden, it also ensures varietal diversification at farm level (fig-1).

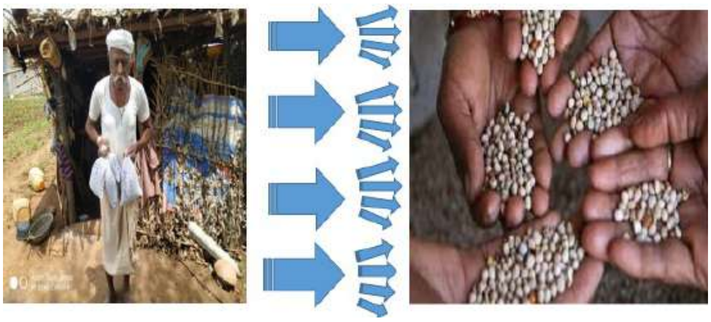

Fig 1. Traditional Concept – Charjhaniya means sharing seed by each farmer with four farmers every time

To further strengthen this farmers' initiatives , with scientific backup, the Indira Gandhi Krishi Vishwavidyalaya and Bioversity International join hands to work on the conservation, promotion and use of traditional crops genetic resources. In 2005, a group of 20 tribal women farmers from six villages in Surguja district in the central-eastern state of Chhattisgarh with interaction with Dr Deepak Sharma, Principal scientist of the university, realized the threats to the survival of their indigenous, superfine, aromatic variety of rice Jeeraphool (Fig-2). For its protection and promotion, they formed a self-help group and applied for GI and bagged GI tag under the name , which skyrocketed the demand.

Fig 2. Crop and seed of Jeeraphool rice

Zero Energy Community Seed Bank

The success of the Jeeraphool initiative was recognized and adopted by a project funded by the Global Environment Facility, supported by the United Nations Environment Programme (UNEP), and implemented by the Alliance of Bioversity International and CIAT and National Bureau of Plant Genetic Resources on behalf of Indian Council of Agricultural Research titled "Mainstreaming agricultural biodiversity conservation and utilization in the agricultural sector to ensure ecosystem services and reduce vulnerability".

To harness the benefits of unique attributes of Jeeraphool amid GI, the members of GI tag holder group named "*Javik Krishi Utpadak Sahkari Samiti Maryadit*" of *Saliyahdih Bansajhal, Ambikapur*, were brought together and established zero energy low-cost seed bank at *Saliyahdih* (Fig 3). The main aim of the seed bank is to provide pure seeds not only of *Jeeraphool* but also of other important landraces of rice and other crops.

Fig 3. Zero energy low-cost seed bank at Saliyahdih

Foreseeing the situation that emerged due to COVID19, group opined that nobody knows when this pandemic is going to end, and to break the chain of infection but not of agriculture, so group members have collected and conserved *rabi* and *kharif* seeds .

The CSB have conserved ~ 50 quintals of seeds for next *rabi* season and distributed 50 q. of Jeeraphool and 20 quintals of mutant varieties as TCDM-1, biofortified varieties Madhuraj-55, Chattishgarh Zinc rice, developed by IGKV, Raipur and 33 local rice landraces, which were confined to formal seed banks (Fig 4).

Besides, paddy CSB have also distributed pigeon pea varieties like Maghi and Chaiti arhar suitable for bund cultivation, *telia urid*, little millet and one foxtail millet.

Fig 4. Distribution of seeds to farmers from CSB under pandemic

Conclusion

Presently, Bioversity International is operating more than 30 CSBs in the country and have planned to establish more jointly with ICAR in general and IGKV in particular in Chhattisgarh. We believe that the community seed bank became a self-support system for the small and marginal farmers located in remote villages. And as special mention under COVID 19, it reduced the risk of infection by reducing the movement of farmers for purchasing of quality seeds. It is setting a new definition of safety and sustainability for the world by conserving and maintaining seed chain. The women group associated with it has always been an inspiration, as they are taking the social responsibility to spread the word about the importance of community seed bank to the farmers of other villages and to build the same model low cost zero energy community seed banks for seed security and sustainability.

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Impacts of Climate Change on Insect Pest

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Introduction

Agriculture is the basic activity by which humans live and survive on the earth. Assessing the impacts of climate change on agriculture is a vital task. In both developed and developing countries, the influence of climate on crops and livestock persists despite irrigation, improved plant and animal hybrids and the growing use of chemical fertilizers. The continued dependence of agricultural production on light, heat, water and other climatic factors, the dependence of much of the world's population on agricultural activities, and the significant magnitude and rapid rates of possible climate changes all combine to create the need for a comprehensive consideration of the potential impacts of climate on global agriculture.

Global Changes in Climate Will Influence

1. Activity, diversity and abundance of insect-pests.
2. Geographical distribution of insect-pests.
3. Development.
4. Expression of host-plant resistance to insects
5. Pest outbreaks and invasion
6. Effectiveness of crop protection technologies

Direct Impacts of Climate Change on Population Dynamics

1. Development & Reproduction.
2. Diapauses.
3. Mortality.
4. Flight & dispersal.

Impact of Climate on Insect Pest Scenario

Climate change driven global warming is affecting the distribution, demography and life history of many species, particularly insects. It is also influencing the phenology of insects including arrival times and emergence time of a range of insects. These changes are having, and will have, consequences for human livelihoods, including an increased spread of pest and diseases of important crops. Following are the notable effects of climate change on insect pest scenario and pest population dynamics.

1. Expansion of geographic ranges: Altered temperature and rainfall regimes with the predictable changes in climate will determine the future distribution, survival and reproduction of the species. With rise in temperature, the insect-pests are expected to extend their geographic range from tropics and subtropics to temperate regions at higher altitudes along with shifts in cultivation areas of their host plants. This may lead to increased abundance of tropical insect species and sudden outbreaks of insect-pests can wipe out certain crop species, entirely. At the same time; warming in temperate region may lead to decrease in relative abundance of temperature sensitive insect population. In future, projected climate warming and increased drought incidence is expected to cause more frequent insect outbreaks in temperate regions also.

Range extension in migratory species like *Helicoverpa armigera* (Hubner), a major pest of cotton, pulses and vegetables in North India is predicted with global climate warming. Subsequently, these ongoing shifts in insect-pest distribution and range due to changing climate may alter regional structure, diversity and functioning of ecosystems.

2. Increase in number of generations: As temperature being the single most important regulating factor for insects. Global increase in temperature within certain favourable range may accelerate the rates of development, reproduction and survival in tropical and subtropical insects. Consequently, insects will be capable of completing a greater number of generations per year and ultimately it will result in more crop damage.

3. Risk of introducing invasive alien species: According to the Convention on Biological Diversity (CBD), invasive alien species are the greatest threat to loss of biodiversity in the world and impose high costs to agriculture, forestry and aquatic ecosystems by altering their regional structure, diversity and functioning.

It is expected that global warming may exacerbate ecological consequences like introduction of new pests by altering phenological events like flowering times especially in temperate plant species as several tropical plants can withstand the phenological changes. Invasion of new insect-pests will be the major problem with changing climate favouring the introduction of insect susceptible cultivars or crops.

4. Impact on pest population dynamics and outbreaks: Changes in climatic variables have led to increased frequency and intensity of outbreaks of insect-pests. It may result in upsetting ecological balance because of unpredictable changes in the population of insect-pests along with their existing and potential natural enemies. Outbreak of sugarcane woolly aphid *Ceratovacuna lanigera* Zehntner in sugarcane belt of Karnataka and Maharashtra states during 2002-03 resulted in 30% yield losses. These situations of increased and frequent pest damage to the crops have made another big hole in the pockets of already distressed farmers by increasing the cost of plant protection and reducing the margin of profit.

5. Breakdown of host plant resistance: Expression of the host plant resistance is greatly influenced by environmental factors like temperature, sunlight, soil moisture, air pollution, etc. Under stressful environment, plant becomes more susceptible to attack by insect-pests because of weakening of their own defensive system resulting in pest outbreaks and more crop damage. Thermal and drought stress associated breakdown of plant resistance have been widely reported. With global temperature rise and increased water stress, tropical countries like India may face the problem of severe yield loss in sorghum due to breakdown of resistance against midge *Stenodiplosis sorghicola* (Coq.) and spotted stem borer *Chilo partellus* Swinhoe.

The environmental factors like high temperature have been found affecting transgene expression in Bt cotton resulting in reduced production of Bt toxins, this led to enhanced susceptibility of the crops to insect-pests like bollworms viz., *Heliothis virescens* (F.), *Helicoverpa armigera* (Hubner) and *Helicoverpa punctigera* (Wallen).

6. Increased incidence of insect vectored plant diseases: Climate change may lead to more incidence of insect transmitted plant diseases through range expansion and rapid multiplication of insect vectors. Increased temperatures, particularly in early season, have been reported to increase the incidence of viral diseases in potato due to early colonization of virus-bearing aphids, the major vectors for potato viruses in Northern Europe.

Pest Management Adaptations to Changing Pest

1. Breeding climate-resilient varieties: To minimize the impacts of climate and other environmental changes, it will be crucial to breed new varieties for improved resistance to abiotic and biotic stresses. Considering late onset and/ or shorter duration of winter, there is chance of delaying and shortening the growing seasons for certain Rabi/ cold season crops. Hence, we should concentrate on breeding varieties suitable for late planting and those can sustain adverse climatic conditions and pest and disease incidences.

2. Alternation in sowing dates of crops: Global climate change would cause alternation in sowing dates of crops which alter host-pest synchrony. There is need to explore changes in host plant interaction under early, normal and late sown conditions in order to recommend optimum sowing dates for reduced pest pressure and increased yield.

3. Rescheduling of crop calendars: As such, certain effective cultural practices like crop rotation and planting dates will be less or non-effective in controlling crop pests with changed climate. Hence there is need to change the crop calendars according to the changing crop environment. The growers of the crops have to change insect management strategies in accordance with the projected changes in pest incidence and extent of crop losses in view of the changing climate.

4. GIS based risk mapping of crop pests: Geographic Information System (GIS) is an enabling technology for entomologists, which help in relating insect-pest outbreaks to biographic and physiographic features of the landscape, hence can best be utilized in area wide pest management programmes. How climatic changes will affect development, incidence, and population dynamics of insect-pests can be studied through GIS by predicting and mapping trends of potential changes in geographical distribution of agro-ecological hotspots and future areas of pest risk.

5. Screening of pesticides with novel mode of actions: It has been reported that, application of neonicotinoid insecticides for controlling sucking pests induces salicylic acid associated plant defence responses which enhance plant vigour and abiotic stress tolerance, independent of their insecticidal action. This gives an insight into investigating role of insecticides in enhancing stress tolerance in plants. Such more compounds need to be identified for use in future crop pest management.

In addition to the strategies discussed above, we need to decide the future line of research and devise policies for combating the pest problems under climate change regimes. Some of these are:

a. Evolve temperature tolerance strains of natural enemies.
b. Development of Weather and pest forecasting models.
c. Developing early warning systems/decision support systems.
d. Awareness regarding impacts of climate change.
e. Adoption of mitigation and adaptation measures.
f. Sensitization of stakeholders about climate change and its impacts.
g. Farmers' participatory research for enhancing adaptive capacity.
h. Promotion of resource conservation technologies.

Conclusion

In India, pest damage varies in different agro-climatic regions across the country mainly due to differential impacts of abiotic factors such as temperature, humidity and rainfall. This entails the intensification of yield losses due to potential changes in crop diversity and increased incidence of insect-pests due to changing climate. It will have serious environmental and socio-economic impacts on rural farmers whose livelihoods depend directly on the agriculture and other climate sensitive sectors.

Dealing with the climate change is really tedious task owing to its complexity, uncertainty, unpredictability and differential impacts over time and place. Understanding abiotic stress responses in crop plants, insect-pests and their natural enemies is an important and challenging topic ahead in agricultural research. Impacts of climate change on crop production mediated through changes in populations of serious insect-pests need to be given careful attention for planning and devising adaptation and mitigation strategies for future pest management programmes.

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Entomophagy: Insects Used as a Food Sources

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Introduction

The use of insects as a reliable and sustainable source of food is called Entomophagy. Insects have played an important part in the history of human nutrition in Africa, Europe, Asia, and Latin America.

Over 1900 species of insects are known worldwide to be part of human diets; some important groups include grasshoppers, caterpillars, beetle grubs, wringed termites, bees, worms, ant brood, cicadas, and a variety of aquatic insects.

It is interesting to know that more than two billion people consume insects on a regular basis, and insect eating provides a significant proportion of the animal proteins consumed in some regions . Because entomophagy is widely practiced, and because it compares favourably with nutrient and environmental aspects of conventional livestock rearing, it has the potential to contribute substantially to reducing under nutrition among an expanding global population.

Many animals, such as spiders, lizards and birds, are entomophagous, as are many insects. insect consumption is not a new concept in many parts of the world. From ants to beetle larvae – eaten by tribes in Africa and Australia as part of their subsistence diets – to the popular, crispy-fried locusts and beetles enjoyed in Thailand.

Why Eat Insects?

There are three reasons:

1. Health:

a. Insects are healthy, nutritious alternatives to mainstream staples such as chicken, pork, beef and even fish (from ocean catch).

b. Many insects are rich in protein and good fats and high in calcium, iron and zinc.

2. Environmental:

a. Insects promoted as food emit considerably fewer greenhouse gases (GHGs) than most livestock (methane, for instance, is produced by only a few insect groups, such as termites and cockroaches).

b. Insect rearing is not necessarily a land-based activity and does not require land clearing to expand production. Feed is the major requirement for land.

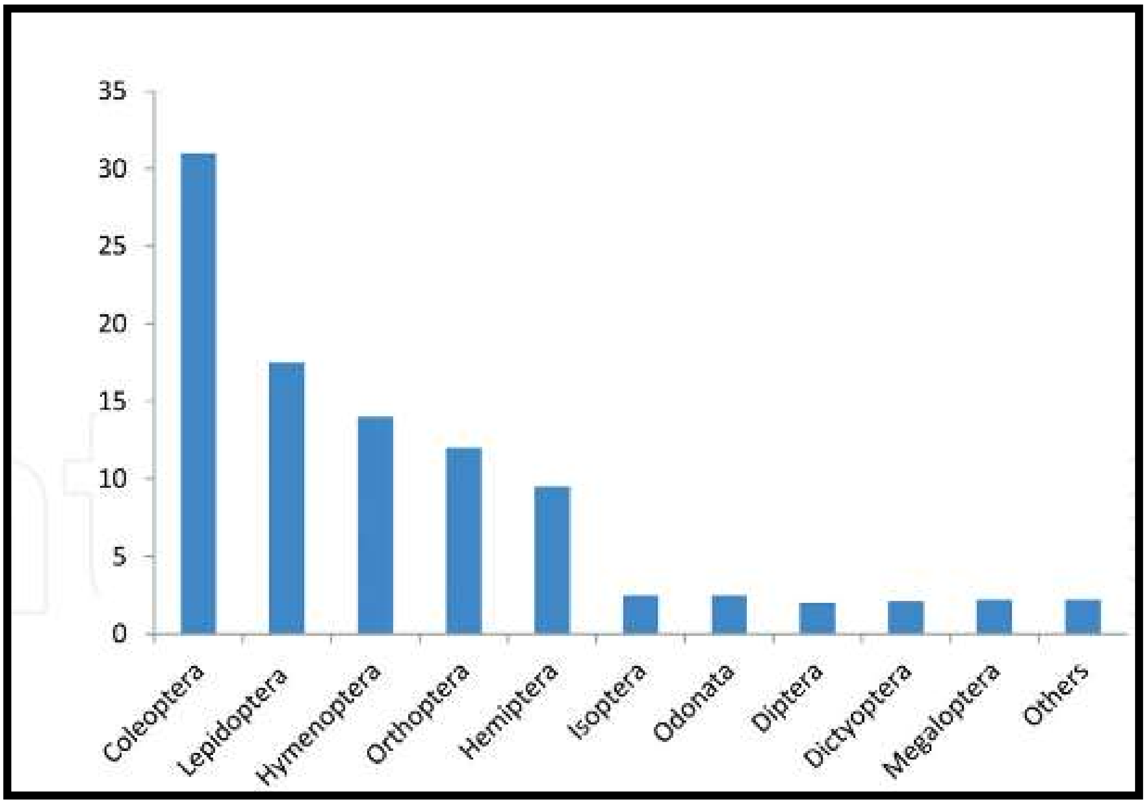
3. Livelihoods (economic and social factors):

a. Insect harvesting/rearing is a low-tech, low-capital investment option that offers entry even to the poorest sections of society, such as women and the landless.

b. Minilivestock offer livelihood opportunities for both urban and rural people. - Insect rearing can be low-tech or very sophisticated, depending on the level of investment.

Edible Insect's Orders

The most important orders of insects consumed in the world are the Coleoptera, Hymenoptera, Isoptera, Lepidoptera, Odonata, and Orthoptera, and they are highly priced. Notable examples of these are the locusts, termites, worms, grasshoppers, caterpillars, palm weevils, and beetle grubs, among others.



Source: (Jongema, 2012)

Nutritional Value of Insects for Human Consumption

The nutritional values of edible insects are highly variable, not least because of the wide variety of species. Even within the same group of edible insect species, values may differ depending on the metamorphic stage of the insect (in particular, for species with a complete metamorphosis – known as holometabolous species – such as ants, bees and beetles), and their habitat and diet. Like most foods, preparation and processing methods (e.g. drying, boiling or frying) applied before consumption will also influence nutritional composition.

insects	Proteins%	Fats%	Fiber%	Ash%	Energy kcal 100g
cockroaches	57.30	29.90	5.31	2.94	-
Beetle sand grubs	40.69	33.40	10.74	5.07	490.3
Flies	49.48	22.75	13.56	10.31	409.78
True bugs	48.33	30.26	12.40	5.03	478.99
Ants and bees	46.47	25.09	5.71	3.51	484.45
termites	35.34	32.74	5.06	5.88	-
Butterflies and moths	45.38	27.66	6.60	4.51	508.89
Grasshopper, locusts and crickets	61.32	13.41	9.55	3.85	426.23

Market Value of Edible Insects

Many rural communities like those in Africa, Asia, and South America know that eating insects provides a valuable source of protein, minerals, and vitamins as well as a tasty snack and therefore must be in high demand. Crickets, grasshoppers, and locusts, for example, are a seasonal delicacy, while the giant water beetles are used in salads.

Medicinal Value of Edible Insects

Scientific validation of traditional wisdom in bioprospecting has assured greater significance. Edible insects have long been a significant dietary factor and remedy for illnesses in many regions of the world. Traditional healers have used insects as medicine to treat various diseases in human beings and animals successfully. Some of these diseases include common fever, scabies, epilepsy, violent headaches, bronchitis, hemorrhage, and dog bite. Insects are also used to treat wound, to prevent gangrene, and to increase milk flow in lactating women, among others.

Beneficial Roles of Insects for Humans

Besides serving as sources of food, edible insects provide humans with a variety of other valuable products. A huge variety of insect species are known to have remarkable commercial and pharmaceutical values. For example, bees and silkworm have been shown to produce massive tons of honey and silk, respectively. These products can be sold in the local as well as in the international markets, while silkworms produce more than 90,000 tons of silk. Also, carmine, a red dye produced by scale insects of the order Hemiptera, is used to colour foods, textiles, and pharmaceuticals. Resilin, a rubberlike protein that enables insects to jump, has been used in medicine to repair arteries because of its elastic properties. In addition to this, other products produced by edible insects such as honey; propolis, royal jelly, and venom have been used in treating traumatic and infected wounds and burns. Furthermore, insect products have also been used in engineering methods in the production of biomaterials.

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Integrated Pest Management for Insect Pest of Soybean

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Introduction

Soybean is one of the most important leguminous crops belonging to family Leguminoceae, sub-family Papilionoceae. It is the world's largest source of animal protein feed and the second largest source of vegetable oil. The productivity potential of soybean is higher than other legumes. It is also a richest and cheapest source of quality protein which can also be used for alleviating protein calorie malnutrition. It contains around 40% protein with all the essential amino acids and 18- 20% oil besides minerals and vitamins. In India, the area, production and productivity of soybean during 2017-18 was 10.16 million (M) ha, 9.5 million metric tonnes (MMT) and 0.905 Metric tonnes (MT)/ha, respectively. While in Madhya Pradesh, it was 5.01 M ha, 4.2 MMT and 0.84 MT/ha, respectively. IPM is a knowledge-intensive sustainable approach for managing pests by combining compatible cultural, biological, chemical, and physical tools in a way that minimizes economic, health, and environmental risks with the help of pest scouts. IPM relies heavily on knowledge of pests and crop interaction to choose the best combination of locally available pest management tools .Therefore, IPM is not a single product that can be stored on shelves like pesticide, and it does not rely on single method to solve all our pest problems. Pests also co-evolve and adapt very quickly to single control tactics through natural selection, and that multiple methods used simultaneously, or an "integrated" approach, is the most effective for long-term, sustainable management programs.

List of Major Insect Pests of Soybean

1. Stem fly (*Melanagromyza sojae*).
2. Tobacco caterpillar (*Spodoptera litura*).
3. Green semiloopers (*Chrysodeixis acuta*).
4. Girdle beetle (*Obereopsis brevis*).
5. Bihar hairy caterpillar (*Spilosoma oblique*).
6. Pod borer (*Helicoverpa armigera*).
7. White fly (*Bemisia tabaci*).

Different Integrated Management Options

1. Pest Monitoring:

a. Roving survey: Survey teams should undertake regular insect pest and disease monitoring on pre-selected routes at 15 days interval and assess bio-control potential in addition to insect pest and disease situation to give early forewarnings. Record should be kept about insect pest and disease incidence and bio-potential fauna on 5 plants per spot selected randomly at 10 spots per ha. After every 10 km distance install sex pheromone trap for early deduction of S. litura @ 10 traps/ ha for mass trapping.

b. Field scouting: Field scouting should be undertaken by the farmers/ extension functionaries to keep a close watch on the appearance of insect pest, disease and bio-control fauna.

c. Pest monitoring through pheromones/light traps: Majority of insect's population can be monitored by fixing and positioning of pheromones or light traps at appropriate stage of crop. Pheromone trap-monitoring - 5 traps/ha may be used to monitor Helicoverpa/Spodoptera population.

2. Cultural practices:

a. Cleaning of infected stubbles followed by deep summer ploughing, optimal fertilizer application, timely sowing.

b. Inter-cropping soybean either with asafetida (early maturing variety) or maize or sorghum in the sequence of 4 rows of soybean with 2 rows of intercrop should be practiced.

c. NPK and S at the rate of 20:60-80: 30-40:20 kg/ ha should be applied.

d. Seed treatment by Trichoderma viride @ 5g or thiram 37.5% + carboxin 37.5% DS @ 3 g/kg seed for the management of seed, seedling and seed borne foliar diseases.

e. Use of insect resistance varieties.

3. Mechanical Practices:

a. Collection and destruction of girdle beetle infested plant parts, egg masses and gregariously feeding larvae of hairy caterpillar and tobacco caterpillar should be done.

b. Rogueing of Sclerotium affected seedlings and yellow mosaic affected plants should be undertaken.

c. Erection of bird perches @ 10-12/ha.

d. Installation of pheromone traps for monitoring incidence of *S. litura* and *H. armigera*.

e. Use of Castor as trap crop for tobacco caterpillar and Dhaincha for girdle beetle.

4. Biological Control:

a. Release Telenomus remus @ 50000/ha against *S. litura*

b. Spray SlNPV @ 250 LE/ha

c. Spray of NSKE @ 5% for management of early stage larvae and sucking pest.

d. Conserve spiders, coccinellid beetles, tachinid fly, praying mantids, dragon fly, damsel fly, Chrysoperla and meadow grass hoppers through minimum use of broad-spectrum pesticides, so as to exploit maximum potential of bio-control fauna.

e. Spray Bacillus thuringiensis var. kurstaki, Serotype H-39, 3b, Strain Z-52 @ 0.75 to 1.0 kg/ha for the management of semilooper complex (Chrysodeixis acuta, Gessonia gemma, Diachrysia orichalcea and defoliators).

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Impact of Insecticides on Environment and Human Health

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Introduction

Pesticides are substances or mixtures of substances that are mainly used in agriculture or in public health protection programs in order to protect plants from pests, weeds or diseases, and humans from vector-borne diseases, such as malaria, dengue fever, and schistosomiasis. Insecticides, fungicides, herbicides, rodenticides, and plant growth regulators are typical examples. During World War II (1939-1945), the development of pesticides increased, because it was urgent to enhance food production and to find potential chemical warfare agents. Consequently, the1940s witnessed a marked growth in synthetic pesticides like DDT, aldrin, dieldrin, endrin, parathion, and 2,4-D. In the 1950s, the application of pesticides in agriculture was considered advantageous, and no concern about the potential risks of these chemicals to the environment and the human health existed. Many of the pesticides have been associated with health and environmental issues, and the agricultural use of certain pesticides has been abandoned .Exposure to pesticides can be through contact with the skin, ingestion, or inhalation. The type of pesticide, the duration and route of exposure, and the individual health status (e.g., nutritional deficiencies and healthy/damaged skin) are determining factors in the possible health outcome. Within a human or animal body, pesticides may be metabolized, excreted, stored, or bioaccumulated in body fat .The numerous negative health effects that have been associated with chemical pesticides include, among other effects, dermatological, gastrointestinal, neurological, carcinogenic, respiratory, reproductive, and endocrine effects .Furthermore, high occupational, accidental, or intentional exposure to pesticides can result in hospitalization and death. Residues of pesticides can be found in a great variety of everyday foods and beverages, including for instance cooked meals, water, wine, fruit juices, refreshments, and animal feeds. Pesticides residues have also been detected in human breast milk samples, and there are concerns about prenatal exposure and health effects in children.

Health Effects of Pesticides

1. Acute Toxicity: Acute toxicity refers to the immediate effects of a particular dose of pesticide on human health. Acute effects can present numerous symptoms, including respiratory problems, nervous system disorders, and aggravation of pre-existing conditions such as asthma. Symptoms range from mild irritations to death. Pesticides can cause irritation of the eyes, nose, and throat; burning, stinging, itches, rashes, and blistering of the skin; nausea, vomiting, and diarrhoea; and coughing, wheezing, headache, and general malaise. Because these symptoms are similar or identical to those caused by other illnesses, acute pesticide poisoning is often misdiagnosed.

2. Chronic Effects: A substantial body of laboratory and epidemiological evidence suggests that certain pesticides are associated with carcinogenesis, immunotoxicity, neurotoxicity, behavioural impairment, reproductive dysfunction, endocrine disruption, developmental disabilities, skin conditions, and respiratory diseases such as asthma.

Chronic health effects from pesticides are problematic to study in humans because most people are exposed to low doses of pesticide mixtures, and delayed health effects are difficult to link to past exposures. Pesticides are biologically active. Some are genotoxic, others disrupt normal neurotransmitter function, while still others mimic human hormones, any of which may create subtle health effects.

3. Cancer Facts: A number of human epidemiological studies have found associations between household or occupational pesticide exposure and childhood leukemia, brain tumors, Wilm's tumor, non-Hodgkin's lymphoma, sarcomas, prostate cancer, and other cancers.

4. Reproductive and Developmental Facts: Occupational exposure to pesticides has been associated with increased risk of miscarriage and with a variety of birth defects, particularly of the musculoskeletal system.

Preventing Adverse Health Effects of Pesticide Exposure

1. Inform patients about the risks of pesticide exposure and discourage use of many pesticides in the home and garden and on pets, particularly in homes with small children or pregnant women.
2. Learn about pesticides used in local schools, hospitals, day care centres, parks, and playgrounds, and push to eliminate use of hazardous pesticides in these environments.
3. Work for strict regulation or phase-out of aerial spraying of chemical pesticides.
4. Support phase-out of the most acutely toxic pesticides, as well as those that cause cancer or reproductive harm.
5. Encourage conversion to organic food production by recommending and purchasing organic food.
6. Support increased funding for independent research to identify pesticide exposure and potential consequent health effects.

Insecticides and Their Impact on the Environment and Human Health

1. Pesticides and human health: Any workers and residents, especially in the rural sector, are in contact with pesticides on a daily basis, so they are at high risk of poisoning by these compounds. This exposure can cause neuropsychiatric squeal (mood disorders, depression, and anxiety), because many pesticides underlie changes in the function (e.g., cholinergic crisis) of the central, peripheral, and autonomic nervous system, which are often followed by suicide attempts. In addition to being causative agents of neuropsychiatric disorders that might culminate in suicide, these effects may lead to the use of pesticides as a weapon .According to data released by the World Health Organization (WHO), suicide by pesticides is common in many Asian and Latin American countries. Pesticides are often poorly controlled and widely available, particularly in countries of low and middle income.

2. Pesticides and environmental health: Pesticides reach the environment primarily during preparation and application. Application can take place via different techniques, depending on factors such as the formulation type, the controlled pest and, the application timing. In agriculture, it is possible to apply pesticides to the crop or to the soil. Liquids sprays are commonly used in crops; for example, boom sprayers, tunnel sprayers, or aerial application. Systemic pesticides can also be employed. As for soils, pesticides can be applied as granules, injected as a fumigant, or sprayed onto the soil surface, which is possibly followed by pesticide incorporation into the soil top layer. Seeds are sometimes treated with pesticides prior to planting. After application, pesticides can be taken up by target organisms, degraded, or transported to the groundwater; they can also enter the surface water bodies, volatilize to atmosphere, or reach non-target organisms by ingestion, for example. The physical and chemical properties of the pesticide, soil, site conditions, and management practices influence the behaviour and fate of pesticides.

Signs, Symptoms and Treatment of Different Classes of Pesticides

1. Organophosphorus:

a. Exposition- Skin, conjunctiva, gastro-intestinal tract and lung.
b. Signs and Symptoms- Muscatine syndrome and nicotine syndrome, resulting of excess acetylcholine in the synaptic cleft
c. Treatment- Maintenance of vital functions and cholinesterase levels.

2. Carbamates:

a. Exposition- Lungs, gastrointestinal tract, and skin.
b. Signs and Symptoms- Miosis, salivation, sweating, tearing, rhinorrhoea, behavioural change, abdominal pain, vomiting, diarrhoea.
c. Treatment- Maintenance of vital functions and cholinesterase levels.

3. Organochlorines:

a. Exposition- Lungs, gastrointestinal tract, and skin
b. Signs and Symptoms- Dizziness, headache, anorexia, nausea, vomiting, malaise, dermatitis, diarrhoea, muscle weakness, tremors, spasms, mental confusion, anxiety
c. Treatment- Maintenance of vital functions and administer diazepam and Phenobarbitals control seizures, and to monitor the airways closely.

4. Pyrethrins and Pyrethroids:

a. Exposition- Skin, lungs and gastrointestinal.

b. Signs and Symptoms- Tremors, spasms, incoordination, prostration, drooling, irregular movements of the limbs, tonic and clonic convulsions.
c. Treatment- Decontamination of the skin and eyes, besides basic maintenance of the vital functions

5. Triazines:
a. Exposition- Skin, eyes, nose and gastrointestinal
b. Signs and Symptoms- Irritation at the site of contamination. Carcinogenic and teratogenic evidences
c. Treatment- t is necessary to decontaminate the site exposed to the substance.

6. Dithio-carbamates:
a. Exposition- They show slow absorption by oral and dermal contact.
b. Signs and Symptoms- Carcinogenic and teratogenic action and thyroid problems.
c. Treatment- There is no specific treatment for poisoning.

7. Phenoxy Derivatives:
a. Exposition- Gastrointestinal and Lungs
b. Signs and Symptoms- Nausea, dizziness, vomiting. As for metabolic acidosis, clinical signs such as hyperthermia (due to uncoupling of oxidativephosphorylation)
c. Treatment- Maintenance of the vital functions, decrease the adsorption of the compounds**.**

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Identification and Management of New Invasive Pest Fall Armyworm, *Spodoptera frugiperda*

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Abstract
The fall armyworm Spodoptera frugiperda is a polyphagous pest recently arrived in India in 2018 on maize; sorghum and sugarcane crop cause severe economic losses. FAW attacked more than 350 plant species, including rice, sorghum, sugarcane and wheat. An adult female moth can lay up to a thousand eggs in her lifetime. They can travel up to 100 km in a single night. Use of cultural, biological and mechanical methods (Intercropping hand picking, dry sand, NSKE ,pheromone traps etc)for the management of fall armyworm and the last resort option for control of FAW is use of chemicals like Spinetoram ,Cholarantraniliprole, Thiamethoxam + lambda cyhalothrin etc.

Introduction
In India, maize is emerging as third most important crop after rice and wheat. Its importance lies in the fact that it is not only used for human food and animal feed but at the same time it is also widely used for corn starch industry, corn oil production, baby corns etc. Nutritionally, maize contains 60 to 68% starch and 7to 15% protein.

The Fall Armyworm, Spodoptera frugiperda is a devastating pest of maize that is native to tropical and subtropical regions of the western hemisphere from the United States of America to Argentina. The scientific name is derived from the feeding habits of the larval life stage, frugiperda meaning "lost fruit" in Latin, as the pest can cause damage to crops resulting in severe yield loss. Fall Armyworm (FAW) was reported for the first time on the African continent in early 2016. Although FAW shows a definite preference for the Poaceae it displays a wide host range attacking over 80 different plant species including major crops such as cotton, groundnuts, sorghum, wheat, potatoes, soybean and sugarcane. Its polyphagous nature presents challenges in management due to the presence of numerous alternative hosts outside the production season of main crop.

Identification
1. Egg: Eggs observed were creamy white in color and covered with greyish-brown scales. Female lays eggs on the upper or lower portion of the leaves.

2. Larva: First and second instar larva are greenish in colour with black colur hair on dorsal side with black head, while the final instars are with dark grey head and dull grey body with white sub-dorsal and lateral white lines. The mature larva is with a typical inverted 'Y' on head capsule and with distinct black spots on the body. Arrangement pattern of black spots is square on 8th and trapezoidal on 9th segment.

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3. Pupa: Pupa is reddish brown in color and pupation occurs in the soil or sometimes in the leaf folds.

4. Adult: Adult male moths were greyish-brown .Forewings of adult female lack distinct markings and dark grey coloured orbicular elongate spots were observed on the outer margins of forewing.

Management

1. Monitoring: Installation of pheromone traps @ 5/acre.

2. Scouting: Start scouting in 'X' or 'zig-zag' direction as soon as maize seedlings emerge. Check your maize at least twice per week after germination. Checking should be done early in the morning or at sunset because this is when the

FAW caterpillars are most active. Walk through your maize farm in an 'X' or 'zig-zag' direction checking for signs of the pest (eggs and larvae) and its damage. If FAW is present then we recommend taking protective measures immediately. If any egg masses are encountered during monitoring, these should be removed and crushed to prevent them from hatching into the damaging stage of larvae.

3. Cultural:

a. Deep ploughing is recommended before sowing. This will expose FAW pupae to predators.
b. Plant your maize at the start of the rains, to avoid the peak migration of FAW adult moths. Avoid late and off-season planting and staggered planting of maize.
c. Plant maize during the long rains season in your region, but grown on-cereal alternative crops in the short rains season.
d. Add manure or compost to your fields and fertilize your crops to maintain high soil fertility to make your crops grow well and make them compensate for any FAW damage better.
e. Intercropping of maize with suitable pulse crops of particular region. (eg. Maize + pigeon pea/black gram /green gram).
f. Erection of bird perches @ 10 /acre during early stage of the crop (up to 30 days)
g. Sowing of 3-4 rows of trap crops (eg. Napier) around maize field and spray with 5% NSKE or azadirachtin 1500 ppm as soon as the trap crop shows symptom of FAW damage.
h. Cultivation of maize hybrids with tight husk cover will reduce ear damage by FAW.

4. Mechanical control:

a. Hand picking and destruction of egg masses and neonate larvae in mass by crushing or immersing in kerosene water.
b. Application of dry sand in to the whorl of affected maize plants soon after observation of FAW incidence in the field.
c. Soil application inside the whorls
d. Mass trapping of male moths using pheromone traps @15/acre.

5. Bio-control strategies: Augmentative release of Trichogramma pretiosum Or Telenomus remus @ 50,000 per acre at weekly intervals or based on trap catch of 3 moths/trap

6. Biopesticides:

a. Application of Metarhizium anisopliae talc formulation (1x108 cfu/g) @ 5g/litre whorl application at 15-25 days after sowing. Another 1-2 sprays may also be given at an interval of 10 days depending on pest damage
b. Nomuraea rileyi rice grain formulation (1x108 cfu/g) @ 3g/litre whorl application at 15- 25 days after sowing. Another 1-2 sprays may also be given at an interval of 10 days depending on pest damage
c. Application of Bacillus thuringiensis var kurstaki formulations @ 2g/litre (or) 400g/acre
d. To control FAW larvae at 5% damage to reduce hatchability of freshly laid eggs, spray 5% NSKE OR Azadirachtin 1500 ppm @ 5ml/ litre of water.
e. To manage 2nd and 3rd instars larvae at 10-20% damage spray Spinetoram 11.7% SC @ 0.5 ml/litre of water OR Thiamethoxam 12.6% + lambda cyhalothrin 9.5% @ 0.25 ml/l of water OR Chlorantraniliprole18.5% SC @ 0.4 ml/litre of water.
f. Apply Spraying chemicals on fall armyworm very early in the morning or late in the evening to maximize their effectiveness. Chemicals take time to work on the FAW caterpillars, do not expect instant results. Be patient and check for fresh signs of FAW infestation after 2 weeks before making a decision on the need to spray again.

Conclusion

The fall armyworm has recently been introduced in India. In this regard, adoption of suitable management strategy is a key criterion for the management of the fall armyworm. If fall armyworm is not properly managed will cause huge crop losses. Farmers are advised to use FAW control operations to minimize crop damage from this pest. There is a need to increase awareness among the farming communities about the life cycle, Symptoms and identification of the pest and its best possible management options.

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Role of Plant Secondary Metabolites

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Introduction

In natural systems, plants face a plethora of antagonists and thus possess a myriad of defence and have evolved multiple defence mechanisms by which they are able to cope with various kinds of biotic and abiotic stress. Generally, it is difficult to assign a change in the physiology of metabolism of the crop to a specific stress factor as normally a complex variety of various stress factors affects the plant simultaneously. However, there are inter-connections that exist between distinct and opposing signalling response pathways for defence against pathogens and insect herbivores and there also appear to be multiple response pathways invoked, depending on the specific stress context. Besides antimicrobial nature, some of which are performed and some of which induced by infection. There are various other modes of defence include the construction of polymeric barriers to pathogen penetration and the synthesis of enzymes that degrade pathogen cell wall. In addition, plants employ specific recognition and signalling systems enabling the rapid detection of pathogen invasion and initiation of vigorous defensive responses. Once infected, some plants also develop immunity to subsequent microbial attacks. Plants produce a high diversity of natural products or secondary metabolites with a prominent function in the protection against predators and microbial pathogens on the basis of their toxic nature and repellence to herbivores and microbes and some of which also involved in defence against abiotic stress (e.g. UV-B exposure) and also important for the communication of the plants with other organisms and are insignificant for growth and developmental.

Principal groups Plant secondary metabolites can be divided into three chemically distinct groups.
1. Terpenes
2. Phenolics
3. N and S containing compounds.

Terpenes

It composed of 5-C isopentanoid units, are toxins and feeding deterrents to many herbivores. Terpenes constitute the largest class of secondary metabolites and are united by their common biosynthetic origin from acetyl-coA or glycolytic intermediates. A vast majority of the different terpenes' structures produced by plants as secondary metabolites that are presumed to be involved in defence as toxins and feeding deterrents to a large number of plants feeding insects and mammals . Below, several examples will draw from the 5 major subclasses:

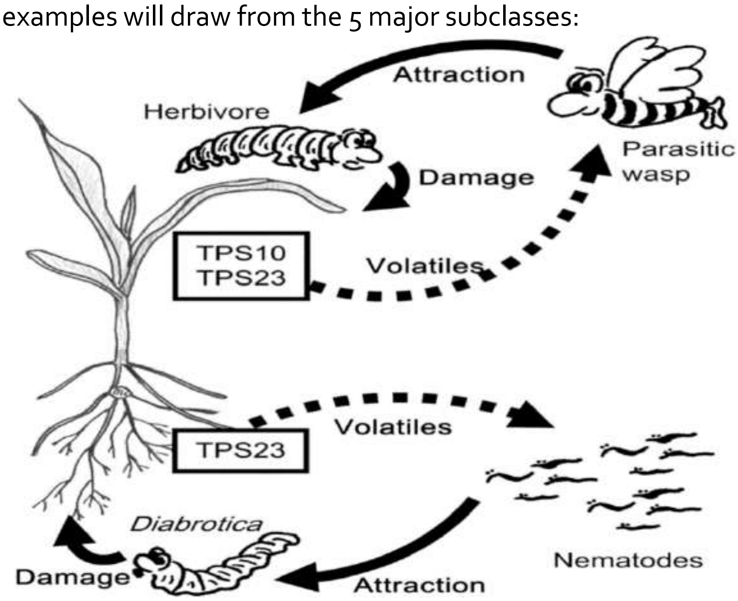

Figure 1.Scheme of terpene-mediated interactions of a maize seedling above and below ground. Damage of maize leaves by lepidopteron herbivores activates the terpene synthases TPS10 and TPS23, which produce a blend of volatile terpenes. This blend attracts several species of parasitic wasps. Damage of the roots by D. virgifera activates the terpene synthase TPS23. The volatile terpene produced by TPS23, (E)-β-caryophyllene, attracts entomopathogenic nematodes.

Below, several examples will draw from the 5 major subclasses:

1. Monoterpenes (C 10): Many derivatives are important agents of insect toxicity. For example, the pyrethroids (monoterpenes esters) occur in the leaves and flowers of Chrysanthemum species show strong insecticidal responses (neurotoxin) to insects like beetles, wasps, moths, bees, etc. and a popular ingredient in commercial insecticides because of low persistence in the environment and low mammalian toxicity.

In Gymnosperms (conifers) like Pine and Fir, monoterpenes accumulate in resin ducts found in the needles, twinges and trunks mainly as α-pinene, β-pinene, limonene and myrcene, all are toxic to numerous insects including bark beetles, serious pest of conifer species throughout the world.

2. Sesquiterpenes (C 15): A number of sesquiterpenes have been till now reported for their role in plant defence such as costunolides are antiherbivore agents of family composite characterized by a five membered lactone ring (a cyclic ester) and have strong feeding repellence to many herbivorous insects and mammals.

3. Diterpenes (C 20): Abietic acid is a diterpene found in pines and leguminous trees. It is present in or along with resins in resin canals of the tree trunk. When these canals are pierced by feeding insects, the outflow of resin may physically block feeding and serve as a chemical deterrent to continued predation .Another compound phorbol (diterpene ester), found in plants of Euphorbiaceae and work as skin irritants and internal toxins to mammals.

4. Triterpenes (C 30): like glucosides (sterols) that protect them against herbivory by most insects and even cattle .Phytoecdysones have some defensive role against insects by disrupting moulting and other developmental and physiological processeswith lethal consequences.

5. Polyterpenes (C5): Several high molecular weight polyterpenes occur in plants. Larger terpenes include the tetraterpenes and the polyterpenes. The principal tetraterpenes are carotenoids family of pigments. Other one is rubber, a polymer containing 1500-15000 isopentenyl units, found in long vessels called laticifers, provide protection as a mechanism for wound healing and as a defence against herbivores.

Phenolic Compounds

Plants produce a large variety of secondary products that contain a phenol group, a hydroxyl functional group on an aromatic ring called Phenol, a chemically heterogeneous group also. They could be an important part of the plants defence system against pests and diseases including root parasitic nematodes.

1. Coumarin: They are simple phenolic compounds, widespread in vascular plants and appear to function in different capacities in various plant defence mechanisms against insect herbivores and fungi. They derived from the shikimic acid pathway, common in bacteria, fungi and plants but absent in animals. Also, they are a highly active group of molecules with a wide range of anti-microbial activity against both fungi and bacteria.

It is believed that these cyclic compounds behave as natural pesticidal defence compounds for plants and they represent a starting point for the exploration of new derivatives possessing a range of improved antifungal activity (figure 2). Some coumarin derivatives have higher anti-fungal activity against a range of soil borne plant pathogenic fungi and exhibit more stability as compared to the original coumarin compounds alone.

2. Furano-coumarins: Normally, these compounds are not toxic, until they are activated by light (UV-A), causes some furano-coumarins to become activated to a high energy electronic state, which can insert themselves into the double helix of DNA and bind to the pyramidinebases and thus blocking transcription and repair and eventually leading to cell death .

3. Ligin: It is a highly branched polymer of phenyl-propanoid groups, formed from three different alcohols viz., coniferyl, coumaryl and sinapyl which oxidized to free radicals (ROS). Its physical toughness deters feeding by herbivorous animals and its chemical durability makes it relatively indigestible to herbivores and insects' pathogens.

4. Flavonoids: One of the largest classes of plant phenolic, perform very different functions in plant system including pigmentation and defence. Two other major groups of flavonoids found in flowers are flavones and flavonols function to protect cells from UV-B radiation.

5. Isoflavonoids: Isoflavonoids are derived from a flavonone intermediate, naringenin, ubiquitously present in plants and play a critical role in plant developmental and defense response. They secreted by the legumes and play an important role in promoting the formation of nitrogen-fixing nodules by symbiotic rhizobia .

6. Tanins: It included under the second category of plant phenolic polymers with defensive properties. Most tannins have molecular masses between 600 and 3000. Tannins are general toxins that significantly reduce the growth and survivorship of many herbivores and also act as feeding repellents to a great diversity of animals.

Sulphur Containing Secondary Metabolites

They include GSH, GSL, phytoalexins, thionins, defensins and allinin which have been linked directly or indirectly with the defence of plants against microbial pathogens.

1. GSH: It is one of the major forms of organic S in the soluble fraction of plants and has an important role as a mobile pool of reduced S in the regulation of plant growth and development. It is rapidly accumulated after fungal attack, may act as systemic messenger carrying information concerning the attack to non-infested tissues.

2. GSL: A group of low molecular mass N and S containing plant glucosides that produced by higher plants in order to increase their resistance against the unfavourable effects of predators, competitors and parasites because their break down products are release as volatiles defensive substances exhibiting toxic or repellent effects.

For example, mustard oil glucosides in *cruciferae* and allylcys sulfoxides in allium. The resulting aglycon rearranges with loss of the sulphate to give pungent and chemically reactive products, including isothiocyanates and nitriles, function in defence as herbivorous toxins and feeding repellent.

3. Phytoalexins: Phytoalexins are synthesized in response to bacterial or fungal infection or other forms of stress that help in limiting the spread of the invading pathogens by accumulating around the site of infection, appears to be a common mechanism of resistance to pathogenic microbes in a wide range of plants .

4. Defensins, thionins and lectins: All these are S-rich non-storage plant proteins synthesize and accumulate after microbial attack and such related situations. All of which inhibits the growth of a broad range of fungi. Some defensins are antifungal or occasionally anti-bacterial activity. Accumulation of thionins in the cell wall of infected wheat spikes of resistant wheat cultivars indicating that the accumulation of thionins may be involved in defence responses to infections and in spreading of Fusarium culmorum. Some plant species produce lectins as defensive proteins that bind to carbohydrate or carbohydrate containing proteins. After being ingested by herbivores, lectins bind to epithelial cell lining of the digestive tracts and interfere with nutrient absorption.

Nitrogen Containing Secondary Metabolites

Most of them are biosynthesized from common amino acids. All are of considerable interest because of their role in the anti-herbivore defence and toxicity to humans.

1. Alkaloids: A large family of N containing secondary metabolites found in approximately 20% of the species of vascular plants most frequently in the herbaceous dicot and relatively a few in monocots and gymnosperms. Generally, most of them, including the pyrrolizidine alkaloids (PAs) are toxic to some degree and appear to serve primarily in defence against microbial infection and herbivoral attack.

They are usually synthesized from one of the few common amino acids, in particular, aspartic acid, lysine, tyrosine and tryptophan. Now most alkaloids are believed to function as defensive elements against predators, especially mammals because of their general toxicity and deterrence capability. Large number of live stocks death is caused by the ingestion of alkaloids containing plants.

2. Cyanogenic glucosides: They constitute a group of N-containing protective compounds other than alkaloids, release the poison HCN and usually occur in members of families viz., Graminae, Rosaceae and Leguminosae (Seigler, 1991).

They are not in themselves toxic but are readily broken down to give off volatile poisonous substances like HCN and H2S when the plant is crushed; their presence deters feeding by insects and other herbivores such as snails and slugs.

3. Non-protein amino acids: Many plants also contain unusual amino acids called non- protein amino acids that incorporated into proteins but are present as free forms and act as protective defensive substances .For examples, canavanine and azetidine-2-carboxylic acid are close analogy of arginine and proline respectively. bind specific molecules originating from pathogens and alert the plant to the pathogen's presence.

The specific pathogen molecules recognised are referred to as elicitors include proteins, peptides, lipids etc. arising from the pathogen wall, the outer membrane or a secretion process can induce phytoalexins production and activate other defence reactions genes Some protein elicitors are boehmerin, harpin or INF1 .All R-gene products themselves are nearly proteins with a leucine rich domain that is repeated in exactly several times in the amino acids sequence .Similarly, β amino-butyric acid can induce disease resistance in Arabidopsis against the fungal pathogen *Hyaloperonospora arabidopsis* and bacterial pathogen (*Pseudomonas syringae*).

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Forensic Entomology: Insect Use as Evidence

Article ID: 30580

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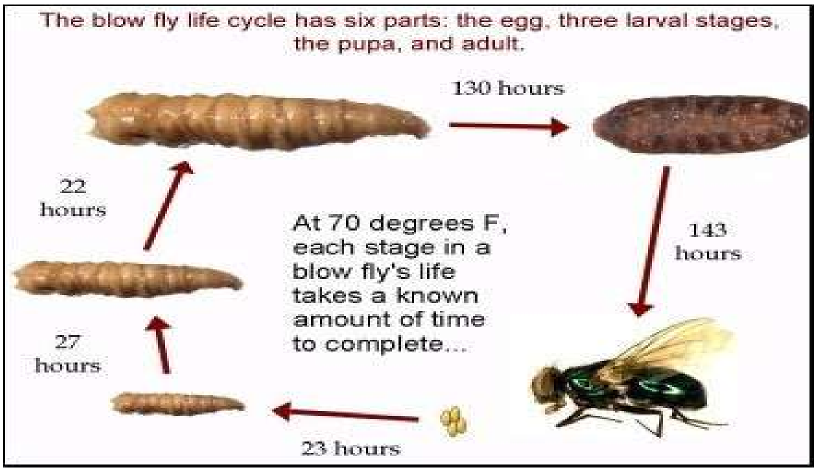
Introduction

Forensic entomology is the analysis of insect evidence for forensic and legal purposes. The insects and other arthropods that feed on decaying remains to aid legal investigations. Forensic entomology Divided into three different branches: urban, stored products and medicolegal. First recorded incident was use of Insects in a criminal investigation in 13th-century China(described in Sung Tzu's book called the washing away of wrongs)When a farmer was found murdered in a field with a sharp weapon, all the suspects were told to place their sickles on the ground. Only one sickle attracted blow flies to the trace amount of blood hidden to the naked eye which resulted in the confession by the murderer. The earliest work has been done by Mackenzie in whom he made observations on dead bodies about the times of appearance of eggs and maggots. Dr. Pankaj Kulshrestha of Medico Legal Institute, Madhya Pradesh has published few papers in case studies of post mortem interval estimation based on flies infesting human corpses.

Major Insects Used in Investigations

1. Flies (blow fly, Flesh flies,house fly, Cheese flies etc.)
2. Beetles (Rove beetles, Hister beetles, Scarab beetles, Carrion beetles etc.).

Most Important Insect for Investigations Blow Fly (Life Cycle)



Estimating the Minimum Post-Mortem Interval (PMI)

Time since death (the time between death and corpse discovery) this is called post-mortem interval or PMI. It helps in Movement of the corpse, Manner and cause of death, Association of suspects with the death scene, detection of toxins, drugs, or even the DNA of the victim through analysis of insect larvae.

Stages of Decomposition

Fresh stage: Blowflies have detected the cadaver; Eggs are being laid, often around the eye, nostrils, mouth, followed by anus or genital openings. At death: Flies begin to arrive. The estimation of the time of death by entomological data after 24 hrs is more accurate than medical examiner's estimation based on the soft tissue examination. Insects were seen attracted within the first 10 min of death to the carcass but no egg laying (oviposition) was found during this state. Cellular breakdown occurs during this stage without morphologic alterations. Even though morphological changes and doors are not obvious to humans, the chemicals released from the cellular breakdown attracts insects even in this early stage.

Bloated stage (Days 2-7): Putrefaction begins at this stage. Gases produced by the metabolic activities of anaerobic bacteria cause an inflation of the abdomen and the carcass forming a balloon-like appearance during the later part. Arthropod activities combined with the putrefaction processes cause internal temperatures of the carcass to rise.

Decay stage (Days 5-13): Abdominal wall is penetrated, resulting in the deflation of the carcass and ending the bloated stage, the internal temperature rises to 14 degrees above the ambient temperature followed by a drop signifying the end of the decay stage. Decaying odours are high during increased temperatures and drop with a fall in temperature. There is a steady decrease in the weight of the carcass by 10th day. There is a conversion of carcass biomass to dipteran larval biomass. The larvae subsequently depart from the carcass to pupate.

Post-decay stage (Days 10-23): The post-decay stage begins when most of the Diptera larvae leave the carcass, leaving behind bones, cartilage, hair, small portions of tissue, and a large amount of wet, viscous material known as by-products of decay (BOD).

Dry stage (days 18-90): This stage is characterized by bones with little cartilage remaining and the BOD has dried up. The transition from post-decay to dry stage is gradual, with declining adult and larval Diptera populations.

Forensic Entomologists apply their knowledge of entomology to provide information for criminal investigations.

A Forensic Entomologist's Job May Include

1. Identification of insects at various stages of their life cycle, such as eggs, larva, and adults. Collection and preservation of insects as evidence.
2. Determining an estimate for the post-mortem interval or PMI (the time between death and the discovery of the body) using factors such as insect evidence, weather conditions, location and condition of the body, etc.
3. Testifying in court to explain insect-related evidence found at a crime scene.

Use of Forensic Entomology

1. The presence of insects on the body that are not found in the area suggests the body was moved, and may indicate the type of area where the murder took place.
2. If the insect cycle is disturbed, it may suggest that the killer returned to the scene of the crime.
3. The entomologist may be able to estimate the date of death and possibly the date of the return of the killer.
4. If maggot activity occurs away from a natural opening, this may indicate a wound. For example, maggots on the palm of the hands suggest defence wounds.

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COVID-19 and its Genetic Constitution

Article ID: 30581

Jahnawi Aparajita, Dharmendra Kumar

The novel coronavirus now termed severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) that causes coronavirus disease 2019 (COVID-19) first appeared in Wuhan, Hubei Province, China, but has since spread over most of the inhabited world. SARS-CoV-2 is a single-stranded RNA virus, the seventh coronavirus known to infect humans. Among these, only the SARS, MERS, and SARS-CoV-2 are known to cause severe clinical disease in humans. Agent factors connected to the variation in the disease manifestations are less well recognized. At present, there are over 30,000 genomes available on various public databases like the Global Initiative on Sharing All Influenza Data (GISAID), many of which had accompanying patient data. Using this data, the researchers looked at 152 complete viral genomes from this database with the related patient data to identify the genetic variations that are potentially linked to the severity of COVID-19, via a genome-wide association study (GWAS).

Using this data, the researchers looked at 152 complete viral genomes from this database with the related patient data to identify the genetic variations that are potentially linked to the severity of COVID-19, via a genome-wide association study (GWAS).

The patient data associated with these genomes was clear enough to allow the patient to be classified as either symptomatic or asymptomatic. The investigators constructed the phylogenetic tree based on the maximum likelihood to visualize how these isolates were related to each other and to other sequences.

The study found that the isolates were very diverse, comprising 16 distinct lineages. However, symptomatic isolates came from almost every lineage, while most of the asymptomatic strains were from lineage B and B.5.

Again, asymptomatic viruses were from patients in Japan and India, while symptomatic isolates came from almost anywhere. In other words, 60/72 asymptomatic strains were from Japan, and 6 from India. On the other hand, 17/80, and 4/80 symptomatic strains were from Japan and India, respectively. The remaining 59 symptomatic strains came from a broad range of countries.

The GWAS performed by the researchers was meant to pick up gene variants that might be linked to COVID-19 severity. They found genetic variations at position 11,083 to be significantly correlated with disease severity. This genomic position was repeated in 75% of all bootstrap trees.

Two variations were found at this site, thymine in about 49% and guanine in 47%, while in 5 sequences, the nucleotides were undetermined. The thymine variation was more likely to be found in asymptomatic infection and the guanine variant in symptomatic.

When the relative risk ratio was calculated for symptomatic disease, the G variant is 4.5 times more likely to be associated with symptoms than the T variant. The odds of symptomatic disease are 37 times higher for the former variant.

A small Shanghai study of 112 patients showed the T variant to be about twice as prevalent in asymptomatic patients compared to symptomatic cases, but not significantly. The current researchers attribute this to the small sample, and the clustering of mild and asymptomatic cases with severe cases, leading to a masking effect.

A second study identified this site as being subject to positive selection pressure, which agrees with the current study. The nearest genetic code to this genome is in the bat CoV, which has a G at this locus. This suggests that G is the original base at this site, prompting the current researchers to call this the 11083G>T.

This mutation is found in the non-structural protein nsp6, and causes the amino acid to change from leucine to phenylalanine.

The interaction between the viral RNA and host microRNAs is thought to underlie the development of disease in viral infection. The present study examines the possibility that the T and G variants act differently because they bind to human miRNAs differently. The two miRNAs that are predicted to bind the G variant uniquely on the positive strand are miR-485-3p and miR-539-3p, both of which have the same nucleotide sequences at the 11,083 location.

Another study shows that miR-485 can reduce antiviral immunity through its interaction with the mRNA that transcribes the retinoic acid-inducible gene I (RIG-1). This gene gives rise to a protein that senses and responds to the presence of viral RNA in the host cell and triggers the antiviral response of the cell. The different ways in which these two variants bind to the miR-485-3p could result in different types of immune response and, therefore, different levels of severity of COVID-19.

The RIG-1 is a pathway that causes the production of the inflammatory cytokine TNF-α, setting off the uncontrolled inflammatory scenario that is called the cytokine storm. Therefore, another possibility is that the G variant might produce RNAs that preoccupy the miR-485-3p, as a result of which the RIG-1 pathway is expressed at an extremely high level and in an unregulated manner. This leads to massive overproduction of TNF- α and severe or critical disease. This theory needs more research to build up a picture of the interaction between these two elements.

The sequestration of miR-539-3p could also happen due to its interaction with the G variant, causing the increased expression of the Jagged1 factor that promotes new blood vessel formation. This miRNA can also increase the level of autophagy. It is interesting that the mutation of interest occurs in the nsp6 that is known to block host autophagy. This could hinder the ability of the cell to transport viral components to the lysosome to be broken down, resulting in a setting favourable for viral infection and making for a severe form of the disease.

The researchers' comment: "Our results have potential applications for the development of better, and more informative test kits, potentially allowing for asymptomatic cases to be distinguished from symptomatic cases." The use of bioinformatics has allowed hypotheses to be generated about the differential virus-host miRNA interaction in the two identified variants. The targeting of the G variant by human miRNAs could explain the variation in severity with these two variants. More research is required to understand how these variations are important in real life.

Rice Bran Oil: Demanding Escalation in Production

Article ID: 30582

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It is also known as RBO. The oil extracted from husk of rice and used as multipurpose healthy source for human consumption. As we all are aware of this genuine fact that agriculture is the back bone of Indian economy. And the nature had provided India with diverse climate tropical, sub-tropical and temperate, this environmental variation observed in India had made us one of the most diversified sectors in the whole world. If we ever want to stand amongst the top ones in this race of global development, then surely one will have to pass through the path of agriculture. Agriculture provides food which is the basic need for which humans are living in this earth. The diversity contains many major crops along with one which act as plate filler for 90% of Asian population.

India second highest production after china, add India's name among the leading producer of the staple food of Asia. Every substitute of plant or crop has its own value and that's true for rice too. The paddy seed hulled and milled, to obtain the rice grain. Do we know that the outer coat of grain which is removed during milling and polishing contain many helpful nutrients that can add up to our health? The coat called Bran. The oil obtained though this bran is called rice bran oil (RBO). The word RBO pop up many questions in our minds, lets discuss them one by one, in order to clarify the mystery of benefit behind this stuff which was once considered as waste. RBO is more popularly known as Heart Oil in Japan. Now, it is emerging as a popular cooking oil in several Asian countries, especially for deep and shallow frying applications (Yogita et al., 2017).

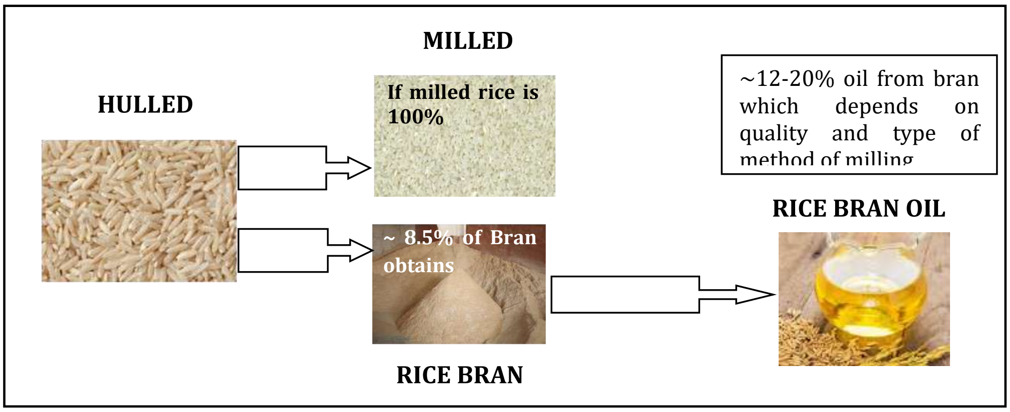
The recent edible oil scenario revealed the steadily increase in per capita consumption of edible oil in India, leads to increase in its import and causing many healthy related problems like diabetes, high blood pressure, high cholesterol etc. The import of edible oil raises approx. 65% in last 50 years. The global development in last decades in India not only enhances the standard of living and daily life style of people but also alter their daily food habits. The fast track life, unhealthy junk food, bad oil consumption all leads to shortening of human lives. The healthy oil in this era is not the demand instead became the need of human cosines. The rice bran oil is the oil come out of waste of rice, had added advantages to health along with low cost. India being leading in rice production has inherent ability to enhance bran oil production. With the launch of Fortune Rice Bran Health in 2012, the first brand to promote 100 RBO, and subsequent promotions by other brands, rice bran oil has been in the limelight (world grain article)

What is RBO?

RBO signifies RICE BRAN OIL. From ancient times, farmer is growing paddy and give in market for processing, polishing, if you ask them, do they know about the "bhushi" remained after milling? Most probably the answer would be- they give it to animals or just thrown them in field. The marginal farmers living their lives in most critical situations and invest every single penny of their pockets to grow a crop. They are needed to be aware about, all possible way they can use the residue of grains in selling. The polishing waste can add up to farmer's income and will improve the living of farmers. The husk of rice left after milling and polishing undergoes high temperature treatment, in order to prepare the raw for extraction of oil from it. The oil obtained from extraction and refinement of this raw is termed as Rice Bran Oil {RBO}.

The various health benefits it provides are:-
1. Cholesterol
2. Menopause
3. Antioxidant stability
4. Calcium absorption.
5. Insulin resistance

A clinical study with 3.1 g/day of RBO unsaponifiable over a 12-month period resulted in a 14.1 reduction in total cholesterol and a 20.5 reduction on LDL-cholesterol. The amount of unsaponifiable compounds present in commercial RBO is dependent on refining processes (Orthoefer et al., 1996) The rice bran oil potential for production is ~1.32 million metric tonne per annum, but we are actually producing 0.80 million metric tonne per annum only. The almost 40 % of potential is still remained unexplored in India.



RBO Chemical Composition and Outline of Micro-Nutrient

Fatty Acids Composition of RBO closely matches the recommendations of AHA, WHO & ICMR, and is highly beneficial in lowering bad cholesterol (LDL) while improving HDL (good cholesterol): LDL ratio to reduce possibilities of atherosclerosis. RBO typically contains 22 of saturated fatty acid (SFA), 43 of monounsaturated fatty acid MUFA and 35 of polyunsaturated fatty acid (PUFA). This composition is extremely close to the American Heart Association AHA and World Health Organization (WHO) recommendations on edible oils (Mehta et al., 2014).

Table 3: Chemical Composition of RBO

Chemical composition of RBO Composition %	
Triacylglycerols (80.5%)	Wax (2.9%)
Free Fatty acids (6.8%)	Phosphatides (1.3%)
Diacylglycerols (4.8%)	Oryzanol (2.0%)
Monoacylglycerols (1.7%)	

The oryzanol is known for its cholesterol reducing property by increasing bile excretion. RBO is extensively used as premium edible oil in most of the Asian countries Thus, Indian agriculture should put more emphases in this sector of science. Not only farmer, the research worker should also work more in this sector to unveil some hidden factual potential.

The Micro Nutrient Profiling and the Benefit it Provides

Oryzanol = 1.2-1.7%

- It is found only in Rice Bran Oil, not other vegetable oils. Oryzanol helps to lower cholesterol by reducing cholesterol absorplon and liver cholesterol synthesis
- Treats nerve imbalance & Menopause disorder, Anti-aging effects, Antidandruff and anti-itching agent.

Tocopherols=0.02-0.08 % & Tocotrienols (Vitamin-E) =0.025-0.17

- It is a type of Vitamin E found the most in Rice Bran Oil. It helps to inhibit Cholesterol synthesis
- The former, Antioxidant, Free radical scavenger, Reduce risk of cardio vascular diseases, arthritis, cancer and cataract, Anti-tumor activities.
- The latter, Atheroscelerosis, Anti-cancer (breast, liver) tumor suppression, Antioxidant.

Squalene = 0.3-0.4%

- It is reported to be a quencher of singlet oxygen and a free radical scavenger and it has been shown to maintain the texture of skin. It is well known for its anti-wrinkle properles.

Phytosterols

- It is found more in RBO than in other vegetable oils. RBO contains up to 18,000 ppm Phytosterols, which help reducing cholesterol absorplon.

What is the Actual Process of Bran Formation?

Rice bran comes from the outer layer of paddy which contain high amount of nutrition but this benefit remains unseen until one such scientist work on this aspect. The husk of rice left after milling and polishing undergoes high temperature treatment, to prepare the raw for extraction of oil from it. The oil obtained from extraction and refinement of this raw is termed as Rice Bran Oil {RBO}. The bran oil formation is explained under three heads.

Rice Bran Oil Manufacturing Process

Rice bran oil expelling, extraction and refining are the processes leads to rice bran oil.

1. Rice Bran Raw Material Preparation: The raw material is prepared by steam heating the husk at 100 degree Celsius to stop lipase hydrolysis. Rice bran is first screened and then heated by steam at temperature higher than 100 degrees Celsius to stop Lipase hydrolysis in rice bran prior to extraction.

2. Rice Bran Oil Extraction: The extraction of crude bran oil can be done through two process- mechanical with oil presses or chemical method with solvent. The bran preparation continues until the required stabilization is obtained. Then, it is sent to an extraction area, where defatted rice bran and high-quality crude rice bran yielded from oil.

3. Rice Bran Oil Refining: Refining is the finest clearing of crude oil and remove majority of free fatty acid, made it useful for agriculture and animal purpose. During refining the edible oil bleaching leaves odour and minor flavour that must need to be removed though steam distillation before packing. However, the consumers sometimes demand for dewaxed oil, for such purpose one must go through one step of dewaxing before distillation. The steam distillation is last step of refinement after which the oil free from fatty acid is ready to be packed and delivered to the retailer.

Challenges Face

The rice bran oil production is facing challenges in their easy adaptation by consumers and increasing production among farmer.

1. Rapid deterioration: The rice bran oil undergoes destruction due to availability of lipolytic enzyme in them. These enzymes attack the fat, break it down into fatty acid, which make oil unsuitable for consumption. These enzymes activate in very early stage of rice polishing, this rapid degradation reduces the quality of bran oil. It was observed that almost 50- 70% of oil disruption can occur, if not prevented or ignored during polishing which will cause loss of produce as well as monetary.

This problem can be overcome by parboiling. The wet heating i.e., parboiling of enzyme inactivate the lipolytic degeneration procedure. The phenomenon is not something new we are adding to the process, as approx. 60% of rice parboiled before milling, due to its role of recovering higher amount of oil.

2. Darker colour of oil: This visible appearance of oil reduces its preference among Indian consumer. The people usually have habit to see pure yellow oil, thus red hue is creating myth of reduce quality in the community, while this slight haze is really nutritious unsaponifiable component that impart immense health benefit to rice bran oil. Technology has been developed by IICT to reduce the colour and haze of oil and make it adoptable for human consumption.

3. Off flavour and neutral taste: We human prefer taste over health thus slight off flavour, changes the preference of customers. And also, many other low cholesterol oils are today available in market with good taste attract consumer towards their side.

4. Lack of awareness: Farmer scientist students are unaware about the immense potential of rice bran oil in Indian market and lack of scientific studies in this sector forcing farmer to prevent their indulgence in this sector.

Future Prospectus

The larger revenue can be receiving through exporting of rice bran oil to other Asian countries, as they use it as premium edible oil specially in Japan, Thailand, china etc. This enhances the scope of India being major leading producer of RBO in the world. The 2015-16 census reported export of nearly 24 thousand metric tons having INR value 22.25 crore. Thus, RBO serves the 10% of total amount obtained from the export of oils, which is very remarkable in increasing India's GDP growth. Associations and organizations like Asian Society of Rice Bran Oil, International Solvent Extractors Association of India and International Association of Rice Bran Oil should update frequently the benefits and statistics about RBO, which would surely increase demand of bran production. (Mehta et al., 2014).

Disadvantages

Although RBO is unique edible oil with numerous health benefits but it has a major disadvantage which can outweigh its benefits.

1. Although RBO reduces cholesterol level but the presence of high excess of omega-6-fatty acids could be detrimental to health. A high consumption of omega-6-fatty acids may increase both breast cancer and prostate cancer.
2. Rice bran itself is potentially high in arsenic so this is another level of concern which requires more research. There are also few side effects of RBO like gas, flatulence, stomach discomfort
3. RBO has also been reported that it lowers the blood calcium in body which is a health concern for people with hypocalcaemia.

Uses of Bran Oil

1. The RBO has an alternative low-cost feedstock for biodiesel production.
2. Wax is the most important by-product separated from rice bran oil.
3. The fermentative production of bio hydrogen using de-oiled rice bran used as renewable biomass revealed through many studies.

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My Research Story: Exploring Unconventional Leafy Greens

Article ID: 30583

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Keywords: Antioxidants, Unconventional greens, Instant soup mix, Vegetable leaf powder.

Wheat, rice, maize, and soybean are the four major crops feeding the world. By 2050, the global population will reach 10 billion. Out of 600 species of vegetable crops only one fourth is utilized and rest are underexploited, underutilized, or unconventional. In the local vegetable market, leaves of the vegetable are thrown away or used as a cattle feed. They are available at no cost and the majority of the masses are unaware of their nutritional potential. At the same time, 24.8 percent of the Indian population is food insecure and 194.4 million people are undernourished. To address this problem, researchers at the Department of Food and Nutrition, College of Community Science, Punjab Agricultural University, Ludhiana conducted a study in 2016-18 to develop antioxidant-rich vegetable leaf powders from unconventional leafy greens. Instant soup mixes were formulated using developed antioxidant-rich vegetable leaf powders.

Unconventional greens are underutilized greens that are not part of a normal diet nor grown commercially on a large scale. Unconventional greens possess immense nutritional potential which can contribute towards nutritional security. Unconventional greens are micronutrient dense nature's gift to mankind that provides vitamins and minerals along with antioxidants. They are inexpensive sources of micronutrients such as ascorbic acid, vitamin A, β-carotene, folic acid, riboflavin, tocopherols, calcium, iron, phosphorus, magnesium, phytochemicals, antioxidants, and essential fatty acids. Increasing the consumption of unconventional greens in our diet can be a food-based approach for treating micronutrient deficiency. These unconventional greens are easily available in the vegetable market at no cost. These are not utilized by general masses rather used for cattle feed due to lack of awareness about their nutritional value. Intake of unconventional greens in the daily diet can be one of the strategies for improving nutritional status. The unconventional vegetable greens are gaining importance as a means to increase the per capita availability of food; hence, it can be explored to improve the nutritional scenario of the country.

Looking into the increasing prevalence of chronic degenerative diseases globally, the need for exploration of underutilized greens is significant to overcome health disorders. Unconventional vegetable greens being a reservoir of essential vitamins, micronutrients, protein, and other phytonutrients have the potential to play a major role in strategies to attain nutritional security and can be explored to prevent degenerative diseases. Vegetable powders can be produced with a view of good consumer appeal and varied use. Dehydrated vegetable greens can be used for improving the efficacy of different products as a nutraceutical and pharmacological products. There are no processed foods that are available, which incorporate dehydrated vegetable greens. There are several soup mixes available commercially; however unconventional vegetable greens have not been explored for soup mix preparation. Based on the above evidence, the study was designed to formulate standardized soup mixes incorporated with vegetable powders prepared from unconventional leafy greens with optimum antioxidant potential.

Unconventional greens of vegetables mainly turnip, radish, carrot, and cauliflower are procured from the local vegetable market of Ludhiana at no cost. Vegetable greens are dried in a hot air oven at three different temperatures and various time intervals. Drying time and temperature were optimized for the retention of maximum antioxidant activity. Fresh leaves of unconventional greens and optimized vegetable leaf powders with maximum antioxidant activity were evaluated for the presence of ascorbic acid and bioactive compounds mainly, total carotenoids, total chlorophyll, flavonoids, and total phenols. A standardized lentil-based instant soup mix recipe was developed. Optimized vegetable leaf powders are incorporated in instant soup mixes up to five percent level. Antioxidant activity of instant soup mixes with or without vegetable leaf powders is determined and compared with the antioxidant activity of ten commercial soup mixes. Consumer acceptability and preference for purchase for the developed instant soup mixes enriched with vegetable leaf powder was measured. Retention of antioxidant activity in formulated instant soup mixes enriched with vegetable leaf powder was evaluated after two months of storage.

Overall research showed that fresh carrot leaves possess maximum antioxidant activity followed by turnip, radish, and cauliflower leaves. Fresh turnip leaves have the maximum content of ascorbic acid. The highest flavonoid and total phenols were reported in fresh radish leaves. Fresh cauliflower leaves have the highest concentration of total carotenoids and chlorophyll. Dried radish leaf powder has maximum antioxidant activity followed by turnip, carrot, and cauliflower leaf powder. Extended drying time has a detrimental effect on antioxidant activity. Ascorbic acid and total phenols are maximum in turnip leaf powder.

Total carotenoids and total chlorophyll content were highest in cauliflower leaf powder. Carrots leaf powder has the highest flavonoid content. Antioxidant activity of instant soup mix incorporated with turnip and radish leaf powder was higher than the instant soup mix without any leaf powder. Commercial soup mixes reported less antioxidant activity as compared to developed instant soup mixes. No effect of storage on antioxidant activity of the developed instant soup mixes except the formulations incorporated with cauliflower leaf powder was observed. Overall acceptability was highest for formulation where no leaf powder was incorporated followed by formulation incorporated with turnip leaf powder and radish leaf powder. Instant soup mix incorporated with turnip leaf powder showed higher consumer acceptability and preference for purchase.

Plate 1. Vegetable leaf powder of cauliflower, turnip, radish, and carrot

The study highlighted that turnip and radish leaf powder enriched soup mixes possessed an excellent antioxidant activity with optimum sensory characteristics and consumer acceptability, so suitable for the consumers who are looking for the new foods with health benefits.

Moreover, the appropriate use of unconventional vegetable leaves in the form of vegetable leaf powder can be an effective effort towards achieving the nutritional security of masses at low cost. Thus, it is recommended that the standardized instant soup mix formulations if incorporated in regular dietary patterns can be a healthy option for general masses owing to their high antioxidant activity in comparison to the soup mixes available in the market.

The research team included- Nidhi Joshi, Dr. Kiran Bains, and Dr. Harpreet Kaur.

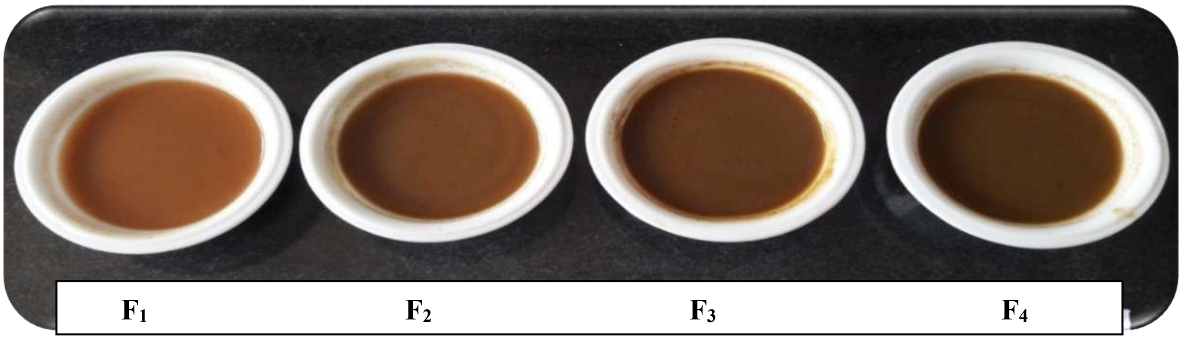

Plate 2. Turnip leaf powder enriched instant soup in order of control, 2.5, 3.75 and 5% incorporation (Left to Right)

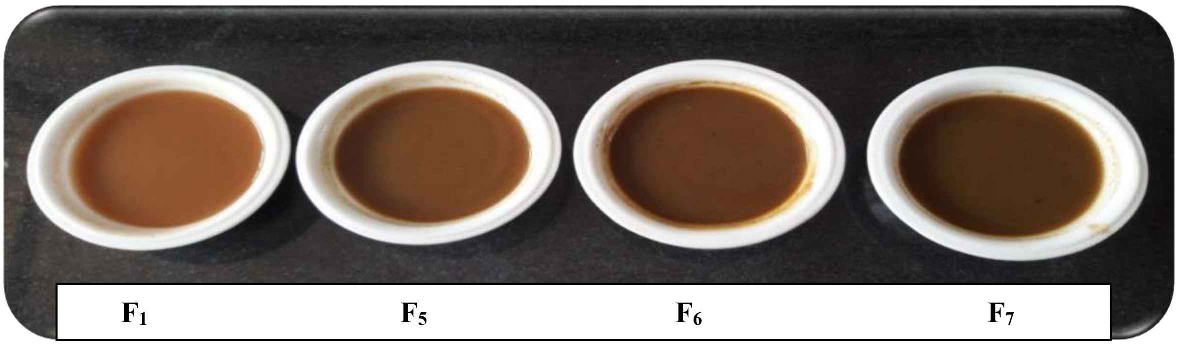

Plate 3. Radish leaf powder enriched instant soup in order of control, 2.5, 3.75 and 5% incorporation (Left to Right)

Role of Micro-Irrigation Techniques to Improve Water Use Efficiency of Crops

Article ID: 30584

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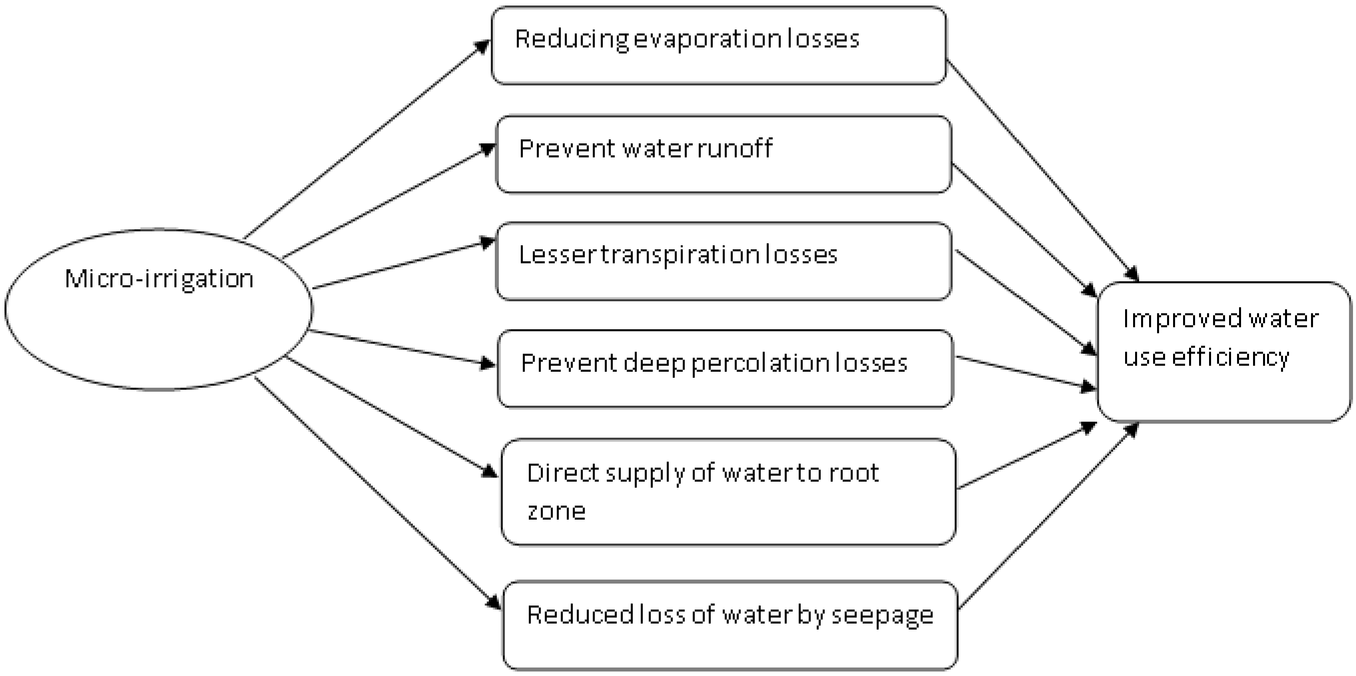
Introduction

Micro-irrigation techniques are most efficient in improving water use efficiency by reducing water loss through evaporation from the soil, transpiration from the plant, surface runoff, and maintaining soil moisture. Micro-irrigation refers to as frequent application of small quantities of water directly above or below the soil surface. The saving of water by micro-irrigation, up-to 50% was possible through maintaining available soil moisture at low water tension during the full growth period (Patel et al., 2006). The loss of water by micro-irrigation is very less because the supply of water directly to the root zone of the crop and the losses by irrigation channel, overflow, over-irrigation is eliminated thus, the water use efficiency of the crop increased by using of micro-irrigation techniques. Micro-irrigation systems are most suitable for horticultural crops for the economic point of view (Dhawan, 2000).

How to Improve WUE by Micro-Irrigation



The loss of water by various means can be reduced by adopting micro-irrigation techniques in field crops by immediately using water by crops. Not only this, but suppression of the growth of other vegetation also improves the water use efficiency of the crop. Micro-irrigation techniques provide water to plants that match the crop evapotranspiration demands and provide optimum soil moisture at critical growth stages resulting in high water use efficiency (Kipkorir et al., 2002). Higher WUE of any crop given more yield than a crop with low WUE (Meena et al., 2013).

Most useful and feasible micro-irrigation techniques are as follows:
1. Drip or trickle irrigation.
2. Sprinkler or overhead irrigation.

Drip Irrigation

Drip irrigation refers to frequent and slow application of water drop by drop to soil through mechanical devices called emitters or application located at selected points along the delivery lines. Drip system of irrigation is used where the water is scarce and that too of poor quality. The application of fertilizers (fertigation) is also possible with drip Irrigation. Drip irrigation saves 50-70% water, maximizes yields, and enhances the quality of produce. It is the most effective way to direct supply of water and nutrients to plant roots which not only saves water but also increases the crop yield. Drip irrigation efficiency ranges between 70-90% and also minimize the surface runoff and deep percolation losses (Postel, 2000).

Advantages

1. Efficient and uniform supply of water to crops.
2. Increased fertilizer use efficiency.
3. Increased water use efficiency of the crop.
4. More water saving.
5. Fewer incidences of disease and pest.
6. Suitable for water scarcity condition such as arid and semi-arid areas.

Sprinkler Irrigation

Sprinkler irrigation is also known as overhead irrigation in which the application of water is done to crop in the form of spray like rain. It is suitable for undulating areas and sandy soils. Water saving by sprinkler irrigation is up to 30-40% as compared to the surface method of irrigation. The water use efficiency is much higher than the surface method of irrigation and it is about 60%. The sprinkler method of irrigation is useful in protecting crops against frost and high temperatures. Fertigation is also possible with sprinkler irrigation. In India, sprinkler systems are mainly used for field crops such as wheat, pearl millet, sorghum, mustard, and groundnut.

Advantages

1. Land levelling and shaping of land are not requiring with sprinkler method of irrigation.
2. Uniform application of water in undulating areas.
3. Protect crops from frost and high temperatures.
4. Early maturing and quality produced obtained by the crops.
5. Saving of labour.
6. Saving of money.

Irrigation Efficiencies Between Drip and Sprinkler Method of Irrigation

Irrigation efficiency	Drip irrigation (%)	Sprinkler irrigation (%)
Application Efficiency	90	60-80
Surface water moisture evaporation	20-25	30-40
Overall efficiency	80-90	50-70

Source: Sivanappan (1994).

Conclusion

It remains no more obscure that huge water losses and thereby lower water use efficiency with the traditional method of irrigation can be successfully addressed by adopting micro-irrigation techniques. AS they reduce evaporation and surface runoff and maintain soil moisture water availability to plants is improved even under limited water conditions.

Advantages

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Brown Manuring

Article ID: 30585

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Introduction

Brown manuring means growing of Sesbania in standing rice crop and killing sesbania with herbicides which will be used for manuring. This manuring is called as brown manuring as the colour of the sesbania residue turns to brown colour because of loss of chlorophyll in leaves. It is just a no-till version of green manuring as in green manuring before flowering crop will be cultivated but, in this case, there is no cultivation, it's just drying or killing of the plants with the help of herbicides.

After sowing of rice sesbania will be broadcasted @ 8.0 kg/ac and after one month it will be killed by spraying 2,4-D ethyl ester. Researches revealed that brown manure adds upto 35 kg/ha N, dry matter and also controls broad leaf weeds. Brown manuring in low fertile soils gives 4-5 quintal higher yields per hectare compared to non-brown manuring fields as it adds organic matter to soil.

Brown manuring is preferred in light soils which are prone to erosion and also to reduce weeds (Sharma, 2014; Singh, 2014). Brown manuring also improves biological, physical and chemical properties of soil along with addition of organic matter. According to Gaire et al., 2013 brown manuring adds 15 kg nitrogen per ha and also smothers weeds and conserves moisture without any additional production costs. Rehman et al., 2007 proved that compared to surface mulch lower weed density and dry weight was observed in brown manuring with Sesbania spp. and other species and also intercropping of brown manuring crops with rice reduces weed densities by about 40-59 per cent.

Sarangi et al., 2016 reported that replacing 25% of nitrogenous fertilizer by brown manuring in direct seeded rice increased plant height by 1.57%, effective tiller number by 9.09%, organic carbon content by 13.04% and grain yield by 7.91% compared to farmers practice. Sarangi et al., 2016 concluded that use can be reduced up to 25 per cent in the farmers field by brown manuring without affecting the economical attributes and saving the precious soil health from the study.

Sharma et al. 2017 noted significantly higher actinomycetes count with brown manuring in Basmati rice cultivated under the method of system of rice intensification. Increasing soil organic matter through brown manure or addition of plant or animal organic matter from external sources is also important in decreasing bulk density of the soil and acting as a buffer preventing or lessening the transmission of compaction to subsoil from external loads acting on the top soil (Hamza and Anderson, 2005).

Conclusion

Brown manuring not only increases plant growth and yield but also adds organic matter to soil which in turn improves physic-chemical properties of soil and also biological properties of soil and also reduces soil erosion. So, growing of brown manuring crops increases yield and quality of produce with reduced cultivation costs. Brown manuring is the best option for growing crops as it also maintains sustainability which are cost effective and eco-friendly and also restores soil health in agriculture.

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Indigenous Knowledge for Rural Development

Article ID: 30586

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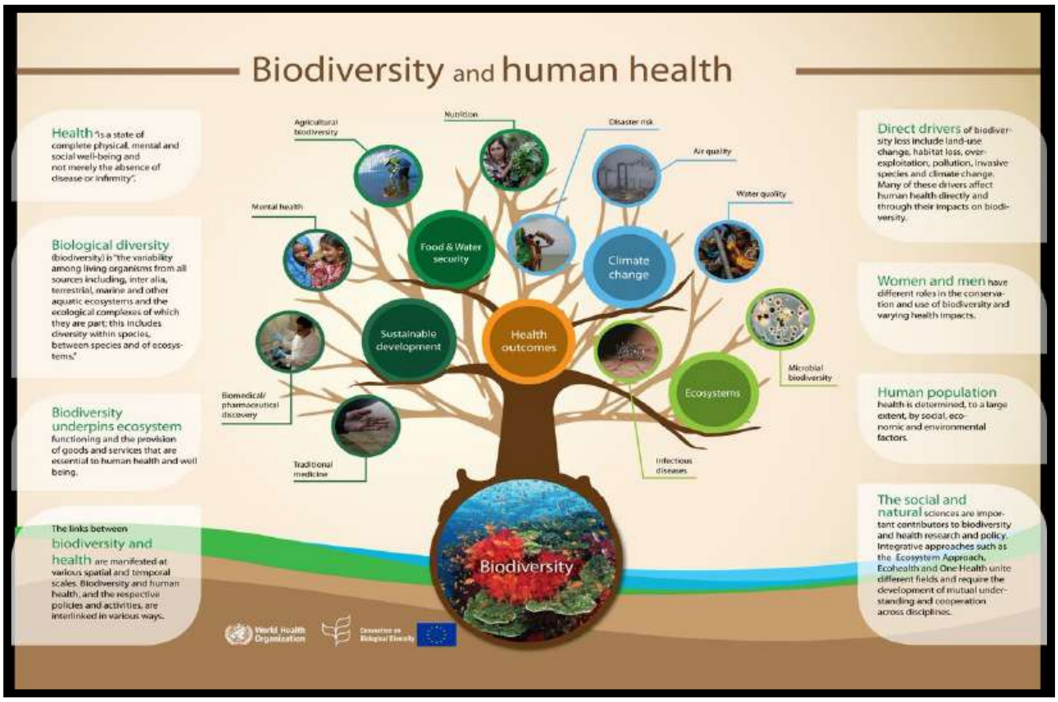

Abstract

Indigenous knowledge is considered as the social capital of the poor. It is their main asset to invest in the struggle for survival, to produce food, to provide for shelter and to achieve control of their own lives. Most of the indigenous knowledge disappears due to the intrusion of foreign technologies and development concepts that promise short-term gains or solutions to problems without being capable of sustaining them. The tragedy of the disappearance of this knowledge system is most obvious to those who have developed it and make a living through it. But the implication for others can be detrimental as well, when skills, technologies, artifacts, problem solving strategies and expertise are lost. The paper thus argues that indigenous entrepreneurs provide an opportunity to imbibe conventional strategies with more sustainable indigenous practices. It concludes by advocating the need to integrate indigenous knowledge systems and mainstream knowledge systems as a means of attaining sustainable development as well as developing effective, low-cost and ecosystem friendly production and consumption patterns.

Introduction

Indigenous knowledge is local. It is rooted to a particular place and set of experiences, and generated by people living in those places. The result of this is that transferring the indigenous knowledge to other places runs the risk of dis-locating it. Indigenous knowledge is the consequence of practical engagement in everyday life, and is constantly reinforced by experience and trial and error.

Indigenous Knowledge and Cultural Diversity

The generation, adaptation and use of indigenous knowledge are greatly influenced by the culture. Economic, social, political and geographical contexts also contribute to generate indigenous knowledge, but to a lesser extent. Therefore, Indigenous knowledge systems show great diversity not only among ethnic groups but among locations also.

There are at least four ways to understand and compare the indigenous knowledge systems in different cultures:

1. A different knowledge of similar things.
2. A different knowledge of different things.
3. Different ways of organizing knowledge.

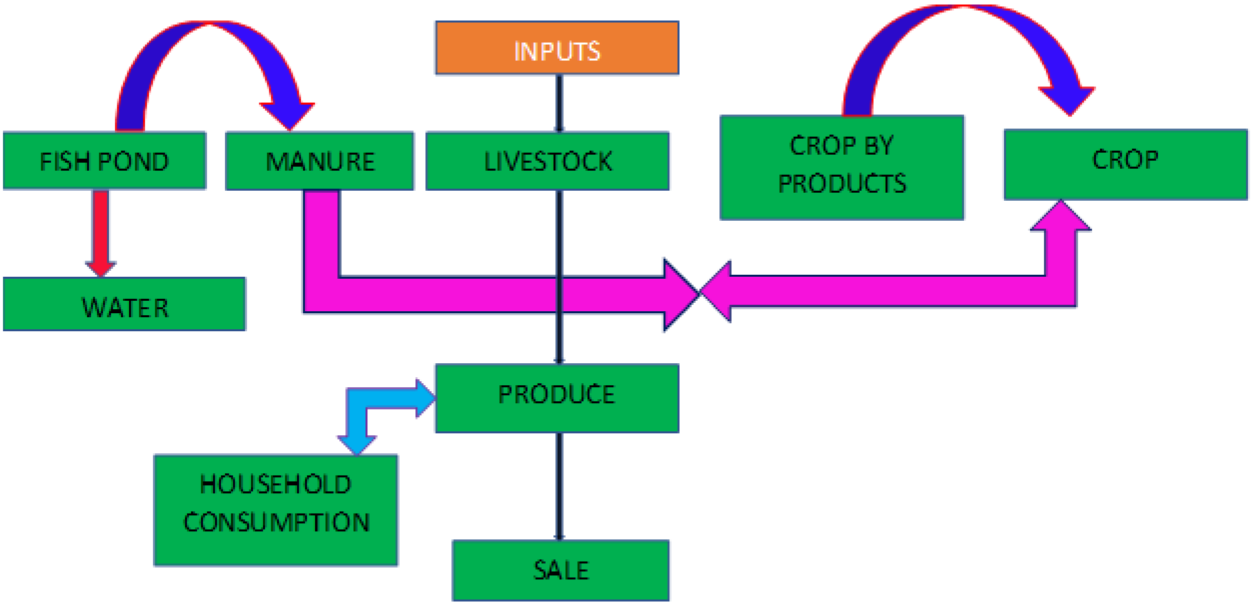

Fig.1. System Framework of Indigenous Knowledge

Indigenous Knowledge and Biological Diversity

Biological diversity is increasingly becoming recognized as important beyond its purely scientific interest. Social and economic values of biodiversity are assuming greater significance as a range of different groups, including Indigenous peoples assert their claims and interest. Indigenous knowledge can help to meet the broader objectives of society, for instance conserving the environment, developing sustainable agriculture and ensuring food security, while its protection encourages the maintenance of traditional practices and lifestyles. Biological diversity is increasingly becoming recognized as important beyond its purely scientific interest. Social and economic values of biodiversity are assuming greater significance as a range of different groups, including Indigenous peoples assert their claims and interests.

Use of Indigenous Knowledge in Sustainable Development Process

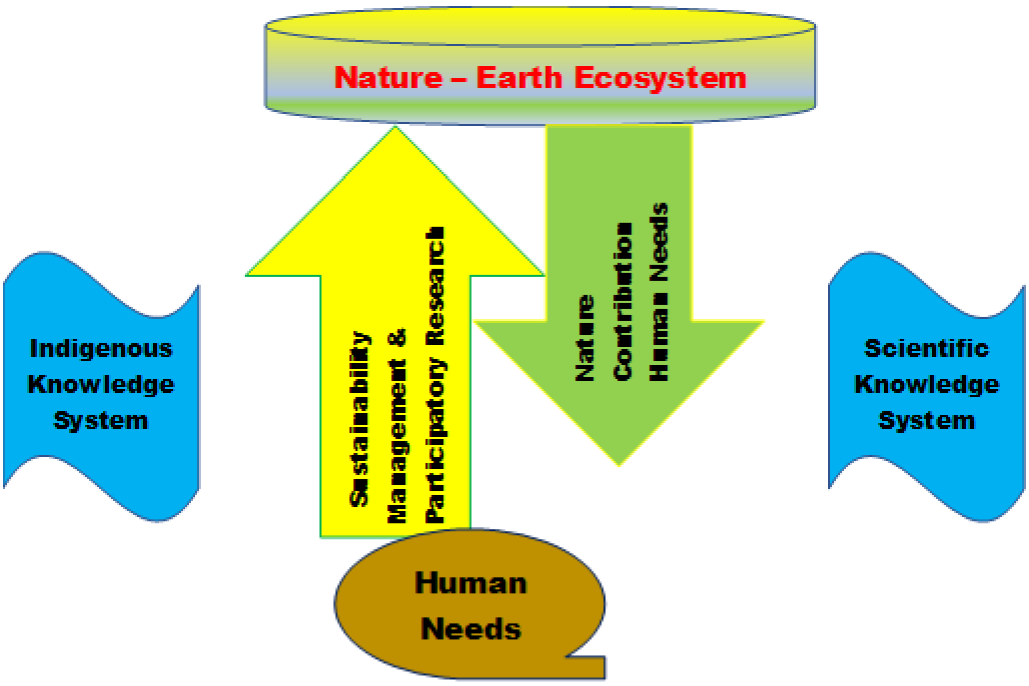

Fig.2. Indigenous Knowledge Contribution

All most all the development actors have now recognized the value of participatory approaches in decision-making for sustainable development. Indigenous knowledge provides the basis for grassroots decision-making. It is recently found that the indigenous knowledge of ecological zones, natural resources, agriculture, aquaculture, forest and game management is far more sophisticated than previously assumed (Posey, 1995).

Expressions of Indigenous knowledge

Indigenous ecological knowledge is expressed in many ways. Some particularly important expressions are customary practices such as hunting, fishing and gathering. Since these activities require knowledge of customary ways of procuring these resources, the exercise by Indigenous peoples of their rights to carry out these activities in accordance with their laws and customs may be regarded as a demonstration of their assertion of their rights to their traditional knowledge systems. Indigenous customary hunting, fishing and gathering practices may therefore be considered aspects of rights relating to land.

Conservation and resources legislation vary in all jurisdictions in terms of whether provisions allow for Indigenous customary or traditional practices. In many cases, legislation includes some exemptions for Aboriginal people from regulations governing hunting, fishing and gathering. These exemptions provide limited recognition of Indigenous peoples' 'traditional' activities concerning land use. Despite these beneficial provisions, there have been some cases in which conflict has arisen between the requirements of conservation legislation and Indigenous peoples' actions.

Challenges to Recognizing and Protecting Indigenous Knowledge

Indigenous peoples have for a long time advocated their wish to be recognized as having unique rights, based on their distinct Indigenous status. While the focus in the quest for Indigenous rights has been on land rights, Indigenous peoples assert that they also have rights in the biological resources on the lands, and in the knowledge, they possess of these resources. Indigenous knowledge of medicinal and other plants and practices is a significant contributor to scientific research and development in pharmaceuticals, cosmetics, foodstuffs, agricultural products, and a wide range of other biologically based products and processes. The challenge is therefore to develop a system which satisfies the needs of industry, achieves conservation goals, and also recognizes and protects the rights of Indigenous peoples.

Knowledge is a fundamental component of Indigenous culture, and must be considered in terms of both its sacred and secular dimensions. To Indigenous peoples, knowledge is not considered independently from its products and expressions, or from actions. These all form part of a closely integrated cultural system.

Conclusion

It is very clear that there is much to be learned from the indigenous knowledge systems of local people. All the academics, policy makers, planers should pay greater attention to this invaluable treasure of knowledge that is threatened by extinction. If we are to move towards interactive technology development from the conventional transfer of technology approach, we all may have to learn many things from our village level experts, the gurus of indigenous knowledge.

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IOT and its Role in Transforming Agriculture

Article ID: 30587

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Introduction

World population is increasing in an alarming rate. There is a serious need for increase in production of agricultural produce to fulfil the requirement of the growing human mass. According to the estimation UN world will need to produce 70% more food in 2050 for satisfying the need of global population. As the natural resources are finite and can't be further increased, hence there is a need of increasing production per unit land per unit input used. To achieve it technological innovations are required and IOT is one of such tools which is playing a major role in solving this issue and enhancing production.

IOT

Internet of Things simply refers to a system of interconnected and intercommunicable devices/objects that can collect and share various data with minimum involvement of human beings. Generally, IOT systems are abundantly used in manufacturing units, transportation industries and also in infrastructure development.

Role of IOT in Agriculture

IOT devices are now also applied in field of agriculture starting from monitoring the growth and development of plant, accessing soil health to managing the supply chain of the final produce. Along with agricultural activities it also monitors the health condition of livestock. It involves use of remote sensing technology and various sensors to collect data regarding soil, atmosphere and crop parameters as well. Wireless Sensor Networks (WSN) and other sensor networks are available which collect data about crop growth rate, soil nutrient status, atmospheric humidity, soil water status etc. And this collected data is further summarised and processed. This stored data helps in discovery of knowledge and decision making. Ground and air-based drones are available which helps in controlling crop growth and hence we can also predict the optimum time of harvest. From the photographs and sensors, we can easily detect the diseases and can follow appropriate control measures. IOT can also be applied to agro-industrial production units so that tracing of product from production unit to the final user is made possible. Sensor networks are used in irrigation scheduling by gathering data about soil and plant water status and there by providing automated irrigation. Now a days IOT framework is also available for assessment of freshness of fruits which are perishable in nature and prone to damage during the transport activities. Characterisation of Frost is also made possible by measuring temperature by help of precision agricultural implements. Green Houses are also controlled using IOT as the IOT systems can manipulate the atmospheric parameters and soil aspects.

Conclusion

IOT is an emerging solution for the increasing production demand. Along with enhancing productivity it also reduces wastes, enhance quality of produce with less cost. This technology includes use of sensors, drones and software which are easily accessible globally hence exchange of data is easier. Further studies are going on in this field which will help in transforming agricultural activities in time to come.

Rain Water Harvesting Techniques

Article ID: 30588

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Introduction

Rainwater harvesting is a technology used to collect, convey and store rain water for later use from relatively clean surfaces such as a roof, land surface or rock catchment. RWH is the technique of collecting water from roof, Filtering and storing for further uses. Rainwater Harvesting is a simple technique of catching and holding rainwater where its falls. Either, we can store it in tanks for further use or we can use it to recharge groundwater depending upon the situation. (Frasier, 1994) RWH system provides sources of soft, high quality water reduces dependence on well and other sources and in many contexts are cost effective.

Need for Rainwater Harvesting

1. As water is becoming scarce, it is the need of the day to attain self-sufficiency to fulfil the water needs.
2. As urban water supply system is under tremendous pressure for supplying water to ever increasing population.
3. Groundwater is getting depleted and polluted.
4. Soil erosion resulting from the unchecked runoff.
5. Health hazards due to consumption of polluted water.

Types of Water Harvesting

1. Roof top rainwater harvesting.
2. Surface runoff harvesting:

It is a system of catching rainwater where it falls. In rooftop harvesting, the roof becomes the catchments, and the rainwater is collected from the roof of the house/building. This method is less expensive and very effective. In urban area rainwater flows away as surface runoff. This runoff could be caught and used for recharging aquifers by adopting appropriate methods.

Components of the Roof Top Rainwater Harvesting System

1. Catchment area
2. Transportation
3. First flush
4. Storage system
5. Delivery system
6. Filtration system.

Catchment Area

The surface that receives rainfall directly is the catchment of rainwater harvesting system. It may be terrace, courtyard, or paved or unpaved open ground.

Transportation

Rainwater from rooftop should be carried through down take water pipes or drains to storage/harvesting system. Water pipes should be UV resistant (ISI HDPE/PVC pipes) of required capacity.

First Flush

First flush is a device used to flush off the water received in first shower. The first shower of rains needs to be flushed-off to avoid contaminating storable/rechargeable water by the probable contaminants of the atmosphere and the catchment roof. It will also help in cleaning of silt and other material deposited on roof during dry seasons Provisions of first rain separator should be made at outlet of each drainpipe.

Storage System
All collected rain water is store in tank or barrels used.

Delivery System
It is a system to deliver of water for uses. There are uses of pumps to take out water from tank and deliver for many purposes. Water is delivering by pips.

Filtration System
Filters are used for treatment of water to effectively remove turbidity, colour and microorganisms. After first flushing of rainfall, water should pass through filters. There are different types of filters in practice, but basic function is to purify water.

Sand Gravel Filter
These are commonly used filters, constructed by brick masonry and filleted by pebbles, gravel, and sand as shown in the figure. Each layer should be separated by wire mesh.

Charcoal Filter
Charcoal filter can be made in-situ or in a drum. Pebbles, gravel, sand and charcoal as shown in the figure should fill the drum or chamber. Each layer should be separated by wire mesh. Thin layer of charcoal is used to absorb odour if any.

PVC-Pipe Filter
This filter can be made by PVC pipe of 1 to 1.20 m length; Diameter of pipe depends on the area of roof. Six inches dia. pipe is enough for a 1500 Sq. Ft. roof and 8 inches dia. pipe should be used for roofs more than 1500 Sq. Ft. Pipe is divided into three compartments by wire mesh.

Benefits of Rain Water Harvesting System
1. Rainwater is a comparatively clean and totally free source of water.
2. Rainwater is improved for scenery plants and gardens because it is not chlorinated.
3. It can supplement other sources of water supply such as groundwater or municipal water connections.
4. It lower the water supply cost.
5. It can provide an excellent back-up source of water for emergencies.
6. It is socially acceptable and environmentally responsible.
7. It uses simple technologies that are inexpensive and easy to maintain.
8. Reduced flood flows and topsoil loss.
9. It is free; the only cost is for collection and use.
10. It is used in those areas which face insufficient water resources.
11. It is good for laundry use as rainwater is soft and lowers the need for detergents.
12. It can be used to recharge groundwater.
13. It minimizes the runoff which blocks the storm water drains.

Conclusion
Efficient management of water resources and education about judicious utilization of water resources along with measures of harnessing, recharging and maintaining the quality of water and water bodies has to be taken up on war footing.

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Hydro-Priming: Ancient Yet Powerful Seed Invigoration Practice

Article ID: 30589

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Introduction

Uniform crop stand is mandatory for better yield in case of every horticultural as well as agronomical crop. Most essential requirement to achieve this objective is good quality of seeds having high vigour but availability of high vigour seeds is low and on the other hand seeds lose their viability and vigour due to mishandling at the time of post- harvest operations and storage. Due to lower vigour seed fails to germinate evenly under biotic (infestation of diverse weed flora) and abiotic (High or very low temperature, drought, flood, heavy metal toxicity, soil salinity) stress conditions. To overcome all these issues, there is an urgent need of pre sowing seed treatment which can invigorate the seed for rapid germination, robust growth of roots and shoots and greater economic yield. Hydro-priming is one of the very old but influential seed treatments which ensure higher and speedy germination under favourable or adverse condition as well. It strengthens the seed to adapt itself in antagonistic growth environment.

Hydro-Priming

Hydro-priming is considered well-structured seed invigoration technique which improves seed quality. It includes soaking of seeds in water for a specific duration and then shade dried it upto the original moisture content. Hydro-priming is a tri-phasic phenomenon which includes imbibition of water through seeds in phase one which encourage metabolism, release of gibberellic acid and activation of hydrolytic enzyme which initiate breakdown of starch in endosperm , mobilization of food from endosperm to embryo in second phase and intrusion of radicle and plumule in third phase. Hydro-priming covers phase I and phase II but does not reach to phase III due to dehydration. It allows seeds to absorb sufficient water to initiate metabolic process but insufficient water to complete germination process. Hydro-priming reduces the time between seed sowing and seedling emergence under field condition resulting fast germination. Soaking of seed accelerate activity of alpha amylase and protease enzymes and causes quick breakdown of carbohydrates, amino acids which helps in fast germination of crop. Hydro-priming had high potential in initiating early flowering and harvesting under stress condition, especially in dry areas. Hydro-priming is being used to reduce the germination time to get synchronized germination, improve germination rate and better seedling in many crops such as maize, soybean, wheat (Shivankar et al., 2003). The major pre germination steps such as DNA and RNA synthesis are accomplished in the seed during the priming state consequently the seeds are physiologically close to germination and have fewer steps to complete than unprimed seeds (Donald, 2000).

Role of Hydro-Priming in Seed Germination

Every crop species requires specific duration for seed soaking because of difference in physical characteristics, chemical composition and metabolic activities of seed. So, standardization of duration for desirable results is necessary. During hydro-priming seeds uptake water without any restriction which helps in initiating germination process but quick dehydration averts it. At the time of sowing whenever the seeds absorb moisture from any kind of substrate, they germinate quickly in comparison to untreated seeds in controlled (laboratory) as well as on farm conditions too. Hydro-priming successfully improved germination index, germination energy and rate of rice (Prasad et. al., 2012), maize (Canak et. al., 2016) under laboratory condition while improved emergence recorded in wheat (Meena et. al., 2012), moong (Golezani et. al., 2014) on field circumstances also. Due to quick absorption of water, core hydrolytic enzymes activities enhance which improves mobilization of food from source (endosperm) to sink (growing embryo). Energy released due to food decomposition motivates fast and synchronized germination.

Role of Hydro-Priming in Biochemical Activities

Impact of hydro-priming on biochemical events occurring inside the seed during germination process is very pronounced. Soaking of seeds in water for a definite period of time not only instigate required metabolism, actions of different enzymes, movement of reserve food material but also increase plasma membrane integrity, membrane stability index through oxidative stress, production of antioxidants and elimination of harmful reactive oxygen species. During the storage of seed, its quality deteriorates due to lipids and phospholipids disintegration of cell wall. Hydro-priming re-establish the vigour of seed through stimulation of different scavenging mechanisms of seed in comparison to untreated seeds. Germination is a multidimensional procedure which involves respiration, metabolism, refurbishing of cell organelles, production of energy and finally protrusion of radicle and plumule. Hydro-priming supports germination at each step and increase seed quality over untreated seeds.

Role of Hydro-Priming in Seed Invigoration

Most of the field crops fail to germinate under moisture deficit conditions, dry land areas, saline soils and late sown conditions due to temperature fluctuations. Improved seed emergence was confirmed by many researches through hydro priming in adverse environmental circumstances. In low temperature conditions mitochondrial respiration lowers down which also influence electron transport chain and energy supply of seed. Hydro-priming successfully strengthen seeds to tolerate low temperature and germinate quickly in comparison to untreated seeds (Canak et. al., 2016). In water deficit situation seed soaking in water as pre sowing seed treatment enhance possibility of seed to germinate with better speed. Due to late harvesting of preceding crop, late sowing of field crops results in less emergence percentage which can be combat through priming by water. Hydro-priming positively boost early growth of seedling too under stressed period which encourages plant to establish itself and perform better over untreated seeds.

Conclusion

Hydro-priming considered as major technique for invigoration of feeble seed lot and farmers can get benefit by soaking of seeds in normal water for specific duration. It is reasonable and easy to conduct process which does not require any high skilled labour. However, optimum hydration duration should be known for proper results.

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Management of Viral Diseases Through Eco-friendly Practices

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Introduction

Management of plant viral diseases is a matter of vital importance and concern to the farmer. It is well established that, the viral diseases in different crops cause enormous losses in terms of quality and quantity of products. Because of the serious losses they cause to agriculture and horticulture, viral diseases have acquired great importance in the realm of plant pathology and call for effective management measures against them. These diseases are not amenable to control by direct methods, unlike fungicides and bactericides, no commercial viricides have yet been developed. However, a number of indirect control measures for different crop plant-virus patho-systems suitable to varied agro-ecosystems have been developed with an aim to avoid the pathogen or to minimize their impact on crop yield. As these diseases routinely cause systemic infections and have very effective methods of transmission, preventing their spread has become a complicated problem (Sastry, 2013).

Problems Associated with Use of Insecticide

1. Development of resistance by pests
2. Resurgence of pests and the development of secondary pests
3. Elimination of natural enemies
4. Impact on non-target species, including endangered species and humans.
5. There is problem of residue in food.

Eco-friendly Management Practices

1. Use of virus free propagules of crop plants: When the annual (vegetable, oilseeds, cereals, pulses etc.,) or perennial (fruit) crops are established by using disease-free planting material with good genetic back ground, then the agriculturist can expect to achieve good yields from the crops. Even after planting the disease-free material, if one does not follow the observations on disease spread and subsequence precautionary measures, then also the expected yield will not be achieved. Hence one has to take continuous steps for restricting the spread of virus diseases by cultural, chemical or biological means which will help in reducing the vector populations, which are often responsible for spread of the virus diseases. Hence virus-free seed and subsequent vector management are the most effective input in achieving higher yields.

2. Phyto sanitation:

a. Plant residues removed, and composted.
b. Removal of Volunteer plants and Alternate hosts.
c. Eradication of over summering or overwintering weed hosts.

3. Alteration in The Crop Cultural Practices: Manipulations and alteration of cultural practices which are simplest, that an agriculturist can employ, offer a wide measure for decreasing the incidence of virus diseases, but have limitations imposed by different growing seasons and crop requirements. Cultural management of virus diseases includes any modification in the production of the crop that lowers the disease incidence by reducing or eliminating the vector population or inoculum sources.

Cultural management includes a diverse set of practices including the following:

a. Plant density: Closer spacing generally reduces the number of infections per unit area; this method requires a higher seeding rate. The planting rate should be such that it should cover the soil without reducing the yield due to competition. When the percentage of infection is low, systemic diseases could be controlled by close planting, which reduces the size of plants and increases the number per unit area. When the percentage of infection is high, control is more difficult, but is still possible if infection strikes when plants are small As the young plants are generally light yellow in colour, the vectors are attracted and also young plants provide a more suitable diet for developing vectors.

b. Alteration in sowing date: Plants are often more susceptible at certain stages of development and they are susceptible to virus diseases in the seedling stage when high vector population exists and crops become resistant with advanced age, resulting in less susceptibility to the virus and the vector. The correct choice for time of planting has been a major concern of farmers throughout history. Adopting planting dates so as to avoid exposing young plants to infection at times when the largest numbers of viruliferous insect vectors are likely to occur is often practiced. Seeding time is important for reducing yield losses, manipulation of sowing and harvesting dates also affect the virus diseases which are carried by air-borne vectors. Adjusting the planting time based on the vector migration i.e. avoidance of vectors by sowing late if vector migrates early and vice-versa. The manipulation of planting or harvesting dates depends mainly on the environmental factors which have direct effect on vector population and also the growth of the plants. Early plantings decreased the disease incidence as the plants become older and more resistant when the insect vector invaded the crop. The period of maximum vegetative growth should not coincide with the period of maximum vector activity because plants infected when flowering or fruiting suffer less than those infected when younger.

c. Effect of barrier cropping: Use of tall plants to protect the crops from the insect vectors. Fast growing taller species which are economical and were tried against many diseases. One should raise the barrier crops which are not alternate host plants for virus and vector multiplication; hence monocot plants were tried as barriers for dicot crops. The barrier or border crops should be selected carefully so that no adverse effects like competition by the protection crop or dangerous pest and disease development should result.

d. Effect of intercropping: The use of non-host crops in inter plantings and barrier situations can significantly reduce the rate of virus spread in the field. Large continuous plantings of susceptible crops create a favourable environment for the succession of virus from one planting to another. Encourages natural enemies of the insect vectors.

4. Cross protection: Cross-protection is a natural phenomenon whereby tolerance or resistance of a plant to one virus strain is induced by systemic infection with a second. The phenomenon was first demonstrated by McKinney (1929), who observed that in tobacco plants systemically infected with a "light green strain" of Tobacco mosaic virus (TMV: Genus Tobamovirus), the appearance of yellow symptoms after re-inoculation with a TMV "yellow mosaic strain" was repressed. In contrast, a "mild dark green" strain did not repress these yellow symptoms upon challenge.
The first demonstrations of virus-disease control by mild strains were done with Citrus tristeza virus (CTV: Genus Closterovirus) (Costa, 1951), and Cacao swollen shoot disease (Posnette andTodd, 1955).

5. Control of vectors:

a. Interfering with Virus Multiplication us
  i. Resistant varieties
  ii. Botanicals

b. Interfering with Vector Behaviour: Reaction to light- mulches and traps.

c. Interfering with the Transmission Process: Oil spray.

Resistant Cultivars

Use of tolerance or resistance as a means of disease control has been previously reviewed, and although this area for the control of insect-transmitted virus diseases has not been overly productive, still, interfering with virus multiplication has contributed to disease control in certain instances.

Sl. No.	Crop	Diseases	Cultivars
1	Rice	Tungro disease	Vikramarya, Bharani, IR 36 etc.
2	Ground nut	Peanut Stem necrosis disease (PSND)	Kadiri 3, Kadiri 4, Vemana, ICGS-11, etc.
3	Red gram	Sterility Mosaic	ICPL 87119 (Asha), ICPL 227, Jagruti and Bahar etc.
4	Bhendi	Yellow vein mosaic	Arka anamika, Parbani kranti
5	Tomato	Leaf curl	Nandhi, sankranthi, vaibhav, Arka rakshak

Botanicals

Induce systemic resistance by de novo synthesis of antiviral substance Possess repellent and antifeedant properties.

Commonly Used Botanicals

Glyricidia leaf extract	Neem leaf extract
Sorghum leaf etract	Garlic cloves extract
Clerodendron leaf ectract	Bougainvillea leaf extract

Conclusion

The management of viral diseases in crop plants is still unsolved mystery. Because there are no proper strategies to control viral diseases at field level, as there in extensive cultivation of food crops. Even some strategies were well in some instances but they are compensating the quality and quantity of food crops. Hence, the management of viral diseases is possible through adopting the integrated approaches, which mainly includes use of organics. The organics played superior role in managing the viral diseases when adopted in integrated disease management system.

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Elucidating Mechanisms of Endophytes in Disease Suppression

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Introduction

Crop plant diseases cause considerable yield losses and therefore represent a major threat in agriculture. Owing to the development of fungicide resistance in pathogens and ecological and public health considerations, the number of available chemical fungicides is being reduced. In addition, the industry faces increasing costs for development and commercialisation of novel disease control products. For these reasons, there is an increasing need for development of alternative disease management products, which can offer environment friendly and economically feasible control of important crop plant diseases. Along with selection of resistant plants and other management practices, biological control by beneficial microorganisms is increasingly considered an important element in integrated disease management strategies and there has been an intensified search for such microorganisms in recent years.

Endophytic microorganisms are particularly well adapted to the host plant, since they spend at least part of their life cycle internally colonising living plant tissue, without causing any immediate, overtly negative effect. Endophytes grow interior intracellularly, systemically or locally *within their hosts without causing visible manifestations of infection or disease* (Schulz *et al.*, 2015).

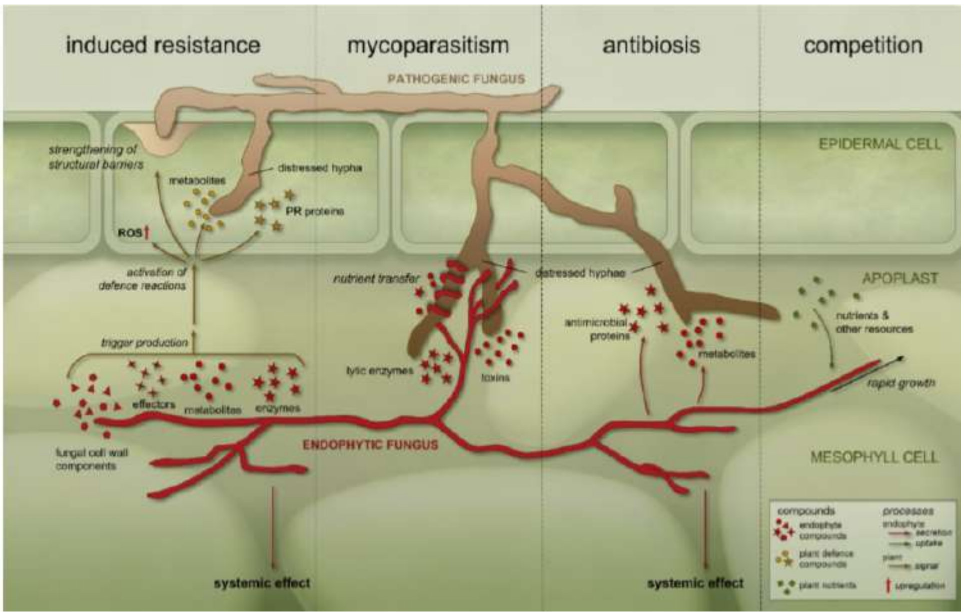
Plant - Endophyte Interaction

Asymptomatic colonization of endophytes is explained by the hypothesis of 'balanced antagonism' with their host (Schulz et al., 2015). The balanced antagonism between the host and the endophyte is maintained by avoiding activation of the host defences and activating resistance against toxic metabolites of the host.

Some endophytes secrete antifungal and antibacterial metabolites at low concentrations, thus inhibiting competitors (both endophytic and pathogenic bacteria and fungi) and maintaining a balance of antagonism with the competitors (Suryanarayanan et al., 2016). Secondary metabolites play a crucial role in maintaining equilibrium of antagonisms among endophytes, competitors and plant hosts.

Mechanisms of Endophytic Biocontrol Agents

In order to optimise the selection and utilisation of endophytes, an in-depth understanding of the general biology of the tripartite interaction between endophyte, host plant, and pathogen is required, as well as of the underlying physiological processes involved.



The following four types of control principles are generally recognised for biocontrol agents and thus also for endophytes:
1. Competition for space and nutrients.
2. Mycoparasitism.
3. Direct inhibition through antibiosis.
4. Induced resistance in the plant by activation of its own defence system.

Above Figure Depicts Mechanisms of Fungal Endophytes in Biological Control of Phytopathogens

The anticipated mechanisms in the tripartite interaction between endophyte, host plant and pathogen include direct inhibition of the pathogen by the endophyte through competition, antibiosis or mycoparasitism, or indirect inhibition through induction of resistance.

Induced Resistance

Different compounds (effectors, metabolites, enzymes) secreted by the endophyte during the colonisation process and released from the cell wall (e.g. chitin, β-glucans) can act as inducing agents and trigger production of a signal in the plant. Transmission and (systemic) translocation of a signal results in elevated activation of defence responses at the site of pathogen attack. Defence responses can include strengthening of structural barriers that halt pathogen penetration, generation of reactive oxygen species (ROS) and production of antimicrobial metabolites and proteins that inhibit pathogen growth.

Mycoparasitism

Mycoparasitism of pathogens by the endophyte can be direct (coiling, penetration of prey) or indirect (no physical contact). In both situations the endophyte obtains nutrients from the pathogen by production of lytic enzymes and other toxins. These compounds can also induce resistance after recognition by the plant.

Antibiosis

The pathogen is inhibited by antimicrobial proteins and metabolites produced by the endophyte. Translocation of these compounds can provide a systemic protection of the plant. They can also induce resistance if detected by the plant.

Endophytes can produce an array of secondary metabolites that may have potential biological activity against pests or pathogens. Some examples of bioactive metabolites include paclitaxel (also known as taxol), podophyllotoxin, deoxypodophyllotoxin, camptothecin and structural analogues (Kusari et al., 2012).

Conclusion

During the colonisation process, the endophyte grows inside the apoplast, taking up nutrients other plant resources, and thereby competing for this niche with arriving pathogens.

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Anthracnose Causing Genus *Colletotrichum*: An Overview on Epidemiology and Management Strategies

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Introduction

Colletotrichum species are a group of pathogenic fungi that devastate farmers around the world and causing huge loses in crop production worldwide. Colletotrichum species cause anthracnose in diverse hostplants such as field crops, fruit-plants, vegetables and ornamentals. The disease is common in the tropics and subtropics regions but some species have been found to inhabit the Mediterranean climate Colletotrichum species are cosmopolitan in distribution and exhibit diverse host-associations. Multiple Colletotrichum species can infect a host plant genus or conversely a single Colletotrichum species can infect many host plants.

Epidemiology

Host	Pathogen	Favourable conditions	Reference
Citrus	Premature Leaf fall- *C. acutatum*	Severe epidemics only in years when there is rain during bloom	Laranjeira *et al.*, 2002
	Fruit rot- *C. gloeosporioides*	10 to 12 hours of leaf wetness and temperatures between 24-28°C	
Guava	Anthracnose- *C. gloeosporioides* *C. guajavae*	Temperatures of about 30°C, as well as long periods of wetness favour the infection process	Lim and Manicom, 2003
Mango	Anthracnose- *C. gloeosporioides*	Humidity above 95 % and temperatures between 20 - 30°C	Fitzell and Peak, 1984
Spinach	Anthracnose- *C. spinaciae*	22°C - 25°C 24 hr leaf wetness	Uysal and Kurta, 2017
Strawberry	Anthracnose- *C. acutatum* *C. fragariae*	7 hr leaf wetness 26-29°C temp.	Leandro, 2003
Apple	Bitter rot *C. acutatum*	Temp-22-24 ° C	Moreira *et al.*, 2016
Black gram	Anthracnose *C. lindemuthianum*	Temp-22°C to 29°C, RH- 80%	Agarwal *et al.*, 2017
Chilli	Anthracnose *C. capsici*	Temp-27°C RH-80%	Saxena *et al.*, 2016
Greengram	Anthracnose *C. truncatum*	Temp-25°C to 30°C 85 to 95 % RH	Kulkarni, 2009

Management

No single management technique has been found to efficiently control the disease. Generally, using a combination of the different strategies like chemical control, biological control, physical control and intrinsic resistance has been recommended for managing the disease.

Chemical Management

Pathogen	Chemicals	Reference
C. gloeosporioides	propiconazole (0.5%),	Chaudhari and Gohel, 2016

Mungbean	carbendazim (12%) + mancozeb (63%) (1%) and propineb (2%) (In vitro)	
	seed treatment with Thiram 75 SD, 3 g/kg seeds + two foliar sprays at 15 days interval starting from initiation of disease with trifloxystrobin + tebuconazole (75 WG), 0.075 per cent or with carbendazim + mancozeb (75 WP), 0.075 per cent.	
C. gloeosporioides Mango	Azoxystrobin at 1, 2 and 4 ml/l suppressed the development of both panicle and leaf anthracnose.	Sundravadana *et al.*, 2006
C. musae Banana	Homai (Thiophanate-methyl 50% WP + Thiram 30% WP) and Topsin (Thiram 30% WP) at the rate of 1.8 and 1.2 g/L respectively. (in vitro)	Priyadarshanie and Vengadaramana, 2015
C. gloeosporioides Guava	Bordeaux mixture (1%), tricyclazole (0.1%), difenconazole (0.05%) and propiconazole (0.1%) (in vitro)	Patil *et al.*, 2007
C. dematium Betle vine	Corozole (200 ppm) -propiconazole 25% Folicur (400 ppm) -tebuconazole 25% Trooper (300 ppm)- tricyclazole 75%	Ahmed *et al.*, 2014
C. truncatum Greengram	propiconazole, carbendazim, hexaconazole @ 0.1 % (In vitro)	Kulkarni, 2009
C. capsici *C. gloeosporioides* Chilli	Cabrio Top (100 ppm) (In vitro) Cabrio Top @ 1750 g/ha (In vivo)	Madhavan *et al.*, 2017
C. falcatum S. cane	Benomyl 50 WP, Folicar and Radomil 75 WP, Tilt @20 and 50 µg mL-1.	Shubani *et al.*, 2008

Botanicals

Pathogen	Botanicals	Reference
C. gloeosporioides Mango	Neem leaf extract (5%) *(In vitro)*	Kolase *et al.*, 2014
C. capsici Chilli	*Pongamia pinnata leaf extract* (10 %) (*In vitro)*	More *et al.*, 2010
C. truncatum Greengram	Garlic extract, neem and eucalyptus oil (10%) (*In vitro)*	Laxman, 2006
C. capsici Chilli	*Solanum tocum* SW., *Datura metel* L. @10 % (*In vitro)*	Gomathi and Kannabiran *et al.*, 2000
C. capsici Pepper	stem and root bark extract of *Azadirachta indica* and the root bark extract of *Vernonia amygdalina* at 10%	Ekhuemelo *et al.*, 2018
C. gloeosporioides Papaya	castor oil 5 and 10 %	Cesar *et al.*, 2012
C. musae Banana	Neemgold, and nimbicidin at 2.0 %	Jagana *et al.*, 2017

Bio-Agents

Pathogen	Bio agent	Reference
C. capsici Chilli	Endophytic colonization of *Burkholderia* sp. strain TNAU-1 @ 0.2%	Madhavan *et al.*, 2017
	P. fluorescens (0.2%)	Paramasivam and Kalaimani, 2008
	combined use of talc-based formulation of P. fluorescens Pf1 (2.5 kg/ha) and azoxystrobin (250 ml/ ha) (In vivo)	Anand *et al.*, 2010
	Fusarium oxysporum, Chaetomium globosum and Trichoderma harzianum (2 %) (In vitro)	Vasanthakumari and Shivanna, 2013
C. truncatum Soybean	*Trichoderma viride* at 0.4 per	Chandrasekaran and Rajappan, 2002
C. truncatum Greengram	*Trichoderma harzianum Gliocladium virens* and *T. koningii. (In vitro)*	Kulkarni, 2009
C.truncatum brown blotch of cowpea	*Trichoderma viride* seed dip in a spore suspension (108 conidia/ml)	Bankole and Adebanjo, 1996

Host Plant Resistance

Pathogen	HPR	Reference
C. capsici Chilli	BS-35, BS-20, BS28, Punjab Lal, Bhut Jolokia, Taiwan-2, IC-383072, Pant C-1, and Lankamura Collection	Garg *et al.*, 2014
	comilla-2	Rahman *et al.*, 2011
C. gloeosporioides Papaya	1% calcium chloride solution at 48°C hot water	Reyna et *al.*, 2017
C. truncatum Greengram	MLTG-2 and TRM-18	Rathaiah and Sharma, 2004
C. truncatum Soybean	PK1129, DSb-2 and Cockerstaurt	Madhusudhan, 2002
C. lindemuthianum Kidney bean	KRC-5 and Hans	Pathania *et al.*, 2005
C. truncatum Greengram	TM-96-2 and TARM-18	Kulkarni, 2009

Source of Edible Vaccine

Article ID: 30593

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Introduction

One of the vital tools of biotechnology is genetic engineering which is used to modify plants, animals and microorganisms according to desired needs. In fact, genetic engineering facilitates the transfer of desired characteristics into other plants which is not possible through conventional plant breeding.

Apart from the use of genetic engineering in agriculture, it is being extensively employed to modify the plants for enhanced production of vaccines, hormones, etc. Vaccines against certain diseases are certainly available in the market, but most of them are very costly. Developing countries cannot afford the disease control through such cost-intensive vaccines.

Alternatively, efforts are being made to produce edible vaccines which are cheap and have many advantages over the commercialized vaccines. Biopharming is one of the best ways for production of edible vaccine at cheap price. Agricultural biotechnology is the topmost priority area that has received considerable attention. In recent years, through plant genetic engineering it has become possible to use genetically engineered plants for the production of therapeutic recombinant proteins, the most important of which are plant-based vaccines.

What is Biopharming?

Biopharming is the production and use of transgenic plants and animals genetically engineered to produce pharmaceutical substances for use in humans or animals. Molecular biopharming involved plant biotechnology entails scientific techniques that can be employed to develop cellular and molecular based technologies to improve plant productivity by improving the quality of plant products as well as reducing environment-induced limitations to plant productivity.

Successful Examples of Production of Edible Vaccine Through Biopharming

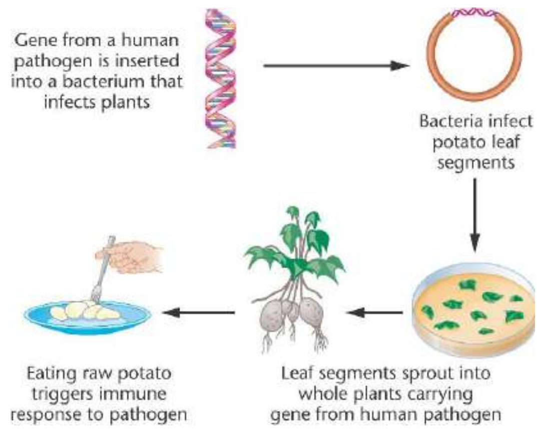
Edible vaccines were first tested on humans in 1997, when scientists asked volunteers to eat anti-diarrhoea potatoes produced by the Boyce Thompson Institute at Cornell University, Ithaca, NY, USA. Roswell Park Cancer Institute in Buffalo, New York also developed edible vaccines in raw potatoes and foreign proteins (HBs IgA) can help to cure human being from Hepatitis B virus.

Molecular biologist of the London Health Sciences Centre developed edible vaccines to combat autoimmune diseases such as multiple sclerosis, rheumatoid arthritis, lupus and even rejection. The first recombinant plant-derived pharmaceutical protein (PDP) was human serum albumin, initially produced in 1990 in transgenic tobacco and potato plants.

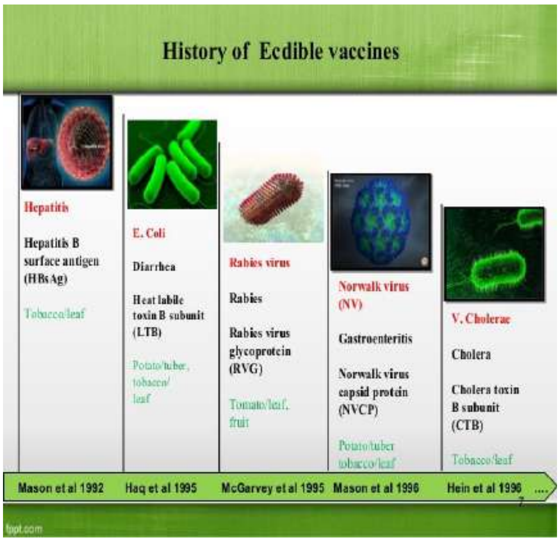
Fifteen years on, the first technical proteins produced in transgenic plants are on the market, and proof of concept has been established for the production of many therapeutic proteins, including antibodies, blood products, cytokines, growth factors, hormones, recombinant enzymes and human and veterinary vaccines.

One of the newest developments in edible vaccinations came during the Ebola outbreak. With much of modern medicine, including the Ebola vaccination, being accessible only to the rich, scientists in the U.S wanted to find a vaccine for the developing world. Professor Charles Arntzen of Arizona State University believed that plants could be the answer. His team began researching and discovered that tobacco plants were ideal for housing the much-needed Ebola vaccine, ZMapp.

Like other edible vaccines, the desired antibodies are produced by fusing their genes to the genes of the tobacco plant. The tobacco is then injected with an artificial virus, stimulating antibody production. Though revolutionary in the fight against Ebola, the tobacco vaccine does have its complications. The outbreak required a large quantity of vaccinations which, with edible vaccines, is hard to develop in a short amount of time.



Procedure for production of edible vaccine through biopharming



Future Scope of Biopharming

At present whole world affected through Covid-19 infection, development of vaccine for covid-19 is only effective way for control it. If vaccine will be developed in near future it will be required in large quantity. So, it is a big challenge for India to multiply it within a short time to prevent the virus spreading quickly which can be achieved through biopharming. Hope if biopharming is accepted there will be a tremendous improvement in target substance multiplication in a better and safer way.

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Growth of Foreign Direct Investment (FDI) in India

Article ID: 30594

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Introduction

Investment, or capital creation, is a key determinant of economic growth. Investments consist of both domestic and foreign investment. Foreign Direct Investment (FDI) is an investment by an investor from another country in an enterprise through which the foreign investor has control over the purchased company. The Organization of Economic Cooperation and Development (OECD) defines this control as having 10 per cent or more of the business's share. If an investor owns less than 10 per cent, it is classified as part of their stock portfolio by the International Monetary Fund (IMF). In other words, Foreign Direct Investment (FDI) is an investment into a company or organization in another country by a party in one country with the goal of creating a lasting interest. This lasting interest differentiates FDI from foreign portfolio investments, in which investors passively hold securities from a foreign country.

FDI is seen as the life blood and a significant tool for economic development as far as the developing countries are concerned. The companies in developing nations need the multinationals' funding and expertise to expand their foreign sales. These countries require private investment in energy, infrastructure, and water to increase employment and wages. In 2019, developing countries received 695 billion dollars, or 47% of total global FDI. However, global FDI remained flat in 2019 at 1.39 trillion dollars showing a 1 per cent decline from a revised 1.41 trillion dollar in 2018. South Asia witnessed a 10 per cent increase in FDI inflows during 2019; amounting to 60 billion dollars. The growth was mainly driven by India, with a 16 per cent increase in inflows to an amount estimated at 49 billion dollars. The majority went into services industries, including information technology (Global Investment Trend Monitor report 2020, UNCTAD). Developed economies, such as European Union and United States, do require FDI. Their companies do so for separate reasons Most of the investments in these countries are by mergers and acquisitions between established firms. These global corporations make investments for either reforming or reorienting on core businesses. Businesses that make foreign direct investments are often considered as multinational corporations (MNCs) or multinational enterprises (MNEs). An MNE may create a direct investment through the creation of a new foreign enterprise, known as greenfield investment, or by acquiring a foreign firm, either known an acquisition or brownfield investment.

Types of Foreign Direct Investment

Mainly, two major types of FDI are: Horizontal and Vertical FDI.

1. Horizontal FDI: The company or enterprise in this case carries out the same operations but in a foreign country.

2. Vertical FDI: By shifting to a different stage of the supply chain, the company extends into a foreign market or merges with a foreign company just to add more value to their value chain. But, on the whole, they are all related to the main sector.

Nevertheless, two other types of FDI have also been observed: Conglomerate and Platform FDI.

Conglomerate FDI

This is an unusual case where a company in a country would acquire an unrelated business in some foreign country.

Platform FDI

In this case, a corporation is extending its business operations into a foreign country, but the production is primarily exported to third countries. This is also referred to as export-platform FDI. It commonly operates in low-cost locations within the free-trade areas.

FDI in India

FDI has helped India in many ways to achieve a certain degree of financial growth, stability and financial development in many ways. It has an important impact on the balance of trade in the country, increasing labour standards, technology transfer and innovative ideas, skills and the general business climate. India ranks among the top ten Foreign Direct Investment recipients' in 2019. It is governed by the FDI policy announced by the Government of India under the provision of the Foreign Exchange Management Act (FEMA), 1999. The Reserve Bank of India (RBI) in this regard issues a notification from time to time, which contains the Foreign Exchange Management (transfer or issue of security by a person resident outside India) Regulations, 2000. The Ministry of Commerce and Industry, Government of India is the nodal agency for motoring and updating the FDI policies. The FDI policy is notified by the Secretariat for Industrial Assistance (SIA), DIPP via press releases. Foreign investors are free to invest in India, with the exception of few sectors / activities where prior approval from the RBI or Foreign Investment Promotion Board (FIPB) is required.

According to the Department for Promotion of Industry and Internal Trade (DPIIT), cumulative FDI equity inflows in the country stood at 456.79 billion dollars during the period April 2000 to December 2019, indicating that government's effort to improve ease of doing business and relaxation in FDI norms are yielding effective results. The recent figures reveals that for the year 2019-20, it stood at 36.79 billion dollar; out of which the service sector has attracted the highest FDI equity inflow of 6.52 billion dollar followed by computer software and hardware (6.34 billion dollar), telecommunications sector (4.29 billion dollar) and trading (3.52 billion dollar). During the period, India received the maximum FDI equity inflows from Singapore (11.65 billion dollar), followed by Mauritius (7.45 billion dollar), Netherlands (3.53 billion dollar), Japan (2.80 billion dollar) and USA (2.79 billion dollar).

Table 1 Growth of FDI inflows as per International Best Practices (as per RBI's monthly bulletin).

Financial year (April- March) 2000-01 to 2019-20	Equity Inflows	Total Inflows	% age growth over previous year (in terms of US $)
2000	2463	4029	-
2001	4065	6130	(+) 52 %
2002	2705	5035	(-) 18 %
2003	2188	4322	(-) 14 %
2004	3219	6051	(+) 40 %
2005	5540	8961	(+) 48 %
2006	12492	22826	(+) 155 %
2007	24575	34843	(+) 53 %
2008	31396	41873	(+) 20 %
2009	25834	37745	(-) 10 %
2010	21383	34847	(-) 08 %
2011	35121	46556	(+) 34 %
2012	22423	34298	(-) 26 %
2013	24299	36046	(+) 5 %
2014	29737	45148	(+) 25 %
2015	40001	55559	(+) 23 %
2016	43478	60220	(+) 8 %
2017	44857	60947	(+) 1 %
2018	44366	62001	(+) 2 %
2019	36769	51429	-
CAGR	19.43	17.70	

Source: Fact Sheets on FDI, DIPP

Table 1 indicates the growth of FDI inflows in India over the past twenty years. During the period, cumulative total FDI inflow was found to be 658893 million dollar and cumulative FDI equity inflow stood at 456911 billion dollars, indicating that government's action to improve ease of doing business and relaxation in FDI norms are yielding results. In absolute terms, total FDI inflows have increased from 4029 million dollars in 2000-01 to 51429 million dollars in 2019-20 registering a compound annual growth rate of 17.70 per cent. Similarly, equity component of FDI has also registered an increase from 2463 million dollars in 2000-01 to 36769 million dollars in 2019-20 at a CAGR of 19.43 per cent. The major boost to FDI has been received from the launch of Make in India initiative in 2014. FDI inflow from April 2014 to March 2019 was approximately 46.94 per cent of the overall FDI received in the country since April 2000.

Role of FDI in Indian Agriculture

Agriculture is an important sector of the Indian economy that accounts for 16 per cent of Indian gross domestic products (GDP). FDI inflow is considered as one of the major reforms over the years for the agriculture sector. Initially, after the liberalization policy, only 45 per cent of the foreign capital was permitted for the agriculture sector. Later on, with the improvisation in the policies, it was amended to allow 100 per cent foreign direct investment under the automatic route. According to Department for Promotion of Industry and Internal Trade (DPIIT), 100 per cent foreign direct investment (FDI) is allowed for the sectors including horticulture, floriculture, development of seeds, animal husbandry, pisciculture, aqua culture, cultivation of vegetables, mushroom and services related to agro and allied sectors. Other than agricultural services, 100 per cent FDI is only allowed in the tea sector. Owing to the inflows of FDI in agriculture, tremendous growth has also been observed in other sectors as well like irrigation, roads, housing, water supply, electrification and telecommunication connectivity. Foreign investment also plays an important role in agricultural retailing by ensuring adequate capital flows into rural economy in a way that is likely to promote the welfare of all sections of society, especially farmers and consumers.

Conclusion

Although, there are some limitations but if used judiciously, FDI promotes employment in the country, increases the individual's income and also contribute towards the improvement of food security. Thus, it can be concluded that while attracting FDI can be a significant factor for growth of the economy, however, it is not an end in itself. The right approach would be to build a country-wide favourable environment for equitable FDI inflows and at the same time develop sound domestic macro-economic and structural policies. This will help in accelerating the pace of development of the economy.

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An Essential Evil: Anti-Nutritional Factors in Legumes

Article ID: 30595

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Pulses are the major protein supplier to the vegetarians worldwide. The quantum of protein is 18-32% and filled with essential amino acids and bioactive peptides. It has substantial quantum of minerals, dietary fibre, vitamins, and supplies adequate energy calories required for human health. Regular pulses consumption avoids occupational disorders and chronic ailments including cardio vascular issues by reducing LDL cholesterol. Pulses are used as input for preparation of many health foods and mixtures. In few cases, either direct consumption or industrial utility of pulses are hampered by few anti-nutritional factors (ANFs).

An anti-nutritional factor is scientifically defined as a substance which interferes with assimilation of certain nutrients, showing toxic or undesirable physiological effects upon consumption. The ANFs inhibit the food digestibility, and thereby reduce protein utilization.

Few examples are phytates, cyanogenic compounds, flatulence causing agents, esterogens, trypsin and chemotrypsin inhibitors, goiterogens, lectins, polyphenols, lathyrogens, saponins, allergens and anti-vitamins. This concise paper provides an insight into the major anti-nutritional factors of pulses and their impact. This would help the budding breeders to understand the importance of anti-nutritional factors and to eliminate such miscreants through genetic manipulation.

The ANFs are grouped into two major categories protein and non-protein ANFs. The protein ANFs cause non-toxic effects (polyphenols) to harmful effects (protease inhibitors). The effect of non-protein ANFs vary to a greater extent. Few examples are alkaloids, phytic acid, phenolic compounds (saponins and tannins).

The beneficial and harmful effects of common ANFs found in pulses are summarized below.

S. No	Anti-nutritional Factor	Harmful effect	Beneficial effect
1	Phytic acid	It forms complex with iron, zinc, magnesium and calcium in the digestive tract, reduce bioo-availability and thereby cause mineral deficiency.	Major storage form of phosphorus in plants (60-90% of total seed phosphorus). It is present as crystals inside protein bodies in discrete regions of seeds. Phytic acid helps for better seed germination and establishment. It is antioxidant and anti-cancer agent.
2	Protease inhibitors	Protease inhibitors are the low molecular weight proteins which form stable complexes with digestive enzymes and affect their digestive activity. The protease inhibitors affect the activity of protein digestive enzymes performance of body digestive enzymes to degrade dietary protein, and limiting intake of amino acids needed to construct new proteins. Examples are Bowman-Birk, Kunitz, and α-amylase inhibitors.	Associated with (i) mobilization of storage proteins, (ii) Regularize the activities of endogenous enzymes, (iii) modulate the apoptosis and programmed cell death, and (iv) stabilize defense proteins. It also acts an insecticide.
3	Tannins	Tannins are the compounds present in chickpea which primarily form the basis of pigmentation in the seeds.	The presence of tannins adds to astringency of tannin- rich foods because of their precipitation due to salivary proteins thereby offers resistance.

		Upon consumption it gets hydroxylated and form insoluble complexes with carbohydrates and proteins. Tannins bind to enzymes and other proteins through hydrogen bonding and form insoluble tannin- protein complexes which are resistant to digestive enzymes of monogastric animals.	
4	Lectins (agglutinins)	Lectins are classified as legume lectins, type II ribosome inactivating proteins, monocot mannose-binding lectins, and other lectins. They bind reversibly to a specific carbohydrate. The deleterious effects include food poisoning, vomiting, bloating, and diarrhoea in humans. Lectins prevent absorption of digestive end products in small intestine by binding with different sugar moieties in intestinal wall and cause coagulation of red blood cells.	Play key role in pharma industries owing to their antifungal, anti-proliferative and HIV-1 reverse-transcriptase activities.
5	Phenolic compounds	Cause digestible issues upon consumption. They reduce the bioavailability of the minerals especially zinc. They form complex with protein and decrease their solubility and digestibility.	Phenolic compounds arise from a common intermediate, phenylalanine, or a close precursor, shikimic acid. They are associated with carboxylic and organic acids, amines, lipids and linkage with other phenol. These associations made phenolic compounds to act against many plant diseases and insects. Act as anti-cancer and anti-atherosclerotic
6	Raffinose family of oligosaccharides (RFO)	RFO consisting of raffinose, verbascose sugars, and stachyose. These sugars are digested in large intestine and produce uncomfortable and unacceptable flatulence (abdominal gas production) when eaten large. Also, interfere with digestion of other nutrients.	During seed germination they serve as a carbon source for new seedlings. Reduce the risk of intestinal cancer; increase stool weight and frequency.
7	Saponin	Cause soap like formation. At high concentration, it causes hemolysis of RBCs and makes holes in membranes and leading to cell death.	Saponins lower cancer risks and glucose, and decrease blood lipids. Diet rich in saponins reduce dental problems.
8	Vicine and convicine	Cause acute hemolytic disease (favism)	Reduce cholesterol

Conclusion

Pulses are consumed as a major plant protein source and additionally they provide sizable quantity of carbohydrate, fibre, vitamins and minerals. Also, pulses are rich in few anti-nutritional factors. These ANFs potentially interfere with digestibility and absorption of few other nutrients and minerals. Alas, they are supporting seed germination, better establishment and having health effect like hypocholesterolaemia, anticancer and anti-atherosclerotic upon consumption in human. Pulses can be equated to a double-edged sword for nutritional and ANF contents. However, the good health benefits are over-ruling the ill-effects of ANFs. The beneficial effects of ANFs in plant protection and medical treatments are to be considered and pursued positively. Pulses are hard dried seeds and can be stored for several months without losing their nutritional value. Pulses cannot be consumed without processing as they are naturally hard seed coated. Few traditional processing methods (milling, dehulling, roasting, soaking, cooking, germination and fermentation) will remove ANFs to a varying degree. The modern processing techniques like fractionation, ultrafiltration extraction and extrusion are helping to reduce the content of ANFs. However, few ANFs are to be genetically modulated for which germplasm screening and targeted breeding programs are to be framed. Recent advances in genomics would hasten the program.

Genetic Erosion

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Summary of Article
This article is brief introduction on Genetic Erosion that covers introduction on What is Genetic Erosion ,Gene pool and Ex- situ & In – situ forms of conserving Genetic reserves.

Introduction
Genetic erosion (also known as genetic depletion) is a process where the limited gene pool of an endangered species diminishes even more when reproductive individuals die off before reproducing with others in their endangered low population.

The term is sometimes used in a narrow sense, such as when describing the loss of particular alleles or genes, as well as being used more broadly, as when referring to the loss of a phenotype or whole species. Genetic erosion occurs because each individual organism has many unique genes which get lost when it dies without getting a chance to breed. Low genetic diversity in a population of wild animals and plants leads to a further diminishing gene pool – inbreeding and a weakening immune system can then "fast-track" that species towards eventually extinction. By definition, endangered species suffer varying degrees of genetic erosion. Many species benefit from a human-assisted breeding program to keep their population viable,[citation needed] thereby avoiding extinction over long time-frames. Small populations are more susceptible to genetic erosion than larger populations.

Gene Pool
The gene pool of a species or a population is the complete set of unique alleles that would be found by inspecting the genetic material of every living member of that species or population. A large gene pool indicates extensive genetic diversity which is associated with robust populations that can survive bouts of intense selection.

Processes and Consequences-Population bottlenecks create shrinking gene pools, which leave fewer and fewer fertile mating partners. The genetic implications can be illustrated by considering the analogy of a high-stakes poker game with a crooked dealer. Consider that the game begins with a 52-card deck (representing high genetic diversity). Reduction of the number of breeding pairs with unique genes resembles the situation where the dealer deals only the same five cards over and over, producing only a few limited "hands".

As specimens begin to inbreed, both physical and reproductive congenital effects and defects appear more often. Abnormal sperm increases, infertility rises, and birth-rates decline. "Most perilous are the effects on the immune defence systems, which become weakened and less and less able to fight off an increasing number of bacterial, viral, fungal, parasitic, and other disease-producing threats. Thus, even if an endangered species in a bottleneck can withstand whatever human development may be eating away at its habitat, it still faces the threat of an epidemic that could be fatal to the entire population.

Prevention by Human Intervention
Can be done by two processes:
1. In- situ conservation.
2. Ex-situ conservation.

In-Situ Conservation
With advances in modern bioscience, several techniques and safeguards have emerged to check the relentless advance of genetic erosion and the resulting acceleration of endangered species towards eventual extinction. However, many of these techniques and safeguards are too expensive yet to be practical, and so the best way to protect species is to protect their habitat and to let them live in it as naturally as possible.

Wild sanctuaries and national parks have been created to preserve entire ecosystem with all the web of species native to the area. Wildlife corridors are created to join fragmented habitats to enable endangered species to travel, meet, and breed with others of their kind. Scientific conservation and modern wildlife management techniques, with the expertise of scientifically trained staff, help manage these protected ecosystems and the wildlife found in them. Wild animals are also translocated and reintroduced to other locations physically when fragmented wildlife habitats are too far and isolated to be able to link together via a wildlife corridor, or when local extinctions have already occurred.

Ex-Situ Conservation

Modern policies of zoo associations and zoos around the world have begun putting dramatically increased emphasis on keeping and breeding wild-sourced species and subspecies of animals in their registered endangered species breeding programs. These specimens are intended to have a chance to be reintroduced and survive back in the wild. The main objectives of zoos today have changed, and greater resources are being invested in breeding species and subspecies for then ultimate purpose of assisting conservation efforts in the wild. Zoos do this by maintaining extremely detailed scientific breeding records (i.e. studbucks) and by loaning their wild animals to other zoos around the country (and often globally) for breeding, to safeguard against inbreeding by attempting to maximize genetic diversity however possible.

Costly (and sometimes controversial) ex-situ conservation techniques aim to increase the genetic biodiversity on our planet, as well as the diversity in local gene pools. by guarding against genetic erosion. Modern concepts like seedbanks, sperm banks, and tissue banks have become much more commonplace and valuable. Sperm, eggs, and embryos can now be frozen and kept in banks, which are sometimes called "Modern Noah's Arks" or "Frozen Zoos". Cryopreservation techniques are used to freeze these living materials and keep them alive in perpetuity by storing them submerged in liquid nitrogen tanks at very low temperatures. Thus, preserved materials can then be used for artificial insemination, in vitro fertilization, embryo transfer, and cloning methodologies to protect diversity in the gene pool of critically endangered species.

It can be possible to save an endangered species from extinction by preserving only parts of specimens, such as tissues, sperm, eggs, etc. – even after the death of a critically endangered animal, or collected from one found freshly dead, in captivity or from the wild. A new specimen can then be "resurrected" with the help of cloning, so as to give it another chance to breed its genes into the living population of the respective threatened species. Resurrection of dead critically endangered wildlife specimens with the help of cloning is still being perfected, and is still too expensive to be practical, but with time and further advancements in science and methodology it may well become a routine procedure not too far into the future.

Summary

Genetic erosion is the depletion of genetic diversity that include stage of extinction for varieties of animals ,wildlife corridors & some plants varieties.

There are some methods to preserve these species such as In-vitro fertilization and In -situ & Ex -situ conserves.

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Agricultural Machineries for On Field Residue Management

Article ID: 30597

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We know that after harvesting of crop we left huge amount of straw and residue. Some time it is burn to take second crop after harvesting. Burning of crop is harmful of soil as well as environment. Burning of crop is major problem not only in India but also problem in all over countries. Management of residue is important to reduce harmful effect on environment by burning. On field management include reduce the size of residue and incorporate with the soil to improve the soil quality. This improve soil quality by improve maintain moisture, improve aeration and reduce soil density.

Introduction

The chopping of paddy stubbles is recommended immediately after combine harvesting because at higher moisture content chopping was found effective. According to researchers investigation the machines developed for residue management of different crops at India and other countries are flail mower, straw chopper cum spreader, tractor operated cross conveyor paddy straw thrower, crop residue crushing machine, forage chopper, tractor operated shredder, stalk stubble breaking and mulching machine, tractor mounted sugar cane shredder, sugarcane trash chopper cum spreader, modified wheat straw chopper, stubble harvester cum chopper and happy seeder etc.

The most of these machines which was used for residue management with rotary power type like flail mower, rotavator. The most important machine and field parameters involved in performance of these machines are forward speed of prime mower, width of cut, fuel consumption, rotary speed of machine, type of soil, moisture content of soil, trash size reduction, chopping capacity, energy requirement, density of trash, and moisture content of trash. On this basis of this review it was revealed that there is no successful machine is available so far paddy residue management, the respective field with which can perform effectively and efficiently cutting, chopping and incorporation of paddy residue in a single pass.

Straw Generation and Implementation of Straw Management Techniques

We know that a huge amount of residue around 500 Mt generated in the agricultural, in which about 140 Mt is burned in combine harvested field. In north Indian region major portion of residue is burn. Crop generation depend on different cropping pattern, intensity and productivity of crop and it vary with states. We know that now mechanization is improved and residue management is also mechanized but adoption is limited.

Collection and moving residue from agricultural field to any place is too much labour intensive, costly and time-consuming process, so some of the farmer prefer burn this residue in the field. Effective management of residue is now adopting varies country without burning in field. Some of the countries like Thailand, Nepal, Indonesia, Malaysia, Philippines and Nigeria are using this residue as animal field, composting, renewable source of energy and for mushroom cultivation etc. On field management is generally done by machinery like happy seed drill, mulcher, baler and straw chopper cum spreader and now adopted in agricultural field for residue management.

Mulcher

Straw mulcher having rotary blades driven by tractor PTO, which cut the straw in small pieces and left in the field shown in Fig.1. It is reduced size of straw easily incorporated with soil with tillage tools and in zero seed drill this residue bed works as mulching for crop. Some researchers are worked on performance of mulcher in India. They reported that effective field capacity is around 0.35 ha/h with speed about 2.5 km/h. Fuel consumption of the paddy straw mulcher is about 6 lit/h. Paddy straw mulcher reduce the straw length about 80% or about 10 cm after operation. One research was explored that average grain yield for treatment T1 (Paddy straw mulcher + wheat sowing with spatial no-till drill) was 2.39 and 0.33% less than T2 (paddy straw chopper-cum spreader + wet mixing with rotavator + no till drill) and T3 (clean field + disc harrow + cultivator x 2 + planter + traditional seed drill) respectively whereas the cost of operation for treatment T1 was 24.38 and 23.55% less than T2 and T3 respectively.

Happy Seed Drill

This is a special purpose sowing implement. When we need sowing just immediately harvesting or stubbles are left in field after harvested by combing this implement is work effectively. a rotary cutting mechanism like rotavator is attached with this sowing implement which cut the stables in small size about 10-20cm with sowing operation shown in Fig.2. Rotary blade direction is opposite to the direction of travel with special shape to cut the stubble/residue of the field. Just after harvesting without removing the stubble we are able to sowing by this machinery. We know that in other machinery incorporation of chopped residue is required that is take some time for incorporation operation. Happy seed drill does not require any additional machinery for mixing operation, in this machinery chopping and sowing operation is done together. Chopped residues give mulching effect to the crop. It is the one of best solution to reduce the problem of straw burning in field.

Fig. 1: Mulcher

Fig. 2: Happy seed drill

Baler

Fig. 3: Baler

Baler is used to make bales from residue which is left in combine harvested paddy field. This machinery consist picking, conveying, compressing chamber, density adjuster and knotting mechanism with crank mechanism, power transmission and hauling system. It gets power from the PTO of tractor. In baling system pick up reel take the straw from the ground and conveyer conveyed it in compression chamber where a ram/piston beat and compress the straw by crank linkage mechanism. After compression a tying mechanism automatically binds the bale and moves it to discharge chamber. By use of baler we lift and bind the straw in a compact form which is easily handle and moveable.

Conclusion

Management of residue in the field or used as animal feed, energy both is very beneficial. Residue management by mixing in soil improves the quality of soil and less time-consuming method of residue management. It improves the organic matters in the soil and also improves the aeration which helps to easy penetrate the root of crop into the soil. Now machineries are very effectively doing their job to incorporate residue into the soil. Machineries reduced the size of straw which help to easily decompose straw into soil. Baler is also very use to remove the straw from the field and use resources for energy and other things.

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An Overview of Baby Corn Cultivation

Article ID: 30598

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Introduction

Corn or maize is highly versatile crop with high-yield and fast-growth. These characteristics make it suitable for wider use and production in the developing world. Developing countries considered maize as grain for the poor and greens for the animal. However, nowadays tender and immature cobs of corn are being used as vegetable. This novel use, known as baby corn (candle corn in Thai cook books), is becoming popular in domestic and foreign markets and has enormous processing and export potential. Domestic market for baby corn is growing due to the increase in number of farmers producing it. Its cultivation is popular in urban and peri-urban areas due to high market demand.

Characteristics, Nutritional Value and Uses of Baby Corn

Baby corn is tiny, immature and unfertilized ears of corn from normal sized corn plants. Many people presume that it comes from dwarf corn plant. The miniature size is due to its early harvest at very immature stage (when silks are about to emerge or just emerged) and is not produced on dwarf corn plant.

Nutritional Value

Half a cup (serving size) of boiled baby corn contains 18 calories, 0.1 g fat, 1.7 g protein, 3.6 g carbohydrates and 1.2 g dietary fibre. Besides, it also has vitamin A (276 retinol equivalents), vitamin C (16 mg), potassium (483 mg), sodium (158 mg), magnesium (76 mg), calcium (51 mg) and iron (2 mg).

Baby Corn: Primary or Secondary Crop

Baby corn could be grown in two different ways:

1. Baby corn as primary crop- variety is planted to produce only baby corn.
2. Baby corn as secondary crop- a sweet corn or field corn variety is planted primarily to produce either sweet corn or field corn. The choice of the variety, planting density and fertilizer rates are different in these two methods. Economic yield may be separated into three components: husk yield, young ear yield (baby corn), and standard ear yield.

The important attributes relevant to baby corn are early maturity, prolificacy (ability to produce multiple ears), synchronized ear emergence and yellow kernels Four hybrids of maize, viz., Ganga -11, FH-3104, CHH -72, HM-4, IMHB-1305, DMRH-1539 are suitable for baby corn due to their high cob yield and average stability.

The hybrids developed at Indian Agricultural Research Institute (PEHM-2, 3, 5) have potential utility as baby corn cultivars. The preliminary efforts have been made in assessing their performance for baby corn production under higher plant density. Now varieties specially bred for baby corn purpose are available in both public and private sectors.

Choosing a Variety

Initially, normal field corn varieties were grown for this purpose. However, it requires varieties to produce more ears per plant. But such varieties are limited in number. Many sweet corn varieties are also suitable for baby corn production.

When baby corn is grown as a secondary crop, the variety must fit the purpose of the primary crop, whether it is for sweet or field corn. A variety should also have good baby corn ear characteristics. Ear quality, not quantity is the primary criterion. Baby corn ears should be 2–4 inches long and 1/3–2/3 inch in diameter at the base.

Cultivation Practices

Baby corn production requires the cultivation practices recommended for normal corn production. But the crop duration is only about 60 days while it is 110-120 days for the grain crop. Among the other cultural practices, one of the important practices is detasseling.

Detasseling

The pollinated tender ears (baby corn) would lose quality and hence it is important to prevent pollination. Thus, removal of tassels (detasseling) is an essential operation for baby corn production to ensure better quality. Detasseling has to be done as and when tassels start emerging (usually around 40-45 days). The detasseling operation should be done on a daily basis till tassels from all the plants are removed.

Maturity Indices and Harvest

Baby corn is generally hand harvested just at silk emergence stage (around 50-60 days after sowing). Ears are ideal for baby corn if they are bite size: 8-10 cm long and 1-1.5 cm in diameter at the base and weigh 7-8 g. To meet these criteria, harvest ears 1 to 3 days after silks become just visible. For baby corn purpose, harvest ears every alternate day (or 2-3 days depending upon the variety). Otherwise ovule size gets increased and ear will be large, pithy, woody and of poor quality in just 4–5 days. Some field corn varieties may have to be harvested before silking. To determine the appropriate time to harvest in a particular area, few ears should be harvested each day starting from the day of ear emergence on the stalk. When baby corn is grown as a primary crop: All the ears are harvested and the harvesting continues over a period of 3–4 weeks (9-12 times) from a single planting. The closer plant to plant spacing (high density planting) results in more high-quality primary ears per hectare. Most varieties will produce 2–3 ears per plant; however, quality of the third ear may not be fully satisfactory. Expected yield is 10t ha-1 of unhusked baby corn ears and 1.2t ha-1 of husked baby corn. When baby corn is grown as a secondary crop, second ear from the top of the plant is harvested for baby corn and top ear is allowed to mature to produce either sweet corn or field corn depending upon the variety planted.

Post-Harvest Management

Though baby corn has husks to protect the young ear, freshness can only be maintained for a limited period. Limited information is available on maintaining quality for export in the fresh form or for processing in canneries. Therefore, research need to be intensified to generate information on this aspect.

Storage and Processing

Refrigerating immediately will help retain sweetness. Unhusked baby corn is better for refrigeration, which would store it for up to one week without losing its quality. If baby corn has to be freeze stored, place husked ears in boiling water or steam for 30-45 seconds, cool then freeze or keep in freezer bags or zip lock bags and place them in the fridge diction of the refrigerator. However, it is best used fresh. The cooked baby corn could be stored by placing a cling film on the container having cooked baby corn. However, it has to be used within a day. Product quality is important in the cannery and the export industry. Rigorous quality control is needed to meet international standards. More efforts in this field would help promote the baby corn cultivation and industry. The international quality standards for baby corn are given below.

Prescribed Quality Standards

Extra Class: The cobs of baby corn in this class must be well trimmed, free of husk, stalk and silk, intact and of superior quality. They must be characteristic of the variety and/or commercial type. They must be free of defects, with the exception of very slight superficial defects, provided these do not affect the general appearance of the produce, the quality, the keeping quality and presentation in the package.

Class I: The cobs of baby corn in this class must be well trimmed, free of husk and stalk and of good quality. They must be characteristic of the variety and/or commercial type. The following slight defects, however, may be allowed, provided these do not affect the general appearance of the produce, the quality, the keeping quality and presentation in the package (FAO/WHO Codex Standard, 2005).

Class II: This includes cobs of baby corn which do not qualify for inclusion in the higher classes, but satisfy the minimum requirements. The following defects, however, may be allowed, provided the cobs of baby corn retain their essential characteristics as regards the quality, the keeping quality and presentation

Presentation: defects in shape, colour and texture; defects in arrangement of undeveloped kernels (ovules); defects on the surface due to bruising, scratches or other mechanical damage. The total area affected shall not exceed 10% per cob; silk attached to and/or broken from the cob shall be minimal without affecting the appearance.

Grade tolerances: Five percent by number or weight of cobs of baby corn not satisfying the requirements of the class, but meeting those of Class I or, exceptionally, coming within the tolerances of that class. Ten percent by number or weight of cobs of baby corn not satisfying the requirements of the class, but meeting those of Class II or, exceptionally, coming within the tolerances of that class. In the case of cobs of baby corn with incompletely removed husk and stalk, only 5 per cent by number or weight of 0.5 cm long of the husk and stalk is allowed.

Size Code	Length (cm)
A	5.0-7.0
B	7.0-9.0
C	9.0-12.0

Provisions concerning sizing: Size is determined by the length of the cob of baby corn, in accordance with the following table:

For all sizes, the minimum width should not be less than 1.0 cm and the maximum width not more than 2.0 cm.

Conclusion

Corn will remain one of the important field crops in the developing countries. Considerable scope exists for promoting baby corn technology in the Asia-pacific region. The baby corn industry provides opportunities for higher income, generates employment for the rural poor and potential for export. Besides, its use as vegetable provides additional source of nutrition to the consumers. Baby corn is expected to catch the attention of more and more consumers and farmers because of its superior taste and texture. Using local produce gives fresh and nutritious food and keeps small farmers in business. Thus, help supports the local economy and conserving natural resources (raw materials for transportation and packaging are saved). In order to harness these benefits, research and development support and appropriate policies at the national level are required. Hence, the Governments should therefore, concentrate on framing policies and development of human resources. In addition, government policies should encompass motivating young farmers and finding creative ways to sustain baby corn industry by involving personnel involved in both private and public sectors. Further, for promoting baby corn industry, regional co-operation for exchange of information and germplasm, regional testing of selected hybrids and varieties, joint meetings and visits, human resource development, collaborative efforts for research and development and sensitization of policy makers for arriving at adoption of appropriate baby corn production and processing technology would be highly desirable.

Effect of Climate on Agriculture

Article ID: 30599

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Summary

This article is based on climate effect on agriculture that include effect of climate change on vegetation and plant population. Effect of carbon dioxide on vegetation and human health. Higher temperatures and changing precipitation patterns will severely affect the production patterns of different crops. Agricultural productivity will also be affected due to increased carbon dioxide in the atmosphere. All these changes will increase the vulnerability of the landless and the poor.

Introduction

Climate change has a serious impact on the availability of various resources on the earth especially water, which sustains life on this planet. Changes in the biosphere, biodiversity and natural resources are adversely affecting human health and quality of life. Throughout the 21stcentury, India is projected to experience warming above global level. India will also begin to experience more seasonal variation in temperature with more warming in the winters than summers. Longevity of heat waves across India has extended in recent years with warmer night temperatures and hotter days, and this trend is expected to continue. The average temperature change is predicted to be 2.33°C-4.78°C with a doubling in CO_2 concentrations. These heat waves will lead to increased variability in summer monsoon precipitation, which will result in drastic effects on the agriculture sector in India. Climate models predict a gradual rise in carbon dioxide (CO_2) concentration and temperature across the globe. These models, however, are not very precise in predicting future changes in local weather conditions. Local weather conditions such as rain, temperature, sunshine and wind, in combination with locally adapted plant varieties, cropping systems, and soil conditions can maximize food production as long as plant diseases can be controlled.

Agriculture production is directly dependent on climate change and weather. Possible changes in temperature, precipitation and CO_2 concentration are expected to significantly impact crop growth. The overall impact of climate change on worldwide food production is considered to be low to moderate with successful adaptation and adequate irrigation . Global agricultural production could be increased due to the doubling of CO_2 fertilization effect. Agriculture will also be impacted due to climate changes imposed on water resources . India will also begin to experience more seasonal variation in temperature with more warming in the winters than summers . India has experienced 23 large scale droughts starting from 1891 to 2009 and the frequency of droughts is increasing. Climate change is posing a great threat to agriculture and food security. Water is the most critical agricultural input in India, as 55% of the total cultivated areas do not have irrigation facilities.

India is home to 16% of the world population, but only 4% of the world water resources. Agriculture is directly dependent on climate, since temperature, sunlight and water are the main drivers of crop growth. While some aspects of climate change such as longer growing season and warmer temperatures may bring benefits in crop growth and yield, there will also be a range of adverse impacts due to reduced water availability and more frequent extreme weather condition.

Impact of Climate Change on Agriculture

Climate change affects all the three aspects of food security: availability, access and absorption. When production decreases, availability of food decreases. Climate change hits poor the most. They don't have income to buy the food, so their access to it is affected. This, in turn, has an impact on health and affects absorption."

Crop Reaction Toward Climate

rice, wheat, maize and sorghum are the worst hit by this phenomenon. By 2030, rice and wheat are likely to see about 6-10 per cent decrease in yields. Also gave examples of crops like potatoes, soybean, chickpea and mustard, on which climate change will have a neutral or positive impact.

An area is believed to be water-stressed when annual water supplies drop below 1,700 cubic metres per person per year. "We are already surviving with around 1,700-1,800 cubic metres per year. We are soon going to be in a situation where there will be wars for water. Much of the prosperity in the last two decades is because of groundwater exploitation. As our demand for water has increased drastically over the years, per capita water availability has taken a beating.

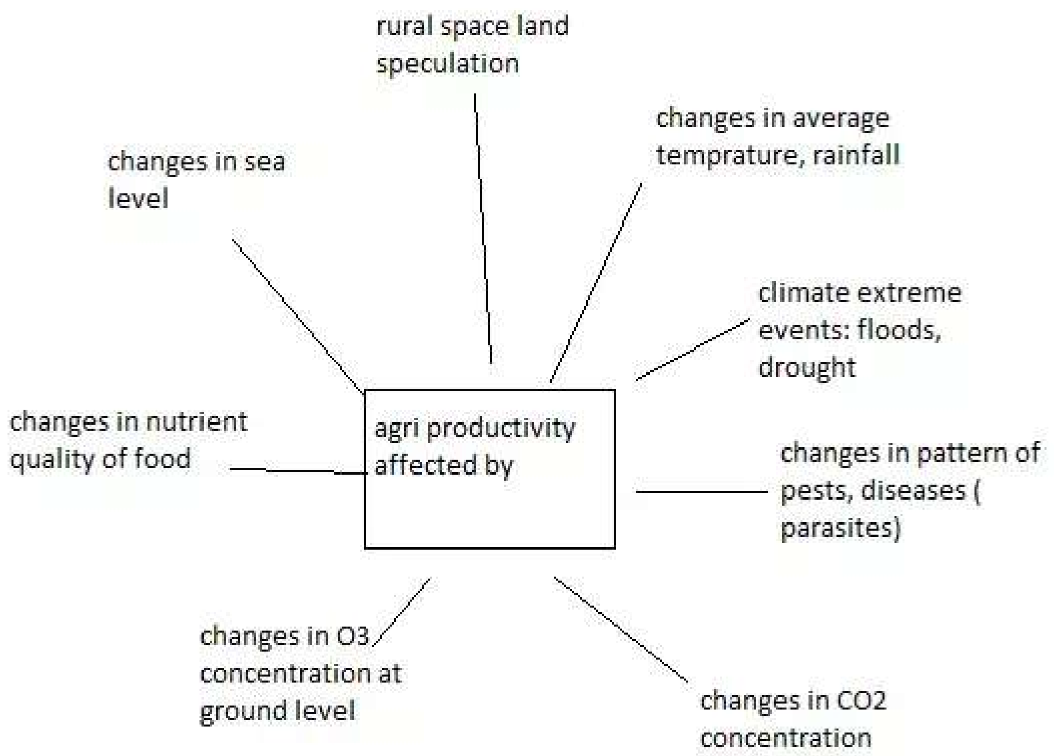

Figure 1 (Flowchart showing Causes that affect agriculture production)

Climate Variability and Food Production

Floods, cyclones and hailstorm, are direct hazards to crops. More subtle fluctuation in weather during critical phases of crop development can also have substantial impact on yields. Cultivated areas are subject to a broader range of influences, including changes in commodity prices, costs of inputs and availability of irrigation water. Climate may have indirect and possibly lagged influences on harvested areas.

Projected Climate Change Scenario Over Indian Subcontinent

Climate change is no longer a distant scientific prognosis but is becoming a reality. The anthropogenic increases in emissions of greenhouse gases and aerosols in the atmosphere result in a change in the radioactive forcing and a rise in the Earth's temperature. The bottom-line conclusion of the Third Assessment Report of the Intergovernmental Panel on Climate Change (IPCC, 2001) is that the average global surface temperature will increase by between 1.4° and 3°C above 1990 levels by 2100 for low emission scenarios and between 2.5° and 5.8°C for higher emission scenarios of greenhouse gases and aerosols in the atmosphere.

Summary

This article contains all the impacts of climate change on agriculture with outlining agri productivity climate variability and projected climate change. It also outlines the longevity of temperature and decrease to growth rate of crops which are at declination due to access carbon.

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Bio-Fumigation: A Sustainable Approach for Management of Soil-Borne Diseases

Article ID: 30600

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Introduction

Recently Department of agriculture and farmers welfare had banned 27 pesticides in India. From the current trends in agriculture production and based on consumer needs it is must to switch on to safer alternatives of plant protection measures instead of chemical control to produce residue free, pest free high-quality produce with conservation of natural ecosystem.

Bio-fumigation is such a way to manage certain soil-borne pest and diseases in an eco-friendly manner.

What is Bio-Fumigation?

Bio-Fumigation is a sustainable approach to manage soil-borne pests and diseases in crop fields, it is a pest suppressive action brought by decomposed plant tissues of certain brassica spp. biofumigants also includes some other plant and animal waste.

Those plants used as biofumigant contains glucosinolate compounds in their tissues, which upon degradation in soil releases glucosinolate degradation products after cellular hydrolysis. Isothiocynates are the major compounds obtained after cellular hydrolysis which are highly suppressive against certain pathogens and reported as antifungal and nematicidal in action (Brown and Morra 1997).

Common Bio-Fumigant Crops in India

Mustard, radish, turnip, rapeseed, sorghum and Sudan grass.

Methods of Cultivation

1. Sowing of bio-fumigant crop and turning into soil at flowering stage.
2. Collection from another field and added before field preparation.
3. Intercropping with biofumigant crops.
4. Crop rotation with biofumigant crops.
5. Application of seed cake and extracts.

Management of Diseases and Pest

Important diseases and pests controlled are *Aphanomyces, Fusarium, Gaumanomyces, Phytophthora , Pythium, Rhizoctonia, Sclerotinia* and *Verticillum*. Species of nematodes suppressed includes *Globodera, Meloidogyne, Pratylenchus* and *tylenchus*.

Beneficial Effects of Bio-Fumigation

1. Disease and pest suppression.
2. It improves soil Physical, Chemical and Biological properties.
3. Supports better plant growth by recycling of nutrients.
4. Cost reduction.
5. Reduce chemical toxicity.

Conclusion

Bio-fumigation helps in maintaining environmental balance by acting as a biological control. Soil becomes healthy and support better microbial activity with reduced use of chemical pesticides. It reduces extra burden and reliance on costly chemical pesticides. This technique will be suited in integrated disease management.

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Sensory Characteristics of Probiotic Cheese

Article ID: 30601

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Summary
Cheeses provide a favourable environment to maintain the viability of probiotics. Probiotics can modify the nutritional and sensory composition of cheeses. Specific probiotics in cheeses promote different beneficial effects in in vivo studies.

Introduction
Cheese has a good potential for delivery of probiotic microorganisms into the human intestine. In addition, the very wide variety of cheese types all over the world, consumption of cheese by almost everybody, as well as the high nutritional value of cheese constitute growing market for probiotic cheese. Probiotic microorganisms must survive in food products above a standard level until the time of consumption without adversely changing their sensory attributes. Since probiotic microorganisms could affect the flavour, texture, and appearance of dairy products, the sensory attributes of these products have been the subject of numerous studies. This article reviews the sensory characteristics of cheese as affected by probiotic microorganisms.

Functional Food
Functional foods are defined as "foods that through specific beneficial physiological action contribute to the health of the consumer"

Probiotics
Probiotics are defined as "live microorganisms which when administered in adequate numbers confer a health benefit on the host"). The probiotics beneficially affect human health by improving the balance of the intestinal microflora and improving mucosal defences against pathogens. Additional health benefits include enhanced immune response, reduction of serum cholesterol, vitamin synthesis, anticarcinogenic activity, and antibacterial activity). With the growth of the functional foods area, more research interest has focused on the incorporation of probiotic bacteria into cultured dairy products to further enhance the nutritional value of these products of *Bifidobacterium* and *Lactobacillus* are widely used as probiotic microorganisms in probiotic foods).

Cheese is a good alternative for delivery of probiotics into the intestine and, as a result, has been the subject of various marketing and research studies in recent years). Cheese has certain advantages as a carrier of probiotics compared with more acidic fermented dairy products such as yogurt. It creates a buffer against the high acidic environment in the gastrointestinal tract (GIT) and thus creates a more favourable environment for probiotic survival throughout gastric transit.

Most of the cheeses tested succeeded in maintaining the viability of these microorganisms. However, a prerequisite of probiotic cheese manufacture is that the cultures survive relatively long chain fatty acid. Cheese contains a complex combination of microorganisms that changes with time; initially containing large numbers of starter lactic acid bacteria (SLAB) and then, with maturation (ripening), an increasing number of nonstarter lactic acid bacteria (NSLAB). Therefore, viability of probiotic bacteria in cheese can be difficult and is a complex phenomenon.

Besides the viability of probiotics in cheese, it is important that incorporation of probiotic bacteria should not affect the expected sensory characteristics (flavour, texture, and appearance) of conventional (non-probiotic) cheeses. However, their addition might contribute to distinct flavour and texture characteristic. Although several studies have shown that probiotic cultures did not considerably affect the sensory quality of cheeses.

Flavour is the 1st indicator (primary driver) for food selection. Also, sensory characteristics of functional foods are superior to their health considerations for consumers from a consumption point of view; Consumers are not interested in consuming a functional food if added ingredients confer disagreeable flavours, even if they result in advantages with respect to their health . Cheeses are categorized, based on texture, from very hard to soft. The flavour of cheese is mild in unripened cheeses and can be sharp in ripened cheeses.

Cheese

As a probiotic food matrix- has a good potential for delivery of probiotic microorganisms into the human intestine due to its specific chemical and physical characteristics compared to fermented milks including higher pH value and lower titrable acidity, higher buffering capacity, greater fat content, higher nutrient availability, lower oxygen content, and denser matrix of the texture. Mentioned factors do enhance the viability and survivability of probiotics in cheese matrices. In addition, a large variety of cheese types all over the world, consumption of cheese by everybody, as well as the nutritional value of cheese have resulted in regular market growth for probiotic cheeses.

In development of probiotic cheeses, regardless of viability of probiotics until the time of consumption and within the GIT, other quality factors of cheese including sensory acceptance, chemical stability, and microbiological conditions throughout the shelf life of this product, technological considerations in industrial production, as well as its price to the consumer have their own substantial importance.

Effect of Probiotics on Biochemical Properties of Cheese

Cheese flavour is very complex and hundreds of compounds are involved. Flavour compounds are produced as a result of proteolysis, lipolysis, and glycolysis. These compounds can be divided into volatile and non-volatile ones. Peptides, FAAs, medium- and long-chain fatty acids, and many organic acids are non-volatile components that are involved in taste. Volatile components emerge as numerous aroma substances (aldehydes, ketones, alcohols, volatile organic acids, short-chain fatty acids, sulphides, and other derivatives from amino acids, fatty acids, and lactose). The enzymes of probiotic bacteria can change the flavour profile of cheese compared to the control (non-probiotic).

Reference

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Effect of Infestation on Nutrient and Physiochemical Properties of Two Cowpea

Article ID: 30602

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Summary of Article

Two cowpea varieties (Ife-brown and Kano-white varieties) were used for the study. The effects of insect infestation on the chemical composition and physicochemical properties of these cowpea seeds were studied. The proximate composition, and water absorption capacities, viscosity, gelation capacity and emulsion properties of infested cowpea varieties were compared with those of uninfected cowpeas.

Introduction

The cowpea is an annual herbaceous legume from the genus Vigna. Due to its tolerance for sandy soil and low rainfall, it is an important crop in the semiarid regions across Africa and Asia. (fig 1 showing cowpeas variety).

Scientific Name	*Vigna unguiculate*
Family	Fabaceae
Rank	Species
Higher classification	Vigina
Kingdom	Plantae
Order	Fabales

Infestation

The legume pod borer, Marucavitrata, is the main preharvest pest of the cowpea. vitrata causes the most damage to the growing cowpea due to their large host range and cosmopolitan distribution. It causes damage to the flower buds, flowers, and pods of the plant, with infestations resulting in a 20–88% loss of yield.

Figure 1

How Infestation Occurs

Callosobruchus maculatus is a species of beetles known commonly as the cowpea weevil or cowpea seed beetle. It is a member of the leaf beetle family, and not a true weevil. This common pest of stored legumes has a cosmopolitan distribution, occurring on every continent except Antarctica. The beetle most likely originated in West Africa and moved around the globe with the trade of legumes and other crops.

As only a small number of individuals were likely present in legumes carried by people to distant places, the populations that have invaded various parts of the globe have likely gone through multiple bottlenecks. Despite these bottlenecks and the subsequent rounds of inbreeding, these populations persist.

This ability to withstand a high degree of inbreeding has likely contributed to this species' prevalence as a pest.(fig.2 showing cowpea weevil).

Figure 2

Calories 116 kcal	
	% Daily Value*
Total Fat 0.5 g	0%
Saturated fat 0.1 g	0%
Polyunsaturated fat 0.2 g	
Monounsaturated fat 0 g	
Cholesterol 0 mg	0%
Sodium 4 mg	0%
Potassium 278 mg	7%
Total Carbohydrate 21 g	7%
Dietary fiber 7 g	28%
Sugar 3.3 g	
Protein 8 g	16%

Effect of Infection on Physiochemical Properties and Nutritional Content

Two cowpea varieties (Ife-brown and Kano-white varieties) were used for the study. The effects of insect infestation on the chemical composition and physicochemical properties of these cowpea seeds were studied. The proximate composition, mineral content, total starch, total soluble sugars, bulk density, fat and water absorption capacities, viscosity, gelation capacity and emulsion properties of infested cowpea varieties were compared with those of uninfected cowpeas. Effects of infestation on nitrogen solubility and on the protein, fractions were also determined Infestation depleted the protein, starch and soluble sugar contents of cowpeas. Oil and water absorption capacities were increased while emulsification, foam and viscosity properties were reduced. The nitrogen solubility pattern was altered. Uninfected Kano-white cowpeas (UKW) possessed better foam properties than uninfected Ife-brown cowpeas (UFB). On the other hand, UFB had better emulsification properties than UKW.

Summary / Conclusion

This article is generally based effects of infestation on both nutrition and physiochemical in between two varieties of cowpea.

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Population Genetics

Article ID: 30603

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Summary

This article will give an introduction about:
1. What is population genetics?
2. Modern synthesis.
3. Neutral theory on origin-fixation dynamics.
4. Introduction of four processes (Selection ,Dominance ,Epistasis ,Mutation).
5. Genetic Drift.
6. Genetic flow.
7. Applications.

Introduction

Population genetics is a subfield of genetics that deals with genetic differences within and between populations, and is a part of evolutionary biology. Studies in this branch of biology examine such phenomena as adaptation, speciation, and population structure.

Population genetics was a vital ingredient in the emergence of the modern evolutionary synthesis. Its primary founders were Sewall Wright, J. B. S. Haldane and Ronald Fisher, who also laid the foundations for the related discipline of quantitative genetics. Traditionally a highly mathematical discipline, modern population genetics encompasses theoretical, lab, and field work. Population genetic models are used both for statistical inference from DNA sequence data and for proof/disproof of concept.

What sets population genetics apart today from newer, more phenotypic approaches to modelling evolution, such as evolutionary game theory and adaptive dynamics, is its emphasis on genetic phenomena as dominance, epistasis, the degree to which genetic recombination breaks up linkage disequilibrium, and the random phenomena of mutation and genetic drift. This makes it appropriate for comparison to population genomics data.

Population genetics began as a reconciliation of Mendelian inheritance and biostatistics models. Natural selection will only cause evolution if there is enough genetic variation in a population. Before the discovery of Mendelian genetics, one common hypothesis was blending inheritance. But with blending inheritance, genetic variance would be rapidly lost, making evolution by natural or sexual selection implausible. The Hardy–Weinberg principle provides the solution to how variation is maintained in a population with Mendelian inheritance. According to this principle, the frequencies of alleles (variations in a gene) will remain constant in the absence of selection, mutation, migration and genetic drift.

Modern – Synthesis

The mathematics of population genetics were originally developed as the beginning of the modern synthesis. Authors such as Beatty have asserted that population genetics defines the core of the modern synthesis. For the first few decades of the 20th century, most field naturalists continued to believe that Lamarckism and orthogenesis provided the best explanation for the complexity they observed in the living world. During the modern synthesis, these ideas were purged, and only evolutionary causes that could be expressed in the mathematical framework of population genetics were retained. Consensus was reached as to which evolutionary factors might influence evolution, but not as to the relative importance of the various factors.

In Great Britain E. B. Ford, the pioneer of ecological genetics, continued throughout the 1930s and 1940s to empirically demonstrate the power of selection due to ecological factors including the ability to maintain genetic diversity through genetic polymorphisms such as human blood types. Ford's work, in collaboration with Fisher, contributed to a shift in emphasis during the course of the modern synthesis towards natural selection as the dominant force.

Neutral Theory of Fixation Dynamics

The original, modern synthesis view of population genetics assumes that mutations provide ample raw material, and focuses only on the change in frequency of alleles within populations. The main processes influencing allele frequencies are natural selection, genetic drift, gene flow and recurrent mutation. Fisher and Wright had some fundamental disagreements about the relative roles of selection and drift.

The availability of molecular data on all genetic differences led to the neutral theory of molecular evolution. In this view, many mutations are deleterious and so never observed, and most of the remainder are neutral, i.e. are not under selection. With the fate of each neutral mutation left to chance (genetic drift), the direction of evolutionary change is driven by which mutations occur, and so cannot be captured by models of change in the frequency of (existing) alleles alone.

The origin-fixation view of population genetics generalizes this approach beyond strictly neutral mutations, and sees the rate at which a particular change happens as the product of the mutation rate and the fixation probability.

Four Process

1. Selection: Natural selection, which includes sexual selection, is the fact that some traits make it more likely for an organism to survive and reproduce. Population genetics describes natural selection by defining fitness as a propensity or probability of survival and reproduction in a particular environment. The fitness is normally given by the symbol $w=1-s$ where s is the selection coefficient. Natural selection acts on phenotypes, so population genetic models assume relatively simple relationships to predict the phenotype and hence fitness from the allele at one or a small number of loci. In this way, natural selection converts differences in the fitness of individuals with different phenotypes into changes in allele frequency in a population over successive generations.

2. Dominance: It means that the phenotypic and/or fitness effect of one allele at a locus depends on which allele is present in the second copy for that locus. Consider three genotypes at one locus, with the following fitness values

3. Epistasis: It means that the phenotypic and/or fitness effect of an allele at one locus depends on which alleles are present at other loci. Selection does not act on a single locus, but on a phenotype that arises through development from a complete genotype. However, many population genetics models of sexual species are "single locus" models, where the fitness of an individual is calculated as the product of the contributions from each of its loci—effectively assuming no epistasis.

4. Mutation: Mutation is the ultimate source of genetic variation in the form of new alleles. In addition, mutation may influence the direction of evolution when there is mutation bias, i.e. different probabilities for different mutations to occur. For example, recurrent mutation that tends to be in the opposite direction to selection can lead to mutation–selection balance. At the molecular level, if mutation from G to A happens more often than mutation from A to G, then genotypes with A will tend to evolve. Different insertion vs. deletion mutation biases in different taxa can lead to the evolution of different genome sizes. Developmental or mutational biases have also been observed in morphological evolution. For example, according to the phenotype-first theory of evolution, mutations can eventually cause the genetic assimilation of traits that were previously induced by the environment.

Mutation bias effects are superimposed on other processes. If selection would favour either one out of two mutations, but there is no extra advantage to having both, then the mutation that occurs the most frequently is the one that is most likely to become fixed in a population. It can have no effect, alter the product of a gene, or prevent the gene from functioning. Studies in the fly *Drosophila melanogaster* suggest that if a mutation changes a protein produced by a gene, this will probably be harmful.

Genetic Drift

It is a change in allele frequencies caused by random sampling. That is, the alleles in the offspring are a random sample of those in the parents. Genetic drift may cause gene variants to disappear completely, and thereby reduce genetic variability. In contrast to natural selection, which makes gene variants more common or less common depending on their reproductive success, the changes due to genetic drift are not driven by environmental or adaptive pressures, and are equally likely to make an allele more common as less common. The effect of genetic drift is larger for alleles present in few copies than when an allele is present in many copies. The population genetics of genetic drift are described using either branching processes or a diffusion equation describing changes in allele frequency. These approaches are usually applied to the Wright-Fisher and Moran models of population genetics.

Gene Flow

It is the exchange of genes between populations or species, breaking down the structure. Examples of gene flow within a species include the migration and then breeding of organisms, or the exchange of pollen. Gene transfer between species includes the formation of hybrid organisms and horizontal gene transfer. Population genetic models can be used to identify which populations show significant genetic isolation from one another, and to reconstruct their history.

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Grapes Composition Abiotic Constrains: Water Stress and Salinity

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Summary

This article gives us a brief knowledge about following topics:
1. Composition of Grapes in abiotic conditions.
2. Water level in grapes that is (water stress & salinity).

Introduction

Grapes quality is complex concept that mainly refers to berry chemical composition, including sugar , acids , phenolics and another aroma compound.

The effect of water stress on grapevine metabolism vegetative development productive performance. However, the extents ton which it's a-can secondary metabolism and wine composition are affected by water stress have seldom been assessed. Salinity effects on vine performance concentration and time of exposure to saline conditions are relevant factors for wine composition.

Water stress and increasing soil salt concentration represent most common abiotic constraint that exert a negative change on Mediterranean vineyards performance. However, studies have proven that deficit irrigation strategies are able to improve grapes composition. In contrast irrigation with saline water shown negative effect to yield and grapes composition.

Although the magnitude of these effect depended on cultivar, rootstock, phenological stage when water applied , as well as on salt concentration in irrigation water. Agronomic practices that minimize these on berry composition and consequently on wine quality must be achieved.

Water Stress

Water is critical for viticulture sustainability because grape production, quality, and economic viability largely depend on water availability .A great effort has been devoted to assess the influence of grapevine water status on berry composition, mainly on red varieties under semi-arid conditions, accounting for total soluble solids (TSS), titratable acidity, and pH, although some other traits such as malic and tartaric acid concentrations, phenolics, anthocyanins, and tannins have been considered in some studies.

Reported results suggest that many factors including genotypes, climate, soil, and vineyard management can influence vine response to water stress, as reviewed confirmed by the meta-analysis reported by Lavoie-Lamoureux . In water-limited areas, deficit irrigation practices can be a useful tool for manipulating berry composition to enhance and modulate the season-to-season variability in red wine composition), leading to changes in wine sensory properties. However, the intensity of water stress and its period of occurrence over the grapevine growing cycle are of paramount importance. Apart from the variability in the response due to genotypes, environment, experimental setup, management practices among others, water stress imposed at pre-variation stages induces major metabolic modifications in the berry that can be maintained even after re-watering). In contrast, post-variation water deficit effects are more variable, preventing a generalization of its positive or negative influences.

In general, a moderate water stress reduces berry weight and titratable acidity but increases TSS, total anthocyanins, and phenolics concentrations in red grapes (Romero et al., 2010), improving berry quality. However, when a certain threshold of water stress is surpassed, these beneficial effects are no longer observed. This response seems to depend on the combination rootstock/cultivar as well as on soil and climate conditions. Water potential is the main indicator of vine water status and some authors established relations between this indicator and berry compositional traits; however, these relationships differ amongst cultivars, region, year, soil types, and management practices. Usually, higher levels of water stress are reported to reduce berry weight and malic acid concentrations while increasing anthocyanins and sugar contents up to a threshold were, they are negatively affected. However, these responses depend on other factors such as crop load, vineyard age, fertilization, soil type, berry maturation stage at harvest, and canopy development, amongst others. Furthermore, few studies have accounted for the effects that water stress might exert on berry skin and seeds, even though this issue is relevant to discern between the effects of dilution of components or to what extent water stress is affecting compound synthesis and metabolism. imposed three levels of water deficit to Shiraz grapevines and observed that the concentration of phenolic compounds increased in berry skins due to berry size reduction; however, timing of stress occurrence and its severity could lead to negative effects on phenolic compound concentrations. observed that water deficits affected differently the anthocyanin composition of Shiraz berries and suggested a differential regulation of the genes involved in the last steps of the anthocyanin biosynthesis pathway. In this sense found that water stress modified polyphenol metabolism of Shiraz and Cabernet Sauvignon depending on the phenological stage, inducing the accumulation of stress-related metabolites such as proline and ascorbate reported that sustained deficit irrigation increased the concentrations of di-hydroxylated anthocyanins while regulated deficit irrigation increased those of tri-hydroxylated anthocyanins. It has been shown that grapevine responds to drought by modulating several secondary metabolic pathways, altering the abundance of some transcripts and metabolites involved in phenyl propanoid, isoprenoid, carotenoid, amino acid, and fatty acid metabolism, as observed for Cabernet Sauvignon and Chardonnay and Sauvignon vert. This might affect flavour and quality characteristics of grapes and wines.

Summary

In this context, we attempted a meta-analysis using published data from irrigation studies in field-grown red and white grapevine varieties from several wine regions worldwide Those works referred to potted vines and those not including leaf (Ψ_l) or stem (Ψ_{stem}) water potential measurements were discarded. When only one of these measurements was present, we used the relationships reported by .to obtain the values for the missing one. In the end, 48 works have been used.

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Allelopathic Potential of Rice Plant

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Introduction

Rice, one of the principal food crops in India. Production of rice is characterized by the weighty use of fertilizers, herbicides, and pesticides that may cause future environmental problems. Allelopathy is the direct influence of an organic chemical released from one living plant on the growth and development of other plants. Allelochemicals are organic chemicals involved in allelopathy. Rice has been extensively studied with respect to its allelopathic effects on weeds as part of a strategy for sustainable weed management. Rice plants possibly release allelochemicals into the neighbouring environment or the rhizosphere. when rice and these plants are grown together, they inhibit the growth of several plant species. A large number of allelochemicals, such as phenolic acids, fatty acids, indoles and terpenes have been identified in rice root exudates and decomposing rice residues which possess growth inhibitory activity against neighbouring plant species. Thus, these compounds may play an important role in defence mechanism of rice in the rhizosphere for competition with neighbouring plants. In addition, it was found that there was no significant correlation between the level of growth inhibitory substances in plants and their level in root exudates (Wu et al. 2001).

Allelopathic Potential of Crude Extracts of Rice Plants

Aqueous extracts of some rice plants were found to inhibit the germination and growth of *Avena ludovicina*, *Convolvulus arvensis*, *Heteranthera limosa*, *Phalaris minor*, *Monochoria vaginalis*, *Brassica oleracea*, *Triticum aestivum*, *Avena sativa*, *Trifolium alexandrinum*and *Lens culinaris* under the controlled conditions of laboratory(Das and Goswami 2001). Several secondary metabolites viz. Phenolic acids, phenyl alkanoic acids, hydroxamic acids, fatty acids, terpenes, and indoles, were identified in extracts of rice plants (Rimando and Duke 2003).Aqueous methanol extracts of rice plants also reported to inhibit the germination and growth of lettuce and *Echinochloa crus-galli* (Chung *et al.*2002).Even though most of the plant tissues contain potential allelochemicals. The compounds which are released from plants into the environment enable the germination and growth of neighbouring plants to be inhibited and act as allelochemicals in the natural ecosystems (Putnam and Tang 1986).

Allelopathic Substances in Rice-Root Exudates

Mattice et al. (1998) incubated allopathic and non-allelopathic rice plants for 48 hrs. in soil and reported that several phenolic acids and fatty acids were found in water obtained from the soil. The concentrations of 4-hydroxybenzaldehyde, 4-hydroxybenzoic acid, 3-hydroxybenzoic acid, p- coumaric acid and caffeic acid were higher in water obtained from soils containing allelopathic rice plants than water obtained from soils containing non-allelopathic rice plants. They also identified compounds contained in these soils, and found that concentrations of 4-hydroxybenzaldehyde, 4-hydroxybenzoic acid, 3-hydroxy-4-methoxybenzoic acid, valeric acid, tetra decanoic acid and stearic acid were higher in the soils of allelopathic rice than soils of non-allelopathic rice plants. Based on these findings they have suggested that the allelopathic potential of rice against the weeds was correlated with the amount of phenolic acids released by the roots of living rice plants.

Allelopathic Substances in Decomposing Rice Residues

The crop residues left over in soil are sometimes harmful to plant growth. Residue can release phytotoxic substances in the soil during its decomposition. Chou and Lin (1976) recorded a decline in plant productivity of the second rice crop in a paddy field containing residues from the first rice crop. They found that aqueous extracts of decomposing rice residues in soil inhibited the growth of *Vigna radiata*, lettuce and rice. Khan *et al*. 2001; Jung *et al.*(2004) reported that the aqueous extracts of rice residues were also found to suppress the growth of *Phalaris minor, Echinochloa crusgalli* and lettuce. Several phenolic acids, such as 2-hydroxyphenylacetic acid, 4-hydroxybenzoic acid, vanillic acid, *p*-coumaric acid and ferulic acid were found in aqueous extracts of decomposing rice residues (Chou and Lin 1976) and in soil in which rice was grown (Chou and Chiou 1979). However, the phenolic acids are usually present in rice soils at concentrations below 5 mg kg^{-1} soil, which is below the bioactive threshold level to cause the allelopathic effects (Olofsdotter *et al*. 2002b).

Momilactone B

Momilactone B was originally isolated from rice husks together with momilactone A (Takahashi *et al.* 1976) it was also found in the leaves and stem of rice(Lee *et al*. 1999a). The function of momilactone A as a phytoalexin was studied extensively and it is evident that it has an important role in rice defence system against pathogens (Takahashi *et al.* 1999 and Agrawal *et al*. 2002). The inhibitory activity of momilactone B against the germination and growth of different plant species has been reported. A 5 µM solution of momilactone B inhibited the germination of *Amaranthus lividus*up to 50%, while a 50 µM solution inhibited root and shoot growth of *Digitaria sanguinalis* and the germination of Poaannua by more than 50% (Lee *et al.* 1999b). The compound also inhibited the root and hypocotyl growth of cress seedlings when the concentration was higher than 3 µM. The inhibitory effect was increased with the increased concentration of momilactone B. Rice plants released momilactone B throughout its life cycle and the release rate increased with plant growth up to flower initiation. Its release rate on the day of flowering started at 2.1 µg $plant^{-1}$ day^{-1} and on average a single rice plant released about 100 µg of momilactone B into the medium over its life cycle (Kato-Noguchi and Ino 2003b). At adensity100 rice plants m^{-2}, momilactone B would be released at approximately 10 mg m^{-2}. Thus, the accumulation of momilactone B may occur under field conditions sufficiently to inhibit the germination and growth of neighbouring plants.

Phenolic Acids

Phenolic acids are often known to be putative allelochemicals and the most common compounds among potential allelochemicals since they are found in a wide range of soils (Hartley and Whitehead 1985). Olofsdotter *et al*. (2002) evaluated whether phenolic acids are responsible for rice allelopathy or not, they found that allelopathic rice varieties did not release a significantly higher amount of phenolic acids than non-allelopathic varieties. The maximum release rate of phenolic acid from rice plants was about 10 µg $plant^{-1}$ day^{-1}. Therefore, at the density of 100 rice plants m^{-2}, the release rate of phenolic acids would be about 1 mg m^{-2} day^{-1}. Five major phenolic acids in rice root exudates viz. 4-hydroxybenzoic acid, vanillic acid, syringic acid, *p*-coumaric acid and caffeic acid, were mixed and their biological activities were determined against *Sagittaria monotevidensis*, the concentration required for 50% growth inhibition of the mixture of these five phenolic acids was 502 µM. The concentrations of these phenolic acids detected in rice roots exudates were by far less than 500 µM (Seal *et al*. 2004b).

Conclusion

Based on the several experiments towards searching for putative allelochemicals released by the living rice plants, number of compounds were identified in rice root exudates and decomposing rice residues, these allelochemicals are successfully prevents weeds in rice field.

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Sustainable Weed Management Options for Improving Crop Productivity

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Introduction

Weeds compete with crop plants for nutrients, moisture, space and sunlight. In general, an increase of one kg weed growth corresponds to reduction in one kg of crop growth. Weeds accounts for 45 % reduction in yield while the insects 30%, diseases 20% and other pests 5%.In India, manual weed control is quite popular and effective. Oflate, labour has become non-availability and costly, due to intensification, diversification of agriculture and urbanization. The usage of herbicides is increasing due to possible benefits to farmers. At the same time, the continuous use of the same group of herbicides over a period of time on a same piece of land leads to weed shift, herbicide resistance in weeds and environmental pollutions. Herbicides in a pond reduce dissolved oxygen and pH and increase biological oxygen demand and at the same time detrimental to the aquatic animals. Herbicide may also kill species of bacteria, fungi and protozoa that combat disease causing microorganisms, thereby upsetting the balance of pathogens and beneficial organisms and allowing the opportunist, disease causing organisms to become a problem. The complexity of these situations has resulted in a need to develop wholistic sustainable weed management options. Sustainable weed management options conserves land, water, plant and animal genetic resources and develop environmentally non-degrading, technically appropriate and economically viable and socially acceptable management system. Successfully meeting the challenge of providing weed control without relying on dangerous chemicals that endanger the ecosystem or human lives, this compendium focuses on management strategies that reduce herbicidal usage, restore ecological balance, and increase food production.

Objectives of Sustainable Weed Management

There are several basic objectives of the sustainable weed management. The main objectives are:
1. To make best use of the resources available for weed control.
2. To develop cultivation methods that manage weeds and improve soil quality and to determine the impact of weed management systems.
3. To minimize use of non-renewable resources like herbicides and to use of renewable energy and recycled mineral resources.
4. To protect the health and safety of farm workers and animals, local communities and environment from the application of chemicals.
5. To protect the economic viability of farming operations and provide sufficient financial reward to the farmer to enable continued production and contribute to the well-being of the community.
6. To produce sufficient high-quality and safe food.
7. To build on available weed control technology, knowledge and skills in ways that suit local conditions and capacity.

Benefits of Sustainable Weed Management

The benefits are reviewed in the context of the environment, society and economics:
1. Soil and water conservation.
2. Mitigation of global warming.
3. Enhanced biodiversity.
4. Reduction of persistent pollution.
5. Increased food nutrient density.
6. Better conditions for farm workers.
7. Competitive yields.
8. Price premiums.
9. Direct-to-consumer marketing channels.
10. Lower input costs and higher the farm income.
11. Lower volatility.

12. Energy savings.

Approaches in Sustainable Weed Management

There are three different approaches involved in sustainable weed control management. These are cultural, mechanical and biological methods, respectively. Chemical weed control is generally not allowed in sustainable weed management systems.

Agronomic Approach of Weed Control

These practices for weed control are mostly non-monetary & relatively of less expenditure. These methods can be used to reduce the intensity of weeds to improve crop yield. The main objective of cultural practices is to provide a short-term relief to crop during initial growth periods of crop production. The various practices involved under the cultural method of weed control are listed below:

1. Planting or Sowing time: As it is a proved fact that weed seeds are thermosensitive in nature, so by adjusting the planting or sowing time of crop plants we can exert a smothering effect on the weeds so that the crop plants have the early advantage over the weeds & therefore, offers less competition for the crop plants. For example, if wheat is early sown then Phalaris minor has less advantage over the wheat crop.

2. Use of clean seed: To ensure that the crops must be free of primary weed infestation the crop seed must be free from weed seeds. *Phalaris minor* was imported along with Mexican wheat seed & then spread to many parts of Indian subcontinent through movement of wheat seeds from place to place.

3. Stale seedbed preparation: The main objective of this technique is to induce germination of weed seed with irrigations before sowing the crop so that 2-3 flushes of germinated weeds are destroyed. This method is ideal for the crops in which germination of crop & weed seed is synchronised.

4. The method of sowing: Closed spacing of crops always gives a chance to the crop plants ahead of weeds. Also, bidirectional sowing of crops helps in reducing weed growth as the distribution of plants over the space becomes adequate & healthy crop canopy structure can be generated which can cover the weeds effectively.

5. Proper seed rate: Higher seed rate enjoys an advantage over the weeds as thick crop stand reduces space for weeds to grow & establish themselves.

6. Crop rotation: Crop rotation is also helpful as monoculture or growing of same cropping system allows the pure stand of some permanent weeds which are very difficult to control .for some permanent weeds of rice -wheat cropping system such as *Phalaris minor* & *Echinocolona spp.* can be controlled by replacing wheat with berseem, raya or winter maize. Wild oat can be completely managed from wheat by replacing it with berseem for 3-4 years.

Fig 1: Intercropping with different crops

7. Intercropping: Weeds can also be manged effectively by intercropping of wide row-spaced crops with closed row-spaced crops & of tall growing crops with short growing crops. Efficient intercrops are cowpea, green gram, black gram, soybean etc.

8. Water management: weeds can also be managed properly by managing irrigation. The role of land submergence in lowland rice has been well noticed all over the world. Under normal irrigations to wheat crop wild oat make luxuriant growth & affect the wheat crop, but in limited irrigation, the wheat plants overtake the wild oat & suppress their growth & development.

Mechanical or Physical Approach of Weed Control

The mechanical or physical methods of weed control are being used since man used to grow crops. It includes various methods like hand hoeing, hand pulling, tillage, digging, sickling, burning, flooding & mulching etc. But each of these methods is labour & time consuming as well as not of complete or full weed control. These methods are listed in detail below:

1. Hand hoeing: Hand hoe is the simplest tool to control annual & biennial weeds which have shallow root system under this system, but it cannot be able in controlling deep rooted & perennial weeds.

Fig 2: Hand hoeing to control weeds

Fig 3: Hand weeding

2. Hand pulling: It is pulling out of weeds by hand (Fig 3). It is very economical in those areas where weeds are scattered & very effective against annual & biennial weeds as they do not regenerate from pieces of roots left in the ground.

3. Tillage: Weeds can be controlled by various tillage operation such as ploughing, harrowing, planking, levelling etc. Many perennial weeds ca also be controlled by deep ploughing continuously for a period of 3 or 5 years.

4. Digging: Under digging the underground propagating parts of perennial weeds are removed from the deep layers of soil. It is followed by hand pulling the weeds. But it is a labour-intensive method which is its main drawback.

5. Sickling: Sickling is mostly used in case of sloppy lands to remove top weed growth & to prevent weed seed production.

6. Burning: In this method, the weeds are burnt with fire along with crop residues in certain crops like sugarcane, potato, maize, cotton etc.

7. Flooding: Here the weeds are managed by flooding the field with 20 -30cm standing water for 5 to 10 weeks. It is very much useful in some perennial weeds like Cyperus spp., Cynodon dactylon & Convolvulus arvensis.

8. Mulching: It has a smothering effect on weeds by restricting the photosynthesis. Mulching is effective against Sorghum halepense, Cynodon dactylon etc. Mulching can be done by straw, hay, paper, polythene films etc. in cash crops.

Biological Approach of Weed Control

These methods involve the utilization of natural living organisms i.e. bioagents such as insects, pathogens & plants to limit the weed infestation. Biological control brings their population below the economic injury level. The merits of

biocontrol agents are their relative cheapness, environment comparatively long-lasting effects & least environment & the non-target organisms. Some outstanding examples of biological control of weeds are:
1. Control of *Eichhornia crassipes* (water hyacinth) using *Necochetina eichhorniae* (hyacinth weevil).
2. *Salvinia molesta* (water fern) is controlled by *Crystobagusspp*.
3. *Lantana camara* in India has been effectively controlled by a moth *Crocidosema lantana*.
4. *Zygogramabicolorata* beetle feeds on Parthenium plants during the rainy season.

Weeds can also be controlled by this method with the help of bioherbicides such as Collego, Devine, Biopolaris, Tripose etc.

Fig 4: Biological weed management

Allelopathic plants: Allelopathy is detrimental effect of one plant on another through production of allelochemicals that escapes into the environment to influence the growth and development of neighbouring plants. Different plant organ such as plant tissues, including leaves, flowers, fruits, stems, roots, rhizomes, seeds and pollen are the main sources of allelochemicals of donor plants are in stressed or competing with neighbouring plants, that released through crop-environmental ecological process.

Allelochemicals have more benefits over synthetic compounds as they have novel structure and short half-life, therefore considered safe of environmental toxic.

Bio-fertilizers: Bio-fertilizers accelerate certain microbial processes in the soil which augment extent of availability of nutrients to plants. Azolla is a free-floating water fern that fixes atmospheric nitrogen in association with nitrogen fixing blue green alga Anabaena azollae. Azolla fronds consist of sporophyte with a floating rhizome and small overlapping bi-lobed leaves and roots.

Dual culturing of azolla in rice fields had the added benefit of suppressing weed growth besides fixing atmospheric nitrogen. Since it formed a mat over the surface, it reduced the entry of sunlight and aeration into soil thereby suppressing weed growth. The addition of azolla in rice fields suppressed the weeds of *Eichinochloa crusgalli* and *Cyperus difformis* and the degree of suppression increased with increase in per cent of azolla cover and water depth.

Herbicide resistant crops: Herbicide resistance is the inherited ability of the plant to survive and reproduce following exposure to a dose of herbicide that would normally be lethal to the wild type. In a plant, resistance may occur naturally due to selection or it may be induced through such techniques as genetic engineering.

The adoption of GM crops has increased dramatically during the last 10 years and currently over 52 million hectares of GM crops are planted world-wide. Approximately 41 million hectares of GM crops planted are herbicide-resistant crops, which includes an estimated 33.3 million hectares of herbicide-resistant soybean.

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Organic Farming and Biodiversity: Approach for Enhancement of Agro-Ecosystem Health

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Introduction

Organic agriculture is a holistic production management system which promotes ecosystem health, biological cycles and soil biological activity. The primary goal of organic agriculture is to optimise the health and productivity of inter-dependent communities of soil life, plants, animals .The organic agriculture system relies on the creation and maintenance of conditions that positively nurture the health of crops and livestock and on harnessing of natural processes. Many involve the positive use of biodiversity, thus making the conservation of biodiversity an integral part of the farming activity.

The Importance of Biodiversity in Organic System

When diversity is encouraged, locally adapted plant and animal breeds which are more appropriate to local ecosystems can be used. Most importantly, agricultural genetic diversity is a basic insurance against crop and livestock disease outbreaks. Organic farmers breed varieties for quality, nutrition, resistance and yield, in reduced input growing conditions. Research has shown that these characteristics are more likely to be found in older native cultivars. In particular, open pollinated varieties offer diverse and regionally adapted characteristics that are better suited to organic agriculture. Organic systems encourage the preservation and expansion of locally bred and indigenous varieties. Farmers who save their own seeds can gradually increase crop resistance to pests and diseases by breeding for "horizontal resistance".

Case Studies

Following are a series of case studies, selected from published materials from diverse sources including intergovernmental, governmental and private organizations. In all of these, the close relationship between the introduction of the organic agricultural system and the maintenance of biodiversity is evident, as is the resulting improvement in the socio-economic conditions of the farmers.

1. Ladang cultivation of organic spices in Sumatra, Indonesia.
2. Organic coffee production and biodiversity management, Chiapas, Mexico.
3. Organic farming for the Mayas' chocolate, Tabasco, Mexico.
4. Organic and naturally coloured cotton, Peru.
5. Organic quinoa from the Cotahuasi river basin, La Unión, Peru.
6. Recovery of local varieties of rice through organic methods, Indonesia.
7. In situ restoration of local varieties through organic agriculture, Andalucia, Spain.

Germplasm Management Practices and Organic Agriculture

The genetic diversity plays a critical role in breeding organic varieties as well as in the production of organic agricultural products presents a unique opportunity to gene banks to establish a much closer relationship with the organic agricultural world and to get the conserved germplasm more intensively used by this sector. In order to achieve a good performance of gene banks while serving the organic sector with the wanted genetic resources and diversity the following management practices in routine gene bank operations are suggested:

1. Consult with organic breeders and farmers, especially those that are involved in participatory plant breeding and variety selection, on the kind of descriptors they would like to see used in the characterization and preliminary evaluation of germplasm accessions.

2. Involve organic breeders and farmers in discussions if and what kind of germplasm material is missing in the collections, where that could be obtained or collected and, whenever feasible, to involve them in the actual collecting activity. Assist in searching for specific traits in germplasm collections worldwide.

3. Whenever relevant and feasible, involve breeders and farmers in routine operations of the gene bank (e.g. regeneration/multiplication) that will allow a better understanding of the available diversity both, between and within species.

4. Carefully consider any steps in the routine operation of preparing seeds for storage that could lead to problems of using the germplasm at a later stage by organic farmers/breeders, e.g. dressing the seeds to be stored with fungicide/pesticide.

5. Ensure that germplasm accessions that are provided to organic breeders and farmers are accompanied with any information that will facilitate their use.

6. Facilitate linkages and collaboration between on-farm conservation or management schemes and organic breeders and farmers;

7. Conduct joint research activities with germplasm material of common interest.

8. Consider the organic agricultural sector to be represented in the gene bank steering committee or supervisory board.

Conclusions

Organic agriculture could play a more prominent role in the "restoration" of old and forgotten crops and varieties as well as in the use of other neglected species into the agricultural landscape. Involvement of the organic agricultural sector directly in gene bank work is good idea for enhancing of production. Gene banks should more actively assess the requirements and priorities of the organic agricultural breeders and farmers. Organic agriculture can make a substantial contribution to the maintenance of genetic diversity on-farm ,in particular for the so called neglected and underutilised species.

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Do Insects Sleep?

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Sleep plays a very important role in maintenance of good health and well-being throughout the life of the humans and other animals. Getting enough quality sleep at the right times helps us to protect our mental health, physical health, quality of life, and safety. Sleep rejuvenates and restores us and without sleep our minds don't work. Scientists are well aware that birds, reptiles and mammal's rest like us and brain wave pattern of them is same as the human during the sleep. It is not an easy task to tell that insects sleep in the same as we do.

Scientists believe that it is essential for insects to get some rest like us to perform their daily activities. Now the question arises do insects rests same like as we do? Insects don't have eyelids to shut their eyes and sleep like us. Insects do take rest but in little different manner than us. Most of the insects remain active either during the day or during the night, so the rest of time when they are not active, they may rest.

Sleep in Insects

The resting state in insects is called torpor and it is not same as sleep. At the time torpor the sensory activities remain suspended and do not respond to the external environment. During asleep, insects not only immobile and also show a high arousal threshold, but there is reduction in the responsiveness of their nervous system to external stimuli. During resting time honey bees antennae are droopy and there is long stillness in the fruit flies.

Similar to humans, young fruit flies sleep significantly longer than old fruit flies and sleep becomes fragmented with age. In addition, short-sleeping fruit fly mutants appear to have a reduced life span. In sleeping bees, the optomotor interneurons in the lobula did not respond to moving patterns presented to their eyes, whereas each movement provoked a clear electrical response when bees were awake.

Where Do Insects Sleep?

The next question arises if insects sleep, where do they sleep? The insect rests in any place where they feel comfortable. For example, some bees clamp their jaws on the plant and fold up their legs. Butterflies rest with their eyes open in leaves and bushes or barks often they hang using their tarsi in upside down manner to protect from predators.

During this time insects' body will enter a low metabolic state and will become inactive. Flies like fruit flies also remain inactive during night and active during day times. The insects do not go search of places to sleep; they generally sleep in comfortable places anywhere which is safe from predators.

What Happens in Insects When Sleep is Deprived?

Fruit flies kept awake beyond their normal active period by tapping the containers in which they present. These fruit flies recovered the lost sleep by napping longer than usual. And in another study population that was deprived of sleep for an extended period of time it was found about one-third of the fruit flies died.

A study conducted in honey bees by disturbing the sleep of the bees by device inseminator, it was found that sleep-deprived honey bees, the insomniac bees could no longer perform an effective waggle dance to communicate with their colony mates. The sleepy bees' dances were not as detailed and thus not helpful.

This waggle dance act as guide to their nest mates and use this information to forage, they are likely to follow the wrong the path wasting their time and energy. Further, sleep-deprived honeybees find it difficult to return to the hive when visiting fresh flower patches, spending more time reorienting themselves with the sky and surrounding landmarks as their compass.

Conclusions

Sleep in insects remains a fascinating state that is not completely understood. Further there requires research to unravel the molecular and physiological mechanisms of the sleep. If researchers involved in the sleep field show interest on the insect sleep it would be interesting to many entomologists and other audience.

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Cultivation Techniques of West Indian Cherry *(Malpighia emarginata)*

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Common Name	West Indian Cherry, Acerola, Barbados Cherry
Botanical Name	Malpighia emarginata (Syn. Malphigia punicifolia)
Family	Malpighiaceae

Introduction

It is a non-climatic fruit and native of West Indies and Northern South America to Southern Texas. It was further introduced in tropical and subtropical areas like India. In India it is grown in Tamil Nadu and Kerala. Being tropical in nature, the plants performed well due to tropical and humid climate. Recent performance of this crop in semi-arid tropics and in problematic soils will pave way to introduce this crop in the wasted lands.

Nutritional Value

The fruits are small, weighing 4-5g/ fruit, contain high percentage of vitamin C (4515mg/100g) and also Calcium (Deficiency Causes Rickets, Osteomalacia.), Proteins (Important for body growth, formation and maintenance of body tissues) and Iron (Act as oxygen carrier in the body.). The daily requirement of vitamin C is 28-70mg/person from child to adult. Therefore, a single fruit of West Indian Cherry can satisfy daily requirement of vitamin C of an adult. Vitamin C deficiency causes scurvy, pain in joints, swelling of limbs, unhealthy gums, tooth decay, delay in wound healing and rheumatism.

The contribution of Vitamin C as the highest source among the all the fruit crops, supports human immune system to combat the pandemic disease COVID-19.

Characteristics of West Indian Cherry

It is a low branching, prickly, bushy shrub reaches to a height of 2-3.5m. It can be pruned to any desired shape hence can be grown as ornamental plant. Multiple or single trunks can be trained but branches are brittle and easily broken. The root system is shallow and plants can be toppled by wind but recovered over time. Leaves are dark to light green, glossy when mature, obviate to lanceolate with minute hairs which can be irritating. Foliage will drop during water stress but recovers well with flush and flowering. The flowers are sessile or short–peduncle in cymes, with small pink to white flowers having five petals. Flowering can occur throughout the year, but is typically in cycles associated with rain. Fruits are round to obovate, cherry like but 3 lobes. They are bright red rarely yellow- orange with skin easily bruised. The pulp is juicy, sweet and sour in taste with a delicate flavour.

Chemical Composition

The ripe fruit contains: moisture, 92.17; crude protein, 8.75; crude fibre,15.45; ash, 4.45; insoluble ash, 0.10; calcium, 0.50; and phosphorous, 0.168% on dry matter (7.82%) basis. The length of the fruit was recorded 1.70 cm with specific gravity (wt/volume) 1.96. The recovery of the juice was, 36.11; pulp, 82.56; and seed, 17.44%. TSS (fruit) 5.44°Brix and acidity 1.18 per cent (Singh and Medhi, 2003).

The vitamin C content of the fruit varied from 3097 to 4515mg/ 100g at ripe stage. Because of the high vitamin C content, it can also be blended with other fruit juices, which are low in vitamin C. There are seasonal factors affecting ascorbic acid synthesis and retention in the West Indian Cherry fruits. It is observed that ascorbic acid content is higher in fruits of grafted plants Nakasone et al., 1966.

Studies Concluded

1. Ascorbic acid content reached a peak between the 16th and 18th day after floral anthesis with an amount exceeding 4000mg/100g of fruit, then declined to concentration lower than those found on 12th day after anthesis. These observations are in general agreement with those of Del Campillo and Asenjo, 1957.

2. Fruits from plants grown in 5 levels of sunlight intensity were analysed for ascorbic acid and observed that fruits from plants grown in direct sunlight gave the highest assay, with declining amounts of sunlight the vitamin C assay decreased. Several other plant characteristics were affected by low sunlight intensity (Singh, 2006).

Other Fruits Rich Source of Vitamin C

The vitamin C content in West Indian Cherry fruits was much higher than other major fruits like Aonla (600- 700mg/100g), Guava (200-300mg/100g), Citrus (50-100mg/100g) and Jamun (290mg/g). Calcium and phosphorous contents were also higher than many other major fruits like grapes, mango, papaya and guava (Bal, 1997).

A concentrate prepared from these fruits is considered useful for the liver, blood circulation, gall bladder and in case of viral hepatitis.

Cultivation Practices

1. Soil and climate: The plant grows well on limestone, clay and other heavy soils as long as it drains well but water logging will cause plant death. Soil pH should be 6.5-7.5 as acid soils do not promote vigorous growth. The plant prefers full sun for fruit development. Fruit yield severely reduced under shade. Due to its smaller and shallow root system, West Indian Cherry can be interplanted with other crops more closely than many trees. Heavy rainfall ranging from 1000 to 3000 mm can be tolerated by these plants. It is drought tolerant also. Irrigation can be used to induce flowering and regulate flower cycles. Under irrigated conditions plant can achieve one to five flowering peaks in a year.

2. Clones: Central Arid Research Institute, Port Blair, Andaman and Nicobar Island, India identified some clones which are superior in yield as follows:

a. B-15 (Commercial planting) and Selection 1.
b. 'B-15' - Vitamin C content (2280mg/100g of fruit).
c. 'Selection 1' - Vitamin C (>4000mg/ 100g of fruit).

3. Propagation: Propagation can be done by seeds (though seeds viability is very low), cuttings, layering, grafting and other standard methods. Cuttings are considered the simplest and easiest method of propagation. Stem cuttings treated with IBA at 1500 ppm give good rooting and survival percentage. Grafting on *Byrsonima crassifolia* rootstock has been successful.

4. Spacing: 2x2m spacing, 420 plants recommended for one hectare which is yield about 10-15 kg/tree/year. According to Jackson and Pennock, 22-ton fruit containing approximately 448kg of vitamin C (20g/kg of fruit).

5. Nutrients: Plants require a good balanced fertilized schedule with FYM 10-15 kg/pit, nitrogen 200g/plant, phosphorous 50 g/plant and potassium 100g/plant should be given at the time of planting. During second year double dose of NPK and FYM must be given before the onset of the monsoon. Since, the plant fruits primarily on current season growth, systematic pruning of the bushes to encourage new growth is necessary and pruning should be done only after harvesting of fruits preferably during October-November.

6. Pest and Disease: There are no serious pests and diseases noticed on this crop. However, a few minor insects of this crop are mealy bugs and aphids.

7. Harvest: The fruits can be harvested after 3 years of planting, though, plants attain its peak bearing stage in 7-8 years of planting. Productivity increases up to 15 to 20 years and then stabilizes or declines but the plants can yield up to 40 years. Harvesting of fruits depends upon its use. Fruits should be harvested at green stage for pickle purpose, for murabba (preserve) light green mature and for candy purpose fruits should be harvested when fruits are red in colour. The fruits deteriorate rapidly once removed from the tree. Sensory difference can be noted within 4 hours. The fruits under rapid fermentation is unusable within 3-5 days and unrefrigerated fruits develop mould quickly.

8. Yield: Well managed plant starts yielding fruits after 3 years of planting and yield about 10 to 15 kg fruits/plant after 5th year.

Value Added Products

The fresh ripe fruits are used for making jams, preserves as murabbas, jellies, candies, syrups, juices and pickles (Singh and Medhi, 2003). The fruit has also been used in baby food and many recipes as a supplement source of vitamin C.

Conclusions

The species being hardy can be grown on a wide range of soil. The nutritive value especially rich in Vitamin C is nowadays highly preferred to protect us from corona virus contamination. Due to this vitamin C rich characteristics nature, West Indian Cherry also invites huge attention in the preparation of various products and condiments enrols its commercial importance in cultivation in dry land, semi-arid zone areas.

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Role of Secondary Metabolites in Plants Defence Mechanisms

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Secondary Metabolites

Plants produce a large and diverse array of organic compounds that appear to have no direct functions in growth and development i.e. they have no generally recognized roles in the process of photosynthesis, respiration, solute transport, translocation, nutrient assimilation and differentiation. They have a very restricted distribution than primary metabolites in the whole plant kingdom i.e. they are often found only in one plant species or a taxonomically related group of species. High concentrations of secondary metabolites might result in a more resistant plant. Their production is thought to be costly and reduces plant growth and reproduction (Mazid et al., 2011)

Classification of Secondary Metabolites

Plant secondary metabolites can be divided into three chemically distinct groups:
1. Terpenes.
2. Phenolics.
3. Nitrogen- Containing Compounds.

Terpenes

The terpenes or terpenoids, constitute the largest class of secondary products. The diverse substances of this class are generally insoluble in water. They are biosynthesized from acetyl-CoA or glycolytic intermediates. All terpenes are derived from the union of five-carbon elements that have the branched carbon skeleton of isopentane. The basic structural elements of terpenes are sometimes called isoprene units because terpenes can decompose at high temperatures to give isoprene:

Terpenes are classified by the number of five-carbon units they contain, although extensive metabolic modifications can sometimes make it difficult to pick out the original five-carbon residues. Ten-carbon terpenes, which contain two C_5 units, are called monoterpenes; 15-carbon terpenes (three C_5 units) are sesquiterpenes; and 20-carbon terpenes (four C_5 units) are diterpenes. Larger terpenes include triterpenes (30 carbons), tetraterpenes (40 carbons), and polyterpenoids ($[C_5]_n$ carbons, where $n > 8$).

Chemical Composition

The ripe fruit contains: moisture, 92.17; crude protein, 8.75; crude fibre,15.45; ash, 4.45; insoluble ash, 0.10; calcium, 0.50; and phosphorous, 0.168% on dry matter (7.82%) basis. The length of the fruit was recorded 1.70 cm with specific gravity (wt/volume) 1.96. The recovery of the juice was, 36.11; pulp, 82.56; and seed, 17.44%. TSS (fruit) 5.44°Brix and acidity 1.18 per cent (Singh and Medhi, 2003).

The vitamin C content of the fruit varied from 3097 to 4515mg/ 100g at ripe stage. Because of the high vitamin C content, it can also be blended with other fruit juices, which are low in vitamin C. There are seasonal factors affecting ascorbic acid synthesis and retention in the West Indian Cherry fruits. It is observed that ascorbic acid content is higher in fruits of grafted plants Nakasone et al., 1966.

Terpenes Defend Against Herbivores in Many Plants

Terpenes are toxins and feeding deterrents to many plant feeding insects and mammals; thus, they appear to play important defensive roles in the plant kingdom (Gershenzon and Croteau, 1992). For example, the monoterpene esters called pyrethroids that occur in the leaves and flowers of *Chrysanthemum* species show very striking insecticidal activity.

Both natural and synthetic pyrethroids are popular ingredients in commercial insecticides because of their low persistence in the environment and their negligible toxicity to mammals.

Many plants contain mixtures of volatile monoterpenes and sesquiterpenes, called essential oils that lend a characteristic odour to their foliage. The chief monoterpene constituent of peppermint oil is menthol; that of lemon oil is lim. Essential oils have well-known insect repellent properties.

They are frequently found in glandular hairs that project outward from the epidermis and serve to "advertise" the toxicity of the plant, repelling potential herbivores even before they take a trial bite. These substances repel oviposition herbivores and attract natural enemies, including predatory and parasitic insects that kill plant-feeding insects and so help minimize further damage (Kessler and Baldwin, 2001).

Among the non-volatile terpene antiherbivore compounds are the limonoids, a group of triterpenes (C30) well known as bitter substances in citrus fruit. Perhaps the most powerful deterrent to insect feeding known is azadirachtin, a complex limonoid from the neem tree (*Azadirachta indica*) of Africa and Asia. Azadirachtin is a feeding deterrent to some insects at doses as low as 50 parts per billion, and it exerts a variety of toxic effects.

Phenolic Compounds

Plants produce a large variety of secondary products that contain a hydroxyl functional group having aromatic ring these substances are classified as phenolic compounds. Plant phenolics are a chemically heterogeneous group of nearly 10,000 individual compounds.

Some are soluble only in organic solvents, some are water-soluble carboxylic acids, glycosides and others are large insoluble polymers. Many serve as defence compounds against herbivores and pathogens. Others function for attracting pollinators and fruit dispersers and also absorbs the harmful ultraviolet radiation.

Types of Phenolic Compounds

1. Coumarins: They are simple phenolic compounds, widespread in vascular plants and appear to function in different capacities in various plant defence mechanisms against insect herbivores and fungi. They derived from the shikimic acid pathway, common in bacteria, fungi and plants but absent in animals.

Also, they are a highly active group of molecules with a wide range of antimicrobial activity against both fungi and bacteria (Brooker *et al*., 2008). It is believed that these cyclic compounds behave as natural pesticidal defence compounds for plants and they represent a starting point for the exploration of new derivatives possessing a range of improved antifungal activity.

2. Ligin: It is a highly branched polymer of phenyl-propanoid groups, formed from three different alcohols viz., coniferyl, coumaroyl and sinapyl which oxidized to free radicals (ROS) by a ubiquitous plant enzyme-peroxidase, reacts simultaneously and randomly to form monomeric units in lignin vary among species, plant organs and even layers of a single cell wall.

Its physical toughness **deters feeding by herbivorous animals and its chemical durability makes it relatively indigestible to herbivores and insects' pathogens**. Lignification block the growth of pathogens and are a frequent response to infection or wounding (Hatfield and Vermerris 2001).

3. Flavonoids: One of the largest classes of plant phenolic, perform very different functions in plant system including pigmentation and defence. Two other major groups of flavonoids found in flowers **are flavones and flavanols** function to protect cells from UV-B radiation because they accumulate in epidermal layers of leaves and stems and absorb light strongly in the UV-B region while letting visible (PAR) wavelengths throughout uninterrupted (Lake *et al*., 2009).

4. Tannins: They are included under the second category of plant phenolic polymers with defensive properties. The defensive properties of tannins are generally attributed to their ability to bind proteins. **Protocatechuic and chlorogenic acids** probably have a special function in disease resistance of certain plants.

They prevent smudge in onions, a disease caused by the fungus *Colletotrichum circinans* and prevent spore germination and growth of other fungi as well.

Types

1. Alkaloids: The alkaloids are a large family of more than 15,000 nitrogen containing secondary metabolites found in approximately 20% of the species of vascular plants. The nitrogen atom in these substances is usually part of a heterocyclic ring, a ring that contains both nitrogen and carbon atoms. As a group, **alkaloids are best known for their striking pharmacological effects on vertebrate animals.**

2. Cyanogenic Glycosides: They constitute a group of N-containing protective compounds other than alkaloids, release the poison HCN and usually occur in members of families *viz.,* Graminae, Rosaceae and Leguminosae (Seigler, 1991). Species that make cyanogenic glycosides also make the enzymes necessary to hydrolyze the sugar and liberate HCN.

3. Glucosinolates: A second class of plant glycosides, called the glucosinolates, or mustard oil glycosides, break down to release volatile defensive substances. Found principally in the Brassicaceae and related plant families, glucosinolates give off the compounds responsible for the smell and taste of vegetables such as cabbage, broccoli, and radishes.

Phytoalexins

These are chemically diverse group of secondary metabolites with strong antimicrobial activity that accumulate around the site of infection. Phytoalexin production appears to be a common mechanism of resistance to pathogenic microbes in a wide range of plants.

However, different plant families employ different types of secondary products as phytoalexins. For example, isoflavonoids are common phytoalexins in the legume family. Phytoalexins are generally undetectable in the plant before infection, but they are synthesized very rapidly after microbial attack because of the activation of new biosynthetic pathways. The point of control is usually the initiation of gene transcription.

Thus, plants do not appear to store any of the enzymatic machinery required for phytoalexin synthesis. Instead, soon after microbial invasion they begin transcribing and translating the appropriate mRNAs and synthesizing the enzymes de novo.

Although phytoalexins accumulate in concentrations that have been shown to be toxic to pathogens in bioassays, the defensive significance of these compounds in the intact plant is not fully known. The experiments on genetically modified plants and pathogens have provided the first direct proof of phytoalexin function *In vivo*. For example, when tobacco was transformed with a gene catalysing the biosynthesis of the phenylpropanoid phytoalexin resveratrol, it became much more resistant to a fungal pathogen than non-transformed control plants were (Hain *et al*. 1993).

In contrast, *Arabidopsis* mutants deficient in the tryptophan derived phytoalexin camalexin were more susceptible than the wildtype to a fungal pathogen.

Conclusion and Future Prospects

Plants have evolved multiple defence mechanisms against microbial pathogens and various types of environmental stress. Besides anti-microbial secondary metabolite, some of which are performed and some of which are induced by infection. The identification of the mechanisms causing ISR will be an important milestone for sustainable agricultural production, as the use of fungicides could then be minimized.

Thus, ISR may become an important strategy for efficiently combating with pathogens in organic forming system. Therefore, additional research in area of natural pesticides development is needed in current scenario. In the long term, it will probably be possible to generate gene cassettes for complete pathways, which could then be used for production of valuable defensive secondary metabolites in bioreactors or for metabolic engineering of crop plants. This will improve their resistance against herbivores and microbial pathogens as well as various environmental stresses.

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Study of Epidemiological Factor in Relation to Population Dynamics of *Phytophthora* Spp.

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Introduction

The genus citrus, one of the most important group of fruit crops worldwide, belongs to the family Rutaceae comprising 140 genera and 1300 species distributed throughout the world. Citrus occupies an important place in the horticulture wealth and economy of India as the third largest fruit industry. Correlation of environmental factor viz., relative humidity, temperature and rainfall with Phytophthora root rot epidemic in citrus has the potential to provide important information for management of the disease. Since high soil moisture is correlated with increase in incidence and severity of root rot caused by *Phytophthora* spp. in many crops.

Thus, correlation of environmental factors with the disease will be valuable tool for epidemiological studies of this pathogen and may be important for the development of suitable management strategies (Benson et al., 2006). The purpose of disease study was to describe epidemiology of Phytophthora root rot in citrus field in relationship to dispersal of *Phytophthora* spp. from disease foci and importance of inoculum sources. We correlated field parameters such as rainfall, temperature, relative humidity, with Phytophthora root rot. Result analysis may provide insight into management consideration for growers.

Collection of Soil Samples from Experimental Fields

Soil sample were collected from Warud tahsil in Amravati district during the period June 2015 to May 2016 by using standard core auger, soil samples were taken up to 30 cm depth from healthy and diseases plants. Soil samples were stored in sterilized polythene bags used for assessment of *Phytophthora* spp.

Preparation of Culture Media: Composition of Corn Meal Agar-PARPH Selective Media

CMA is not rich in nutrients; it is very suitable for isolation of *Phytophthora* from infected tissue. Corn meal (60 g/litre distilled or deionised water) is autoclaved at 121°C for 15 minutes and filtered. Then, 15 g agar agar was added into it and autoclaved at 121.6ºC for 15 min. Following antibiotics were added with required concentrations (µg/ml = mg /l = ppm).

Antibiotic/ Fungicide/ Chemical	Stock solution (mg/ml)	Amount (ml) to add to 1litre media	Final concentration (µg/ml)
Benomyl	Not readily soluble	5 mg powder	5
PCNB	Not readily soluble	25 mg powder	25
Nystatin	100	0.25	25
Ampicillin	100	5	500
Rifampicin	10	1	10
Hymexazol	50	1	50

Density of Phytophthora Propagules/g of Soil

To determine the Phytophthora propagules density the soil samples were collected from selected experimental fields with the help of standard core auger (20 cm deep, 8.0 cm diameter with total 1005 cm^3). Four soil cores were collected from each treatment tree at 2.5 feet distance from the trunk and pooled to make a composite sample. 10 g soil from the homogenized sample was added to 90 ml of 0.025 per cent agar.

One ml soil slurry was plated to each of 10 plates/ replicate on modified. CMA-PARPH medium. Plates were incubated at 270C for 3 days and the Phytophthora colonies were counted. Propagules density was calculated /g of soil volume. The weather data. viz. relative humidity, temperature and rainfall, was collected from experimental fields at Warud tahsil.

Correlation with Environmental Factors

Environmental parameters viz., relative humidity, temperature and rainfall were correlated with incidence and intensity of root rot and gummosis of citrus. Also effect of their parameters was checked against the propagule density of pathogen.

Effect of Environmental Factors on Propagule Density of *Phytophthora* Spp.

Ten soil samples were collected from selective fields of Nagpur mandarin of different locations *viz.* Nagziri-A, Nagziri-B, Goregaon-C, Bargaon-D and Benoda-E of Warud Tahsil. All the soil samples were found to be associated with *Phytophthora* spp. The leaf bait technique and soil spreading methods were used for isolation purpose. Phytophthora was isolated on selective PARPH medium (Jefferson et al. 2000). The use of selective medium was found effective in the detection of *Phytophthora* spp. even, low inoculums was present in the soil (Zitko et al. 1987; Gade 2009).

Table 2. Effect of Environmental Factors on Propagule Density of *Phytophthora* Spp.

Sr. No.	Month	Humidity (%)	Rainfall (mm)	Temp. (oC)	Experimental fields Cfu / g of soil				
					Nagz-A	Nagz-B	Gorn-C	Barg-D	Benoda-E
1.	June	32.91	171.20	30.10	8.8*	8.2	7.4	8.7	7.9
2.	July	37.21	32.00	28.72	16.5	24.1	18.6	32.7	14.3
3.	August	45.55	181.61	26.04	19.6	22.4	25.8	43.6	17.8
4.	September	42.37	86.11	27.06	20.8	28.6	29.2	42.7	19.5
5.	October	43.10	2.03	26.83	18	27.7	25.4	38.9	19.2
6.	November	35.70	0.87	29.20	13.5	20.5	17.6	30.5	13.8
7.	December	39.46	2.27	28.00	14.5	20.6	14.2	27.4	13.5
8.	January	55.31	0.00	20.04	13.1	17.7	12.8	22.1	11.7
9.	February	46.77	8.38	24.44	10.9	13.8	10.6	16.9	10.1
10.	March	51.06	15.24	26.59	8.1	9.8	7.9	10.2	7.3
11.	April	19.88	0.76	35.24	5.8	5.6	5.8	5.4	5.6
12.	May	17.35	3.34	43.24	5.4	4.6	5.2	4.4	3.2

*Mean of 10 replications. Plot-A Nagziri, Plot-B Nagziri, Plot-C Goregaon, Plot-D Bargaon and Plot-E Benoda. The isolation frequency indicated that Phytophthora was present in almost all the selected soil samples collected from rhizosphere of citrus.

Results

Present results of association of Phytophthora with citrus rhizosphere confirms the findings of Naqvi 1999; Gade 2009 and Deokar 2009 who reported and isolated *Phytophthora palmivora*, *P. parasitica* and *P. citrophthora* from the soil samples collected from citrus growing areas of Amravati districts showing maximum propagule density of Phytophthora per gm of soil found in month of August Bargaon plot D 43.6 cfu / g of soil at highest rainfall (181.61 mm) and lowest propagules was found in month of May Benoda plot E which was 3.2 cfu / g of soil. The propagule density of *Phytophthora* spp. fluctuated through the sampling period, with a general increase from July to September. The maximum propagules did not exceed 43.6 cfu / g of soil.

Propagule count increased gradually from July to reach the greatest value in August, then decreased sharply in October and again increased in December. Similar results conformity with work of Ahmed *et al.*, (2012). Study of the seasonal variation of *Phytophthora* spp. in five selected plots showed that *Phytophthora* spp. population varied according to difference in climate, management and rootstock, with general increasing incidence of the pathogens starting from July. This fluctuation is similar to the pattern of seasonal variation of *Phytophthora* spp. population in Italian citrus orchards (Ippolito et al., 1992) and nurseries (Salama, 2008).

Effect of Environmental Factors on Propagule Density of *Phytophthora* Spp.

The relative humidity, rainfall and temperature were correlated with propagules density of *Phytophthora* spp. The positively non-significant correlations were existed between relative humidity and rainfall with propagules density of *Phytophthora* spp. Temperature was negatively significant with propagules density of *Phytophthora* spp. in Benoda plot (E).

Table3. Correlation Coefficients Between Environmental Factors and Propagule Density of *Phytophthora* Spp.

Sr. No.	Meteorological parameter	Experimental Fields				
		Nagz-A*	Nagz-B	Gorn-C	Barg-D	Benod-E
1.	Humidity	0.514	0.508	0.408	0.463	0.515
2.	Rainfall	0.309	0.090	0.295	0.254	0.246
3.	Temperature	-0.558	-0.558	-0.435	-0.503	-0.578*

R value 0.576* Significant at 5% level. Plot-A Nagziri, Plot-B Nagziri, Plot-C Goregaon, Plot-D Bargaon and Plot-E Benoda. The present results confirm the findings of Lutz et al., 1991, who correlated germination of propagules of *P. parasitica* with accumulation of heat unit from 0-150 degree-days but was correlated negatively with accumulation of heat units from 15-1650 degree-days.

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Agricultural Machineries for On Field Residue Management

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We know that after harvesting of crop we left huge amount of straw and residue. Some time it is burn to take second crop after harvesting. Burning of crop is harmful of soil as well as environment. Burning of crop is major problem not only in India but also problem in all over countries. Management of residue is important to reduce harmful effect on environment by burning. On field management include reduce the size of residue and incorporate with the soil to improve the soil quality. This improve soil quality by improve maintain moisture, improve aeration and reduce soil density.

Introduction

The chopping of paddy stubbles is recommended immediately after combine harvesting because at higher moisture content chopping was found effective. According to researchers investigation the machines developed for residue management of different crops at India and other countries are flail mower, straw chopper cum spreader, tractor operated cross conveyor paddy straw thrower, crop residue crushing machine, forage chopper, tractor operated shredder, stalk stubble breaking and mulching machine, tractor mounted sugar cane shredder, sugarcane trash chopper cum spreader, modified wheat straw chopper, stubble harvester cum chopper and happy seeder etc. The most of these machines which was used for residue management with rotary power type like flail mower, rotavator.

The most important machine and field parameters involved in performance of these machines are forward speed of prime mower, width of cut, fuel consumption, rotary speed of machine, type of soil, moisture content of soil, trash size reduction, chopping capacity, energy requirement, density of trash, and moisture content of trash. On this basis of this review it was revealed that there is no successful machine is available so far paddy residue management, the respective field with which can perform effectively and efficiently cutting, chopping and incorporation of paddy residue in a single pass.

Straw Generation and Implementation of Straw Management Techniques

We know that a huge amount of residue around 500 Mt generated in the agricultural, in which about 140 Mt is burned in combine harvested field. In north Indian region major portion of residue is burn. Crop generation depend on different cropping pattern, intensity and productivity of crop and it vary with states. We know that now mechanization is improved and residue management is also mechanized but adoption is limited. Collection and moving residue from agricultural field to any place is too much labour intensive, costly and time-consuming process, so some of the farmer prefer burn this residue in the field.

Effective management of residue is now adopting varies country without burning in field. Some of the countries like Thailand, Nepal, Indonesia, Malaysia, Philippines and Nigeria are using this residue as animal field, composting, renewable source of energy and for mushroom cultivation etc. On field management is generally done by machinery like happy seed drill, mulcher, baler and straw chopper cum spreader and now adopted in agricultural field for residue management.

Mulcher

Straw mulcher having rotary blades driven by tractor PTO, which cut the straw in small pieces and left in the field shown in Fig.1. It is reduced size of straw easily incorporated with soil with tillage tools and in zero seed drill this residue bed works as mulching for crop. Some researchers are worked on performance of mulcher in India. They reported that effective field capacity is around 0.35 ha/h with speed about 2.5 km/h. Fuel consumption of the paddy straw mulcher is about 6 lit/h. Paddy straw mulcher reduce the straw length about 80% or about 10 cm after operation.

One research was explored that average grain yield for treatment T1 (Paddy straw mulcher + wheat sowing with spatial no-till drill) was 2.39 and 0.33% less than T2 (paddy straw chopper-cum spreader + wet mixing with rotavator + no till drill) and T3 (clean field + disc harrow + cultivator x 2 + planter + traditional seed drill) respectively whereas the cost of operation for treatment T1 was 24.38 and 23.55% less than T2 and T3 respectively.

Happy Seed Drill

This is a special purpose sowing implement. When we need sowing just immediately harvesting or stubbles are left in field after harvested by combing this implement is work effectively. a rotary cutting mechanism like rotavator is attached with this sowing implement which cut the stables in small size about 10-20cm with sowing operation shown in Fig.2. Rotary blade direction is opposite to the direction of travel with special shape to cut the stubble/residue of the field. Just after harvesting without removing the stubble we are able to sowing by this machinery.

We know that in other machinery incorporation of chopped residue is required that is take some time for incorporation operation. Happy seed drill does not require any additional machinery for mixing operation, in this machinery chopping and sowing operation is done together. Chopped residues give mulching effect to the crop. It is the one of best solution to reduce the problem of straw burning in field.

Fig. 1: Mulcher

Fig. 2: Happy seed drill

Baler

Baler is used to make bales from residue which is left in combine harvested paddy field. This machinery consist picking, conveying, compressing chamber, density adjuster and knotting mechanism with crank mechanism, power transmission and hauling system. It gets power from the PTO of tractor.

In baling system pick up reel take the straw from the ground and conveyer conveyed it in compression chamber where a ram/piston beat and compress the straw by crank linkage mechanism. After compression a tying mechanism automatically binds the bale and moves it to discharge chamber. By use of baler we lift and bind the straw in a compact form which is easily handle and moveable.

Fig. 3: Baler

Conclusion

Management of residue in the field or used as animal feed, energy both is very beneficial. Residue management by mixing in soil improves the quality of soil and less time-consuming method of residue management. It improves the organic matters in the soil and also improves the aeration which helps to easy penetrate the root of crop into the soil. Now machineries are very effectively doing their job to incorporate residue into the soil. Machineries reduced the size of straw which help to easily decompose straw into soil. Baler is also very use to remove the straw from the field and use resources for energy and other things.

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Significance of Drip Irrigation System Installation and Management – A Review

Article ID: 30613

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Abstract

The executives of the drip irrigation water system framework require legitimate information on the framework, atmosphere, and reasonable ecological conditions for the developed harvests. To accomplish great administration rehearses for the trickle water system, the effects of atmospheric factors on plant development and creation during various seasons ought to be comprehended.

The arranging of water system framework and establishment of parts in the correct manner is viewed as one of the most fundamental issues to guarantee the most noteworthy productivity conceivable utilization of accessible water system water and permits the plants to profit by the most water utilized Intermittent support of the water system framework is significant, particularly when the water system framework is minimal and by dribble, for the maintainability of the water system framework and guarantees no poor dispersion of water productivity. This paper depicts the dribble water system framework parts, establishment, and the board of the clients which are required for the various partners in the farming division.

Keywords: Drip Irrigation, atmospheric, productivity, plants.

Introduction

Regardless of what our identity is or where we live water is a key part of our everyday life. Albeit the vast majority of the world's surface is secured by water, in any case, the water accessible for agribusiness is diminishing step by step. Because of globalization of exchange and monetary progression of approaches it has gotten unavoidable to utilize present-day water system advancements in agribusiness, particularly in plant harvests to acquire more significant returns of good quality items and to win great income by the cultivating network (Berbel et al., 2018).

Small scale water system frameworks including sprinkler water systems are at one time a framework wherein better returns of prevalent quality items can be gotten from crops by using the accessible water assets in a restricted amount (Du et al., 2015). The dribble water system is an inconceivably effective watering strategy that gradually conveys water legitimately to a plant's root framework, through a system of little channels (Plusquellec, 2009). This technique for the water system is appropriate for the harvest with wide dispersing, though, the sprinkler water system is reasonable for crops that are firmly separated (Lecina et al., 2010). On the off chance that we don't have great soil, we can utilize hydroponics. On the off chance that we don't have a decent atmosphere, we can utilize nurseries or net-houses. Be that as it may, on the off chance that we don't have water, we basically can't develop anything.

Trickle water system is 40% progressively effective on the grounds that it utilizes 40% less water than traditional water system strategies. Intermittent support of the water system framework is significant, particularly when the water system framework is smaller and by trickle, for the manageability of the water system framework and guarantee no poor appropriation of water proficiency. The upkeep incorporates fix and replaces any of the pieces of the water system framework to forestall breaks and terminations.

Components of Drip Irrigation

There are three main components of the drip irrigation system which are as follows:
1. Water Source and Pump: The water source could be an open well, bore well, or a channel. A siphon can be introduced relying on the accessibility of water and territory to be inundated.

2. Filtration Unit: The filtration unit comprises of channels, pressure check, venturi, and fertigation tank. The water is sifted by various channels before it is lead to the dribble framework. There are chiefly 3 sorts of channels for example hydro-violent wind channels, sand/media channels, and screen/circle channels. Reasonable channels are introduced by the polluting influences found in the wellspring of water (Arshad et al., 2017).

3. System of channels: The system of channels comprises of fundamental lines, sub-primary lines, laterals, scoops/producers, and control valves. The width and the length of these segments are dictated by the plan of a framework and in like manner, producers are found relying on the water necessity of the harvest (Arbat et al., 2010).

Plan of the System

The dribble water system is a mechanical framework that feeds water to a known number of plants under fitting tension going from 1.0 – 2.0 kg/cm2. The significant measures while planning a trickle water system framework are the outpouring from the siphon ought to be equivalent to the surge from the dribble framework. In the event that the outpouring from the siphon is less and the zone to be inundated is more than parcelling of the region is required (Arshad et al., 2014).

Nature of the Material

Nature of the material utilized in various segments of a dribble water system framework is significant in light of the fact that more often than not it stays on soil presented to the climatic conditions and thus ought to be fit for enduring the changing climatic conditions and keep going long (Bosch et al., 1992). The materials ought to and must be of ISI guidelines with the ISI marks with the individual number of parts glues on it.

Focuses to be Followed During Establishment

The accessibility of water and the measure of water required by the harvest ought to be resolved before establishment. Water to be utilized in dribble water system ought to be checked for its appropriateness before utilizing it. A reasonable siphon ought to be introduced relying upon the water yield and strain to be produced for the trickle framework. Typically weight of 1.5 – 2.0 kg/cm2 is required for trickle water system; while 3.0 – 5.0 kg/cm2 for sprinkler water system (Bucks et al., 1981). The water channels utilized relies upon the wellspring of water system water. On the off chance that the wellspring of water is a drag well with less physical polluting influences, just screen channels can be introduced. On the off chance that a wellspring of water is an open well or a waterway screen/plate channels alongside sand and hydro-violent wind channel must be introduced. Mainline and sub-principle lines ought to be introduced in an adjustable way for example pipes with a bigger width ought to be associated first followed by pipes with a littler measurement (Camp et al., 1993). This encourages keeping up uniform weight in the framework other than diminishing the expense and giving the necessary quantum of water consistently to all the plants. The mainline and sub-fundamental lines ought to be covered in any event 45 – 50 cm profound to keep them from getting harmed during social activities precisely. In light of the accessibility of water harvests to be developed and dispersing 12mm or 16mm laterals ought to be introduced.

Management of the System

A dribble water system is a mechanical framework that performs at a specific weight of water; if the framework needs to perform well for quite a while the weight ought to be looked after appropriately. Regardless of whether great quality materials are utilized and introduced in a logical way, there is a chance of disappointment if the field upkeep isn't appropriate and ordinary. In this manner, the administration of the framework is of prime significance. Intermittent support of the water system framework is significant, particularly when the water system framework is minimized and by dribble, for the manageability of the water system framework and guarantee no poor circulation of water proficiency (Grabow et al., 2006). The support incorporates fix and replaces any of the pieces of the water system framework to forestall holes and terminations. Additionally, it incorporates upkeep and washing the channel and water system funnels to expel the amassed pollutions and salts.

Serious Problems in the Drip Irrigation System

1. Stopping up of the laterals and producers forestalling and simple stream and uniform dissemination of water.
2. Spillage in various segments of the framework.
3. Snappy mileage of the material.
4. Harm to the segments from the diverse livestock.
5. Among these things, laterals and drippers are increasingly inclined to obstructing. The primary purpose behind stopping up is the weight of various physical polluting influences in water for example small sand/soil partials, natural

substances, synthetic pollutions (calcium carbonate/salts of manures), and organic contaminations of (microorganism and green growth).

Control of Biological Impurities

1. The board of channels: Provincial sort of reasonable limit channels ought to be obligatory introduced relying upon the nature of water. The polluting influences gathered in the channels ought to be cleared every day, fortnightly, or month to month spans. Also, it ought to be flushed and cleaned once per week.

2. The executives of the Section and Laterals: the end-tops in the areas ought to be opened and the framework ought to be worked for at any rate thirty minutes to evacuate the physical polluting influences gathered at the finishes. Additionally, the contaminations in the laterals can likewise be removed by opening the end-tops of the laterals.

3. Acid treatment: The drippers and laterals obstructed by different concoction debasements including manure deposits (assuming any), utilized for fertigation can be evacuated by rewarding the framework either with Hydrochloric corrosive, Sulphuric corrosive, or Nitric corrosive. Among these, a Hydrochloric corrosive at (25%) portion is best for the treatment.

Method of Acid Treatment

The known amount of hydrochloric acid in water; pump it into the system through a venturi or a fertigation tanks after the system is filled with water. Allow acid solution into the system until a pH of 4.0 is reached both at a starting and at the last emitter. Retain this mixture for 24 hours. The acidified water in the system reacts with the salts deposited in the system and dissolves it.

1. Chlorination: Chlorination is done to evacuate the natural contaminations gathered in a trickle water system framework. Chlorination should be possible either by utilizing Calcium hypochlorite, Sodium hypochlorite, Chlorine or Calcium hydrochloride (Bleaching powder).

2. Technique for Chlorination: Absorb the necessary amount of fading powder water 1 day before treatment. Give the arrangement access to the framework through a venturi or a fertigation tank and permit it to remain in the framework for 24 hours. Later on, open the end-tops of the segments and laterals. Run the framework for about an hour so the polluting influences are tossed out of the framework.

Control of Uneven Distribution of Water in the System

The fundamental explanation behind the lopsided appropriation of water in the framework is because of the distinction in the weight of the water. A base weight of 1.5 – 2.0 kg/cm2in dribble water system, while for sprinkler water system, at least 3.0 – 5.0 kg/cm2pressure ought to be kept up. Now and then the water pressure decreases because of the stopping up of the channels. In this way the channels ought to be spotless normally.

Conclusion

Dribble water system is an unfathomably productive watering strategy that gradually conveys water legitimately to a plant's root framework. This kills water misfortune because of vanishing which is regular with overhead watering gadgets like sprinklers or flooding. To accomplish great administration rehearses for dribble water system, the effects of atmosphere factors on plant development and creation during various seasons ought to be comprehended. Intermittent upkeep of the water system framework is significant, particularly when the water system framework is minimized and by dribble, for the maintainability of the water system framework and guarantee no poor appropriation of water proficiency. The clients may expand the proficiency and strength of the dribble water system framework by keeping up its parts and establishment arranging which is vital for the improvement in the rural area.

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Saline Soil - Reclamation and Management

Article ID: 30614

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Introduction

Soils having higher proportion of soluble salts affect adversely the growth of plants. The salt level in saline soils exceeds a limit of 4.0 dSm-1. Mostly these soils are dominant with chloride and sulphate salts. These salts are neutral salts and hence the pH of these soils may not exceed 8.5. Saline soils are formed through a soil forming process called salinization in semi-arid and arid zones.

Classification of Saline Sodic Soils

	EC (dsm1)	ESP	pH
Saline soil	> 4.0	< 15	< 8.5
Sodic soil	< 4.0	> 15	> 8.5
Saline-sodic soil	> 4.0	>15	< 8.5 or > 8.5

Effects of Soil Salinity

The characteristics feature of saline soil is white encrustation on surface of soils due to evaporation of water to atmosphere leaving the salts on soil surface. Presence of salts leads to alteration of osmotic potential of the soil solution. Consequently, water intake by plants restricted and there by nutrients uptake by plants is also reduced. In these soils due to high salt levels microbial activity is reduced. Reduced microbial activity result in slow decomposition of organic matter. Slow decomposition leads to slow nutrient availability particularly nitrogen and sulphur.

Due to osmotic potential alteration water from plants cells moves to soil and plants are affected due to dehydration. As a result, drying of leaves and finally death of plants is commonly seen in saline soils. Apart from above effects, specific ion effects on plants are also seen due to toxicity of ions like chloride, sulphate etc.

Reclamation

All saline soils can be reclaimed easily, if good quality water is available. Since the salts in these soils are soluble in nature, using quality water they can be solubilized and leached off from the field. In the absence of good quality water, it becomes necessary to manage saline soils for better growth of plants.

Management of Saline Soils

1. Crop management: Growing crops that are tolerate high level soil salinity e.g.: Cotton, Ragi, Barley, sugar beet, Beet root, curry leaf, Bermuda grass, saline grass, spinach etc. Crops that are tolerant to soil salinity at medium level are paddy, wheat, onion, maize, sunflower, castor, grape, pomegranate, tomato, cabbage and potato. Crops that are tolerant to low level of soil salinity are garden beans, Reddish, lime etc. Black gram, green gram is sensitive to soil salinity. Crops are to be chosen based on the soil salinity level.

2. Soil / Cultural management: Growing crops in raised beds will reduce accumulation of salt around root zone. Planting seedlings / sowing seeds on sloppy ridges decreases accumulation salts around root zone. Mulching of soil prevents evaporation which reduces accumulation of salts due to capillary rise of water on surface of soils. Providing drainage in water logged areas also helps to reduce salt accumulation.

3. Fertilizer Management: Addition of extra dose of nitrogen to the tune of 20 – 25% of recommended level will compensate the low availability of N in these soils. Addition of organic manures like, FYM, compost, etc helps in reducing the ill effect of salinity due to release of organic acids produced during decomposition. Green manuring (sun hemp, Daincha , Kolingi) and / or green leaf manuring also counteracts the effects of salinity.

4. Irrigation management: Proportional mixing of good quality (if available) water with saline water and then using for irrigation reduces the effect of salinity. Alternate furrow irrigation favours growth of plant than flooding. Drip and sparkler irrigation systems aim are reduced use of water which is favourable for growth of plant since slat accumulation also reduced with low usage of water.

Conclusion

All the above four management practices suitably integrated to reduce the soil salinity which is favourable for better growth of plants and ultimately for better yields. Management of saline soils becomes essentials and unavoidable particularly in areas where both soil as well as irrigation water are saline in nature.

Need and Importance of Crop Insurance in Agriculture

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Abstract

Present article is addressed to need and importance of crop insurance in agriculture sector. Production risk, market or price risk, institutional risk, financial risk, etc. are the different risks occurred in agriculture. To overcome such risks and uncertainty, crop insurance is a specialized version of insurance. So, there is a need of crop insurance to provide insurance coverage and financial support to the farmers in the event of prevented sowing & failure of any of the notified crop as a result of natural calamities, pests & diseases. It encourages the farmers to adopt progressive farming practices, high value in-puts and higher technology in Agriculture. It helps to stabilize farm incomes, particularly in disaster years. There is a need for some subsidization by government.

Key Words: Agriculture, Crop, Insurance.

Introduction

Agriculture is imperious business in India. Risk is crucial factor in all business activities. Risks in agriculture business are production risk, market or price risk, institutional risk, financial risk, etc. Agricultural Insurance is a special insurance which covers risk in farming industry. Crop insurance is a specialized version of insurance which has exclusively been designed for agriculturists for protecting them from financial loss arising out of any unforeseen risks or perils which are generally beyond the control of farmers (AIC 2008). There are many risk causing factors in agriculture responsible for causing insecurity in mind of farmer and instability in his income. So, there is need of crop insurance as part of risk management tool in agriculture. Agriculture in India is not just dependent on weather conditions, but also suffers the brunt of natural disasters. Government can facilitate agricultural insurance in several ways. In case farmers are asked to pay full premium themselves then chances of adoption of insurance are bleak.

Need of Crop Insurance

There is a need of crop insurance to provide insurance coverage and financial support to the farmers. It can provide information, on weather patterns, locations of farms and crops, incidence and history of perils and crop yields. It can help to meet the costs of the research to be undertaken before starting an agricultural insurance program. It can also provide reinsurance. Substituting existing crop insurances with weather insurance in India will not only introduce a more efficient and low-cost insurance scheme for the Government, but it will also provide a more transparent and actuary fair insurance product to the farmer. Crop insurance make farmer confident that in the event of any loss from risks and uncertainties in their operations, they will be indemnified by the insurer.

Agricultural insurance is considered an important mechanism to overcome the risk to output and income resulting from various natural and manmade events. Unfortunately, agricultural insurance in the country has not made much headway even though the need to protect Indian farmers from agriculture variability has been a continuing concern of agriculture policy. According to the National Agriculture Policy 2000, "Despite technological and economic advancements, the condition of farmers continues to be unstable due to natural calamities and price fluctuations". In some extreme cases, these unfavourable events become one of the factors leading to farmers" suicides which are now assuming serious proportions (Raju and Chand, 2007). Crop insurance is a means of "protecting the farmers against uncertainties of crop yields, arising out of practically all-natural factors beyond their control". Crop insurance may be of different types according to different criteria.

Crop Insurance Schemes in India

A number of crop insurance schemes launched in India from period to period, though, the first existing attempt was made in the 1970s. The details of various insurance schemes progressed till date, is as follows.

Name of Insurance Scheme	Period	Approach	Crops Covered
Crop Insurance Scheme (CIS)	1972-78	Individual	H-4 Cotton, groundnut, wheat, potato
Pilot Crop Insurance Scheme (PCIS)	1979-85	Area	Cereals, millets, oilseeds, cotton, potato and Chick pea
Comprehensive Crop Insurance Scheme (CCIS)	1985-99	Area	Food grains and oil seeds
Experimental Crop Insurance Scheme (ECIS)	1997-98	Area	Cereals, pulses and oil seeds
National Agricultural Insurance Scheme (NAIS)	1999-2010-11	Area and Individual	Food grains, oilseeds, annual commercial and horticultural crops
Farm Income Insurance Scheme (FIIS)	2003-04	Area	Wheat and rice
Weather Based Crop Insurance Scheme (WBCIS)	2003-04-Continuing	Individual	Food grains, oilseeds annual commercial and horticultural crops.
Modified National Agricultural Insurance Scheme (MNAIS)	2010-11 Continuing	Area and Individual	Food grains, oilseeds, annual commercial and horticultural crops
Pradhan Mantri Fasal Bima Yojana (PMFBY)	2017	Area	All Cereals, millets, & oilseeds, pulses and Annual Commercial / Annual Horticultural crops.

Conclusion

Even though various insurance schemes launched from period to period in India but our country has accomplished restricted purposes. Expanse of insurance schemes in terms of area and number of farmers is infinitesimal, payment of indemnity based on area approach miss affected farmers outside the compensated area and most of the schemes are not practicable. Mounting the acquaintance of crop insurance would therefore increase government costs extensively. Apart from this, the programme is reorganized judiciously to make it practicable, the strategies of its future development to comprise and impact more farmers is remote. This need developed efforts by Government in terms of planning suitable schemes and providing economic backing for agricultural insurance.

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COVID 19: The Seeds and Juices that Boost Our Immune System Stronger

Article ID: 30616

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At a time when the world is dealing with the deadly COVID-19, it is very important to take extra safeguards to keep our self-protected from getting infected. This is why we require a healthy and a powerful immune system. Individuals with certain illnesses like diabetes, hypertension, cardio vascular disease, and respiratory issues are at a higher risk of having COVID-19 complications. It also aggravates with age as the general immunity reduces as we get aged. The food we eat plays a key feature in regulating our overall health and immunity. By making some lifestyle changes or by including some immunity-boosting food items in our diet we can improve our immunity. In this article, I will tell you about three important seeds and juices that we can have at this time to keep our immune system stronger. These are good choices for the older generation too.

Pumpkin Seeds

These seeds are important natural food for human health as these are nutritional powerhouses. It is rich in zinc (Zn) for fertility, immune boosting and rich in Iron (Fe) for healthy blood. It can aid in enhance blood cholesterol profile. Pumpkin seeds are a good source of healthful oils, omega-3 fatty acids, vitamin E (most powerful natural antioxidant – free radical scavenger), folate (Vitamin B9)- helps the body convert carbohydrates into glucose, potassium, calcium, magnesium and good source of polyunsaturated fatty acids and other antioxidants that enhance the health of the heart, bones and other functions. The fatty acids in these seeds have a range of beneficial nutrients such as sterols, squalene, and tocopherols. It was found that there were 265 mg of total sterols in every 100 g of pumpkin seed kernel. Plant sterols and phytosterols are known to help reduce levels of "bad" LDL cholesterol. Vitamin E in these seeds helps strengthen the immune system and keep healthy blood vessels.

We can eat them raw or try dry roasted seeds as a snack. We can also use them in baking, garnish for soups and salads, or with granola.

Flax Seeds

Flax seeds have advantageous effects on the immune system. It contains two components that favorably affect the immune system: alpha-linolenic acid (ALA), an essential omega-3 fatty acid, a lignans, a type of phyto estrogen. The ALA component of flaxseed influences immunity- the body's ability to defend itself successfully against foreign substances - through its effects on membrane phospholipids and the production of eicosanoids and cytokines. Lignans on the other hand control certain mediators of the immune response and thus play an important role in the clinical management of auto immune diseases (Blackburn, 1992); (Parbtani and clark, 1995).

Flaxseeds contain seven times more potassium(K) than a banana and more calcium(Ca) than a cup of skim milk. Aside from fatty fish, flax seeds are one of the only foods containing large amounts of the incredibly beneficial Omega 3 fat. Consuming a half cup of flax seeds per day will provide us with 831 mg of Potassium, 236 mg of Calcium, 431 mg of Magnesium, and 112 mcg of Folic acid and 50 grams of Omega 3 fats.

My suggestion is to don't take them raw or unripe flax seeds. Take a teaspoon of freshly ground flax seeds. Add them to water and leave it overnight. Consume it the next day, early morning and it can also take by preparing ladoos made with flaxseed, ghee and jaggery.

Sesame Seeds

These seeds are packed with many health benefits. From digestion to bone health sesame seeds are beneficial for our body in different ways. These seeds are popularly known as til. It helps us to fight against some health issues like cold, cough, flu or fevers which are common during the winter season. Taking sesame seeds helps us to boost our immunity.

These seeds contain several nutrients like iron, zinc, vitamin B6, vitamin E, selenium and many more which aids the functioning of the immune system. The bioactive components present in the seed include vital minerals, vitamins, phytosterols, polyunsaturated fatty acids, tocopherols and unique class of lignans such as sesamin and sesamolin which provide defence mechanism against reactive oxygen species.

We can take these sesame seeds by making laddu also called til laddu (seeds, ghee and Jaggery) and also try toasting them and sprinkling the seeds over a salad.

Mixed Beet Root, Carrot, Ginger and Apple Juice

This juice by three root vegetables that keep our immune system healthy and decrease inflammatory symptoms. Inflammation is often an immune response to infections originating from viruses or bacteria. Cold or flu symptoms include a runny nose, coughs, and body aches. People who have suffering with rheumatoid arthritis may find this juice especially beneficial, as adding ginger has anti-inflammatory effects.

By taking this mixed juice we will get potassium from the carrots, beets, and apple, vitamin A from the carrots and beets, vitamin B-6 from the carrots, vitamin B-9 from the beets, vitamin C from the apple.

Strawberry and Kiwi

Strawberries and kiwis are other healthy options also called vitamin C-packed drink. Since it takes about 4 cups of strawberries to make 1 cup of juice, you may want to blend these fruits into a smoothie rather than a juice. Also adding skim milk as milk is a good source of protein and vitamin D, which is hard to come by in juices that use only fruits or vegetables. Many people are deficient in vitamin D, which is largely found in sunlight and in smaller amounts in animal products.

Notable nutrients (in one serving): calcium from the skim milk, manganese and potassium from the strawberries, banana, and orange, vitamin B-6 from the banana, Folic acid from the strawberries and orange, vitamin B-12 from the skim milk, vitamin C from the strawberries, kiwi, and orange, vitamin D from the skim milk, vitamin K from the kiwi and zinc from the skim milk.

Conclusion

One of the main challenges in treating viral diseases is the development of resistance against the virus by enhancing or boosting body immune system. With fast mutation in genome of the virus, may be an antiviral drug proves to be ineffective in a short time. Therefore, it is necessary to find a natural source for inhibiting viral infection by using these seeds and juices that result in healthy immune system.

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Cropping Paradigm of *Jasminum grandiflorum*

Article ID: 30617

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Jasmine is the most important loose flower and dominating the traditional flower market in India. These flowers are used by the people for personal decoration, for social and religious offering, perfume (concentrate extraction). Since, the flowers are perishable within a short span will have to be disposed of in the markets very soon. With the advanced technologies, now-a-days jasmines are airlifted to Bangalore, Gulf countries and US on daily basis.

Of the several species of jasmines, commercially valued jasmine is *Jasminum grandiflorum* used for the production of jasmine concrete which is commonly called as Pitchi, Jathimalli, Spanish Jasmine all over the world which belongs to the family Oleaceae.

Botanical Description

They are climbing, trailing and erect shrubby flowering plants and these are both over green and delicious species. Leaves are opposite or alternate, simple, trifoliate or pinnate, leaflets entire. Flowers are white, yellow or rarely reddish, sometimes solitary, more often in cymose clusters of three to many, usually fragrant; corolla tubular with four to nine lobes, stamens two, ovary 2 loculed with 1-4 erect ovaries. Fruit is a berry and black in colour.

Soil: Prefers red and sandy loam soil.

Climate: Wammer Summer and mild winter.

Variety: Co-1, Co-2 released by TNAU and Arka Surabi (IIHR).

Planting Material: Layers.

Propagation Method

Rooted cuttings or layers. Sometimes terminal cuttings (12.5-15cm long) are also used.

Field Preparation: The land has to be ploughed twice or thrice to a fine tilth and pits is filled with top soil mixed with compost in equal proportion.

Planting Season: June to November.

Spacing: 2.0 x 1.5m.

Pit Size: 30 x 30 x 30cm

Number of layers: 3350 / ha

Nutrition Recommendation: FYM @ 10 kg/ pit is applied before planting. NPK @ 60:120:120 g/plant/year is applied in two equal splits during December (after pruning) and June- July.

Micronutrients

Foliar spray of 0.25% $ZnSO_4$ + 0.5% $MgSO_4$ + 1% $FeSO_4$ (In case of expression of micronutrient deficiency, spraying should be done at fortnightly intervals until the chlorotic symptoms disappear).

Biofertilizers: Soil application of 2 kg each of *Azospirillum* and *Phosphobacteria* per ha at the time of planting. It is to be mixed with 100kg of FYM and applied in pits.

Pruning Season: Last week of December

Pruning Height: Prune the bushes at 45-50 cm height from ground level.

Pinching: After pruning to enhance productivity

Irrigation Schedule: March to October

Harvest: Morning Hours

Labour Requirement: 30-40 persons to pick flowers from an acre

Grading: Based on corolla tube length, bud size, shape and freshness.

Packaging Material: Corrugated cardboard boxes for Distant market and Bamboo baskets for local markets.

Shelf Life: 24 hours

Yield: 11 t/ha throughout the year

Value Addition: Jasmine Concentrate -0.27%

Concrete Preparation

The harvested flowers were soaked in hexane (food graded having 70°C boiling point) at the rate of two litres per kilo of flowers for half an hour and filtered. The perfume substances were dissolved in the hexane. Then the solvent is evaporated over a water bath at 75°C. The evaporated wax like sediment is known as concrete.

Plant Protection

1: Pests:

- **a. Bud worm:** Serious pest in Jathimalli and Mullai. Spray of thiacloprid 240 SC @ 2 ml/lit or 2 ml of monocrotophos per litre of water gives better result.
- **b. *Holotricha* beetle:** Install light trap to attract the adults immediately after summer rain.
- **c. Red spider mite:** To control mite population spraying (any one) of:
  - i. Fenazaquin 10 % EC @ 2 ml/lit.
  - ii. Propargite 57 % EC @ 2ml/lit.
  - iii. Wettable sulphur 50 WP @ 2 g/lit is recommended.

2: Diseases:

- **a. Leaf Spot:** Remedy: Spray mancozeb @ 2.0 g/l from the onset of monsoon at monthly intervals.
- **b. Root rot:** Drenching the soil around the plant with Copper Oxy Chloride (COC)- 2.5 g/l of water is recommended against root rot.



3: Nematode: Application of 10g of aldicarb granules near root zone will control the nematode population.


Sowing to harvesting is a critical thing in flower crop cultivation. Follow the cropping pattern to enhance the yield and improves the marketable quality of flowers for better concrete preparation.

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Biochar: A Sustainable Approach to Future Farming

Article ID: 30618

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Summary
Biochar is a new alternative which can serve the purpose of increasing soil fertility and food production in a more sustainable manner without land and natural resource degradation. This context introduces and promotes biochar as an input for the agriculture production system which can boost the production in a long run in an eco-friendly manner, its advantages and limitations.

Introduction
The needs to develop more sustainable agriculture systems and improve weak rural economics necessitate major changes in agriculture management. Soil degradation, including decreased fertility and increased erosion, is a major concern in global agriculture (Jianping, 1999).

Long-term cultivation of soils could result in degradation, containing soil acidification, soil organic matter depletion, and severe soil erosion (De Meyer et al. 2011). Furthermore, the decrease in soil organic matter decreases the aggregate stability of soil (Annabi et al. 2011). Therefore, it is crucial to remediate the degradation of soil by simple and sustainable methods. Manures and composts contain pathogens, heavy metals, and pharmaceuticals, which may cause long-term contamination of farmland.

Moreover, manures and composts have the potential to lead to ammonia and methane releases, which can aggravate global warming and serious groundwater and stream nutrient pollution. Being a renewable resource and due to its economic and environmental benefits, biochar is a promising resource for soil's fertility management. Furthermore, biochar loaded with ammonium, nitrate, and phosphate could be also proposed to be a slow-release fertilizer to enhance soil fertility (Spokas et al. 2012; Schmidt et al. 2015).

What is Biochar?
Biochar is a solid carbon rich material obtained from the carbonisation of biomass. It is produced through a process known as pyrolysis, means thermal decomposition of organic material (like wood chips etc, crop wastes and manure) under controlled supply of oxygen (O_2), and at relatively low temperatures (<700°C). This process often mirrors the production of charcoal, which is perhaps the most ancient industrial technology developed by humankind.

However, it distinguishes itself from charcoal and similar materials by the fact that biochar is produced with the intent to be applied to soil as a means to improve soil health, to filter and retain nutrients from percolating soil water, and to provide carbon storage. Due to the molecular structure of biochar, it is in a more stable form than the original carbon (i.e. plant biomass, manure, etc.) both chemically and biologically. As a result, it is more difficult to breakdown biochar in the soil, resulting in a product that can remain stable in the soil for hundreds to thousands of years.

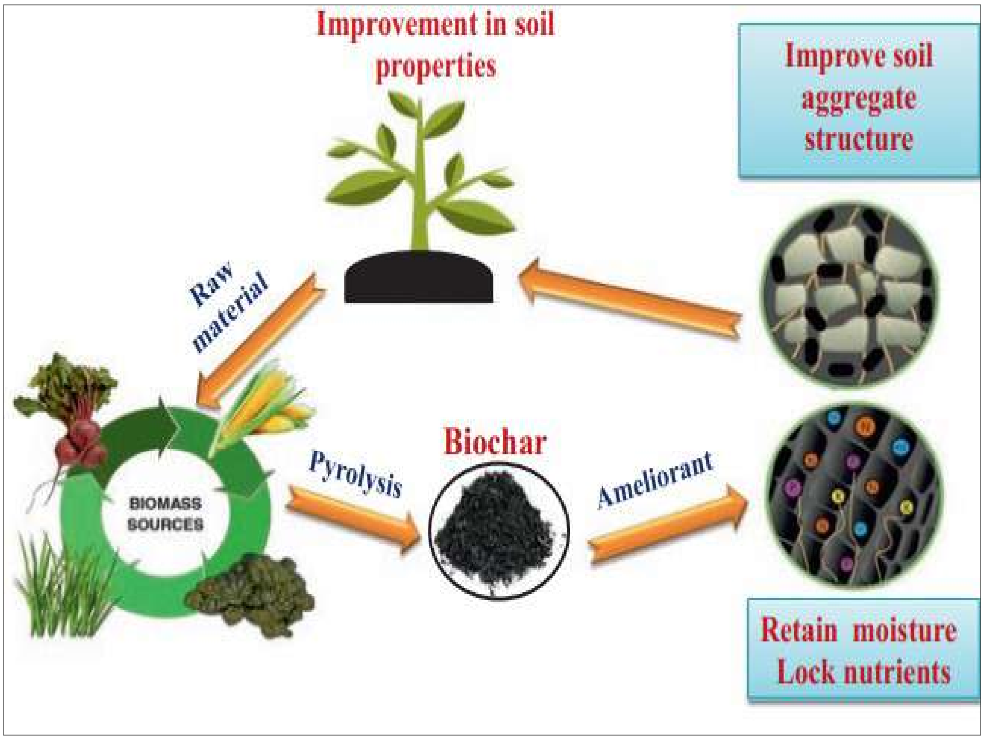
Properties of Biochar
The physical and chemical properties of biochar affect its adsorption properties. For instance, theincrease of acidic functional groups in biochar can increase the adsorption ofNH_4^+ (Spokaset al., 2012). Biochar has a high specific surface area, high amounts of oxygen-containing functional groups, and a high stability (Huang et al., 2016).

The physicochemical properties of biochar mainly depend on the feedstock and the pyrolysis temperature (Cantrell et al., 2012). Many feedstocks, such as wood-chips, organic wastes, plant residues, and poultry manure, can be used to produce biochar (Mohan et al., 2014).

Agricultural Benefits of Biochar

Many studies exclaimed that the application of biochar on the soils can enhance the content of organic matter in the soils and improves the fertility of the soil. There are number of studies which show that by the addition of biochar in the soils it will result in the better soil texture, more porosity, good structure, and density and particle size distribution. As biochar have higher porosity and more surface area it will help in the providing space for microorganisms which are beneficial for the soil and also help in binding of important anions and cations.

Many researches provided evidences that by the addition of biochar the growth rate of crop increased, quality of water improved, reduction in nutrient leaching, reduction in acidity of soil, more water retention, and decrease in fertilizer use. In the presence of added nutrients, the nutrients uptake by plants increased, growth rate increased significantly by the application of biochar in soils (Woods et al.2006).



Nutrient Availability in Soils

By incorporating biochar in the soil, it will result in the better soil texture, more porosity, good structure, and density and particle size distribution. As biochar have higher porosity and more surface area it will help in the providing space for microorganisms which are beneficial for the soil and also help in binding of important anions and cations and increase cation exchange capacity (CEC) (Laird et al.2010). Biochar application leads to the increase in pH of the soil and that leads to improved availability of phosphorous and potassium (Atkinson et al.2010). When biochar is applied on the soil, oxidation process is observed on the surface of particles.

The reason for the reported high CEC is the oxidation of aromatic carbon which leads to the formation of carboxyl groups (Liang et al.2006). The increase in CEC aids in increasing the fertility of soil, as the nutrients will remain attached to the soil opposing the leaching process because of CEC. When highly oxidized organic matter attached with the surface it will create negative charge on the surface. This results in the decrease of positive charge on the sites. However, the results from the studies showed that the effect of biochar is more expected on the soils having macro pores (Tryon,1948).

Constraints in Application of Biochar

1. The utility of biochar is well reported for only a few geographical locations across the world. Much more research is required to completely understand its benefits or disadvantages in soils round the globe.

2. In some cases, yields may decline because of the sorption of water and nutrients by the biochar, which reduces the availability of these resources for the crops. Biochar has also been shown to inhibit germination.

3. Some biochar's can act as a source of contaminants, such as heavy metals, Volatile Organic Compounds, Polycyclic Aromatic Hydrocarbons, and Dissolved Organic Carbon.

4. The fine ash along with biochar is a source for dust, which pose a great risk for respiratory disorders.

5. In high pH (alkaline) soils, an increase in soil pH is not desirable as crops only tolerate a certain range of soil pH.

6. Soil loss by erosion can be an issue when top dressing with biochar. This occurs by transportation of small, light biochar particles by wind and/or water. Proper incorporation into a soil blend is necessary.

7. Residue removal is required to be used as a feedstock for biochar production. This could result in reduced incorporation of crop residues into soils and potentially lead to negative effects on soils. This would be the case if farmers were to use all of the straw produced in a field to form biochar, for instance.

Biochar Application Rates

Biochar is not like fertilizer, which generally needs to be applied annually. As biochar is stable in soils, it may be built up to an optimum level which can then remain constant indefinitely. Currently, we do not know what the optimum rates are, but some studies have reported adding biochar up to 20 percent of the soil by volume.

Conclusion

Biochar application in the fields helps in increasing the soil fertility, improved soil texture, improved sorption for nutrients which then helps in reducing the use of fertilizer which leads to the decrease in pollution through fertilizer run off. Biochar is highly efficient in increasing the crop production and yield.

One of the major benefits of biochar is that it's helping in combating with climate change by sequestering the carbon dioxide from the atmosphere. It can also be used for the rehabilitation of destructed landforms. Biochar is posing many benefits to the environment agriculture and economy in the long run, so it's highly recommended to include it in agricultural practices. More research works should be carried out to overcome the constraints and disseminate the knowledge to the farmers.

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Boosting of Farmer Income Through Rice – Fish Farming

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Introduction

Farming family in India is mainly dependent on rainfed farming with high risk of weather uncertainty. In a constant struggle to survive, the small and marginal farmers over the years have evolved techniques which have benefited them immensely. But without knowing the scientific basis of such integration they have been practicing the system for a long time. In India, traditionally, farming has been family based and majority of them are smallholders. The success of farming family lies not in 'specialization' but in practicing farming to meet diverse household needs rather than market opportunities alone.

Hence, income from seasonal field crops alone in small and marginal farms is hardly sufficient to sustain the farming family. Rice the dominant staple crop of the tropical Asia and has a rich diversity of cultivated ecotypes based on three varieties of *Oryaza sativa, indica* and *japonica.* Rice-fish farming is practiced in many countries in the world, particularly in Asia. While each country has evolved its own unique approach and procedures, there are also similarities, common practices and common problems. There are four basic rice agro-ecosystems each with particular edaphic conditions: irrigated ecosystem, upland and lowland rainfed ecosystem and flood prone (deep water) ecosystem.

Fish rearing in rice fields is a 2000-year-old apparently successful practice, where fish are stocked with the aim of increasing and diversifying the rice field productivity and is probably the most promising alternative to rice mono cropping. Fish culture in these ecosystems is concurrent or rotational with rice carried out at four intensities: traditional (capture), low intensity culture (with feed and fertilizer), medium intensity (only fertilization) and high-density culture (with feed and fertilizer). The integration of fish into rice farming provides invaluable protein, especially for subsistence farmers who manage rainfed agriculture systems. Rice field provide shade and organic matter for fish, which in turn oxygenate soil and water, eat rice pests and favour nutrient recycling.

Rice crop is strongly influenced by water supply. Water should be kept standing in the field throughout the growth period. This requirement is applied either naturally by precipitation or artificially by irrigation. The daily consumptive use of rice varies from 6-10 mm and total water is ranges from 1100 to 1250 mm depending upon the agro-climatic situation, duration of variety and characteristics of the soils. The rice fields retain water for 3-8 months in a year. Rice-fish farming means growing of rice and fish together in the same time and same piece of land. It also includes that growing of rice and fish serially one after another in the same land in same water after harvesting of rice. Rice and fish are staple food if most Indian parts.

In socio-economic activity fisheries rank second in the world in agriculture sector. Rice-fish may grow in same compartment or different compartments with connecting water channel. Having rice in fields along with fish in the water is an epitome of abundance and sufficiency of nutrients for both growth and development. Global recognition and interest in rice-fish farming helps in combat malnutrition and poverty has been well known for a long time. The culture of fish in paddy fields, which remain flooded even after rice harvest, serves an off-season occupation and additional income to the farmer. This system needs modification of rice fields, digging peripheral trenches, construction of dykes, pond refuge, sowing improved varieties of rice, manuring, stocking of fish at 10,000/ha and finally feeding of stocked fish with rice-bran and oilcakes at 2-3% of body weight.

Field Management for Rice-Fish Farming

1. Site selection: The site location should be in low lying areas for equal distribution of water the all over the field.

2. Types of soil required: The soil should be fertile and rich in organic manure and high-water holding capacity. Normally silty clay or silty clay loam are most suitable for rich-fish farming.

Fish Culture

1. Rice and fish are cultivated together in rice plots, and this is known as simultaneous culture.
2. Rice fields of 0.1ha area may be economical. Normally four rice plots of 250 m2 (25 X 10 m) each may be formed in such an area. In each plot, a ditch of 0.75 m width and 0.5 m depth is dug.
3. The dykes enclosing rice plots may be 0.3 m high and 0.3 m wide and strengthened by embedding straw.
4. The water depth of the rice plot may vary from 5 - 25 cm depending on the type of rice and size and species of fish to be cultured.
5. Five days after transplantation of rice, fish fry is stocked at the rate of 5000/ha or fingerlings at the rate of 2000/ha. The stocking density can be doubled if supplemental feed is given daily.

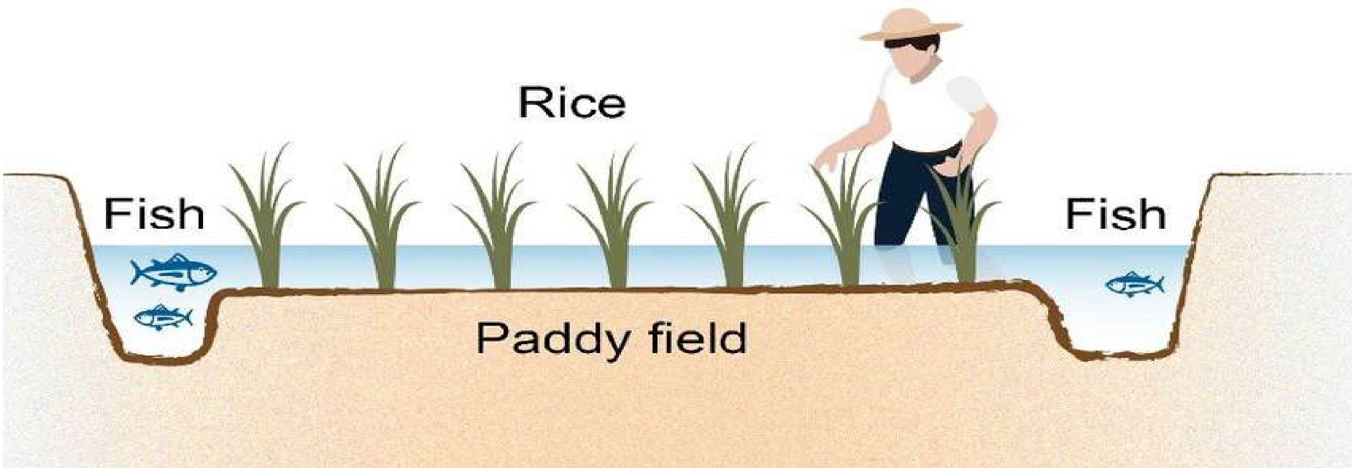
Modification Need

Several field modifications are developed over the years in order to make the rice fields to be suitable for fish cultivation. All modifications are made by "Basic common sense" for sustaining of fish along with rice. By providing all suitable conditions the yield is increased. This is achieved by making portions of the rice field deeper than the ground level for the fish to sustain. There are four physical improvements that are commonly made to prepare rice fields for fish culture:
1. Increasing bund height: By maintaining maximum bund height of about 45-50 cm since the water level of rice does not exceed to more than 20 cm.

2. Supply of protective screens: Providing of protective screens to fish not to escape from the water and not to become pray for the birds.

3. Proper drainage availability: Without maintaining proper drainage the fishes do not equally distribute to field areas and their growth is affected due to congested atmosphere.

4. Fish refuses/trenches: These are the holes that are made in between plot or some areas for to provide the fishes to live when the water level is decreased and also helpful in time of fish harvest, we can harvest fishes in single time with the help of these trenches.



View of rice-fish farming

Selection of Species

1. Rice variety: Number of submerged and dwarf varieties are developed in India for water logging tolerance. These varieties can with stand in the fields even when water logging conditions in rainy days. Some of submerged varieties some example of rice is Swarna-Sub 1, IR64-Sub1, Samba-Mahsuri-sub 1, Panidhan, Tulsi, CR260 77, ADT 6, ADT 7, Rajarajan and Pattambi 15 and 16 are suitable. These varieties not only possess strong root systems but also are also capable of withstanding flooded conditions.

Further, they have a life span of 180 days and fish culture is possible for about four to five months after their transplantation. Harvesting is done when fish attain marketable size. Fish culture in rice fields may be attempted in two ways, viz. simultaneous culture and rotation culture. In the former, rice and fish are cultivated together and in the latter; fish and rice are cultivated alternately.

2. Fish species: Fish species selected based on their tolerance capacity of extremely high temperature 40°C as well as low temperatures 10°C, low oxygen levels and high turbidity. The fish species used for rice-fish farming are such as *Cirrhinus cirrosus, Catla catla, Labeo rohita, Cirrhina mrigala, Cyprinus carpio, Chanos chanos, Oreochromis mossambicus, Anabas testudineus, Mugil* spp., *Clarias batrachus, C. macrocephalus, Lates calcarifer, Channa striatus* and *C. marulius* have been widely cultured in rice fields.

Management from Pest, Disease and Weeds

Using chemicals to control pest and diseases in rice-fish fields may be become toxic to fishes even they do not harm crop. Integrated pest management to be followed by using traditional, cultural and biological pest control methods. Fishes do not eat leaf folder larvae but presence of fish waste and deep water may have favoured oviposition, hatching and feeding of the insect larvae.

Herbicides are to be applied before transplantation and fishes are stocked 10-15 days after application. Diseases are controlled by spraying organic formulations like neem oil with specific concentration. If field more infested previous year and to control the menace of insects, the insecticide Furadon (Carbofuran) may be used at the rate of 1 kg/ha. The insecticide is mixed with basal fertilisers and applied once during the final harrowing. It may be stated by some researcher that fish grown in insecticide-applied rice fields are safe for human consumption.

Nutrient Requirement for Rice

For supplying of nutrient requirements for rice organic supplements like Amritpani, Jeevamrutha, Beejamrutha, Panchagavya are applied along with vermicompost and farmyard manure in low quantity because fish excrete ammonia which is source of nitrogen.

Nutritional Requirement for Fish

Feed for fish is provided through litter of hen, rice barn, starch granules which are highly proteinaceous to fishes.

Harvesting

After a period of 10 weeks (if stocked with fry) or six weeks (if stocked with fingerlings), the rice fields are slowly drained off and the fish are harvested. The harvesting of fish may be done about a week before the harvest of rice. The growth rate of fish is also moderate in rice fields as the production of plankton, the fish food organisms, is rich. Individual growth of 60 g and a per hectare yield of 500 kg have been reported under the simultaneous culture practice.

Prospects

1. Doubles the profit per unit area.
2. Environment friendly and soil health is not disturbed.
3. Low input cost.
4. Improves soil organic matter by fish excreta and reduce fertilizer input.
5. Reduction in the number of harmful insects, such as paddy stem borers, whose larvae are eaten by fish.

Constraints

1. Skilled labour is required for management.
2. Sometimes fishes may damage seedling.
3. Managing of crop diseases through organic formulations is risky.
4. Practicing rice-fish farming in the first-year costs more.

Conclusion

There is a need to analyse the reasons for low adoption of this technology and to formulate the management strategies. Integrated rice-fish farming results in mutual benefit to both rice and fish. Rice is benefited in the form of additional nutrients which come from fish excreta. In addition, the aquatic weeds of rice also get reduced due to fish presence. In turn, fish gets benefit in the form of favourable micro climate due to presence of rice plants.

However, rice requires a majority of nutrients in the form of inorganic fertilizers whereas fish needs nutrients in the form of organic form. Training must be organised for rice growing farmers for their attention and increase income through rice-fish farming. It also reducing the emission of greenhouse gases, co-culture systems have beneficial effects on farm income and improving the livelihood of poor rural people and progressive farmers.

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Nano-Fertilizers: Adding New Dimension to Smart Delivery of Plant Nutrients

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Summary

This article gives an overview of an emerging technology of Nano-Fertilizers and its relevance in present agriculture system which demands for the accelerated food production with limited resources and least environmental degradation. This context will give brief description and promote Nano-Fertilizers as an alternate option that can highly favour farmers in precise and cost-effective application of the most important input of the production system in a long run, advantages and limitations as well.

Introduction

Agriculture is for all time the strength of developing countries. Aside from filling up the people's stomachs, it also plays an important part in the economy of a country. Demographic data as of May 2018 revealed that the total world population is7.6 billion people, where India's population contributes a vast figure of about 1.35billion. Providing food to such a full-size population is a big challenge, and in dealing with it, there is a need for unremitting flow of novel technology into this sector. The new emerging science of nanotechnology can provide an explanation to fix these problems of food production. Norio Taniguchi of the Tokyo Science University first defined the term "nanotechnology" in the year 1974. Currently nanotechnology provides Nano-Fertilizers for efficient nutrient management. Nano-Fertilizers is a successful tool in agriculture for enhancing nutrient supervision because these nano-based fertilizers have extra infiltration capacity, large surface area, nutrient use efficiency, and stress tolerance ability and above all, it is very eco-friendly, thus avoiding residues in environment (Panpatte et al. 2016).

Nano-Fertilizers and its Role in Agriculture

Nanotechnology used to modify and synthesize materials which are used to improve the soil fertility for enhanced yield; augment crop quality and quantity are called Nano-Fertilizers. They play an important role to heighten nutrient efficiency by controlled release of nutrients based on plant need and lessen cost of food production and environmental safety by reducing fertilizers over use.

Nano-Fertilizers are a customized form of conventional fertilizers which are either bulk materials or made from vegetative or reproductive parts of plants with the help of nanotechnology by using different physical, chemical, or biological methods. The molecular properties of nanoparticles are completely different from its bulk material due to its small size and increased surface-to-volume ratio. Replacing conventional fertilizer by Nano-Fertilizers can be a powerful attempt toward sustainable agriculture.

Properties of Nano-Fertilizers

1. Higher surface area: Nano-Fertilizers have a high surface area mainly because of its small particle size. Due to this property it can be supplied in additional sites to help different metabolism in plant system, leading to production of more photosynthates. The raise in surface area elevates reactivity of Nano-Fertilizers with other compound and improves nutrient uptake and nutrient use efficiency.

2. High solubility: Nano-Fertilizers have high solubility in a wide range of solvents like water. This characteristic of Nano-Fertilizers helps in solubilization and dispersion of insoluble nutrients in soil and thus bioavailability of nutrients increased.

3. Small particles size: Particle size of Nano-Fertilizers is less than 100 nm which increases its penetration capacity in plants from applied surfaces such as soil or leaves, thus increasing nutrient uptake by plants (Liscano et al. 2000).

4. Easy penetration and controlled release of fertilizers: Due to the high rate of penetration, Nano-Fertilizers play an important role in increased availability of nutrient to the plant and thus healthy growth of seedling. Toxicity of fertilizer is minimized by controlled release of Nano-Fertilizers: Nano-ZnO is recorded to have higher peanut seeds germination percent and root growth compared to bulk Zinc sulphate (Prasad et al. 2012).

5. Nutrient uptake efficiency: Nano-Fertilizers increase fertilizer efficiency and uptake ratio of soil nutrients in crop production and thus salt away fertilizer assets. Nano-Fertilizers also decrease leaching loss of fertilizers (Cui et al. 2010).

6. Effective duration of nutrient release: Bulk fertilizers when applied is effective for short-term duration, but by using Nano-Fertilizers, the duration of nutrient release can be increased (Cui et al. 2010).

Comparison of Nano-Fertilizers and Conventional Fertilizers

Properties	Nano-Fertilizers	Conventional fertilizer
Solubility	High	Low
Dispersion of mineral micronutrients	Improved dispersion of insoluble nutrients	Lower solubility due to large particle size
Soil adsorption and fixation	Reduced	High
Effective duration of release	Extended effective Duration	Used by the plant at the site and time of application; the remainder is converted into insoluble form
Loss rate	Reduced loss of fertilizer Nutrients	High loss rate due to leaching, drifting, run-off

Examples of Potential Nano-Fertilizers Designs (Adapted from Manjunatha Et Al. 2016)

1. Slow release: the nano-capsule slowly releases nutrients over a specified period of time.
2. Quick release: the nanoparticle shell breaks upon contact with a surface (such as striking a leaf).
3. Specific release: the shell breaks open when it encounters a specific chemical or enzyme.
4. Moisture release: the nanoparticle degrades and releases nutrients in the presence of water.
5. Heat release: the nanoparticle releases nutrients when the temperature exceeds a set point.
6. pH release: the nanoparticle only degrades in specified acid or alkaline conditions.
7. Ultrasound release: the nanoparticle is ruptured by an external ultrasound frequency.
8. Magnetic release: a magnetic nanoparticle ruptures when exposed to a magnetic field.

Why We Want to Use Nano-Fertilizers?

1. Three times increase in nutrient use efficiency.
2. 80-100 times less requirement to chemical fertilizers.
3. 10times more stress tolerant by the crops.
4. Complete bio-source, so eco-friendly.
5. 30% more nutrient mobilization by the plants.
6. Near 20-55% improvement in the crop yield.

Advantages of Nano-Fertilizers

1. Nano coatings and technology can help in numerous ways to reduce costs and increase productivity around the farm.
2. Improvement in soil aggregation, moisture retention and carbon build up.
3. The yield per hectare is also much higher than conventional fertilizers, thus giving higher returns to the farmers.

Limitation of Nano-Fertilizers

1. The Catchy term 'Nanotechnology' also pose some risks and problem towards the health and also towards environment.
2. The initial studies performed for nano materials have caused serious health hazards and also showed toxic effects, also when entered into human body caused tissue damage reaching all the vital organs.

Conclusion

Application of different Nano-Fertilizers has a greater role in enhancing crop production. By application of Nano-Fertilizers, there will be reduction in cost of fertilizers and pollution hazards. Nano-Fertilizer has great application in agriculture and thus is a great concern to society. Nutrient use efficiency of fertilizers in crop production can be enhanced with effective use of Nano-Fertilizers. Nano-Fertilizers rather than conventional fertilizers are more accurate, smart, effective, and easily synthesized and cost less. Though it has lots of positive application, still when it comes to agriculture sector, it is far behind from all other existing techniques. People need to be educated, and also few sample products of Nano-Fertilizers should be provided to them for their trials which will aid in the use of Nano-Fertilizers. If there is equal support from both public and private sectors, then Nano-Fertilizers can become a novel technique and more researches can be carried out. The use of Nano-Fertilizers may be helpful in feeding a growing population. As a coin has two sides, though the use of Nano-Fertilizers has few disadvantages, in the near future it can be accepted as a novel technique. Research and development sector are giving importance toward nanotechnology and Nano-Fertilizers development so as to uplift agricultural sector and to benefit farmers.

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Cotton Its Integrated Pest and Disease Management

Article ID: 30621

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Introduction

Cotton (Gossypium spp.) belongs to family Malvaceae is one of the major fibre crops. It accounts for around 25% of the total global fibre production. Out of known 50 species only four species are being cultivated, two allotetraploids (G. hirsutum and G. barbadense) and two diploids (G. herbacium and G. arboretum). Gossypium hirsutum also known as the long staple cotton shares more than 90% of the cotton in world. In the world, about 80 countries cultivate cotton crop in which top five producers are India, China, Pakistan, USA and Brazil. Cotton is one of the most important commercial crops cultivated in India. In raw material consumption basket of the Indian textile industry, the proportion of cotton is around 59%. It plays a major role in sustaining the livelihood of an estimated 5.8 million cotton farmers and 40-50 million people engaged in related activities such as cotton processing and trade. India also has the distinction of having the largest area under cotton cultivation in world. Many factors like diseases, pests and weeds cause huge losses to cotton. In this we will discuss the Integrated management of various diseases and pests.

Important Diseases

1. Fusarium wilt
2. Verticillium wilt
3. Root rot
4. Grey or Areolate mildew
5. Boll rot
6. Alternaria leaf blight
7. Myrothecium leaf spot
8. Cercospora leaf spot
9. Bacterial leaf blight or Angular leaf spot disease
10. Anthracnose
11. Cotton leaf curl virus Disease.

Important Pests

1. American ball worm
2. Pink ball worm
3. Spotted ball worm
4. Cotton stem weevil
5. Stem roller
6. Leaf roller
7. Whitefly
8. Termite

Integrated Pest and Disease Management

1. Seed Treatment-: for the control of seed borne diseases we go for seed treatment with Carbendazim @4g/kg
2. Spray schedule-: after 6 weeks of sowing, in last week of June or first week of July go for spray of Streptocycline (6-8 g/acre) or Copper-oxy-chloride (600-800g/acre) in 150 to 200 liters of water. After mixing properly spray at an interval of 15 to 20 days for 4 times for control of bacterial diseases like Anthracnose, bacterial leaf spot.
3. For Ball rot control go for spray of Copper-oxy-chloride (2g/lit of water) or Bavistin (2 g / lit).
4. For adhesion of fungicides on the leaves add 10 g Salvate 99 or 50 ml Tryton in 100-liter solution of fungicide.
5. For Grey mildew go for spray of 10 g copper per acre or Bavistin (2 g / liter water).
6. Do not go for cultivation in the field where is problem of Root rot for at least 3 years
7. In fields where is problem of Root rot, we could go for intercropping with Moth bean.
8. Destroy the self- sown plants.

9. Remove all the weeds existing in the field.
10. All the remaining portions of cotton must be destroyed with deep tillage operations.
11. For destroying fungus residing in the soil go for deep tillage with plough.
12. Destroy the weeds on banks of canals and empty fields.
13. Don't go for cultivation of crops like Bhindi near the cotton crop.
14. Don't go for cultivation of American cotton near the orchard of lemon.
15. Apply Animal dung of FYM in the field.
16. After the last picking of cotton allow grazing of goats in the field so that they can eat up the remaining unopened or partially open balls.
17. Don't put the remnants of cotton crop in field keep them in your village.
18. Expose the field to sun after deep ploughing allowing the insects larvae to come up and those will be picked up by birds
19. Don't grow cotton near solanaceous crops like Tomato as they act as host for insects like whitefly.
20. For control of American ball worm Chlorpyriphos 20% EC 1250ml/ha or Acephate 75% SP 780 g/ha
21. For control of leafhopper NSKE 5% 25 kg/ha.
22. For whitefly Neem seed kernel extract 5% (50 kg) and neem oil at 5ml/l of water or Chlorpyriphos 20% EC 1250 ml/ha.

Conclusion

Cotton is an important cash crop provides livelihood to many people in India. Many diseases and pests attack cotton crop and cause huge yield losses. So, it become important for us to manage the diseases and pests in an Integrated way to keep our environment safe and it is economical too.

Defoliator Insect Pests of Soybean and their Management

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Introduction

Soybean is ranks first among oilseed crop in world and India both. The wide spread cultivation of the crop has dramatically changed the socioeconomic status of the farmers of Rajasthan. Soybean is a miracle crop having rich source of protein (40-50 %) and oil (20-25 %). But the production and yield of soybean are always not obtaining up to the expected level.

One of the major constraints in the production of soybean is the pest complex associated with this crop. Even though pest attack is from sowing to harvest and even in storage, among this defoliator are important. These are attracted to lush green foliage causing damage up to 70 %. Hence, it is important to know about these pests and their management strategies.

1. Tobacco leaf eating caterpillar *(Spodoptera litura*): The larvae attack the crop normally in the month of August and September. The larvae feed on the chlorophyll of the leaves. The eaten leaves give the appearance of whitish yellow web. The soft pods are chewed by the larvae and the thick pods are bored and then the grain is eaten up.

2. Gram caterpillar *(Helicoverpa armigera):* The attack of this insect normally occurs in the month of August. The young larva feeds on the chlorophyll of young leaves and skeletonizes it. They feed voraciously on the foliage in early stage, may defoliate the plant and later they feed on flowers and pods.

3. Green semilooper (*Crysodeixis acuta):* The caterpillars feed voraciously on leaves starting from the edges inwards and leaving behind only midribs and stalks.Damage is Maximum in August- September and with excessive loss of foliage. Although the semilooper is feeds on a variety of plants.

4. Bihar hairy caterpillar (*Spilosoma oblique):* The attack of this insect normally occurs in the month of August. The young larva feeds on the chlorophyll of young leaves and skeletonizes it. They feed voraciously on the foliage in early stage, may defoliate the plant and later they feed on flowers and pods.

Management

1. Cultural control:

a. Deep summer ploughing.
b. Early sowing during June showed significantly lower incidence of tobacco leaf eating caterpillar
c. Intercrop soybean either with (early maturing) Pigeon pea variety or maize or sorghum in the sequence of 4:2 should be practiced.
d. Proper crop rotation with dissimilar crops should be followed.
e. Sowing of tolerant varieties like MAUS 47 and JS 80 21.
f. Destroy crop residues
g. Optimum seed rate. (70-100 kg/ha) should be used.

2. Mechanical control:

a. Collect & destroy infested plant parts, egg masses and young larvae.
b. Light Trap: mostly insect is nocturnal the attract to light Install one light trap (200W mercury v lamp) five hectare to catch the adults of some nocturnal pests such as hairy caterpillar (positively phototropic).
c. Erection of bird perches @ 30-40/ha.
d. Install pheromone traps at a distance of 50 m @ 25-30 traps/ha for each insect pest.

3. Biological control:

a. Spray bio agents like B. thuringiensis and B. bassiana @ 1kg or 1 lit/ha at 35-40 and 50-55 days after sowing respectively.
b. The dispel, NSKE 4 %, and cow urine 20% and cow dung ash were found effective for controlling tobacco leaf eating caterpillar of soybean.
c. Insecticides of plant origin are extracts of neem, tobacco (decoction), karanj, pyrethrum, garlic, chillies, etc. They are effective antifeedants and safe to predators/parasites (ecofriendly). Neem-based pesticides, such as Azadirachtin 0.03% EC (Neembecidine) @ 3 ml/l L water, Azadirachtin 0.15 % EC (Neem Gold) @ 5ml/1 L water, Azadirachtin 0.03% EC (Godrej Achook) @ 5 ml/1 L water, or Neem seed water extract 5%, spray checks the leaf feeding caterpillars of soybean. Choudhary and Shrivastava (2007) neem-based products, application of neem seed kernel extract (NSKE) at 5 per cent + neem leaf extract (NLE) at 10 per cent reduced the maximum larval population (51.59 per cent).

4. Chemical control: Different chemical are used for management of defoliator insect pest like Quinalphos 25 EC @ 1.5 litter/ha, Spinetoram 11.7 SC @ 450 ml/ha, Profenophos 50 EC @ 1.25 litter/ha, and Rynaxypyr 18.5 SC @ 100 ml/ha are used. Kushram *et al*. (2017) evaluated the efficacy of plant products along with insecticide against the management of defoliators (*Spodoptera litura* and *Chrysodeixis acuta*) in soybean crop. They found that chemical insecticide treatment *i.e.* triazophos 40 EC @ 750 ml/ha was found most effective with minimum larval population of *S. litura* (0.37 larva/mrl) and *C. acuta* (0.28 larva/mrl).

Conclusion

Management is a need of present time, especially for defoliator insect pests in soybean for sustainable production. Various components viz., cultural practices, use of effective bio-agents/bio-pesticides, resistant varieties, need based use of effective economical pesticides and plant products etc. have been found very effective in management approach for soybean insect pests and their use need to be encouraged in order to reduce down the reliance on chemical pesticides for sustainable agriculture as well as increasing the quality and productivity.

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Use of Information and Communication Technology (ICT) for Enhancement of Agriculture

Article ID: 30623

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Introduction

Information and Communication have always played a vital role in the dissemination of information on agricultural practices for greater access among farmers. The word 'Information and Communication Technologies' could be used for a multitude of stand including telephone, television, video, voice information systems, and fax (Warren, 2002). In broad terms, ICT covers all high-tech technologies in manipulating and communicating information. Agriculture is the prime sector in India, and could benefit immensely with the applications of ICTs especially in transforming socio-economic conditions of poor in rural areas (Patel and Sayyed 2014). Farmers have always searched new methods to increase the crop production. ICTs are the boon to agriculture as they provide the farmers with data, information and knowledge with which they can empower themselves with timely and relevant information thus increase the production, reduce in expenses of production. ICT in agriculture is also referred as 'E- agriculture' is developing and applying innovative ways to use ICTs in rural areas, with the primary focus on agriculture. In agriculture, information required varies based on the agroclimatic regions, size of holding, crops cultivated, technology followed, weather condition, market orientation and family needs etc.

Tools of ICT

Television and radio broadcast were tools to communicate information to farmers in past; however, in the last two decades, Internet and mobile technology have emerged. Now ICTs now include computer-based applications and communication tools such as mobile phones, social media (Balaji et al. 2007).

Today computer, internet and mobile are turning out to be extremely important and Information and Communication Technologies (ICTs) are facilitating fast sharing of information and innovations and acting as catalyst for improving farmers lives and agricultural production by improving access to agricultural information (Parganiha et al. 2012).

ICT Initiatives in India

1. Mobile apps:

a. Kisan rath: The Ministry of Agriculture & Farmers' Welfare, Govt. of India recently launched a new mobile app "Kisan rath" developed by the National Informatics Centre (NIC) for the farmers amidst nationwide lockdown to facilitate transportation of food grains and perishables across the country. It allows transporter to online register their vehicles online and facilitates transportation of agricultural produce. With the use of this app, both traders and farmers can easily purchase and sell crops.

b. Kisan suvidha: Kisan Suvida Mobile app was developed by the Ministry of Agriculture and Farmers Welfare and inaugurated by Hon'ble Prime Minister during 'Krishi Unnati Mela' in New Delhi on 19th March 2016. The app has very simple interface with focus on providing information on six essential areas of farming such as Weather, Market Prices, Plant Protection, Agroadvisory, inputs Dealers and Kisan Call center. This mobile app is available in five languages Hindi, English, Punjabi, Tamil and Gujarati.

c. Pusa Krishi: Launched by union agriculture minister in 2016. This app provides information about the latest technologies developed by IARI Pusa, New Delhi. Such information will help in increasing returns to farmers. This Mobile App convert dream "LAB to LAND" of our Prime Minister into reality.

d. Agri market: This app is used by farmers to get prices of crops in markets within 50 km of their own device location. This app automatically captures the location of the person using mobile by GPS and fetches market price of crops within the range of 50 km.

e. Soil Health card: National Informatics Centre has designed and developed an android mobile phone application for Soil Health Card. This application captures Latitude and Longitude automatically when "Location" is on. The farmer details, land details, crop details and fertilizer details can be entered using this mobile app.

f. Pashu Poshan: Pashu Poshan mobile application is developed by National Dairy Development Board (NDDB) and launched by Union agriculture minister Radha Mohan Singh on 7 July 2015 to help dairy farmers to raise milk yield and reduce the feed cost thus boost dairy farmers' income. The app recommends a balanced ration by considering animal profile, i.e. cattle or buffalo, milk production, age etc. The locally available feed ingredients are adjusted with mineral mixture.

2. Agriculture portals:

a. AGRISNET: Under the National e-Governance Plan of Department of Agriculture & Co-operation, AGRISNET Project was launched which help farmers to access the information online information for agriculture, animal husbandry, horticulture and fisheries departments. It allows farmers to upload the scanned photographs and can get the desired information from various domain experts with the use of Information and Communication Technology (ICT).

b. AGMARKNET: Agricultural Marketing Information Network (AGMARKNET) portal was launched in March, 2000 by Ministry of Agriculture, Government of India to facilitate collection and dissemination of information related to better price and thus empowering decision-making ability of the farmers regarding selling of their produce.

c. e-Choupal: ITC (Indian Tobacco Corporation) limited launched "e-Choupal " in June 2000 to empower rural farmers by connecting through internet for procurement of agricultural produce. It is the largest private sector initiative among all Internet-based interventions in rural India.

d. e-Sagu: It means electronic cultivation. It is an ICT based personalized agriculture dissemination system developed since 2004 which aims to improve farm productivity by delivering farm-specific agro-expert advice in a timely and personalized manner at the farmers door-steps. The expert advice is generated by experts based on the information about the crop situation received in the form of both text and digital photographs by the farmers.

e. e-Arik: Arik means agriculture in the tribal language of Arunachal Pradesh the e-Arik project was initiated in 2007 in North Eastern India which disseminates climate smart agricultural information and technology to achieve food security. Information such as crop cultivation, management, marketing is disseminated to the farmers.

f. Warana Wired Village project: This project started in 1998 in the rural areas of Maharashtra, India by a non-governmental cooperative organization with the aim of overall development of farming community rather than agriculture specific with the help of ICT.

3. Village Knowledge Centres (VKCs): Village knowledge centres were initiated in 1998 by MS Swaminathan research foundation (MSSRF), a Non-Governmental Organization (NGO) to disseminate appropriate information regarding farming, loans, education, health, governmental news etc by providing adequate telecommunications infrastructure. The main objectives were to reduce the digital gap and gender divide in rural India using ICT.

4. Soil Health Card: Soil Health Card Scheme was launched by the Government of India on19th February 2015. The scheme, plans to resolve the problems of soil to farmers which will carry crop-wise recommendations of nutrients and fertilizers necessary for the individual farms to assist farmers to improve productivity through careful use of inputs.

5. Kisan Call Centres (KCC): Kisan Call Centres (KCCs) was launched in 2004 by Ministry of Agriculture to harness the potential of ICT in Agriculture. KCC centres work in 14 different locations and covers all states and UTs with the aim at answering farmers queries on a telephone call in farmers own dialect. These call Centres are working in 14 different locations covering all the States and UTs through toll free telephone lines. A country wide common eleven-digit number has been allotted for Kisan Call Centre.

Problems of Adoption of ICT

The common problems encountered in adoption of ICT in rural areas are ICT illiteracy, availability of relevant and local contents in their own languages, easy and affordable accessibility and other issues as awareness of the latest technology and willingness for adoption of new technologies (Kumar and Sankarakumar 2012). Also, the involvement of the human interface at the last mile indicating that there is human dependency in transmission of Information Knowledge to farmers. Dossani et al. (2005) and Saravanan (2010) reported that in agriculture, despite the rapid spread and potential of ICTs to facilitate farmers' access to information, many of the initiatives face common challenges such as issues of sustainability, affordability, ease of use, accessibility, scalability, and availability of relevant and localized content in an appropriate language.

Conclusion

The use of modern tools of ICT have lots of potential to help each and every aspect of work including in the area of agriculture which needs to be capitalized so that growth of nation occurs along with doubling of farmers income. Also, the technology usage happens in right and meaningful direction instead of using for wrong purpose as every coin has two sides.

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Crime Against Women in India: Problem Towards Sustainability

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Summary
On 25 September 2015, the United Nations General Assembly adopted the agenda for Sustainable Development (SD) as the agreed framework for international development. The agenda has a stand-alone goal on gender equality and the women empowerment. India is a country where women contribute almost equal share of total population but in recent years there has been frightening increase in atrocities and violence against womankind in the country which creates hindrance in the path of sustainability.

There have been enacted various laws and legislation to curb the crimes, but the problem still persists. Keeping this matter under consideration the study has been undertaken to examine the status of crime across different states of the country. The study has been based on the secondary data collected from the official website of the Niti Aayog on three national-level indicators which have been acknowledged from the fifth goal of sustainable development viz. Goal of Gender Equality. The study concluded that Assam is facing highest rates of crime against women, Manipur state recorded the highest cases of domestic violence and Mizoram dominated in sexual crime against girl child.

Himachal Pradesh, Goa and Uttarakhand are the top-performers states when the three indicators were taken on the basis of mutually inclusive. None of the state and UT (Union Territory) have achieved the target of 100 score i.e. zero crime rate. It is suggested that just laws to protect women are not enough; awareness programmes advocating women safety will bring changes in the attitudes towards women. Even by using social media, cultural events, and festivals as a platform to promote women safety can play an important role now a days.

Keywords: Women, Sustainable Development, India.

Introduction
Over the last decades, SD has gained the particular attention of a wide range of decisional factors. These decisional factors reinforce that the prosperity of people and society is possible with the aid of continual, inclusive, and sustainable economic development of all countries and regions (Fleacaet al, 2018). United Nations adopted the global Sustainable Development Goals (SDGs) for 15 years (2016-2030), which will further become a core concept and main principle to guide global and national economic and social development (Zhu, 2017). India along with other countries has signed the declaration, comprising seventeen SDGs. Among the vital goals of SDGs, gender equality has always remained a core theme for women promotion in sustainability.

Population of the women contributes 48.59 per cent of the total population that is 129.02 crore in year 2016. Whereas the projected sex ratio is likely to reach from 945 in 2016 to 948 in 2021 (Anonymous, 2019), which clearly depicts that population of women is almost contribute equal part of the total population and continuously increasing. But in recent years there has been an alarming increase in atrocities and violence against women in the country. It is estimated that the growth rate of crime against women would be higher than the population growth rate (Kalaiyarasi, 2015). According to a latest report prepared by India's National Crime Records Bureau (NCRB), a crime has been recorded against women in every three minutes in India. Every 60 minutes, two women are raped and a sizeable proportion (18%) of ever-partnered women and girls aged 15 to 49 have suffered physical and /or sexual partner violence (Anonymous, 2018-19). The number of crimes against women stood at 3.5 lakh in 2017, with the crime rate at 57.9 as against 56.6 in 2014.

India's commitment towards undertaking reforms to ensure gender rights and equality is reflected in several legislations viz., the Dowry Prohibition Act 1961, Protection of Women from Domestic Violence Act 2005, Section 376 Indian Penal Code relating to Rape, Sexual Harassment of Women at Workplace Act, 2013, Prohibition of Child Marriage Act, 2006.Even at present government implements various schemes for combating all forms of discrimination by creating awareness about their rights and facilitating institutional and legislative support.

Table 1: Index Score of States/ UTs on Crime Against Women

Indicator	Crimes Against Women	Domestic violence	Sexual crime against girl child
Front Runner (65-99)	Bihar, Goa, Gujarat, Himachal Pradesh, Jharkhand, Karnataka, Manipur, Meghalaya, Nagaland, Punjab, Tamil Nadu, Uttarakhand, Andaman and Nicobar Islands, Dadra and Nagar Haveli, Daman and Diu, Lakshadweep, Puducherry	Goa, Himachal Pradesh, Kerala, Mizoram, Nagaland, Sikkim, Uttarakhand, Jammu and Kashmir, Lakshadweep	Andhra Pradesh, Arunachal Pradesh, Assam, Bihar, Goa, Haryana, Himachal Pradesh, Karnataka, Madhya Pradesh, Maharashtra, Manipur, Odisha, Punjab, Rajasthan, Uttarakhand, West Bengal, Chandigarh, Daman and Diu, Delhi, Jammu and Kashmir
Performer (50-64)	Andhra Pradesh, Arunachal Pradesh, Chhattisgarh, Kerala, Maharashtra, Mizoram, Sikkim, Tripura, Uttar Pradesh, West Bengal, Chandigarh, Jammu and Kashmir	Assam, Gujarat, Karnataka, Maharashtra, Punjab, Rajasthan, Andaman and Nicobar Islands, Chandigarh	Chhattisgarh, Gujarat, Jharkhand, Kerala, Nagaland, Sikkim, Tamil Nadu, Telangana, Uttar Pradesh, Andaman and Nicobar Islands, Dadra and Nagar Haveli
Aspirants (0-49)	Assam, Haryana, Madhya Pradesh, Odisha, Rajasthan, Telangana, Delhi	Andhra Pradesh, Arunachal Pradesh, Bihar, Chhattisgarh, Haryana, Jharkhand, Madhya Pradesh, Manipur, Meghalaya, Odisha, Tamil Nadu, Telangana, Tripura, Uttar Pradesh, West Bengal, Dadra and Nagar Haveli, Daman and Diu, Delhi,Puducherry	Meghalaya, Mizoram, Tripura, Lakshadweep, Puducherry

Source: https://niti.gov.in/, accessed on June 20, 2020.

To measure India's scenario towards crime against women's, three national-level indicators have been acknowledged from the fifth goal of SD viz. Goal of Gender Equality (Table 1). Index score is classified on the basic of category of Performance i.e. Achiever (100), Front Runner (65-99), Performer (50-64) and Aspirants (0-49). Score 100 demonstrates zero crime in the state, which was the national target to be achieved by 2030.

Contents of the table showed the index score of States/ UTs on three indicators of sustainable development which are explained below:

1. Crime against Women (Rate of crimes against women per 100,000 female population): About 58 women are victims of crime for every one lakh female population, in India. The highest rate of crimes against women is witnessed in Assam among states at about 144 women per one lakh female population and 133 in Delhi among UTs. The lowest rate of crimes against women is in Nagaland about 7 and 10 in Dadra & Nagar Haveli amid UTs.During 2018, out of total crime committed against women, crime rate was the highest for cruelty by husband and relatives (27%), followed by assault with intend to outrage modesty(24%) and Kidnapping & Abduction (19%), (Anonymous, 2018).

2. Domestic violence (Percentage of ever married women aged 15-49 years who have ever experienced spousal violence): One out of three married women aged between 15 to 49 years' experience a physical, sexual, or emotional form of spousal violence (Anonymous, 2015-16). The survey highlights that spousal violence reduces with a rise in education and wealth control amongst women. While Sikkim and Lakshadweep have the lowest rates of spousal violence at 3.5 per cent and 8.9 per cent, respectively. Amid states Manipur has shown high rates of 54.7 per cent and Puducherry with 40 per cent among UTs.

3. Sexual crime against girl child (Proportion of sexual crime against girl children to total crime against children during the calendar year): The proportion of sexual crime against girl children to a total crime against children is about

59.97 per cent (Anonymous 2017). The UT of Jammu & Kashmir has the lowest rate of sexual crimes against girl child to the total crimes against children at 14.79 per cent, while Himachal Pradesh among states with 35.84 per cent. Whereas highest rate was observed in Mizoram (among states) and Lakshadweep (among UTs) with 170.26 and 200 per cent respectively.

Himachal Pradesh, Goa and Uttarakhand are the top-performers among States if we take three indicators together but still none of the State and UTs have achieved the target of 100 score means zero crime against women which is the major concern of concerned agencies.

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Indigenous Traditional Knowledge in Indian Agriculture

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Introduction

The term indigenous technical knowledge (ITK) or "Traditional knowledge" has been used in the literature inter–changeably. Traditional knowledge is gathered over a period of time and transferred from generation to generation. It is synonymous to local knowledge and is defined as "A sum total of knowledge based on acquired knowledge and experience of people in dealing with problems and typical situation in different walks of life" (Mishra et al., 2002). Knowledge is not confined to tribal groups or the original inhabitants of an area of any country. It is not only confined to rural people rather, any community possesses indigenous knowledge, Rural or Urban. These are varying from place to place and knowledge spreads through folk songs, stories & scriptures etc. A considerable body of work and associated literature relating to indigenous technical knowledge already exists. The literature covers a broad range of resources, including forest management (Messerschmidt, 1986; 1987; Appleton and Hill, 1994).

Characteristics of ITK

1. ITK is not static but dynamic.
2. Exogenous knowledge and endogenous creativity bring change to ITK.
3. ITK is mainly qualitative in nature.
4. ITK study needs a holistic approach.
5. ITK, if properly tapped, can provide valuable insights into resources, processes, possibilities and problems in particular area.
6. ITK is recorded and transferred through oral tradition.
7. ITK is learned through observation and hands-on experience.
8. ITK forms an information base for variety.
9. ITK reflects local tradition.

Classes of ITK in Agriculture

1. Climatology
2. Local soil and taxonomy
3. Soil fertility
4. Primitive cultivar
5. Inter cropping
6. Agronomic practices
7. Irrigation and water management
8. Plant protection
9. Post-harvest technology and methods.

Identification and Collection of ITK

1. Documentation of oral histories.
2. Agro-ecosystem analysis by mapping and transect walk.
3. Manual discriminative analysis.
4. Decision tree analysis.
5. Use of local resource persons.
6. Analysis of journals and newspapers.
7. Continuous interactions during on-farm experiments.
8. In-depth interview of farmers.
9. SWOT analysis of the indigenous community.

Indigenous Technologies Practiced by Farmers

1. ITK in good germination:

a. Radish seeds are soaked overnight in butter milk before sowing.

b. Cucurbits seeds are kept embedded in fresh cow dung ball which are then buried deep in soil for better germination.

c. In desert areas chickpea is sown behind camel drawn ploughs in sand dunes areas.

d. Cut end of sugarcane sett are plastered with a mixture of honey, ghee, the fat of hogs and cow dung.

2. Scarecrow for scaring birds: A scarecrow is a decoy or mannequin, often in the shape of a human. Humanoid scarecrows are usually dressed in old clothes and placed in open fields to discourage birds from disturbing and feeding on recently cast seed and growing crops.

3. Mulching:

a. Tree leaves (karanj-pongamia pinnata) and paddy straw are used as mulch materials.

b. This conserves the soil moisture and simultaneously keeps the soil cool which provides favorable conditions.

c. These mulches act as organic matter to enhance the crop.

d. Effective for weed control.

4. Bamboo sticks puts on rice field:

a. These will acts as resting places for birds and to look for prays.

b. Especially, Rice Bug, Green leaf hopper, Brown Plant hopper control.

c. Biological control of insects.

5. Panchagavya:

a. Provides nutrient to plant.

b. Provide resistance against insect pest and disease.

c. 3% i.e. 3 kg in 100 lit of water is the best dose for application.

d. 6 lit of panchagavya should be applied in one acre of land.

6. Beushening in rice:

a. Practiced in direct -seeded low land rice in Odisha, MP, Bihar, WB, and UP to control weeds, optimize crop stand and provide soil aeration

b. Cross ploughing young crops 4 to 6 weeks after sowing with a light country plough in 5-10 cm standing water once or twice depending upon the density of weeds and crop stand. if there are too many weeds it is followed by flanking.

7. Terrace or contour cultivation:

a. Practiced in valleys and foot hills.

b. Bench terraces are made across the slope.

c. The vertical interval is not more than 1m.

d. This helps to control soil erosion and retaining rain water in the slopes

e. Widely grown crops are rice and turmeric.

8. Irrigation practices- Bamboo drip irrigation:

a. Bamboos divert water from perennial springs on hilltops to the lower by gravity.

b. Used to irrigate the betel leaf or black pepper crops.

c. 8-20 liters of water per minute enters the bamboo pipe gets transported over several hundred meters and finally gets reduced to 20-80 drops per minute.

d. Used mostly in winter, as the soil in Meghalaya has low water holding capacity.

Pest & Disease Management in ITK

1. Tulsi is used to control the blast of rice control of insect in sapota, guava.
2. Methi is used to control of insect of okra e.g. Fruit borer.
3. Kerosene oil is used to control of ant in climber to control of termite.
4. Castor oil is used to controls white fly in cotton, stored- grain pest in pigeon pea.

5. Dry chilli smoke for rat control in wheat.
6. Madar *(Calotropis gigantia)* is used to prevent attack of thrips in paddy nursery.
7. Lemon is used to control of hairy caterpillar and aphid in cotton.
8. Mixture of 10 lit. Cow urine + 3 lit. sour buttermilk in 100 lit water is used for fungus control which is also known as Gauban
9. Mixture of 1 kg cow dung, 5 lit cow urine, 5 kg neem leaf in 100 lit water. Then make up the volume approx. 100 lit and mix it and after 24 hours filter the content and put in 1.0 lit. bottle. Take15 ml/10 lit pump for control of all sucking pests in pulses, veg. and fennel crops. It is also known as Neemastra.

Storage

1. Gunny bag is used to storage of grain with common salt, camphor and neem leaf.
2. Mud bin storage is used to storage of grain.
3. Wooden box storage is used to storage of vegetable seeds with cow dung.

Conclusion

Indigenous technical knowledge provides valuable inputs to make efficient use of natural resources and extends relevant support for sustainable development. Indigenous techniques used in different component of farming system are mostly organic, eco-friendly, sustainable, viable and cost effective. ITK based practices will help to furthering the concept of biodynamic and natural farming where the soil-health building process is left to the nature, as the inputs for ITK are drawn from the products of soil and are returned to the soil in the form of compost or manure or soil and plant health-protecting agents. But there is a need to explore, verify, modify and scientifically validate these practices for their wider use and application.

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Biofortification in Wheat to Increasing Zinc and Iron

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Introduction

Wheat (Triticum aestivum L.) is a major cereal which contributes about 28% of the world's food demand. The wheat grain has a high nutritional value in protein, fats, starch, and minerals. The major essential micronutrients for human health are Fe, Zn, I, Se, Cu, Ca, and F as well as vitamins. The World Health Organization (WHO) has estimated that around 2 billion people across the globe are suffering from "hidden hunger", where some 815 million are facing micronutrient deficiencies. Among them, Zn is considered as the fifth most serious leading to several deficiency diseases. The World Health Organization estimates that approximately 25% of the world's population suffers from anaemia, and that Fe deficiency anaemia led to the loss of over 46,000 disability adjusted life years (DALYs) in 2010 alone. An estimated 17.3% of people worldwide are at risk of inadequate Zn intake and Zn-deficiency leads to estimated annual deaths of 433,000 children under the age of five.

Biofortified staple foods cannot deliver equally high levels of minerals and vitamins per day, compared to supplements or fortified food products, but they can increase micronutrient intake for the resource-poor people who consume them daily, and therefore complement existing approaches. One common agricultural strategy is the agronomic approach using micronutrient fertilizers, but this involves some technology and costs. On the other hand, crop biofortification via breeding or genetic modification offers a sustainable and low-cost way to provide essential micronutrients to people in both developing and developed countries. Genetic biofortification involves classical breeding approaches designed to characterize and exploit genetic variation for mineral content, as well as new approaches involving gene discovery and directed genetic modification. It is expected that adoption of micronutrient-dense wheat varieties will be driven by their improved agronomic properties, higher yield potential, resistance to new strains of rusts, and tolerance to climate change induced heat and drought stresses. The provision of wheat grains with higher micronutrient levels is a challenging task for wheat breeders, but one that would complement the use of supplemental fertilizers, particularly on soils inherently low in these nutrients. This review synthesizes the progress made in wheat biofortification approaches, including genetic and agronomic biofortification strategies by traditional cross breeding and fertilizer management strategies, respectively.

During the past decades, the Consultative Group on International Agricultural Research (CGIAR) has taken a major initiative in the program "Harvest-Plus". International Maize and Wheat Improvement Centre (CIMMYT) have initiated research to determine the available genetic variability for grain mineral elements from a wide range of germplasm in the genus Triticum, and to study the feasibility of using them in future wheat-breeding programs. Under Harvest Plus program, more than 3000 wheat accessions were screened for zinc and iron concentration by the International Maize and Wheat Improvement Centre (CIMMYT). Zinc concentration ranged from 20-115 ppm and iron concentration was recorded in the ranges of 23-88 ppm with the highest levels found in landraces. The most promising germplasms were evaluated across the sites and generations and it was verified with respect to stability. While variances were associated with environmental effects, high heritability were observed for zinc and iron concentrations across environments. Breeding efforts are being done on transferring the zinc trait from diverse sources into locally adapted, agronomically competitive germplasm, considering consumer preferred end-use quality attributes.

Most of the cereal-based foods usually contain a low intrinsic amount of Zn and Fe, particularly when grown in Zn and Fe-deficient soils. Considering this burning issue, Harvest Plus, a CGIAR research program in agriculture, is working together with different national and international organizations to improve nutrition and public health by developing and promoting biofortified food crops rich in vitamins and minerals. It provides global leadership in the development of technology for micronutrient biofortification. Harvest Plus has already released more than 150 biofortified cultivars of 10 crops in 30 countries.

Genetic Biofortification of Zinc and Fe

Genetic biofortification may involve both traditional breeding as well as biotechnological tools. Efforts to do this have led to the development of programs such as Harvest Plus, Golden Rice, and the African Biofortified Sorghum Project, all focusing on the development of crop cultivars capable of producing grains richer in Zn, Fe and other micronutrients.

Genetic biofortification uses plant breeding techniques to produce staple food crops with higher micronutrient levels by reducing levels of anti-nutrients and increasing the levels of substances that promote nutrient absorption. It offers a sustainable solution to malnutrition problems by exploring natural genetic variation to develop mineral-dense crop varieties. The Harvest Plus initiative of the CGIAR is working worldwide with international and national partners to improve the health of the resource poor. Plant breeders screen existing accessions in global germplasm banks to determine whether sufficient genetic variation exists to breed for a particular trait. They then selectively breed nutritious cultivars of major staples, rich in Zn and Fe concentrations and with substances that promote the bioavailability of Zn and Fe.

Germplasm Screening of Wheat

Germplasm screening of wheat and its wild relatives has revealed substantial genetic variation for grain Fe and Zn concentrations. Materials with the highest Zn and Fe concentrations are progenitors of wheat such as einkorn wheat, wild emmer wheat, and landraces. Unfortunately little variation exists in improved adapted wheat varieties. Researchers therefore focused on a more in-depth evaluation of wheat landraces and the secondary gene pool, i.e. tetraploid and diploid progenitors of hexaploid wheat, was evaluated for micronutrient concentration. *Triticum dicoccoides*, *Aegilops tauschii*, *T. monococcum*, and *T. boeticum* were among the most promising sources of high Fe and Zn grain concentration. Zinc and Fe have been recognized as the most essential nutrients; but both these nutrients are lower in many crops globally. Large germplasm screening of cereals and their wild relatives revealed substantial genetic variation for grain Fe and Zn concentrations. For example, recently more than 3000 accessions, including wild relatives hexaploid, tetraploid, and diploid has been screened for Zn and Fe at the International Maize and Wheat Improvement Centre (CIMMYT).

A number of accessions were identified as having high concentrations of Fe and Zn belonging to einkorn wheat and wild emmer wheat, and landraces. Unfortunately, there is little genetic variation in improved wheat cultivars. Therefore, currently, research focus needs to shift to the in-depth evaluation of landraces of all cereals. For wheat, it has been reported that Zn concentrations ranged between 30 and 98 mg kg− 1. In another study, Fe concentration of 20–60 mg kg− 1 was observed in wheat. In rice, substantial genetic variation of Zn concentration was observed in brown rice (13.5–58.4 mg kg− 1). On the other hand, grain micronutrients showed wide genetic variation in response to e[CO_2]; For example, rice. Therefore, future research should be focused in the direction of screening promising genotypes compatible with shifting global climate.

Agronomic Biofortification

In addition to improvements in yield, disease resistance and processing quality, there has been growing research interest over the past 20 years in improving the health benefits of cereal crops, including increasing their mineral and vitamin contents, an approach known as biofortification. However, this has focused on increasing the mineral content in the wholegrain, rather than on the starchy endosperm tissue (which may limit the bioavailability). There are two main biofortification approaches: agronomy and genetics (including conventional breeding and genetic modification; GM). Using agronomic methods, the zinc content of grain can be increased by simply fertilising the plants with zinc salts; for example, foliar application of $ZnSO_4$ increased total grain zinc by about 60%. However, such agronomic practices are less effective for iron, except if combined with increased nitrogen fertilisation which may not be economically or environmentally acceptable. Conventional breeding has been used by workers at the International Crops Research Institute for the Semi-Arid Tropics (ICRISAT, India) to develop varieties of sorghum and pearl millet with increased contents of iron and zinc, and at the International Maize and Wheat Improvement Center (CIMMYT, Mexico) to increase the zinc content of wheat grain. The zinc biofortified lines from CIMMYT are currently being grown in Pakistan and India and have 20–40% higher zinc concentration and at least comparable grain yield to the best local cultivars. Furthermore, human intervention trials to determine the bioavailability of the zinc in the biofortified lines are currently being carried out in Pakistan. However, despite a number of research programmes globally, including at CIMMYT, no high iron wheat lines have yet been developed by conventional breeding.

Challenges Ahead

The genotype and environment interaction with respect to grain yield and nutrient density has not been clearly understood. Most of the studies for improvements in nutrient use efficiency have been limited by expensive and laborious phenotyping. Furthermore, bioavailability of nutrients is another important factor in assessing the grain quality. Changing climate conditions may further exaggerate the problem. It was reported that C_3 grains and legumes have lower concentration of Zn and Fe, when grown under field conditions at the elevated atmospheric CO_2 concentration. Myers et al., 2014 reported that wheat grown at elevated CO_2 had 9.3% lower Zn and 5.1% lower Fe as compared to those grown at ambient CO_2. Drive for higher yield is generally accompanied with the dilution effect of minerals due to more starch accumulation in grains.

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Crop Modeling in Agriculture

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Agricultural models are mathematical equations that represent the reactions that occur within the plant and the interactions between the plant and its environment. Owing to the complexity of the system and the incomplete status of present knowledge, it becomes impossible to completely represent the system in mathematical terms and hence, agricultural models' images of the reality. Unlike in the fields of physics and engineering, universal models do not exist within the agricultural sector. Models are built for specific purposes and the level of complexity is accordingly adopted. Inevitably, different models are built for different subsystems and several models may be built to simulate a particular crop or a particular aspect of the production system.

Input Data Requirement

1. Weather data: Min. Max. temp., pressure, humidity, solar radiation, wind speed etc.
2. Crop data: crop name, variety, crop phenology, LAI, test wt. grain yield.
3. Soil Data: thickness, pH, EC, N, P, K, OC etc.
4. Crop management: date of sowing and transplanting, seed rate, depth of sowing, all other inputs.

What is Simulation?

Simulation is process of building model and analysing the system.

Why We Need Simulation Model?

1. To assimilate knowledge gained from field experimentation.
2. To provide a structure that promote interdisciplinary collaboration.
3. To promote the use of system analysis for solving the problems.
4. To offer dynamic, quantitative tool for analysing complexity of cropping system.

Steps in Simulation Modeling

1. Development
2. Calibration
3. Validation
4. Application
5. Extrapolation.

Types of Crop Modeling

1. Emperical Model: Direct description of observed data is possible. Emperical model is expressed as regression equation and its used to estimate final yield.

2. Mechanistic model:

a. Mechanistic model describes the behaviour of the system in terms of lower level attributes.
b. Models have ability to mimic relevant physical, chemical or biological processes and describe how and why a particular response result.

3. Static and dynamic models: A static model is one that does not contain time as variables even if the end products of cropping systems are accumulated over time. Dynamic model explicitly incorporate time as a variable.

4. Deterministic and stochastic models:

a. Deterministic model predict for quantities (crop yield or rainfall) without any associated probability distribution, variance or random element.
b. Stochastic model technically difficult to handle and quickly become complex.

5. Simulation and optimising models:

a. Simulation models form a group of models that is designed for the purpose of imitating the behaviour of a system. This model is mechanistic and deterministic.

b. They are designed to mimic the system at short time intervals, the aspect of variability related to daily change in weather and soil conditions is integrated.

c. Most crop models that are used to estimate crop yield fall within this category.

Model Uses

1. As a research tool:

a. Research understanding
b. Integration of knowledge across disciplines
c. Improvement in experiment documentation and data organisation
d. Genetic improvement
e. Yield analysis.

2. As crop system management tools:

a. Cultural and input management
b. Risk assessment and investment support
c. Site specific farming.

3. As policy analysis tools:

a. Best management practices
b. Yield forecasting
c. Introduction of a new crop
d. Global climate change and crop production.

4.Limitations of models:

a. Models are developed by agricultural scientist but user group are different.
b. As different users possess varying degrees of expertise in the modelling field, misuse of models may occur.
c. Model performance is limited to the quality of input data.
d. Most simulation models require that meteorological data be reliable and complete.
e. Model users need to understand the structure of the chosen model, its assumptions, limitations.

Models for Simulating Soil-Plant Processes

Model	Details	Model	Details
AUSCANE	Sugarcane	WOFOST	Wheat & maize, Water and nutrient
COTTAM GOSSYM-COMAX	Cotton	EPIC	Erosion Productivity Impact Calculator
SIMPOTATO	Potato	CERES	Wheat, Rice
CropSyst	Wheat & other crops	ORYZA1	Rice, water

Conclusions

Models are holistic, knowledge-based tools for global and local applications. It can be used to improve agronomic efficiency, environmental quality and sustainability. Model need quality data for calibration and validation. Difficult to capture all the complexities of biological systems by using model. Use them with caution.

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Utilization from Wastes: Homemade Tootii-Frutti Made from Watermelon Rind

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The waste utilization of fruit processing industry has become one of the main challengeable aspects in the world due to the generation of large quantities of by products including peels, seeds, unused flesh in different steps of processing chain. However, these plant by products are rich in valuable compounds which can be utilized in various industries ass novel, low-cost, economical and natural sources of dietary fiber, antioxidant, pectin, enzyme, organic acids, food additives, essential oil.etc purification and fermentations.

The aim of this review is to highlight the possibilities of utilization of by products from pineapple, banana, apples, grapes, citrus fruits, aonla processing in industries and to promote the integral exploitation of the by- products rich in bio-active compounds.

Watermelon *(Citrullus lanatus)* is a tropical fruit belonging to family Cucurbitacae, is a vine like flowering plant, which is large and contains heavy leaves and white to yellow flowers. It refers to both fruits and plant of a vine-like (climbers and trailer) herb originally from South Africa and one of the most common types of melons, commonly in fruit platters or as a refreshing desert at a picnic, watermelons are available in a wide range of sizes and shapes.

Mostly people eat only the juicy flesh of a watermelon; however, the rind is completely edible as well, it is beneficial to your body in a number of ways. In fact, it is much like watermelon flesh, is mostly made of water. Around 95% of a watermelon's nutritional value comes from the rind. Watermelon is the third most popular fruit in the world containing good quantity of nutrients. It contains vitamin C as well as vitamin A. Expectedly high in citruliine, amino acid and arginine (used in the urea cycle to remove ammoniacial from the body).

Watermelon rind is one of the major solid wastes generated by several restaurants, cottage fruit juice producers and food industries in the world. The rind, which is the green skin that keeps are that water- logged delicious fruit safe, is completely edible. It contains approximately 30% of total weight, 14.9- 35.7% protein (full fat free basis) and 35-59% on fat free basis. This waste rind is not presently being utilized for any value-added processes due to limited research activities focusing on the possible converse on of the waste to other valuable products. Therefore, the main focus of this experiment is to successfully document he physico- chemical properties and sensory characteristics of Watermelon rind. (Md.Islam, 2019).

Mineral Composition of Watermelon Rind

Iron	1.29 mg/100 g
Manganese	1.42 mg/100 g
Phosphorus	135.24 mg/100 g
Calcium	29.15 mg/100 g
Sodium	12.65 mg/100 g
Copper	0.45 mg/100 g
Zinc	1.29 mg/100 g

Vitamins Composition of Watermelon Rind

Vitamins	Rind
Retinol (Vit.A)	50.15 ± 1.41
Thiamine (Vit. B1)	0.03 ± 0.01
Riboflavin (Vit. B2)	0.02 ± 0.1
Niacin (Vit. B3)	0.04 ± 0.1
Ascorbic acid (Vit. C)	7.23 ± 0.02

Pyridoxine (Vit B8)	0.04 ± 0.00

Benefits of Consuming Watermelon Rind

1. Workout as a boost.
2. Reduce blood pressure.
3. Rich in fibre.
4. Breakdown kidney stones.
5. Weight loss.
6. Anti-inflammatory.
7. Treat urinary tract infections.

Value addition is a process in which of the same volume of a primary product, a high price is realized by means of processing, packing, upgrading the quality or other such methods. It is one of the important components of nutritional security. Small scale processing unit, organic food processing, non-traditional crop production, agri-tourism and bio-fuels development are the examples of various value-added projects that have created new jobs in some rural areas.

Value Addition in Horticultural Crops

1. Horticulture deals a large group of crops. Therefore, cultivation of crops which belong to us and possess great medicinal, nutritional, health promoting values.

2. India as second largest producer of fruits and vegetables, only 10 per cent of that horticultural produce is processed, but other developed and developing countries where 40-80% produce is value added.

3. Horticultural crops provide varied type of components, which can be effectively and gainfully utilized for valued addition like pigment, amino acids, oleoresins, antioxidants, favours, aroma. Etc.

4. Post-harvest losses in horticultural produce are 5 to 30 per cent which amounts to more than 8000 crore rupees per annum. If we subject our produce to value addition the losses can be checked.

5. Horticultural crops are right material for value addition because they are more profitable, has high degree of process ability and richness in health promoting compounds and higher potential for export.

Therefore, horticultural crops are right material for value addition in the present context of agricultural scenario and we should go for new product development to be unique and novel.

On a commercial scale the rind can be exploited to produce watermelon jam and a flour that can be an additive in baking. The watermelon seed flour can be incorporated in the formulation of weaning food. The Value-added products like pickles, tutti-frutti, jam, and cheese were prepared using the portion of watermelon rind.

In Indian English, tutti-frutti usually referred to candid raw papaya. These are small cubical pieces, often brightly coloured. It is a sweet and colourful confectionary candied fruit mainly prepared from the raw papaya but here we used watermelon rinds. Tutti-frutti is generally used for toppings for ice creams, desserts, and cakes. Mainly the colour of tutti-frutti comes in bright red colour, yellow and green.

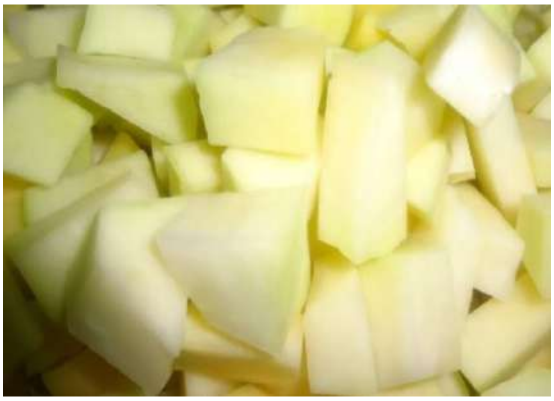
Homemade Tutti-Frutti from Watermelon Rinds Recipe

1. Ingredients:

Watermelon rind / White Part	5 cups chopped
Lemon juice	1 tsp
Colours	Any colours
Vanilla essence	2 tsp

2. For sugar syrup:

Sugar	2 ½ cup
Water	2 ½ cup

Cutting of Matured Watermelon

Cooking with the addition of sugar and water

Keeping it for 10hrs

Preparation of Tutti-frutti

Method for the Preparation of Watermelon Rind Tutti-Frutti

1. Cut watermelon into pieces and remove the red edible part and outside skin.
2. Take only the white part and cut into small cubes.
3. Add water and cook these cubes until they cooked well.
4. Filter all the water and keep the cubes aside.
5. Take a pan, add sugar and water.
6. Once the sugar melts and comes to boil, add cooked watermelon cubes and cook well.
7. Once it cooked well, transfer it to a bowl and desired colours and vanilla essence.
8. Keep this for 10 hours or the whole night.
9. Once all the sugar syrup and colour absorbed well, filter the sugar syrup and spread the cubes on a plate.
10. Once remaining sugar syrup in the cubes is slightly dry, collect all tutti-frutti in a container and kept it in a fridge.

Certification of Organic Farming

Article ID: 30629

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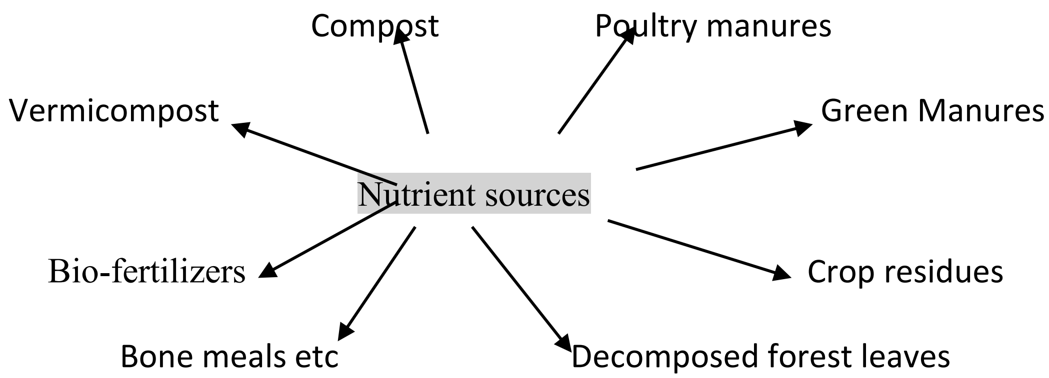
Introduction

Organic farming is a form of food production system wherein traditional wisdom and ancient knowledge of Indian farming community such as crop rotation, residue recycling etc. are amalgamated with modern practices of crop cultivation and livestock management to enhance profitability without much dependence on off-farm resources. Organic farming is a holistic production management system which is promotes and enhances agro-ecosystem health, including biodiversity, biological cycles and soil biological activity to help use "On farm inputs" for production of safe foods without pollution from synthetic chemicals and reduction of cost.

Importance of Organic Farming

Protect our natural resources of land, water, plant and animal diversity. Restore soil health and build fertility for sustainable production system. The best use of on farm wastes help to reduce environmental pollution and reduction of production cost. To control pests and diseases by agronomic, biological and mechanical measures so as to protect our life, our biosphere and environment without recourse use to toxic pesticides. Production of healthy, nutritious and pesticides residue free food, vegetables, fruits and spices.

Nutrient Sources for Organic Farming



Certification of Organic Produces

Organic certification is the certification process for producers of organic food and other organic agricultural products. Generally, any business directly engaged in food production can be certified, including seed suppliers, farmers, food processors, retailers and restaurants.

Purpose of Certification

Organic certification addresses a growing worldwide demand for organic food. It is intended to assure quality and prevent fraud, and to promote commerce.

While such certification was not necessary in the early days of the organic movement when small farmers would sell their produce directly at farmers' markets, as organics have grown in popularity, more and more consumers are purchasing organic food through traditional channels, such as supermarkets.

Process of Certification

1. Documentation: extensive paperwork is required, detailing farm history and current set-up, and usually including results of soil and water tests.

2. Planning: a written annual production plan must be submitted, detailing everything from seed to sale: seed sources, field and crop locations, fertilization and pest control activities, harvest methods, storage locations, etc.

3. Inspection: annual on-farm inspections are required, with a physical tour, examination of records, and an oral interview.

4. Fee: an annual inspection/certification fee (currently starting at $400–$2,000/year, in the US and Canada, depending on the agency and the size of the operation).

5. Record-keeping: written, day-to-day farming and marketing records, covering all activities, must be available for inspection at any time.

6. In addition, short-notice or surprise inspections can be made, and specific tests (e.g. soil, water, plant tissue) may be requested.

Organic Certification Agencies

There are two types of certification agencies which are:
1. Indian certification agencies.
2. International certification agencies.

Indian Certification Agencies

Government of India through Director General of Foreign Trade, New Delhi, allowed the export of organic products only if they are produced, processed and packed under a valid organic certificate issued by a certification agency accredited by one of the accredited agencies designated by the Government of India.

The Government of India has Recognized the Agencies

1. Tamil Nadu Organic Certification Department www.tnocd.org
2. Spice Board www.indianspices.co
3. APEDA www.apeda.com
4. Coffee Board www.indiacoffee.org
5. Tea Board www.teaboard.gov.in

International Certification Agencies

Imported organic produce from Latin America is subject to certification standards and guidelines just as stringent as produce produced in the United States.

Under the US Organic Foods Production Act of 1990 (OFPA), the USDA is required to review the certifiers of imported organic produce, in order to ensure that they meet the requirements of the US National Organic Program (NOP).

Organic Certification

1. Argencert
2. California Certified Organic Farmers (CCOF)
3. International Federation of Organic Agriculture Movements (IFOAM)
4. The Ecological Farming Association
5. Organic Farming Research Foundation (OFRF)
6. Organic trade Association
7. Organic trade Association
8. Community Alliance with Family Farmers
9. Institute for Market ecology (IMO)
10. Ecocert International

11. Demeter.

Conclusion

The major focus in switching over to organic farming is to provide us safe and nutritious food and simultaneously to restore our natural resources of land water, bio diversity flora and fauna for future generation. Organic farmer, therefore normally works towards optimisation rather than maximization of farm produce under his farming situation while observing the principles of Diversity, Variability and Integrations.

Since, agriculture is the back bone of Indian economy and results of preceding revolutions such as green revolution and white revolution had been encouraging, the time is ripe enough to make "Organic revolution" as the next important breakthrough for the Indian Agriculture.

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Integrated Farming System in Dry land Ecosystem

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Introduction

Integrated farming system is defined as an integrated set of elements/components and activities that farmers perform in their farms under their resources and circumstances to maximize the productivity and net farm income on a sustainable basis. When different enterprises are dependent, complementary and supplementary to each other, they interact among themselves and affect the others. Such a mixed farming system is termed an "integrated farming system.

Importance of IFS

In India, arid and semi-arid regions cover approximately 166.2 million ha (Srinivasarao et al., 2013) which spread across the length and breadth of the country, and hold an important place with respect to size, human and animal population and agro-ecological diversity. These regions are characterized by hostile environmental conditions that include low and erratic rainfall, high wind velocity led to low and uncertainty in agricultural production. Integrated farming systems (IFS) can play an important role for enhancing production, income and livelihood; minimizing risk associated with farming in arid and drier semi-arid regions and in enhancing mitigation and adaptation to climate change. It has been conclusively established that IFS involving integration of different enterprises, enhanced productivity, profitability, resource use efficiency, generated more employment and minimized resources degradation and risks.

Concept of IFS

The Integrated Farming System (IFS) approach can stabilize income streams through natural resource management and livelihood diversification. The IFS approach has several goals: sustainability, food security, farmer safety and poverty reduction. This involves using the output of a business component as input to other related companies where feasible, for example, mixing cow dung with crop residues, and industrial waste can be converted into nutrient-rich vermicompost.

Component of IFS in Dry Land Ecosystem

1. Crop husbandry: mono or multiple
2. Livestock: milch animals/drought animals
3. Poultry
4. Duckery
5. Horticulture
6. Goatery/sheep rearing
7. Agro-forestry
8. Biogas plants
9. Agri-silviculture system

Goals of IFS

The four primary goals of IFS are given as below.:

1. Maximization of yield of all component enterprises to provide steady and stable income.
2. Amelioration of system's productivity and achieve agro ecological equilibrium.
3. Avoid build-up of insect-pests, diseases and weed population through natural cropping system management and keep them at low level of intensity.
4. Reducing the use of chemicals (fertilizers and pesticides) to provide chemical free healthy produce and environment to the society.

Advantages of IFS

1. Increasing productivity is one of the most important benefits of an integrated farming system; increasing productivity means that due to the intensification of crops and related agricultural enterprises, the economic output per unit area per unit time increases.

2. The rate of profit also increases as productivity increases. This is because we use the waste or by-products of one enterprise as inputs for other agricultural enterprises.

3. The adoption of new technologies is one of the important benefits of integrated farming systems. This is because adopting technology requires money. Large farmers have finances, so they can easily adopt it. However, small farmers often face financial shortages. But because of the integrated farming system, they have the opportunity to increase farming benefits and adapt to new technologies.

4. This method ensures environmental safety. How about it? Since we use the waste of one company as the input of the production function of another company, the waste pollution is minimized, thereby ensuring environmental safety.

5. In this way, you can fight deforestation. Growing wood and fuel wood and crops in the field not only uses the free space of the land, but also provides wood for many purposes. Therefore, the pressure on natural forests can be reduced and the natural ecosystem can be protected. Increase the livelihood and sustain the productivity of farmers.

Conclusion

1. Keeping in view the importance of Integrated Farming Systems in substantial increase in profitability was made to integrate best possible enterprises to study the feasibility and develop appropriate model for dry land ecosystem.

2. The dominant farming system identified was crops + dairy representing 80 % house hold of small farm groups.

3. To get maximum possible returns from different component enterprises with available farm resources, low cost - cost effective and also environmentally safe technological modules were prepared in consultations of the experts of different disciplines.

4. Different land use system developed should be used in better way for increased and stabilized production in drylands.

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Importance of Biological Control Agents in Crop Protection

Article ID: 30631

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Introduction

Biological control is defined as the application of one living organism to control another. The biological application is mainly introduced to reduce the population of a pest and to produce pest free yields. It is a self-sustaining and long-term treatment method for managing invasive plants.

The living organism applied in this system is used to suppress a weed infestation and to control pests including insects, pathogens and grazing animals. Biological control is the use of a pest's natural predators in controlling their populations in order to minimize their impact on economic and environmental practices. It is an alternative to pesticides and poisons that can offer a few distinct advantages as well as disadvantages.

Biological Control Agents

The natural enemies like parasitism, predation and other mechanisms for controlling the plant pests are referred as a biological control agent.

They play an important role in controlling the plant pests like nematodes weeds, insects and mites. The biological control agent helps in maintaining and balancing the plant species along with their natural enemies.

Concept of IFS

The Integrated Farming System (IFS) approach can stabilize income streams through natural resource management and livelihood diversification. The IFS approach has several goals: sustainability, food security, farmer safety and poverty reduction.

This involves using the output of a business component as input to other related companies where feasible, for example, mixing cow dung with crop residues, and industrial waste can be converted into nutrient-rich vermicompost.

Need for Biological Control

The production of food grain should increase in order to meet the needs of the growing population. Beyond good agronomic and horticultural practices, growers often rely heavily on chemical fertilizers and pesticides.

However, the environmental pollution caused by excessive use and misuse of agrochemicals, as well as fear mongering by some opponents of pesticides has led to considerable changes in people's attitudes towards the use of pesticides in agriculture. A concomitant increase in the proportion of pests and diseases resulted in the increased use of toxic chemical for their management.

The number of species resistant to pesticides and fungicides is increased. In recent years after signing of the general agreement of trade and tariff of world trade organization more emphasis is given to the use of eco-friendly pesticide for crop production in view of their least toxic nature, low levels of disease resistance and low residue problems. Biological controls should be integrated with other control measures because different methods are effective at different times and locations under varying conditions.

Types of Biological Control Agents

1. Inundative Biological Control Agents: This approach uses pathogens, where they are used to apply on a target weed at a very high rate in an aspect that is similar to herbicide application. The most common pathogens used in inundative biological control include nematodes and nuts. This approach does not prevent the invasive plant from implementing at a later date.

2. Inoculative Biological Control Agents: It uses agent populations at low rate that would waver in a natural prey and predator relationship. This method adopts natural predators of the invasive plant to create an eternal relationship between a plant and biological control animals.

List of Biological Control Agents

1. Parasitoids: They lay eggs in the body of the host i.e. insect, eventually killing the host. It is later used as a source of food for the developing larva. It is one of the most widely used biological control agents.

2. Predators: They are mainly free-living species that consume preys in large number during their lifespan. Since the majority of insects constitute crop pests. Some of the predators include lacewings, spiders, flies, beetles and dragonflies.

3. Pathogens: Virus, bacteria and fungi are relatively pathogenic microorganisms that are host specifics or kill their host. Some of the microbial diseases occur naturally but they are used as biological pesticides.

4. Bacteria: Bacteria's belonging to coccobacillus group are more pathogenic to insects. They are used for biological control. They infect digestive tract of insects thus limiting the options for controlling insects with sucking mouthparts namely scale insects and aphids.

5. Viruses: The use of insect virus as a controlling agent is still in inception. Since they are host specific, they turn out to have good potential as biological control agents.

6. Fungi: The fungi entomophaga is effective against pests namely green peach aphid.

Techniques in Biological Control

1. Introduction: Importing foreign natural enemies to combat the introduced pests. For example, Vedalia beetle against cottony cushion scale.

2. Augmentation: It is a tactics of biological control where the efforts are made to increase the natural enemy population either by propagation and release or by environmental manipulation.

3. Inundative: Parasitoids *Cotesia* are applied against sugarcane borer.

4. Inoculative: Parasitic wasp *Encarsia formosa* are applied against glasshouse whitefly.

5. Conservation: Conservation is defined as the actions to preserve and increase the natural enemies by environmental manipulation.

Advantages of Biological Control Agents

1. Biological control is less costly and cheaper than any other methods.
2. Biological control agents give protection to the crop throughout the crop period.
3. They do not cause toxicity to the plants.
4. Application of biological control agents is safer to the environment.
5. They multiply easily in the soil and leave no residual problem.
6. Biological control agents not only control the disease but also enhance the root and plant growth by way of encouraging the beneficial soil micro flora. It increases the crop yield also.
7. Biological control agents are very easy to handle and apply to the target.
8. Biological control agent can be combined with bio-fertilizers.
9. They are easy to manufacture.
10. It is environmentally safe i.e. harmless to human beings and animals.

Disadvantages of Biological Control Agents

1. It is a slow process.
2. It affects the product quality.
3. Pest is not completely destroyed by these biological control agents.
4. It is effective only for large scale.
5. Initial cost is high.
6. A lot planning is required in developing a successful system.

Nanotechnology as Smart Fertilizer

Article ID: 30632

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Abstract
Nano-fertilizers are being studied as a way to increase nutrient efficiency and improve plant nutrition, compared with traditional fertilizers. A Nano fertilizer is any product that is made with nanoparticles or uses nanotechnology to improve nutrient efficiency.

Due to its extremely minute size it can be used as a novel scientific approach that involve the use of material and equipment capable of manipulating physical as well as chemical properties of a substance at molecular levels. It has provided the feasibility of exploiting nanoscale or nanostructured materials as fertilizer carriers or controlled release of nutrient for building of so-called "smart fertilizer" as new facilities to enhance nutrient use efficiency and nano based treatment of agriculture waster so as to protect environment.

Introduction
The word "Nano" means one-billionth, so nanotechnology refers to materials that are measured in a billionth of a meter (nm). A nano-meter is so small that the width of a human hair is 80,000 nano-meters. The field of nanotechnology has resulted from advances in chemistry, physics, pharmaceuticals, engineering, and biology.

Due to their extremely minute size, they have many unique properties that are now being explored for new opportunities in agriculture. There are naturally occurring nanoparticles that have been previously proposed for agricultural use, such as zeolite minerals.

Classes of Nano-Fertilizers
1. Nanoscale fertilizer (nano particles which contain nutrients).
2. Nanoscale additives (traditional fertilizers with nanoscale additives).
3. Nanoscale coating (traditional fertilizers coated or loaded with nanoparticles).

Nano-Farming: A New Frontier in Agricultural Development
Recent advancements in the fabrication of nanomaterials of different sizes and shapes have yielded their wide array of applications in medicine, environmental science, agriculture and food processing. As agriculture faces numerous and unprecedented challenges, such as reduced crop yield due to biotic and abiotic stresses, including nutrient deficiency and environmental pollution, the emergence of nanotechnology has offered promising applications for precision agriculture (figure).

The term precision agriculture or farming has emerged in recent years, meaning the development of wireless networking and miniaturization of the sensors for monitoring, assessing, and controlling agricultural practices. More specifically, it is related to the site-specific crop management with a wide array of pre- and post-production aspects of agriculture, ranging from horticultural crops to field crops.

Recent advancements in tissue engineering and engineered nanomaterials-based targeted delivery of CRISPR (clustered regularly interspaced short palindromic repeats) Cas (CRISPR-associated protein) mRNA, and ss RNA for the genetic modification (GM) of crops is a noteworthy scientific achievement .Further, nanotechnology provides excellent solutions for an increasing number of environmental challenges.

For example, the development of Nano sensor has extensive prospects for the observation of environmental stress and enhancing the combating potentials of plants against diseases . Therefore, such continuous improvements in nanotechnology with special preference on the identification of problems and development of collaborative approaches for sustainable agricultural growth has remarkable potential to provide broad social and equitable benefits.

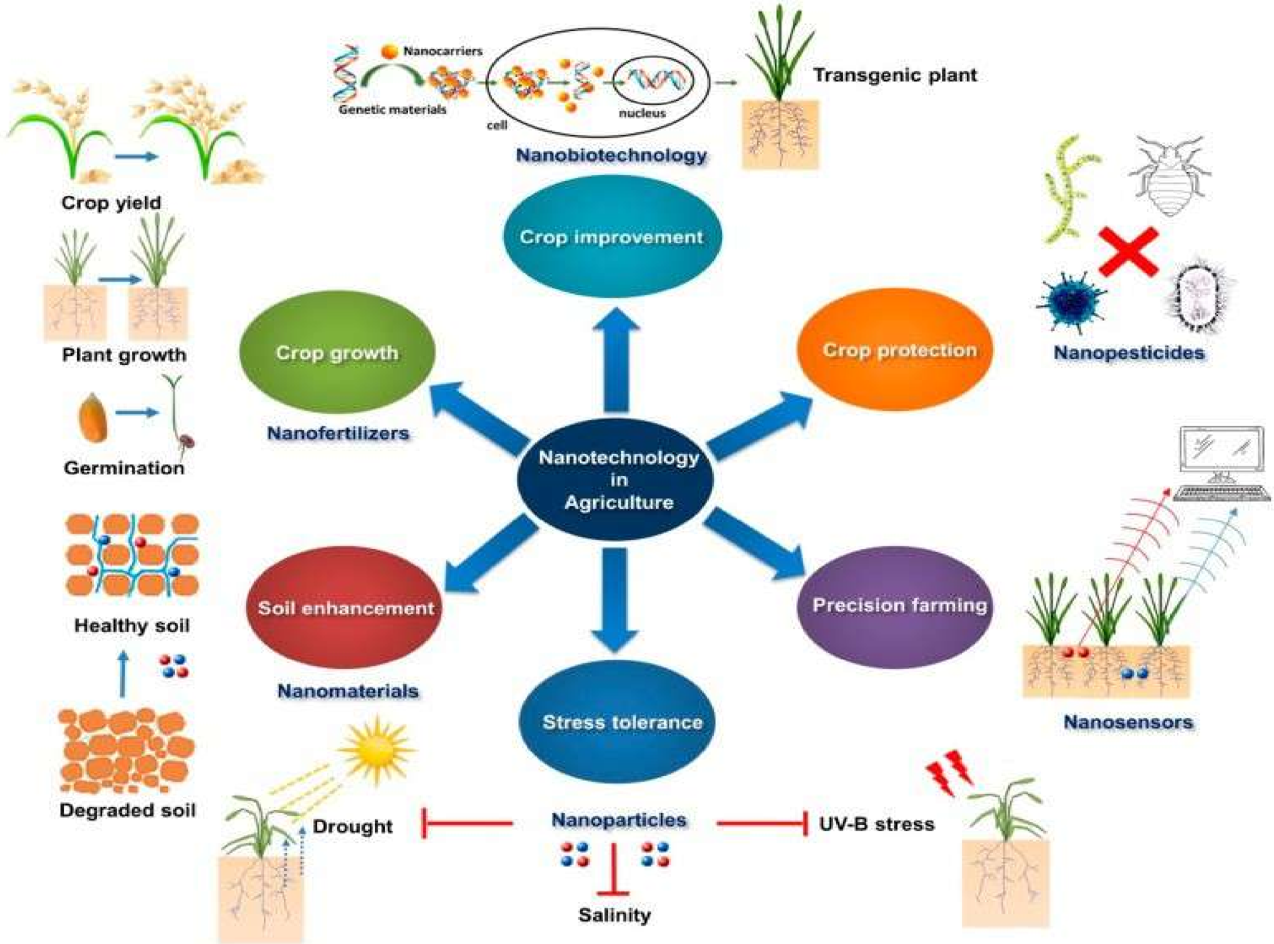

Fig :Application of nano technology in agriculture. Control release of nanofertilizers improve crop use efficiency and crop improvement.

Nano the Smart Fertilizer: A Miracle in Practice

Now a days nanotechnology providing different nano devices and nanomaterial which having a unique role in agriculture such as nano biosensors to detect moisture content and nutrient status in the soil and also applicable for site specific water and nutrient management, Nano-fertilizers for efficient nutrient management, Nano-herbicides for selective weed control in crop field, Nano-nutrient particles to increase seed vigour, Nano-pesticides for efficient pest management and Nano herbicides are effective in weed management.

Nano-fertilizers are advantageous over conventional fertilizers as they increase soil fertility yield and quality parameters of the crop, they are nontoxic and less harmful to environment and humans, they minimize cost and maximize profit. Nano particles increase nutrients use efficiency and minimizing the costs of environment protection. Improvement in the nutritional content of crops and the quality of the taste. Optimum use of iron and increase protein content in the grain of the wheat .Enhance plants growth by resisting diseases and improving stability of the plants by anti-bending and deeper rooting nanotechnology also suggested that balanced fertilization to the crop plant may be achieved through nano-technology.

Conclusion

Nanotechnology in the form of Nano-fertilizers clearly has a potential to dramatically impact and improve agriculture. However, the current degree of understanding of Nano-material behaviour, effects and fate in agriculture systems is poor. Through the delay and control on release mechanism, Nano-fertilizer technology has a significant influence on Nutrient Use Efficiency (NUE), energy, economy and environment. Immense scope lies for exploration of benefits of Nano-fertilizers in the field of agriculture.

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Impacts of Covid-19 On Indian Agriculture

Article ID: 30633

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Introduction

The ongoing health crisis around COVID19 has affected all walks of life. Protecting lives of people suffering from the disease as well as frontline health responders have been the priority of nations. Governments have swung into actions since the Corona virus attack created an unprecedented situation. India declared a three-week nation-wide lockdown till mid-April in the initial phase, which was subsequently extended for achieving satisfactory containment of the virus spread. During these challenging times, how does Indian Agriculture respond to the crisis and how do government measures affect 140 million farm households across the country and thereafter impact the economy of a very important country in the developing world? We assess the immediate challenges that COVID19 has posed to the farm sector and suggest mitigation measures to ensure a sustainable food system in the post-crisis period.

Immediately after the nation-wide lockdown was announced, the Indian Finance Minister declared an INR 1.7 trillion package, mostly to protect the vulnerable sections (including farmers) from any adverse impacts of the Corona pandemic. The announcement, among a slew of benefits, contained advance release of INR 2000 to bank accounts of farmers as income support under PM-KISAN scheme. The Government also raised the wage rate for workers engaged under the NREGS, world's largest wage guarantee scheme. Under the special scheme to take care of the vulnerable population, Pradhan Mantri Garib Kalyan Yojana (Prime Minister's scheme for welfare of the poor), has been announced. Additional grain allotments to registered beneficiaries were also announced for the next three months. Cash and food assistance to persons engaged in the informal sector, mostly migrant laborers, have also been announced for which a separate PM-CARES (Prime Minister Citizen Assistance and Relief in Emergency Situations) fund has been created.

The Indian Council of Agricultural Research (ICAR) has issued state-wise guidelines for farmers to be followed during the lockdown period. The advisory mentions specific practices during harvest and threshing of various rabi (winter sown) crops as well as post-harvest, storage and marketing of the farm produce.

The Reserve Bank of India (RBI) has also announced specific measures that address the "burden of debt servicing" due to COVID19 pandemic. Agricultural term and crop loans have been granted a moratorium of three months (till May 31) by banking institutions with 3 percent concession on the interest rate of crop loans up to INR 300,000 for borrowers with good repayment behaviour.

Immediate Challenges

In spite of all these measures and in view of continuing restrictions on movements of people and vehicular traffic, concerns have been raised regarding negative implications of COVID19 pandemic on the farm economy. This is the peak of rabi season in India and crops like wheat, gram, lentil, mustard, etc. (including paddy in irrigated tracts) are at harvestable stage or almost reaching maturity. This is also the time when the farm harvests reach the mandis (market yards) for assured procurement operations by designated government agencies. Moreover, any severe disruption to the supply of perishable fruits and vegetables, dairy products, fish, etc. having mobilized to meet the increasing demand from a bulging middle class as well as urban and rural consumers, may create irreparable damage to all actors in the supply chain. The migration of workers from few parts to their native places has also triggered panic buttons, as they are crucial for both harvesting operations and post-harvest handling of produce in storage and marketing centers. The Union Home Ministry, in a very significant move, has notified to exclude movement of farmers, farm laborers and harvesting and sowing-related machines from the purview of lockdown.

Making the food grains, fruits and vegetables and other essential items available to consumers, both in rural and urban areas, is the most critical challenge for Government machinery during the lockdown period. Smooth functioning of the supply chain, with adequate safety measures for the people involved, is of paramount importance. Transportation of public distribution system (PDS) items to last mile delivery agents, by both rail and road, has to be ensured by respective Government agencies. Distribution of the commodities to vulnerable population, while maintaining prescribed guidelines and protocol, particularly of social distancing, must be effectively monitored.

As the ongoing lockdown coincides with the rabi harvesting season, farmers across the country look up to the Government to ensure uninterrupted harvesting of the crops as well as smooth procurement operations. The Union Home Ministry's circular waiving restrictions on the inter- and intra-State movements of farmers/laborers, as well as harvesting and related farm machines, is indeed a step-in right direction. While ensuring availability of laborers for critical farm operations, their safety (from any COVID infection) and welfare must be prioritized by the Government systems. The sale of dairy products; fish; poultry, etc. has also been hit during the lockdown period as the uptake by the organized industry players has been affected due to shortage of workforce and transport issues. As weather has been very erratic over past few months in many parts, harvested produce must also be protected from such risks.

Mitigation Measures

The poor sections of society are always the hardest hit in any disaster or pandemic situation. With about 85 percent of Indian farm households being small and marginal farmers, and a significant part of the population being landless farm laborers, welfare measures to contain any damage from COVID are definitely going to help them with sincere implementation. The focus of the Government therefore has to be to protect the lives of every citizen. However, people living on agriculture and allied activities, mostly those losing their income from informal employment at this lockdown period, have to be provided with alternative avenues (cash transfers) till the economy bounces back (when this health crisis is successfully overcome).

To sustain the demand for agricultural commodities, investments in key logistics must be enhanced. Moreover, e-commerce and delivery companies and start-ups need to be encouraged with suitable policies and incentives.

The small and medium enterprises, running with raw materials from the agriculture and allied sector or otherwise, also need special attention so that the rural economy doesn't collapse.

To obviate the immediate concerns of scarcity of farm labour, policies must facilitate easy availability of machinery through state entities, Farmer Producer Organizations (FPOs) or custom hiring centres (CHCs) with suitable incentives. It is also suggested to explore leveraging NREGS funds to pay part of the farm labour (with farmers paying the balance wage amount) to lessen the monetary burden on the farmer, while ensuring wage employment to the landless laborers and workers.

To answer queries relating to the announced measures of Government and addressing grievances of farmers, besides providing advisories on farm operations; availability of agri-inputs, dedicated toll-free helplines/call centres (in local/vernacular languages) must be established by the Government.

Agriculture in India is a State subject, and as has been observed in past years, policies and programs vary from one State to the other. However, agricultural activities, being interconnected in neighbouring regions, agri-sops or benefits must not distort the market scenario. Waiver of farm loans, evidences suggest, have not fully benefitted the majority of small and marginal farmers. Rather, it affects the future credit behaviours of the borrowers and thus negatively impacts the agricultural credit culture altogether. As the kharif (rainy/wet) season is fast approaching, institutional lending of crop loans should be expanded and facilitated for smooth (and sufficient) flow of credit to borrowing farmers. Agri-inputs – seeds, fertilizers, agro-chemicals, etc. – have to be pre-positioned for easy availability. Private sector must play a significant role with necessary policy support.

Relaxation of the norms by Agricultural Produce Market Committees (APMCs) allowing farmers to sell their produce beyond the designated mandis will certainly ease the burdens of farmers. State Governments must gear up their machineries for smooth procurement operations of farmers' marketable surpluses at MSP (minimum support price) or through other price support schemes.

Under the COVID19 pandemic, being a health crisis of unprecedented proportions, the major share of future Budget allocations obviously (and logically so) would be apportioned for the health sector. However, investments should not be crowded out of the primary sector to prevent irreversible damage to the farm economy. Manufacturing and services sectors may be severely hit in the short run till the time the economy bounces back. It will be thus very appropriate to focus attention on the agriculture sector as a growth engine and also to bring resilience in food (and nutrition) security. At this critical stage, where climate change is already adversely impacting the agriculture sector, productive investments, including on research and innovation, would be very purposeful.

Structural reforms such as land leasing, contract farming and private agricultural markets, etc. have long been advocated to bring enhanced investments into the agriculture sector and to push its growth. However, there has not been uniform implementation of these legislations by State Governments and so the full potential of the sector is unrealized. These reforms need significant political will. Concerns of a slowdown in the zeal of States, post-COVID scenario, could be tackled with suitable incentive mechanisms by the Federal Government to the States.

With a burgeoning population, there is a corresponding rise in food demand in India. However, the negative externalities of the Green Revolution, particularly the environmental trade-offs and staple cereals fundamentalism, have since been realized. It is thus desirable to switch over to a suitable model with a far stronger nutrition focus where diets are more diverse. A post-COVID situation offers that unique opportunity to repurpose the existing food and agriculture policies for a healthier population.

There have been global concerns, rather speculations, on restriction of exports of agricultural commodities by a few global players. India, being trade-surplus on commodities like rice, meat, milk products, tea, honey, horticultural products, etc. may seize the opportunities by exporting such products with a stable agri-exports policy. India's agricultural exports are valued at 38 billion US Dollars in 2018-19 and can rise up further with conducive policies. Development of export-supportive infrastructure and logistics would need investments and support of the private sector, that will be in the long-term interests of farmers in boosting their income.

Many climate models predict a favourable monsoon in the 2020 season (the India Meteorological Department has also since officially announced) as the El-Nino weather phenomenon, that disrupts rainfall in India, is not evident. This is indeed good news in the COVID scenario, assuming agriculture can practice largely unscathed.

Good news is that Government of India has now increased its focus on nutrition (besides food)- security and raising farmers' income (rather than enhancing farm productivity). Changing the consumer behaviours with suitable programs and incentives is already in the agenda. For all these to happen, the existing landscape of policy incentives that favour the two big staples of wheat and rice has to change. Designing agricultural policies, post-COVID19 scenario, must include these imperatives for a food systems transformation in India.

Effect of Covid-19 on Global Food Security

Article ID: 30634

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Introduction

As public life shuts down globally and health systems buckle under the strain of Covid-19 pandemic, concerns over food supply are one of the major nightmares to make it up to the headlines. The present global health threat has brought the economy and other allied activities to a screeching halt, ushering concern over different sectors of public interest, agriculture and food supply being one of them. For most sectors, this sudden halt is scarier and has forced hard immediate decisions to be taken by officials and administrators. On one hand many, speciality food growers have benefitted from the surge in produce sale at grocery stores but saw reduced exports due to logistical issues, grain sector remains stuck in a rut, with pressure on commodity prices, weakening basis for cereal crops in some markets, and export volatility likely over the next two to three months.

FAO is particularly concerned about people's access to food in the medium and long run. With the economies slowing down, especially of the developing countries, the rate of unemployment has been to have an upward trend. The impact of this pandemic will be felt more in countries which are specifically import dependant as they continue to struggle to obtain resources to feed their citizens. Thus, as the demand for agricultural products will decline over the next few weeks, their prices will significantly go down which will in turn lead to negative impact of farming community and other agricultural and allied sectors

Impact of Covid-19 on Global Food Security

The impact of the present pandemic is seen to have decreasing in some countries; although in other countries it is still noted to show an upward increasing trend. Both lives and livelihood are at risk from this catastrophe. Reduction in international trade, quarantines and disruption in supply chain are minimizing people's access to sufficient and nutritious supply of food especially in countries that have been hit hard.

Cases of hoarding are been reported while distress sale in still seen in backward countries. But according to FAO, there is yet no need to panic since globally there is enough food for everyone. FAO is particularly concerned about access to food in medium and long run. The impact of Covid-19 is particularly felt more in countries which are food import-dependent. Food price in such countries are likely go down which means primary sector of such countries will face an economic disturbance.

Disturbance in food supply chain are likely to be expected particularly in commodities such as fruits, vegetables, fish, milk, meat, etc. Social distancing as well as cautious behaviour of workers may impede farmers from agricultural operations and food processors- who handle the majority of agricultural commodities. Lack in supply of fertilizers, veterinary medicines and other inputs could hamper global food production.

Closures of restaurants and less frequent grocery shopping diminish demand for fresh produce and fisheries products, affecting producers and suppliers. Sectors in agriculture, fisheries and aquaculture are particularly affected by restrictions on tourism, closure of restaurants and café and school meals suspension.

Implications of Covid-19 Situation: A Future Prospect

As restrictions cease international trade, blockages to transport route has reduced people's access and demand for fresh food. A perishable harvest therefore, now needs to be quickly sold, processed or stored in relatively limited time and at a particular risk. Transport restrictions are already curbing farmers' productive potential and hindered them from their selling price.

As the restaurants and street food outlets remains shut, a potential market for many primary sector employees and their source of income is affected especially there has been seen a reduction in fish and meat sector. Also, it has been confirmed from developing countries, supply and demand of fresh food products has reduced because of trade restrictions and cautious behaviour trend of traders and customers.

Lesser developed countries are particularly at risk from this pandemic as it can drastically reduce the labour potential and have a significant negative impact on income and livelihood as well as production which are labour intensive such as agriculture and other allied sectors. Some of the African are particularly at a much greater risk as it is already facing food shortage putting both producers and consumers at a crucial state. People need to have access to agricultural inputs for continuity of food grain production. As far as, animal husbandry sector is concerned, herders need to mobilize with their herd in search of pastures and water as it increasing dries up before rainfall sets in. Thus, some countries would be facing much greater catastrophe than others

The need to upgrade international standards for hygiene, working conditions and living facilities on agricultural activities and on-board fishing vessels, as well as throughout the fish value chain, need to be reconsidered in the light of the pandemic.

Conclusion

The Food and Agricultural Organization of United Nations has stressed over the significance of healthy trade flow to avoid issues concerning global food security and people's access to healthy and fresh food products. In the days ahead, it is important to establish stable trade network for supply of agricultural products and other allied inputs as in the long run it will play a significant part in global food production and consumption. Timely supply of essential food products is imperative. The officials and administrators must now look to go ahead and solve disputes related to border control in order to ensure exchange of agricultural products and to fulfil global agricultural needs in months ahead.

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Role of Host Plant Resistance in IPM

Article ID: 30635

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Introduction

Host plant resistance is defined as those heritable characteristics possessed by the plant which influence the ultimate degree of damage done by the insect. It is the capacity of plant species to avoid, tolerate or recover from injuries caused by insect populations, limiting insect feeding and reproduction. Host plant resistance to insects is an effective, economical and environment friendly method of pest control. The most attractive feature of host plant resistance is that farmers virtually do not need any skill in application techniques and there is no cash investment. HPR not only cause a major reduction in pesticide use and slowdown the rate of development of resistance to insecticides in insect populations but also lead to increased activity of beneficial organisms and reduction in pesticide residues in food and food products.

Mechanisms of Resistance

1. Antixenosis / Non-Preference: Some varieties are unattractive or unsuitable for colonization, oviposition or both by the insect pests. Host plant characters responsible for non-preference of the insects for shelter, oviposition, feeding etc. It denotes presence of morphological or chemical factor which alter insect behaviour resulting in poor establishment of the insect. For example, trichomes in cotton provides resistant to whitefly, wax bloom on crucifer leaves deter feeding by DBM.

2. Antibiosis: Antibiosis refers to an adverse effect of the host plant on the biology i.e. survival, development and reproduction of the insects and their progeny due to the biochemical and biophysical factors present in it. Antibiosis may be due to presence of toxic substances, absence of sufficient amount of essential nutrients, nutrient imbalance. Physical factors in antibiosis are thick cuticle, glandular hairs, silica deposits, tight leaf sheath etc. Some of the chemicals present in plants that imparts resistance against various insects are as follows:

a. DIMBOA against European corn borer i.e. *Ostrinia nubilalis*.
b. Gossypol against American bollworm i.e. *Helicoverpa armigera*.
c. Sinigrin against Aphids i.e. *Myzus persicae*.
d. Cucurbitacin against Cucurbit fruit flies.
e. Salicylic acid against Rice stem borer.

3. Tolerance: In case of tolerance, the host plant is attacked by pests but there is little or no loss in biomass production or yield. Ability to grow and yield despite pest attack. It is generally attributable to plant vigour, regrowth of damaged tissue, to produce additional branches, compensation by growth of neighbouring plants. It is generally found that the attack of shoofly, stem borer or cutworm in germination stage aggravates their growth. The tolerance may be due to ability of the host to suffer less damage by the pests. For example, aphids in sugar beet and brassica, greenbugs in cereals etc.

Host Plant Resistance in IPM

Host plant resistance is a very important component of IPM. Selection and growing of a resistant variety minimize cost on all other pest management activities.

1. Compatibility with chemical control- Host plant resistance enhances efficacy of insecticides. Higher mortality of leaf hoppers and plant hoppers in resistant variety compared to susceptible variety. Lower concentration of insecticide is sufficient to control insects on resistant variety.

2. Compatibility with biological control- Resistant varieties reduces pest numbers thus shifting pest : predatory or parasitoid ratio favourable for biological control. For example, predatory activity of mirid bug *Cyrtorhinus lividipennis* on

BPH was more on a resistant rice variety IR 36 than susceptible variety IR 8. Insects feeding on resistant varieties are more susceptible to virus disease (NPV).

3. Compatibility with cultural method- Cultural practices can help in better utilization of resistant varieties. For example, use of short duration, pest resistant plants effective against cotton boll weevil.

Advantages of Host Plant Resistance

1. It has cumulative effect i.e. lasts for many successive generations.
2. It is eco-friendly and does not effect on man and animals.
3. Specific to the target pest and so natural enemies are unaffected.
4. It is easily adoptable so high yielding insect resistant variety easily accepted and adopted by farmers at less cost.
5. It is very compatible and can be combined with all other components of IPM.
6. Decreased pesticide application and so resistant varieties requires less frequent and low doses of insecticides.
7. It is effective where other control measures are less effective.
8. Persistent for long time therefore some varieties have durable resistance for long periods.

Disadvantages of Host Plant Resistance

1. It is a time consuming which requires from 3-10 years by traditional breeding programmes to develop a resistant variety.
2. It has genetic limitation i.e. absence of resistance genes among available germination.
3. Biotypes can develop i.e. a new population capable of damaging and surviving on plants previously resistant to other population of same species.

Nematode Pests in Rice & their Management

Article ID: 30636

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Introduction

Rice is the most important staple food for about half of the human race. It ranks third after wheat and maize in terms of worldwide production. With the ever-increasing pressure on food production and intensity of rice cultivation, proportionate compounding of pest and disease problems has been observed in several regions of the world. The plant parasitic nematodes, which are generally considered minor pests are gaining importance, as the economic losses caused by them are coming to light the world over. Rice can be sown in soil directly or transplanted, in partially flooded or completely submerged situation. Each of these methods has its own merits and demerits. The root-knot nematodes infecting rice are prevalent in all these systems, but are more serious in upland cultivation, light textured soils and direct seeded crops. It is estimated that Root-knot nematode alone in rice cause yields loss of 16% in India which equals to the monetary loss of Rs. 23272.32 million (Walia and Chakrabarthy, 2018). The problem aggravates faster when more than one crop of rice is grown in a year in the same field.

Irrigated Rice

Paddy fields have good water control and the rice is flooded throughout the growing season. *Hirschmanniella* spp. are found in large numbers in irrigated, lowland and deep-water paddies. *H. oryzae, H. mucronata* and *H. gracilis* cause slowing of growth and reduced tillering. The root-knot nematode, *Meloidogyne graminicola* is found in these situations but causes serious damage when there is water stress. It can also multiply on wheat during warmer parts of the season and present higher initial population levels for the next rice crop. Some other species of root-knot nematodes, such as *M. sasseri*, *M. oryzae*, *M. salasi* etc. are also known to infect rice but their presence has not been reported from India. *Aphelenchoides besseyi* causes the white-tip disease of rice.

Deepwater Rice

Deepwater rice grown in river-side areas, where there is no structured water control. Flooding occurs periodically throughout the growing season. The main nematode causing damage in deep-water growth is *Ditylenchus angustus*. When an infestation occurs, white patches are apparent on leaves, panicles become crinkled and empty, serious yield loss occurs.

Upland Rice

Rice grown in upland conditions without surface water, depends solely on rainfall. *M. incognita*, *M. javanica* are two of the most commonly occurring nematode species to cause disease in upland growing regions. They can cause a reduction in plant height and reduce the yield upto 60% These nematodes mainly survive in the soil as eggs or juveniles, but are not able to survive long periods of flooding. Damage by *M. javanica* may be seen as galls on the roots whilst *M. incognita* demonstrates no apparent galling.

Wilting, reduced tillering and poor yields are common symptoms. Flooding the soil may control these nematodes but in upland condition ample water source for flooding is seldom available. *M. graminicola* also causes damage in upland conditions. Chemical control is uneconomical due to a low yield of upland rice varieties. *Heterodera oryzicola* is also known to infect upland rice causing reduced root growth which in turn reduces yield. *Pratylenchus* spp. and *Hoplolaimus indicus* also affect upland rice and in areas where other cereals are grown in a rice-based cropping system.

Most of the times the losses caused by the parasitic nematodes in rice are overlooked mainly due to unawareness and economic condition of the rice farmers. Usually, farmers feel that the nematode problems are also controlled by other chemicals used for various purposes in rice culture. On the contrary, importance of nematode pests is becoming increasingly common in certain pockets wherever forced changes in cropping systems/production technologies are adapted in rice growing countries to face the economic and trade challenges.

Above information has shown that rice is attacked by some major 5-6 nematode genera. The present article, however, shall focus on root-knot nematode problem of paddy in India.

Management

1. At nursery level: The soil solarization in nursery bed may effectively reduce nematode populations. Prior to sowing, the nursery bed is covered with a plastic polyethylene tarp for 4-6 weeks. Soil solarization of area for nursery beds for 3 – 4 weeks in summer and nursery-bed treatment with carbofuran @ 2 kg a.i./ha were found very effective in reducing root-knot nematode infestation in rice nursery.

This raises temperature by 4°C over non-mulched soil to reach 40-50°C at 10 cm depth. The nematodes become undetectable in the upper 15 cm soil later. It can give a reduction of *Meloidogyne* spp. population in rice beds of over 80% and improve seedling growth.

2. At field level: Carbofuran was found to be most effective as seed treatment for control of *M. incognita* in upland rice. Seed soaking at 0.1-0.2% for 12 h was found to be effective in reducing the root nematode population:

a. Seed soaking in 500 ppm carbofuran or carbosulfan @ 0.1% for 12h; root-dip in 200 ppm of carbofuran for 12h.
b. Carbofuran @ 1 kg a.i./ha in two equal split doses 15 and 45 days after sowing or transplanting.

Carbofuran treatment improves yield of the first rice crop but the treatment in a crop does not leave benefit for the second rice crop. Due to its short life cycle, *M. graminicola* populations may be similar after only a single rice crop and after three consecutive crops.

To ensure higher rice yields, *M. graminicola* populations should be maintained at low density by rotation with non-host crop, ideally for two seasons before planting rice. Seed treatment with neem-based pesticides can reduce populations and damage caused by *M. graminicola.*

Integrated nematode management against root-knot nematodes in rice-wheat cropping system.

Nursery-Bed Treatment

1. Selection of root-knot nematode free area for nursery.
2. Soil solarization of area for nursery-beds, for 3-6wk in late April-May.
3. Application of carbofuran @ 0.1 g a.i. /ha.

Main Field

1. Summer ploughing of main field twice at 2week interval.
2. Puddling of main field before transplanting.
3. Avoiding direct sowing of rice in main field.
4. Crop rotation with mustard or other non-host crops.
5. Late sowing of wheat in late Nov. to mid-December using suitable variety.
6. Green manuring with Sesbania spp., or *Crotolaria* spp. if time permits.

Conclusion and Future Prospects

The root-knot nematodes, especially *M. graminicola* are emerging as serious bottleneck in increasing rice production. The intensive cultivation of rice in areas with decreasing water availability increases the severity of the problem. In the rice-wheat cropping system, the wheat crop serves as a green bridge, supporting these nematodes in Rabi between two rice crops, thus enabling rapid build-up of the nematode population.

Many monocots and some dicot weeds also support these nematodes. The damage potential has been proved. Rice being a widely grown staple food crop, the quantum of total crop losses is much more than apparent and the repercussions can lead to food insecurity. The information on the ecology and survival strategies of these nematodes is limited. Biology and ecology of these nematodes markedly differ from the other popular species of root-knot nematodes, viz., *M. incognita, M. javanica, M. arenaria* and *M. hapla* which have attracted most of the attention of the nematologists so far.

Yet, good amount of information has become available on distribution, biology, hatching behaviour, host range, crop damage and efficacy of different methods of control. Concerted effort is now necessary to understand the ecology, host resistance mechanism and interactions with plant and other organisms in the rhizosphere.

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Indian Saffron: Healthiest Medicinal Spices of India

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Abstract

Indian saffron which is commonly known as Turmeric, since time immemorial, has been touted as one of the healthiest medicinal spices of India. This is one spice definitely present in every Indian household - whether in the integral spice box or your grandmother's home remedy cabinet. Not surprisingly, India is among the most prominent producers and consumers of turmeric in the world. Turmeric is a powerful herb with over 300 nutrients including beta-carotene, ascorbic acid (vitamin C), calcium, flavonoids, fibre, iron, niacin, potassium, zinc among others. But the active compound which has caught the attention of scientists, supplement industries and food technologists is curcumin for its anti-inflammatory and anti-bacterial properties.

Introduction

A member of the ginger family, turmeric's root (rhizomes) and leaves are edible and are used in various cuisines, especially in South Asian cuisines - Indian, Nepalese, Cambodian, Indonesian, and Thai and in several Mediterranean dishes. Turmeric is used as a root and in the dried powdered state for cooking, for protection against infections, for beauty as a cosmetic measure in most of our homes. Although it has been used in Asia for thousands of years, Arab traders first introduced turmeric to Europe in the 13th century. It was mentioned in Marco Polo's writings about his 1280 journey to China and India.

Turmeric is among the richest food sources of Iron - 67.8 mg per 100g of turmeric powder. One teaspoon (3g) of turmeric powder provides 2mg of Iron - 10% of the adult daily requirements. Essential oils extracted from turmeric oil exhibits antifungal properties and is active against respiratory tract viruses such as those causing flu. The oil may help remove sputum, relive cough and prevent asthma.

The oil also acts as a natural mosquito repellent for both day and night mosquitoes. Infections controller: In alternative and herbal medicine, turmeric is used to treat conjunctivitis, chicken pox, urinary tract infections and liver ailments. Topical application of turmeric may prevent proliferation of skin tumours. Intake of turmeric extract may reduce the cell-damaging effects of chronic hyperglycaemia in diabetes patients. Antioxidant and germicidal properties of turmeric have led to its extensive use in medicinal and cosmetic products.

Curcumin present in turmeric not only acts like an antioxidant, it also boosts the body's natural antioxidant capacity. Turmeric is known to help with digestion. It is used in traditional medicine for reducing flatus for abdominal pain and distension. It is also known to help with improving appetite, post-meal fullness, and improving liver functions. Kacchi Haldi, as it is also known, is also applied as an ointment to any kind of cuts or injuries.

As we know Turmeric is a powerful immunity booster. It is also consumed uncooked with milk and warm water or tea, to help combat flu or cold. It helps enhance the immunity and eliminate cold, cough and chest congestion if any. While the powdered form has its benefits, the raw roots of turmeric are quite helpful too.

According to research published in the journal *PLOS ONE* (Public Library of Science), curcumin, a compound found in turmeric is known to have anti-inflammatory properties that help boost immunity. Turmeric, which is anti-viral, anti-fungal and anti-bacterial, is also prebiotic that promotes the growth of healthy bacteria in our gut. Curcumin helps up in boosting up the immunity and helps to fight against viral replication. Curcumin suppresses various inflammatory molecules which are responsible for the causes of the damage by viruses. Cancer is the second leading cause of death in the world and one of the major public health problems.

The main mechanisms of action by which curcumin exhibits its unique anticancer activity include inducing apoptosis and inhibiting proliferation and invasion of tumours by suppressing a variety of cellular signalling pathways. Several studies reported curcumin’s antitumor activity on breast cancer, lung cancer, head and neck squamous cell carcinoma, prostate cancer, and brain tumours, showing its capability to target multiple cancer cell lines.

Despite the great advances in cancer therapy, the incidence and mortality rates of cancer remain high. Therefore, the quest for more efficient and less toxic cancer treatment strategies is still at the forefront of current research. Curcumin, the active ingredient of the *Curcuma longa* plant, has received great attention over the past two decades as an antioxidant, anti-inflammatory, and anticancer agent. A few laboratory studies on cancer cells have shown that curcumin has anti-cancer effects.

It seems to be able to kill cancer cells and prevent more from growing. It has the best effects on breast cancer, bowel cancer, stomach cancer and skin cancer cells. In addition, the recent advances in the drug delivery systems for curcumin delivery to cancer cells have been highlighted.

Conclusion

It is concluded that the curcumin is active ingredient of the Curcuma longa extract, which has been widely studied over the past few decades for its anti-inflammatory, antioxidant, anticancer, and anti-androgenic effects. Curcumin has shown considerable anticancer effects against several different types of cancer, including prostate cancer, breast cancer, colorectal cancer, pancreatic cancer, and head and neck cancer both in vitro and in vivo. Furthermore, its efficacy and safety in cancer patients either alone or in combination with other anticancer agents has been proven in several clinical studies with human subjects.

With the pandemic of Coronavirus, we are facing today, we wouldn't say that turmeric is a treatment or a 100% protection against COVID 19, but keeping your immunity up definitely protects you better against the onslaught of infections. Also, immunity is built up over time, not in one day, so by inculcating good habits and adopting a healthy lifestyle and eating well, we can face challenges in life.

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Soil Suppressiveness Against Plant Parasitic Nematodes

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Introduction

Most soil borne pathogens are difficult to control by conventional strategies like resistant host cultivars and synthetic biocides. Focus on search for alternative strategies of control because some reasons like lack of reliable chemical controls, Public concerns about adverse effects of soil fumigants such as methyl bromide and due to breakdown of host resistance by pathogen populations. Plants have developed a defence strategy against soil borne pathogens that involves selective stimulation & support of antagonistic rhizosphere microorganisms. Over the past century, evidence has accumulated in which susceptible plants remain almost free of infection despite ample exposure to virulent inoculum of soil borne pathogens.

What is Suppressive Soil?

The Glossary of Plant-Pathological Terms (1997): "soils in which certain diseases are suppressed due to the presence in the soil of microorganisms antagonistic to the pathogen or pathogens."

Suppressive soil differs from conductive soil in which Slow and contained expression of disease is takes place, Pest population below EIL or at equilibrium and shows Diverse microbial activity.

On the Basis of Number of Organisms Responsible for Suppressiveness (Weller Et Al., 2002)

1. General/ Non-transferable suppression/ Nonspecific antagonism/ Biological buffering:

a. Definition: Widespread but limited ability of soils to suppress the growth or activity of soil borne pathogens (Area wide, Intensity low).
b. Suppressive activity due to total microbial biomass in soil- competition for resources.
c. Inhibition through direct antagonism.
d. Enhanced by- application of organic matter, agronomic practices, etc.- All lead to increased microbial activity
e. Since no single organism is responsible for suppression, not transferable between soils.

2. Specific suppression/ Transferable Suppression:

a. Area small, Intensity high.
b. Effects of individual or select groups of microorganisms.
c. Transferable (0.1 to 10% W/W).

Therefore, Soil Suppression= General + Specific suppression.

On Basis of Longevity of Suppression (Hornby, 1983)

1. Natural/Long- standing suppression:

a. Occur naturally as an inherent characteristic of their physical, chemical, and (or) biological structure of soil
b. Indigenous microflora protect plants against soil borne pathogens.
c. Origin not known.
d. Survive in absence of host plants.

2. Induced suppression:

a. Initiated and sustained by anthropogenic factors- agronomic practices, such as planting a crop or adding organic or nutritional amendments, which changes the microflora.
b. Origin known.
c. Intimate relation with host plants.

Develops as a result of the build-up of antagonists in response to a high pathogen population, especially in cases where susceptible crops are grown in succession.

Characteristics of Nematode Suppressive Soils (Kerry, 1988)

1. Initially apparent: Incidence and severity of disease is lower than expected for the prevailing environment as compared to that in conducive soil.

2. Slow development: Suppressiveness takes many years to develop and requires presence of nematode and susceptible crop.

3. Needs same host crop over a period of time: It is usually found under a perennial crop or where crops are monocultured or grown in intensive rotations.

4. Initial damage to the crop: Extensive nematode multiplication and severe crop damage precedes the development of suppressiveness.

5. Sensitive to physical and biological treatments: Suppressiveness of biological origin can be removed by physical or biocidal treatments.

6. Nematode specific: Suppressiveness is often specific to particular nematodes

7. Transferable: Specific suppressiveness can be transferred to conducive soils.

8. Maintained nematode population: In suppressive soil nematode population density fluctuates around an equilibrium level which may be above or below the economic damage threshold for the nematode.

Factors Responsible for Suppressive Soils

1. Biotic Factors/Biological basis of soil suppression: All biotic entities and their products in soil, mainly includes soil microorganisms

2. Abiotic factors: Soil physical and chemical factors.

Some Organisms Involved in Nematode Suppressiveness

Sr.No.	Bacteria	Fungi	Predatory nematodes	Predatory mites
1.	*Pasteuria spp.*	*Paecilomyces lilacinus*	Mononchids	*Hypoaspis calcuttaensis*
2.	*Pseudomonas fluorescens, P. aeroginosa*	*Pochonia chlamydosporia*	Dorylaimids	*Rhizoglyphus echinopus*
3.	*Bacillus subtilis, B. thuringiensis, B. cereus, B. firmus, B. sphaericus.*	*Trichoderma viride, T. harzianmum*	Nygolaimids	*Tyrophagus similis, T. putrescentiae, T. zachvatkini*
4.	*Rhizobium etli*	*Nematophthora gynophila*	Actinolaimids	*Gamasellodes vermivorax*
5.	*Azotobacter chroococum, Azospirillum lipoferum*	*Glomus mosseae, G. fasciculatum*	Aphelenchids	*Rhodacarcus roseus*
6.	*Burkholderia cepacia*	*Myrothecium verrucaria*	Diplogasterids	*Cosmolaelaps vacua*
7.	*Streptomyces avermitilis, S. costaricanus, S. griseus*	*Hirsutella rhossiliensis, H. minnesotensis*		*Macrocheles muscaedomesticae*

Advantages of Suppressive Soils

1. Reduces effect of hazards of chemicals against our environment and increases public safety.
2. The most sustainable method of nematode management in intensive agriculture.
3. Provide a valuable source of potential biological control agents.

4. Soil amendments and some crop cultivars may be used to alter microbial communities in the rhizosphere to the detriment of the nematode pests.

Limitations of Nematode Suppressive Soils

1. Takes more intensive management and planning.
2. May restrict flexibility in early years.
3. Diseases control is not achieved immediately.
4. Control is often to one species.
5. The manipulation of biocontrol agents to increase control is often difficult to achieve with practical treatments.

Conclusion

Today, farming is more oriented towards input intensive- intensive cropping systems. There is lot of opportunity to expand and extend the knowledge about suppressive soils from lab-to-field. Novel technologies of breeding, Microbiology, Bio technology can be used to build suppressiveness against PPN .Better investigations into Physical chemical natural of suppressive soils shall bring more options to induce PPN control.

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Sugarcane Rust: A Newly Important Disease

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Introduction

Sugarcane is the main source of sugar (80%) globally and holds a prominent position as a cash crop. The sugar juice is used for making white sugar, brown sugar (khandsari) and jaggery (gur). The main by-products of sugarcane industry are bagasse and molasses. Bagasse is mainly used as fuel and also used for production of compressed bre board paper, plastic and others. Molasses is used in distilleries for the manufacturing of ethyl alcohol, butyl alcohol, citric acid and rum is the best potable spirit made from molasses and also used as an additive to feeds for livestock. Press mud can be used as soil amendment in saline and alkali soils. Green tops of cane are good source of fodder for cattle. About 80% of sugar is obtained from sugarcane and the remaining 20% is produced through sugar beet. An average person consumes about 24 kg of sugar every year.

Symptomatology

Small, yellowish spots which are visible on both the surface of leaves and these spots increase in size, mainly in length and turn reddish to brown/orange brown to yellow brown. A narrow, pale yellow-green halo develops around the lesions. Under severe conditions, numerous lesions occur on individual leaf giving them an overall rusty appearance and these lesions coalesce to from large, irregular necrotic areas is usually result in premature death of the leaf. The discoloration of these crops is readily seen from a distance.

Epidemiological Factors

The pathogen is primarily spread through wind-blown or water-splashed urediniospores and those settle on leaves of the sugarcane plant and infect under favourable environmental conditions. Temperatures between 15 and 25°C are favourable for spore germination whereas, spore germination increases rapidly above 97% RH. The optimum temperature for teliospore germination is 26°C.

Yield Losses

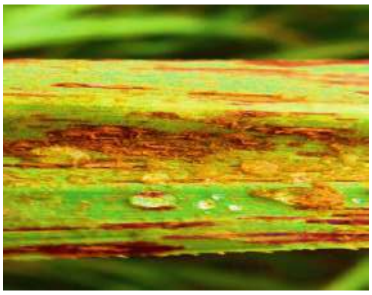
1. Brown rust 10 to 40 %.
2. Orange rust 15 to 43 %.
3. Tawny rust 10 %.

Characteristics of the Three Rust Species Infecting Sugarcane

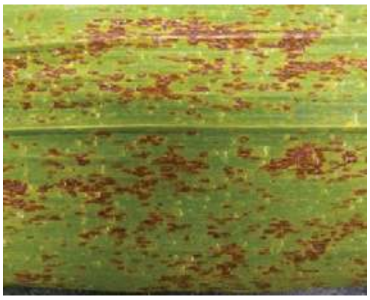
Common name	Brown rust	Tawny rust	Orange rust
Causal organism	*Puccinia melanocephala*	*Macruropyxis fulva sp. nov*	*Puccinia kuehnii*
Lesions (pustules) Colour	Dark brown to reddish-brown	Dark brown to reddish-brown, may be some purpling around the border	Orange to orange-brown
Size	Up to 20 mm long and 3 mm wide	Up to 20 mm long and 3 mm wide	Up to 4 mm long and 3 mm wide
Distribution on leaf	More concentrated near the leaf tip	More concentrated near the leaf tip	More concentrated towards the leaf base, tend to occur in groups

Spores Colour Position on leaf Abundance (fresh pustules)	Cinnamon to orange-brown Mainly on lower leaf surface Very rarely on upper leaf Usually sparse	Bright orange when fresh becoming dark-reddish brown over time Most abundant on lower leaf surface Common on upper leaf surface Abundant, easily transferred to clothes and skin	Orange Mainly on lower leaf surface Very rarely on upper leaf surface Relatively abundant
Age of cane	Less than 6 months	All ages	Usually more than 6 months
Favourable conditions	Cool (less than 25°C), misty or light rain, heavy dews, high humidity. Limited by temperatures exceeding 30°C	Cool (15 to 23°C), misty or light rain, heavy dews, high humidity. Limited by temperatures exceeding 30°C	Warm, wet, high humidity Limited by temperatures exceeding 30°C
Season (Most common but not limited to)	August to November, March to June	August to October, June	November to April
Other notes		Often most severe on the leaves closest to the ground in young plants. As fresh orange spores disperse, more difficult to distinguish from brown rust.	

Brown rust



Tawny rust



Orange rust

Screening Technique

1. Preparation of spore suspension: One day before experimental inoculation, urediospores of *P. melanocephala* were collected from infected plants. Spore suspensions were prepared by flooding leaves with sterile distilled water and dislodging the spores with a small brush. The spore concentration was quantified and standardized to 5×104 spores ml-1 with a haemocytometer.

2. Field inoculation: At two months after planting, all lines and control were inoculated with spore suspensions using a hand-pressured sprayer until saturation of the leaf surface. Relative humidity was maintained by irrigating 2-3 times every day to ensure high humidity for spore germination. Ratings were undertaken when rust symptoms became obvious in the susceptible cultivars (approximately 4-5 weeks after inoculation).

Disease reactions were rated on a 1 to 9 scale, this scale is based on visual assessment of the disease symptoms: 1 = no symptoms; 2 = yellow flecks; 3 = few pustules; 4 = some pustules, moderate number of pustules of lower leaves; 5 = moderate number of pustules, slight premature necrosis of lower leaves; 6 = numerous pustules, more premature necrosis of lower leaves than 5; 7 = numerous pustules, death of lower leaves; 8 = numerous pustules, death of upper leaves; and 9 = numerous pustules, extensive leaf necrosis.

Rust ratings of 1 was considered highly resistant; 2, resistant; 3, moderately resistant; 4, moderately susceptible; 5 to 7, susceptible; 8 to 9, highly susceptible.

Integrated Disease Management

1. Use of disease resistant varieties:
   a. Highly Resistant - Co 94008, Co Snk 03044, Co 07015, Co 08008, Co 99004, Co 08009.
   b. Resistant - Co 86249 (Bhavani), Co 85004, SNK 635, CoN 07071, Co Snk 08101, Co08020, Co Snk 07103.
2. Remove the collateral hosts.
3. Follow the long furrow or pair row method of planting.
4. Destruction, removal and burning of affected and dried leaves.
5. After the harvest of diseased crop the left-over trash should be burnt immediately.
6. Use of parasitic fungus *Darluca filum (Eudarluca caricis)* as biocontrol agent against *P. kuehnii.*
7. Propineb @ 0.25% or Mancozeb @ 0.20% or Tebuconazole @ 0.1% are found to be effective against rust, should be sprayed on the foliage just after the appearance of rust pustules, thrice at 15 days interval.

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Current Scenario of Transgenic Crops

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Introduction

In India 75% of the pesticide used is insecticide, as against 44% globally which create serious risks (environmental, human and animal health) due to inadequate regulatory control involving sales and distribution of highly toxic pesticides and also increasing population, urbanization, income, dietary preferences and malnutrition cases. These problems creating pressure on developing countries to require extraordinary steps like GM crops. Genetically modified crops (GM crops) are plants used in agriculture, the DNA of which has been modified by adding of gene of interest using genetic engineering techniques. More than 10% of the world's crop lands are planted with GM crops. The first GM crop approved in India is Bt cotton. Then the further development of GM crops which are edible by living organisms are rejected. In 2012 parliamentary standing committee on agriculture, in its 37th report asked for an end to all GM field trials in the country. Then 21 new varieties of genetically modified (GM) crops such as rice, wheat, maize and cotton have been approved for field trials by the NDA government in July 2014. But the edible crops are not approved by GEAC (the regulatory body of India) even though Bt brinjal, GM-mustard, Golden rice are developed in India.

Genetically modified crops are developed by the insertion of transgene which involves two methods: They are indirect gene transfer and direct gene transfer.

Indirect Gene Transfer

Vectors like Ti and Ri plasmids present in *Agrobacterium tumefaciens* and *Agrobacterium rhizogenes* respectively are important. These plasmids are necessary for target gene transmission to target area of plant. The *Agrobacterium sps* enter into target area of plant in a following manner.

1. Release of chemicals from wounded plants and chemo attraction
2. Binding of acetosyringone to Vir A and signal reception by vir G
3. Activation of Vir genes and formation of Vir proteins
4. Excision of T-DNA
5. Formation of T-pilus and transfer of T-DNA.
6. Parallel activation of MKK 4/5 signalling and activation of VIP.
7. Delivery of T-DNA into nucleus.
8. Vir F mediated degradation of VIP and release of T-DNA from complex.
9. Integration of T-DNA into host.

Finally, expression of T-DNA occurs in the plant cell. The insertion of target gene from outside to *Agrobacterium sps* require the help of direct methods.

Direct Methods

These are also called as vector less methods because target gene was directly inserted into targeted area. The electroporation and particle bombardment are the widely used methods.
1. Electroporation: Electrical pulses are applied to a suspension of protoplasts with DNA placed between electrodes in an electroporation cuvette. Short high-voltage electrical pulses induce the formation of transient micro pores in cell membranes allowing DNA to enter the cell and then the nucleus.

2. Particle bombardment: Tungsten or gold (1-2um) particles are used for transformation. The coated particles are loaded into a particular gun and accelerated to high speed either by the electrostatic energy released from a droplet of water exposed to high voltage or using pressurized helium gas: the target would be plant cell suspensions, callus cultures or tissues.

Regulatory Body of Transgenic Plants in India

The top biotech regulator in India is genetic engineering appraisal committee (GEAC). The committee functions as a statutory body under the environment protection act, 1986 of the ministry of environment & forests (MoEF).

Under the EPA 1986 "rules for manufacture, use, import, export and storage of genetically engineered organisms or cells 1989", GEAC is responsible for granting permits to conduct experimental and large-scale open old trials and also grant approval for commercial release of biotech crops.

Presently there are six committees.
1. Recombinant DNA advisory committee (RDAC).
2. Review committee on genetic manipulation (RCGM).
3. Genetic engineering appraisal committee (GEAC).
4. State biotechnology coordination committee (SBCC's).
5. District level committees (DLCs).
6. Institutional biosafety committee (IBSC).

Advantages of Transgenic Crops

1. Genetically modified crops act as high yielding varieties to produce more in small area of land which can help to feed the rapidly increasing population.
2. Spend less money producing more crops, hence increases farmers income finally increase the GDP of India.
3. Use fewer pesticides and herbicides - The amount of pesticide chemicals used on the plants are reduced, so their exposure to dangerous pesticides are also reduced. Ex. Bt cotton
4. Do less tilling to remove weeds, reduce labour cost and thereby protecting the soil
5. GM foods are better texture, flavour and nutritional value.
6. GM foods are a longer shelf life for easier shipping (eg: flavr savr tomato)
7. India is the largest importer of edible oil in the world around 50% of its domestic consumption is imported can be reduced by development of GM crops to produce higher yield.
8. GM crops are used for production of vaccines-bio pharming.
9. No need to do removal of weeds by tillage system when herbicide tolerant plants are grown. This zero till agronomic system contribute to a reduction in soil erosion.

Disadvantages of Transgenics

1. Allergic reactions: It states that genetic modification often adds or mixes proteins that were not indigenous to the original animal or plant, which might cause new allergic reactions in our body.

2. Raise of super pest: The chance in evolution of pest (resistant biotype, pathotype) is more.

3. Cross-pollination: Cross-pollination (eg: maize) can cover quite large distances, where new genes can be included in the off spring of organic, traditional plants, wild, weedy relatives crops or non-target organisms that are miles away. This can result in difficulty in distinguishing which crop aids are organic and which are not, posing a problem to the task of properly labelling non-GMO food products.

4. Some GMO foods have antibiotic features (antibiotic gene is used for identification of target gene) built into them to make them immune to diseases or viruses. These antibiotics can make actual antibiotic medicines less effective.

5. Disruption of natural control of insect pests through inter trophic-level effects of the Bt toxin on natural enemies.

6. Escalation of herbicide use in HT crops with consequent environmental impacts including reduced weed populations and biodiversity because reduced weed populations leading to declines in bird populations that feed on or shelter in weeds or feed on the arthropods supported by weeds.

Applications of GM Plants

The GM technology is applied to so many crops resistant to biotic, abiotic stresses and nutritional enhancement to avoid under nutrition and environmental risk.

Rice	Insect resistance	cry2Aa2
	Nutritional enhancement	Ferritin gene
Golden rice	Nutritional enhancement	GR-2
Chickpea	Insect resistance	cry1Ac
Pigeon pea	Insect resistance	cry1Ac
Sorghum	Insect resistance	Event-4/19

Conclusion

The wide advantages of transgenic crops for a society to solve food security or nutrition security issues have been well established. If eating foreign DNA and protein is dangerous we have been doing so for all of our lives with no apparent effects, because all are eating the fruits, vegetables, bacteria (curd, rotten things), fungi etc., which are having the DNA (foreign DNA for human health) not effecting the body. Still the effect of edible GM crops on the living organisms are on debate. So, it is necessary to increase the research to know more impacts in India and to approve the GM crops to avoid malnutrition and environmental risk.

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Youth and Agri-Start-ups: A Review in the Indian Context

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Abstract
India, home to one-fifth of the world's population belonging to the age group of 15-24 years has failed to attract its youth in the highest employment offering sector i.e. agriculture (53 per cent). Education report has shockingly concluded that out of the rural youth population already engaged in farming, only 1.2 per cent aspire to become farmers and 75 per cent of the total youth is migrating towards the cities in search of alternate employment opportunities.

During the outbreak of COVID-19, private workers/daily wagers lost their jobs leading to the spike in the unemployment rate in India. Safety issues and inaccessibility to the basic needs have forced the people to return their homes. Before the outbreak of this pandemic, the Indian government was making efforts to attract youths in agriculture via schemes, but these efforts are no more sufficient to serve the purpose.

Keywords: Youth, Agriculture, ARYA, Market-led agriculture, COVID-19.

Introduction
As per the latest census of 2011, youth (aged 15-24 years) constitutes about 19.1% of India's total population which is expected to reach 34.33% of the share in population by 2020. Youth being enthusiastic, vibrant, innovative, and dynamic is the most important section of the population. Youth shows strong passion, motivation, and will power which also make them the most valuable human resource for fostering economic, cultural, and political development of a nation.

A country's ability and potential for growth is determined by the size of its youth population. Conventionally, the period from adolescence to middle age is termed as a youth because various agencies consider age as the major determining factor for defining youth. For example, the UN defined youth as the population falling in the age group of 15 to 24. The National Youth Policy (2003) adopted the 13-35 age group for defining youth which was later modified in 2014 to 15-29 years.

What Does the Indian Youth Want?
Report of the World Economic Forum (WEF) titled 'Young India and Work' (2018) have outlined the wants, demands, and limitations faced by the Indian youth. The report revealed that the influence of family and peers on the educational and career choices of India's youth is declining as 50 per cent of the respondents cited interest in their field of study as the primary reason for opting for it.

Today's youth is open towards alternate forms of employment as 63 per cent of the youth were moderately or highly interested in supplementing their income with gig work. Although there is still a large proportion of youth that is inclined towards public sector jobs as they offer job security and higher pay supported by the fact that 63 per cent of the respondents considered a good salary as the most important factor for choosing a job. 82 per cent of the female respondents opined that full-time employment is their ideal employment thereby breaking the stereotype that women prefer part-time jobs. 51 per cent of the Indian youth reported that a lack of information about the available job opportunities matching their skills is a significant barrier that can be counteracted upon through better access to career counselling and mentoring services.

A majority of the young Indians are interested in pursuing higher education as 84% of the respondents considered that post-graduate degree is a must to pursue their ideal job, while 97% aspire to have a degree in higher education. 76% of the youth were very much interested in participating in a skill development programme even though less than 3% of the country's total working population is trained in any form. Therefore, till today, the youths prefer to work in the public sector and exhibit stigma for unconventional and additional employment options. Increased awareness and dissemination of information on the changing labour market and emerging job opportunities can help break this sceptic outlook towards self-employment and gig work.

Burning Issue

The Indian youth is no more interested in taking up agriculture as a profession because it is risky and lacks profitability as 22.50 per cent of the farmers continue to live below the official poverty line. Agriculture has been unable to fulfil the wants and demands of the youth thereby losing its age-long charm amongst the new generation. This allegation is supported by the fact that 42 per cent of the youth aged 14–18 years are working regardless of their enrolment in any kind of formal education.

Of these, 79 per cent work in agriculture, mostly on their own family's farm yet only 1.2 per cent of them aspire to become farmers. Apart from this, most rural youths are not inclined to return to agriculture. The proportion of the population falling in the age group of 15–35 years age is 35 per cent and of this 75 per cent reside in the rural areas, their out-migration to cities is threatening the future of agriculture and food security thereby signaling to a very alarming situation that 'who will manage farming in the times to come' (12th Annual Status of Education Report, 2017).

According to the agricultural census of 2016, the average age of Indian farmers was found to be 50.1 years and none of the definitions by any agency cover 50 years of age under the category of youth. 76% of the youth would prefer to undertake some other vocation instead of farming. The rest 24% who would be interested to continue, would do so only because it was their ancestral tradition (CSDS, 2014). If provided with an alternative, two out of five farmers would quit farming (MoSPI, 2003).

Government Initiatives for Attracting Youth into Agriculture (Pre-COVID-19)

The government is doing its best to make the agricultural sector attractive to youth. In the final report of the National Commission on Agriculture (2006), fostering youth participation in farming and post-harvest activities was amongst the ten major goals that were highlighted to achieve faster and more inclusive growth for farmers. Blackie et al. (2010) concluded that higher education is equally essential for the development of the agricultural sector.

The government has been establishing agricultural universities (National/ State) and Krishi Vigyan Kendra's to support education and research and development in the field of agriculture. Government has been granting recommendations & scholarships to UG, PG and Ph.D. students for pursuing education. In 2017-18, ICAR gave a recommendation to 1450 UG students, 2252 Post-graduate, and 486 Ph.D. students. During 2017-18, KVKs organized skill development training in 30 job roles in which 3,778 rural youths participated (DARE, 2018). Attracting and Retaining Youth in Agriculture (ARYA) is an ambitious project dedicated exclusively for the youth, under these 930 different enterprises were established which in turn benefitted 2,467 rural youths.

National Agricultural Higher Education Project (NAHEP) is another flagship educational programme dedicated to providing quality education to the agricultural students as a result of which more students can qualify NET and ARS examinations conducted by the ICAR {16% of the registered candidates qualified ARS (preliminary) 2016 and 22.45% of the registered candidates qualified the NET 2017 (I)}. Rural Awareness Work Experience (RAWE) has been upgraded to Student READY (Rural Entrepreneurship Awareness Development Yojana) for the final year agricultural and allied subject graduation students, where they are reoriented for ensuring and assuring employability and to develop entrepreneurs for emerging knowledge-intensive agriculture.

Student READY now has five sub-components i.e. Experiential Learning, Rural Awareness Works Experience (RAWE), In-Plant Training / Industrial attachment, Hands-on training (HOT) / Skill development training, and Students Projects. Under RAWE, 11,970 students were benefited via industrial attachment during 2017-18. Agri-Clinic and Agri-Business Centre (ACABC) is a central sector scheme for the creation of self-employment opportunities for agriculture graduates along with providing extension services to the farmers.

The National Institute of Agricultural Extension Management (MANAGE) is the implementing agency for the training component and National Bank for Agriculture and Rural Development (NABARD) is the implementing agency for the subsidy component of the ACABC scheme. Under this scheme, 47,955 candidates have been trained and 20,934 agri-ventures have been established throughout the country between 2002 to June 2016. Some other initiatives include Mera

Gaon Mera Gaurav (MGMG) programme, Farmer FIRST programme, promotion of farmer to farmer extension, farmer field school, extension-reforms farm school. During 2017-18, 25 Agri-business incubation (ABI) centres were supported/established in various institutes and under Farmer FIRST project 51 FFP centres spread over 20 states of India were funded.

Short-Comings / Lacunae of Indian Agriculture

The transformation of the agricultural sector from production-oriented to market-oriented is the need of the hour. We are still stuck with the production aspect i.e. input requirement, input use efficiency, production technologies, and related activities. The surplus in production as of now amounts to half success and is therefore not sustainable in the long run as dumping of tomatoes, milk and other produce in 2017 exemplify neglect of this other half segment of agriculture.

The post-production understanding of what the markets demand points to the need for promoting "fork-to-farm" signals rather than a "farm-to-fork" discussion. The youth wants agriculture to become market-driven and have a profit motive. The course curriculum of agriculture also hasn't been updated much according to the needs of the market. STUDENT READY is the recent update that has been brought for RAWE that too only for the UG degree programme, but what about the other degree programmes?

Prospects of Indian Agriculture

According to the report of Doubling Farmer's Income by 2022, agriculture holds a lot more potential to attract youth into it. The main key features of the report are discussed here:

1. Credit linked subsidy back-ended scheme for the agricultural graduates to set up static and mobile testing laboratories (STLs/MTLs). On the occasion of National conference on Agriculture 2022: doubling farmers' income, Our Prime Minister Shri Narendra Modi said that the package of products provided to farmers based on the results of soil health testing should be included in the training module of B.Sc. Agriculture course which could also be linked to skill development. The agricultural graduates should be provided with the training and investment to set-up soil testing labs at the block and district level and cater to the needs of the farming community. SAUs may launch short-term diploma courses on soil health management for 10+2 pass rural youth to supplement these STLs.

2. Development of cold-chain/agri-logistics infrastructure coupled with market reforms under the APLM Act, 2017 would not only strengthen the linkage between MSMEs and large enterprises but will also incentivize the entrepreneurs in food processing industries (FPI) to set up plants near to the village/semi-urban centers. This will create considerable off-farm/non-farm employment for rural youth and can act as reverse logistics to supply consumer goods in rural areas.

3. Food processing is another sector within agriculture which is showing immense potential as the market of food processing is expected to grow to $543 billion by 2020 with a CAGR of 14.6%.

4. Promotion of seed production activity as an enterprise for youth and the creation of 'Seed Export Hubs' can help them to gain employment and steady income.

5. Entrepreneurship in the organized retail chain for fruits and vegetables can be promoted. Example: SAFAL.

6. Creation of Farmer Producer Organisation (FPO): The farmers can also connect with rural haats and big markets in the area by forming small organizations at their level. By becoming a member of such an organization, they will be able to buy in bulk, sell in bulk, thus increasing their earnings.

7. Nutrition led marketing is another market that is expected to bloom and attract youths into it due to the rising awareness level of nutrition and health-consciousness amongst the younger generation. Example: organic farming.

8. Primary Rural Agricultural Markets (PRAM/GrAM): Under the scheme, the infrastructure of 22 thousand rural markets shall be developed and upgraded and will finally be integrated into the APMC. This means that the farmers will have a regional market at a distance of 5-15 kilometers that will help him connect with any of the markets in the country. Farmers will be able to sell their produce directly to the consumers through these rural markets thereby increasing their income and the consumers will get good quality products at a cheaper price, which can be a win-win situation for both the consumers and farmer producers.

9. Promoting animal husbandry and pisciculture and initiating Pashu Vigyan Kendra on the lines of KVKs: Within the food sector there is a growing demand for proteins, fruits, vegetables, meats, fish, milk, etc. with a substantive transition from the cereal base. ex: BAIF.

10. Pack-houses: Women can be actively employed in sorting, grading, and packing activities, and rural youth can be promoted to take up driver-entrepreneurship on the associated transportation units.

11. Mushroom cultivation can be taken by the youths as its demand has increased over time due to changes in consumption habits.

12. Linkages with other sectors: production linkage is of two types backward and forward which arise from the inter-dependence of the sectors on each other for meeting its input demands. In 2006-07, for the production of one unit of agriculture, 0.138 units were required from agriculture itself, 0.083 units were required from industry, and 0.095 from the service sector.

13. Entrepreneurship in farm mechanization: custom hiring services/ uberization is a very common and successful concept in Punjab which can be easily replicated in other states involving farm youth.

14. Under RKVY-RAFTAAR, funds and training are provided for promoting enterprise and incubation centres.

15. Agri-tourism: ATDC, Maharashtra is facilitating linkages with other sectors, for example, agriculture and tourism provide the most natural entry points for synergies through agro-tourism. Weaving in the agricultural sector into tourism is a means to stimulate the revenue of agribusinesses and hence creating jobs.

Agricultural Skill Council of India (ASCI)

ASCI collabs with government departments and institutions like the Ministry of Agriculture and Farmers' Welfare, Ministry of Defence, Ministry of Rural Development, Ministry of Environment & Forest for benefitting the youth by providing skill-based training. They even organize job fairs/ rozgar melas at different places where employers from agriculture and allied sectors participate and offer placements.

They have developed more than 150 quality packs (QP) in the field of agriculture and allied sciences, majorly classified into farm mechanization and precision agriculture, agricultural crop production, amenity horticulture and landscaping, production horticulture, animal husbandry, agri-information management, dairy farm management, equine management, poultry farm management, fisheries, soil health management, commodity management, post-harvest supply chain management, seed industry segment, forestry/ agroforestry, watershed management, and other allied sectors.

Job Opportunities for Youth in Agriculture

The incomes of farmers can be significantly improved by shifting the workforce away from agriculture to more productive employment in the non-farm sector (Himanshu, et al., 2016). The assumed rate of shift is at 2.0 per cent per annum for all the states/UTs, where the rates of the shift have been less than 1.81 per cent.

According to a market research report "Smart Agriculture Market by Hardware and Network Platform (GPS/GNSS Devices, Sensor Monitoring Systems, and Gateway/Router), Service (Connectivity, System Integrator, Supply Chain Management), Software, Application, and Geography - Global Forecast to 2022", the smart agriculture market has been estimated to reach USD 18.45 Billion by 2022, at a Compound Annual Growth Rate of 13.8%.

The driving force for the Smart agriculture market is an increase in the adoption of technology in agriculture, the global increase in food demand, and assistance in monitoring livestock performance and health. The seven sectors of satellite mapping, e-market platforms, livestock traceability, climate sensing stations, product traceability, agriculture drones, and smart farming together have the potential to create approximately 2.1 million additional jobs with an annual job value of around INR 34,000 Crores. for the Agriculture sector throughout the country in the next 8 – 10 years.

These applications will bring forth a lot more predictability in farming practices and will help in improving the income and life of the farmers which will, in turn, reinstate the faith of the current generation on farming activities. Furthermore, this shall pave the way for the creation of many IoT based jobs for the Agriculture sector.

Agri-Tech Ventures in India

Today's youth is tech-savvy by nature as technology provides accurate and reliable results. Agriculture has also come under its influence as 9 per cent of the young females and 18 per cent of the young males were found to be interested in setting up an agri-tech business in the agriculture, forestry and fisheries sector.

Farmers have also realized 1.7 times increase in average income by trying new tech solutions that were made possible through digital penetration and funding to evolve farmers and Agritech start-ups rapidly over the past few years. In 2018, 35 new startups were established, summing up to 450 agri-tech startups in India which is currently growing at 25 per cent and together they were able to generate an investment of 248 million USD till June 2019 (NASSCOM, 2019).

The agri-tech ventures are majorly working in these broad areas:
1. Market Linkage provides a digital platform that connects farm output with the customer, it is one of the easiest ways to take farmers' products directly to the end customer. It features an efficient supply chain. Example: Our food, Ecozen solutions, Agrowave, Farmlink, Agricx, Waycool, etc.

2. Digital/Precision Agriculture based businesses offer innovative technology solutions for increasing crop productivity and farming process efficiency through traceability and crop scanning. Example: Fasal, Cropin, Kisan Hub, Kisan Raja, Krishi Hub, Agnext.

Fasal is an Artificial Intelligence-powered IoT platform that uses AI and data science to make on-farm predictions and delivers actionable insights and recommendations to farmers to grow more and grow better. FASAL helps in irrigation management, pest and disease management, fertilizer, and pesticide management. It predicts disease and pest outbreaks and provides strategies accordingly.

Fasal works in the pre-harvest value chain of food production intending to reduce the input cost in terms of water, and chemical usage, improved crop yield. Farmers were able to increase their crop yield by 10-15 per cent, save water up to 20-25 per cent, and reduce the number of chemical sprays up to 40 per cent.

3. Providing farmers with better access to agricultural inputs at their doorsteps helps them to understand the best input product to increase the yield and productivity. Example: Dehaat provides 360° solutions to farmers under one roof through their dual delivery model of the technology platform and service delivery center.

They connect farmers to the latest technology and information, market quality input, and technical support throughout the season at affordable prices. It offers services related to crop input, crop output, and crop advisory. Example: DeHaat, Bighaat, Agrostar, Gramophone, etc.

4. Custom Hiring Services/ Uberization: Farming as a Service offers affordable technology solutions to farmers for efficient farming by converting fixed cost to variable cost on one hand and providing access to expensive implements on the other hand. Example: EM3, Oxen, Kheytinext, Goldfarm, etc.

5. Financing: Farmers in India struggle to get finance but agritech based financing start-ups helps with easy access to finance. Farmers do not have a good credit history which makes it even more difficult for them to raise funds through traditional channels. Example: Gramcover, Samunnati, Jai Kisan, farMart, etc.

The agri-tech ventures in India are not having a smooth sail, as it seems to be as these ventures also face hardship and challenges like any other sector. According to the NASSCOM Agritech CEO Survey, 2019 the major challenges for Indian agri-techs were outlined to be raising funds (39%), lack of policy (29%), lack of digitalization (20%), and farmers mindset (12%).

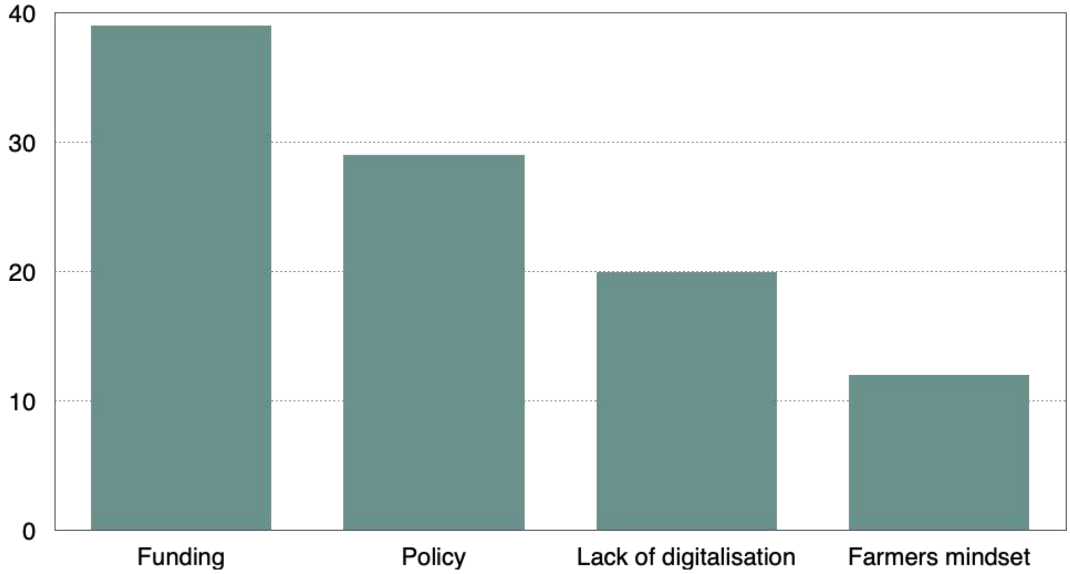

Figure 1: Key challenges for India agri-tech firms

Impact of COVID-19 on Agriculture and Agri-Start-ups

Food has always been one of the most important commodities for the survival of life on earth and the outbreak of COVID-19 has helped us to realize the importance of farming and food. The outbreak of pandemic in India lead to a delay in the harvest of rabi crops, the higher unemployment rate in India as many daily workers/ private job employees lost their jobs, huge economic loss to different sectors and enterprises as they ran out of business.

The agriculture sector also faced a huge setback as the supply chain was disrupted, APMC was non-operational for quite some-time and the farmers had to suffer huge economic loss. The lockdown highlighted that despite achieving self-sufficiency in food-grain production, India has a poor post-harvest mechanism. The agro-tourism will have to go under wraps for some years, agri-start-ups are recommended to extend their runway time-period as the generation of new investments will be extremely difficult.

Along with the supply chain, the input delivery system has also faced challenges, thereby making way for the alternatives, for example, to tackle the issue of non-availability of laborers, direct-seeded rice was promoted and adopted by the farmers in Punjab. The online delivery system of food items was benefitted during the lockdown as most of the people preferred home delivery over them visiting the market place on their own. During the Unlock phase of lockdown, several agri-techs were able to generate funds as it became quite evident that the future of farming lies with the digitalization, mechanization, and other man-less technologies to ensure the safety of the products and the humans.

Jai Kisan, a Mumbai-based fin-tech platform that caters to the financial needs of the emerging rural markets raised 30 crores as series A funding while another agri-tech startup AgriO2O, a New Delhi-based company which manufactures hydroponics-based farm equipment secured an angel funding. This sudden increase in investment in agri-tech companies indicates the increase in awareness of business houses towards the importance of agriculture and food and its life-supporting role. These also signify the creation of jobs and opportunities for youth in agri-techs and will fuel the agripreneurship ideas of young farmers and agriculturists.

Conclusion

The challenges relating to youth and agriculture are complex and haven't been understood well until now. Most of the discussions focus on what needs to be done and not how things need to be done. Various committees have almost similar recommendations for engaging youth in agriculture, but all these recommendations lack the roadmap of achieving the said goals.

There are approximately 145 agri-tech ventures in India, but none of them has been founded by an agricultural student, the reason for this may be because the agriculturists are not exposed to the concept of thinking agriculture from the business or a profit-making point of view. Most of the recommendations are for transfer of knowledge, youth-specific skill development programmes, use of ICT in agriculture, better supply chain management. While these interventions are aimed at inspiring the younger generations to enter the agriculture section, the response is not commensurate to the efforts put in by the national and international institutions.

Non-engagement of youth in the discussions and overlooking their wants and aspirations have given rise to negative perceptions regarding agriculture as a profession. Considering the demands and needs of the current generation, it can be said that they do not lack drive, are open to alternate forms of employment, and have some profit orientation too. These attributes point towards the trainability of present-day youth in Agri-preneurship building programmes. It has to be understood that before accepting a job in the agriculture sector, modern youth will pitch themselves against others working in the private/public sector that is risk-free and provides steady income every month.

The state governments should try to create enough additional employment opportunities in the agriculture sector so that the youth would be attracted to stay home and take up the farming activity. Post-pandemic consumers would be more concerned about the origin of their food-produce, for which the state governments should try to encourage the cultivation of food products based upon the consumption habits and requirements of the general masses. The post-harvest operations should be given a boost to ensure minimum wastage of food and better alignment of demand and supply of food.

Post-pandemic, Block-chain, increased R&D in the agriculture sector, the achievement of >50 per cent of self-sufficiency in food-grain production as per the consumption habits of the state are some of the areas where the government can focus upon to make agriculture more attractive for youths. Another issue that lies for the youth is that, it is very rare to find agriculturists turning into agri-preneurs.

The underlying reason may be because the entrepreneurship requires risk-bearing ability, keen knowledge about business, decisive and action-oriented mindset and many other factors which are hard to come by. Therefore, efforts should be made to modify the course curriculum in such a way, so that the young minds could have a practical exposure towards the entrepreneurship in agriculture which may help them to develop interest in this field.

The six key interventions for attracting youth in agriculture were discussed by Katyal and Katyal (2018) that included investigating youth's issues and demands, followed by creating awareness amongst them about the available modern techniques and technologies that agriculture can offer to them.

Experiential learning programmes on the production of high-value products can be conducted by the Agriculture Skill Council of India (ASCI) thereby converting farmers to Agri-preneurs. Developing supply-chains and markets for the better sale of produce and exploiting the full-potential of processing in agricultural commodities can help attract youth in non-farm sectors.

Policy intervention along with institutional, financial, and legal backing up of public bodies like NITI Aayog and Ministry of Agriculture and Farmers' Welfare Ministry can effectively help in stimulating the core concerns of youth regarding agriculture. Moreover, the issues discussed here indicate changing the orientation of farming from production to marketing to make agriculture profitable and attractive for today's youth.

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Cultural Practices in Integrated Disease Management

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Introduction

The term cultural control describes the activities of humans aimed at controlling disease through the cultural manipulation of plants. The methods of cultural control of disease involves agricultural cropping, harvesting and storage, tillage, crop rotation, soil management, growing of resistant varieties, planning of land use and other related practices. The success of cultural practices depends upon understanding the biology of pathogen and response of the host to infection.

Disease Management Through Cultural Practices

Cultural practices - Practices pertaining to the cultivation of crops.

Principles (Avoidance, Exclusion, and eradication).
1. To destruct infection centre.
2. To break infection chain.
3. Starving of pathogen.
4. Create unfavourable conditions for pathogen.

Methods

1. Cultural practices which reduce initial levels of inoculum.
2. Cultural practices which reduce the rate of spread of disease.

Cultural Practices Which Reduce Initial Levels of Inoculum

1. Selection and preparation of planting materials:

a. Selection of geographical area and field
b. Disease escaping verities
c. Resistant cultivars - continuous plant breeding programs
d. Avoid monocultures and follow mixed cultivars and multiline cultivars
e. Use of certified seed (internal, external and contamination) - to avoid introduction of disease in new area.
f. Dry climate for seed production - Anthracnose of Bean *(Colletotrichum lindemuthianum)* and cucurbits *(C. lagenarium)*, Ascochyta blight of Pea, Bacterial blight of Bean (*Pseudomonas syringae pv. pisi* and *P. s. pv. phaseoli*) and black rot of cabbage *(Xanthomonas campestris pv. campestris)* can be avoided.
g. Isolation distance for seed plot and inspection of seed plots.
h. Drying (Downy mildew of maize) and aging of seeds to reduce pathogen viability- Fusarium wilt of cucurbits: (internally seed borne) store seeds more than 2 years and in case of cotton bacterial blight store seeds more than 1 year.
i. Cleaning of seeds (Sclerotia, Ear cockle or cyst, ergot and smut of pearl millet) - hot air blast and 20 % common salt solution for hand cleaning.
j. Thermal and chemical treatment of seed/setts to control seed/sett borne diseases - Hot Water Treatment (52 °C for 20-30 min.) for sugarcane setts and Thiram/vitavax seed treatment in wheat.
k. Site and treatment of nursery beds - Citrus gummosis, club root of cabbage, RKN of tomato.
l. Adjustment of harvesting time of the crop; Delayed harvesting of grains in temperate region - contaminate the grain.
m. Selection of planting material. Contaminated knives and secateurs during the preparation of vegetative propagated material for planting - Black scurf of potato, red rot of sugar cane.

n. Proper hygiene procedures during planting. Seedling injury (transplanting) and labour contaminate with Tobacco mosaic virus.

2. Destruction of crop residues:

a. Burying **(Sclerotium rolfsii)** - deep ploughing

b. Burning (flag smut in wheat): Burning 10 cm layer of litter on the soil surface destroys nematodes to a depth of 9 cm.

c. Removal of infected crop debris.

3. Elimination of living plants/plant parts that carry pathogens - volunteer host plants, alternative hosts – Roughing:

a. Eliminate Juniper plants to reduce pear rust *(Gymnosporangium).*

b. Removing diseased plants or plant parts in Loose smut of wheat (before ear head emergence).

c. Pruning and use of disease-free scion and root stock.

4. Management of insect vectors: Removal and destruction of breeding sources.

5. Crop Rotation: Deep rooted crops rotated with shallow rooted crops i.e cereals with pulses.

For soil borne pathogens, the pathogen not get host and die:

Beneficial crop	Pathogen reduced	Host
Rice	*Verticllium dahlia*	Cotton
Pea	*Goeumannomyces graminis*	Wheat
Maize, Wheat and Sorghum	*Ralstonia solanacearum*	Potato
Legume cover crop	*Streptomyces scabies*	Potato
Barley	*Meloidogyne incognita*	Cotton
Groundnut	*Meloidogyne incognita*	Tomato
Beet	*Pratylenchus penetrans*	Cereals
Legume, Sesame and Wheat	*Pratylenchus indicus*	Rice

Cultural Practices Which Reduce the Rate of Spread of Disease

1. Tillage Practices: Ploughing under infected plants after harvest, such as leftover infected fruit, tubers or leaves, helps to cover the inoculum with soil and speed up its disintegration and concurrent destruction of most pathogens carried in or on them.

2. Drainage: Removal of excess water. Sett rot of sugarcane and Downy mildew of Bajra are reduced.

3. Fallowing: The field is tilled and left fallow for a year or part of year. During fallowing, pathogen debris and inoculum are destroyed by microorganism with little or no replacement. In areas with hot summer, fallowing allows greater heating and drying of the soil, which leads to a marked reduction of nematodes and some other pathogens.

Ex: *Fusarium moniliforme* infection on sorghum and corn has been reduced dramatically. Flood fallowing reduces Panama wilt and root knot nematode incidence in Banana.

4. Sowing practices:

a. Alteration of date of sowing:

i. Early sowing - white rust of crucifers - less disease.

ii. Sowing immediately after rains - *Rhizoctonia* root rot of Gram - severe disease.

b. High temperature and moisture: In North India, early planting (October) of Pea and chickpea result in more severity of root rot and wilt disease.

c. High temperature and moisture:

i. Early sowing - Groundnut leaf spot disease is managed.

ii. Late planting - Bacterial blight of cotton and Downy mildew of Maize is managed.

iii. Feb-March planting - BYVMV disease in okra is very less.

d. Depth of sowing:

i. Deep sown Potato piece - more of *Fusarium* spp. and *Rhizoctonia* diseases

ii. Deep placement of seed – more of Head smut disease in maize.

iii. Deep placement of seed increases the *Ascochyta* blight disease in Chickpea.

e. Crop density:

i. Increase plant density in (*Pythium*, *Fusarium*, *Rhizoctonia*) infecting crops.

ii. Less problem of white fly, *Cucumber mosaic virus* and *Verticillium* wilt of cotton in dense plant compared to crop sown in less densely.

f. Direction of sowing: Modifying the soil environment and provides good drainage.

5. Intercropping:

a. Chick pea + Barley reduce the *Ascochyta* blight of chickpea.

b. Soybean rust (*Phakopsora pachyrhizi*) is more severe in soybean and maize intercrop.

c. Anthracnose (*Colletotrichum lindemuthianum*) is more severe in maize and cowpea intercrop.

6. Mixed Cropping:

a. Pigeon pea + Sorghum - reduce *Fusarium* wilt disease in Pigeon pea.

b. Wheat/Barley+ Chick pea/Pea - reduce wheat rust.

7. Management of top soil and soil amendments: Mulching, summer deep ploughing, burning of thrashes (30-45cm) on nursery bed - reduce the disease spread (rain splash).

8. Flooding: Flooding of cotton field infected with *Xanthomonas campestris* pv. *malvacearum* (wilt) for 6 weeks reduces the disease but little effect on *Verticillium* wilt.

9. Irrigation:

a. Irrigated fields - less incidence of scab and charcoal rot of potato.

b. Excess irrigation - more of citrus gummosis and damping off diseases.

10. Fertilizer applications and crop nutrition:

a. Zinc application- reduces maize downy mildew

b. Sulphur fertilization - inhibits the occurrence of *Cercospora* leaf spot in groundnut

c. More nitrogenous fertilizers - More Powdery mildew, Downy Mildew, Ergot and Rust, Rice (Blast, false smut, sheath blight and bacterial leaf blight)

d. More Phosphorous fertilizer - less potato scab and more *Cucumber mosaic virus* in spinach.

11. Management of soil acidity and alkalinity:

a. Club root of cabbage reduced by increasing the soil pH >7.

b. Common scab of potato - severe at pH 5.2-8.0 - application of Sulphur may reduce the disease.

12. Strip farming: The rate of spread of more specialized parasites is restricted.

13. Trap and decoy crops:

a. Oat crop - manage cereal cyst nematode (early harvest of oat crop for fodder).

b. Rye grass (*Lolium* spp.) reduces the incidence of club root of crucifers (*Plasmodiophora brassicae*) in infested soil and poisonous weed (*Datura stramonium*) reduces the incidence of powdery scab of potatoes (*Spongospora subterranea*).

14. Harvesting time and practices: Careful handling of agricultural produce: *E.g.*: Harvesting of mango without pedicels during cloudy weather leads to more stem end rot disease.

Rural Development: A Pre-requisite for Indian Economy

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Abstract
Rural development has been a topic of interest among the researchers and policy makers since last few decades. India being an agrarian economy has vast areas of villages. Majority of people in India still reside in the rural areas and it is thus very important to develop them in order to have a comprehensive development of the country. Ensuring inclusive growth and development can help the rural people gain better standards of living and attain psychological and financial security. This article aims to highlight the importance of rural development and the various aspects that need to be taken care of to bring about socio-economic development of the rural masses.

Keywords: Development, Economy, Rural.

Introduction
G. Shah defines rural development as "the development of rural areas, often rural development has meant the extension of irrigation facilities, expansion of electricity, improvement in the techniques of cultivation, construction of school building and provision of educational facilities, health care etc." It is important to understand that rural development is a process aims at improving the quality of life and ensuring economic wellbeing of the rural masses.

Moreover, it is all the more essential as most of the rural people in India depend on agriculture not because it is profitable but because they have no other employment opportunities with them. Thus, rural development is important for bringing about stability in the lives of the needy. The concept of this is very extensive and comprehensive.

Scope of Rural Development in India
The concept of rural development focuses on the upliftment of the rural economics of the various sections and levels of people in India who face gave poverty issues. Not only that, but it also emphasizes to combat the various problems faced by the villages which hold back their growth.

Developing rural areas focus on the improvement in the following sectors of the peri-urban areas:
1. Health and sanitation of the village
2. Education
3. Women Empowerment
4. Ensuring law and order of the area concerned
5. Land reforms
6. Development of infrastructure for agri-allied activities
7. Availability and access to credit facilities.

Thus, the term rural development encompasses a long-term and complex process that involves the fundamental transformation of the rural society at all levels through planned programmes.

Important Aspects of Rural Development
The essentials aspects of rural development are as follows:
1. Agricultural Development using better inputs, infrastructure and land reforms.
2. Changes in the socio-economic institutions.
3. Political non-interference for better effectiveness and implementation of the development programme.
4. Cooperation and positive attitude of the people involved in the programme.
5. Active participation of the rural masses guided by dedicated and committed village leaders.

Fig1. Rural Masses Engaged in Different Activities

Integrated Rural Development

The very concept of IRD is the need of the hour especially in the context of India. It addresses itself to multifarious problems of the villages at the same time in an integrated and interdependent approach. Rao defines integrated rural development as "the optimum utilization of the natural and human resources of a given rural area for the enrichment of the quality of life of the population." It is a holistic concept rather than a sequential one. It thus signifies that various facets of rural development are integrally connected.

Conclusion

Rural development is an important and essential concept in developing countries like India. Apart from strengthening the agricultural sector, rural development aims at creating rural entrepreneurship that plays a vital role in the development of the country. It helps in generating employment opportunities in the villages with low capital, raising the real income of the people, contributing to the development of agriculture by reducing disguised unemployment, underemployment, unemployment, poverty, migration and economic disparity. Thus, it is necessary to monitor the rural development programmes by ensuring information symmetry, providing adequate and timely credit and giving constant motivation to the ruralites by the government, academicians and the extension workers for successful implementation of the rural development programmes.

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Finger Millet: For Alleviating Malnutrition in Reference to Climate Change

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Agriculture is adversely affected due to aberrant weather conditions that is increased temperature and changing rainfall pattern (onset, quantity and intra-seasonal distribution) posing a threat to food security. Climate change and population explosion are exerting pressure on agriculture sector to produce more food from less land. The uncertain climatic conditions such as changing temperature, erratic rainfall, and onset of severe floods and droughts are affecting the food production and food security.

A key issue is whether we will be able to feed the projected global population of 9 billion in 2050 equitably, healthily and sustainably (Beddington, 2010). The possible alternative is identifying suitable crops that are adaptive to local climate, have high nutrient value and can efficiently withstand biotic and abiotic stresses.

Introduction

Wheat and rice are the major staple food of most of the world population. The production of wheat and rice increased manifolds while production of millets lagging behind after Green revolution. Millets domesticated and cultivated by small farmer in semi-arid and tropical regions. Millets include small-grained cereal crops, namely finger millet (*Eleusine coracana*), Pearl millet (*Pennisetum glaucum* (L.) R. Br), proso millet (*Panicum miliaceum*), kodo millet (*Paspalum scrobiculatum*), foxtail millet (*Setaria italica*), barnyard millet (*Echinochola crusgalli* (L.) P.Beauv.), and little millet (*Panicum sumatrense*).

India is contributing nearly 60% of the global production. Finger millet is consumed without dehulling. It well adapted in higher rainfall areas (600-1,200 mm) and wide range of agro-climatic conditions. It has greater resistance to pests and diseases and can withstand significant levels of salinity, short growing season, resistant to water logging, drought tolerant, requires little inputs during growth. In India, it is widely cultivated in the states of Karnataka, Tamil Nadu, Andhra Pradesh and parts of North India.

Nutraceutical Importance of Finger Millet

Nutrient composition of millets with respect to protein, carbohydrate and energy values are comparable to the major cereals like Rice, Wheat, Maize and Sorghum (Tables 1). It has high content of calcium (0.38%), protein (6%–13%), dietary fibre (18%), carbohydrates (65%–75%), minerals (2.5%–3.5%), phytates (0.48%), tannins (0.61%), phenolic compounds (0.3–3%) and trypsin inhibitory factors. It has anti-diabetic, anti-diarrheal, anti-tumerogenic, anti-inflammatory, antiulcer, antioxidant, atherosclerogenic effects and antimicrobial properties.

Table 1 Nutrient Composition of Cereal Grains

Crop	Protein (%)	Fat (%)	Starch (%)	Ash (%)	Carbohydrates (g)	Total phenol (mg/100 g)	Crude fibre (%)	Total dietary fibre/100 g
Wheat	14.4	2.3	64	1.8	71.2	20.5	2.9	12.1
Rice	7.5	2.4	77.2	4.7	78.2	2.51	10.2	3.7
Maize	12.1	4.6	62.3	1.8	66.2	2.91	2.3	12.8
Sorghum	11	3.2	73.8	1.8	72.6	43.1	2.7	11.8
Finger millet	7.3	1.3	59.0	3	72.6	102	3.6	19.1
Pearl millet	14.5	5.1	60.5	2	67.5	51.4	2	7
Proso millet	11	3.5	56.1	3.6	70.4	0.10	9	8.5
Foxtail millet	11.7	3.9	59.1	3	60.9	106	7	19.11
Kodo millet	8.3	1.4	72.0	3.6	65.9	368	9	37.8

Little millet	7.7	4.7	60.9	6.9	67	21.2	7.6	-
Barnyard millet	6.2	4.8	60.3	4	65.5	26.7	13.6	13

The seed coat also shows anti-cancer and anti-diabetic activities, mainly due to its high polyphenol content that indicates anti-oxidant activity, and high fibre that promotes slow digestion and blood sugar stability (Devi et al., 2014). The finger millet grains are superior to rice and wheat as it contains essential amino acids such as methionine and tryptophan, (Fernandez et al., 2003).

Finger millet has slow digestibility, thereby supplying energy throughout the day. The plant itself is reported to be diaphoretic, diuretic, and vermifuge, and its leaf juice has been given to women in childbirth (Dida and Devos, 2006). It has also been used as a folk remedy for various ailments including leprosy, liver disease, measles, pleurisy, pneumonia, and small pox (Dida and Devos, 2006).

It helps in preventing constipation, high cholesterol formation, diabetes and intestinal cancer due to high fibre content. Finger millet is gluten free and hence beneficial for patients suffering from celiac disease.

Why Finger Millet is Known as Climate Resilient Crop?

Finger millet is generally cultivated in arid regions which well adapted to adverse climatic conditions, grow under high temperature, low moisture and poor soil or infertile soil. Compared to all the cereals finger millet is less sensitive to climate variability and generally experiencing smaller decline in yields under climate extremes hence known as a climate resilient crop.

Conclusion

Finger millet is high in calcium, zinc and iron and referred as a nutri-cereal or as a nutraceutical crop hence, it is beneficial for children, women and breast-feeding mothers. It possesses important amino acids, which help fight malnutrition and hidden hunger worldwide. Although wheat and rice are the major cereal crops of the entire world still finger millet plays an important role in supplying staple food due to its higher nutritional qualities. It provides food security for poor people in Sub-Saharan Africa and South Asia due to its longer storability. In addition, shorter duration and suitability to cultivate in all seasons make it a desirable crop in an intensive cropping system. The seeds of finger millet have an extended shelf life as they are resistant to damage by storage pests, hence the seeds can be stored for famine prone periods and areas. It not only provides food security but also provide fodder, fibre, nutrition, health, environment and livelihood with minimum cost of production which offers great opportunities for food and nutrition security.

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Active Packaging: A Modern Packaging Technology

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Introduction

In recent years food packaging is not merely a resistance against the external contamination. Humans have reached a threshold in production of food but the problem of safekeeping the produce is still questionable Which lead the researchers to quest for innovation in food and beverage packaging fulfilling the demands of the future world. Now there an increasing demand for a food packaging which not only protects the food but increases its shelf life with retention of flavours, colour and aroma.

Packaging protects the food from environmental factors such as heat, light, moisture, oxygen, enzymes, spurious odours, microorganisms, insects, dirt and dust. Some future demand functions of packaging are traceability, tamper indication and product quality. One of the technologies which are used for high-quality foods is Active packaging.

Active Packaging

Food either it is raw or processed is in continuous interaction with the atmosphere. The food itself keeps on releasing gases which significantly affects the quality of the food. Active packaging deals with the gases which surround the products in the package or is present in the headspace above the food.

Active packaging takes advantage of the technology in packaging films which are selective in nature that is they allow selective gases across it. So Active packaging may be defined as a packaging in which subsidiary constituents have been deliberately included in or on either the packaging material or the package headspace to enhance the performance of the package system (Roberson, 2016). Active packaging actively maintains or improve the condition around the food by either allowing or removal of gases around the food or headspace.

Packaging increases the shelf life by controlling the moisture migration, respiration rates, microbial growth, volatile flavours, aromas and delaying oxidation. The selectivity of packaging material to several gases can be varied through micro-perforation, coating, lamination, co-extrusion and by using certain Nano-composites (creates a barrier for oxygen, carbon dioxide, moisture etc.).

Applications of Active Packaging

1. Oxygen Absorbers: As the name suggests the packaging system can absorb oxygen. These are also known by the name of oxygen scavengers which makes use of either iron or ascorbic acid. By using iron powder(large surface area can capture more oxygen) very low oxygen concentration which is less than 0.01% can be achieved which is lower than the oxygen levels achievable by vacuum or gas flushing.

Oxygen scavengers also work by the mechanism of the metal catalyst, ascorbate/metallic salts and on enzyme based. These packages are used for bread, cake, cooked rice, biscuits, cured meats and fish, dried foods and beverages (Lee, 2010).

2. Carbon dioxide Scavengers: CO_2 Scavenger can be physical absorbents such as zeolite or an active carbon powder or chemical absorbents such as $Ca(OH)_2$ or $Mg(OH)_2$ usually packaged in small pouches of paper with perforated polypropylene. Carbon dioxide absorbers also use Iron oxide/calcium hydroxide, ferrous carbonate/metal halide. These package systems are used in coffee, fresh meats and fish, nuts and snacks (Zhou *et al.*, 2010).

3. Ethylene absorbers: Plants release ethylene during ripening process which can have both positive and negative effects on the fresh produce. As they can catalyse the ripening process but in return, they also increase respiration rate as their limitation which is not desirable inside the package (Prasad and Kochhar, 2014).

Ethylene absorber packaging system takes use of potassium permanganate, activated carbon and activated clays for their function. Among them potassium permanganate is toxic hence it is mixed with an inert substrate such as alumina and silica gel and placed inside a sachet which is added in the packages. These are used in fruits and vegetables (Smith et al., 2009).

4. Moisture Absorbers: Moisture plays an important role in deciding the shelf life of a stored product. In high moisture food packages, there are chances of liquid water accumulation on the package due to temperature fluctuation which can lead to spoilage due to moulds and bacteria or deterioration of quality in the package. For such purpose, moisture absorbents are used which are made two-layer of microporous or nonwoven films between which a superabsorbent material is placed (Rooney, 1995).

Superabsorbent polymers have a high affinity for water and can absorb 500 times its weight of water which includes carboxymethyl cellulose, graft polymer of starch and polyacrylate salts. These are generally used in fish, meat, poultry, snack, sandwich and horticulture products (Aday *et al.*, 2011).

5. Ethanol Emitters: These are used to increase the shelf life by preventing mould growth. These are the sachets of ethanol absorbed on silica which generated fumes of ethanol inside the package. The main disadvantage of the method is that they can create off flavour and odours. The technology is being used from ancient times in Arab countries to increase the shelf life of fruits, and it is used in Japan to extend the shelf life of bakery products (Smith et al., 1995; Labuza and Breene, 1989).

6. Antimicrobial food packaging: These packaging materials increase the shelf life by reducing the growth of the microorganisms (Han, 2003). These packaging systems make use of several mechanisms such as organic acids, silver zeolite, spice and herb extracts, BHA/BHT antioxidants, vitamin E antioxidant, volatile chlorine dioxide, sulphur dioxide to control the growth of microorganisms. These are used in the packaging of fruit juices, fried snacks, fish, meat, dairy and poultry products (Cooksey, 2005).

7. Flavour/odour absorbers: Depending upon food inside the package there is a requirement to alter the Odour inside the package. Depending on the need either to keep or to remove the odour out of the package several active packaging materials such as cellulose triacetate, acetylated paper, citric acid, ferrous salt/ascorbate, activated carbon/clays/zeolites are used. This package system is used for fruit juices, fried snacks, fish, cereals, poultry and dairy products (Brody et al., 2001).

8. Temperature-controlled packaging: Several foods require to be served at a particular temperature either hot or cold. Temperature can be controlled by two methods either using insulating materials or by increasing the thermal load of the food. Self-heating can are in trend from a long time in Japan, they make use of the exothermic reaction of lime and water to heat the food product.

This type of packaging system takes use of non-woven plastics, double-walled containers, hydrofluorocarbon gas and ammonium nitrate/water. These are usually used in ready to eat meal, meat, fish, poultry and beverages (Day, 2003).

Conclusion

Active packaging system provides a means of increases shelf life with better retention of flavours and a lesser amount of preservative needed. This system offers a vast opportunity in the field of food processing which can be trusted by consumers as it is capable of maintaining both flavour and nutritional value altogether. However, the implementation of such technology still depends upon firstly on cost-effectiveness and acceptance in the market.

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Weaning Food

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Introduction

Weaning food plays an important role in the overall growth and development and mental health of the children (Amankwah et al 2009). Infants need nutritionally balanced supplementary foods in addition to mother's milk because of the increasing demands of the growing body (sajilata et al 2002; Umeta et al 2003).

Age to Introduce Weaning Food

Infants need nutritionally balanced supplementary food in addition to mother's milk after an age of 6 months, because of the increasing nutritional demand of the growing body.

Need of Weaning Food

As the baby grows and becomes more active, breast milk alone is not sufficient to meet the full nutritional and physiological needs of the infant. Weaning food play an important part in the development of neuromuscular coordination.

The Characteristics Needed in A Weaning Food

1. The food should be rich in calorie and adequate in protein, vitamins and minerals.
2. The protein should be of high biological value.
3. The food when stirred up with cold/warm water or milk should form a slurry or semisolid mass of soft consistency enabling the child to swallow it easily.
4. The food prepared as above should have low dietary bulk or viscosity.
5. As far as possible, the food should be precooked and pre-digested or processed in such a way, that it needs minimum preparations prior to feeding and is easily digested by the child.
6. The food should be free from anti-nutritional factors (substances that hinder the digestibility or are otherwise harmful, such as enzyme inhibitors, gas producing factors and toxic components).
7. The indigestible fibre content of food should be low.
8. It is advisable not to add artificial colours and flavours to weaning foods.
9. As far as possible, the composition of the food must be as per the guidelines laid down and standards recommended by the Indian Standards Institution (ISI) and other competent agencies.

Vitamin Content of Weaning Foods

In general, exclusively breastfed infants of mothers who do not have any vitamin deficiency are protected against vitamin deficiency, up to 6 months of age, except for vitamin K. However, in some situations, supplementation with some specific vitamins is necessary. After 6 months it is important to give fresh vegetables and fruit in addition to the breast milk and weaning food, for instance, a piece of banana, mango or papaya as a snack.

Dietary Fibre Content of Weaning Foods

Higher fibre content of weaning food may inhibit mineral absorption and reduce the digestibility of protein in foods (Amuna et al., 2000). The dietary fibre content of fortified complementary food should be reduced to a level not exceeding 5 g per 100 g on a dry weight basis (Huffman and Martin, 1994).

Animal Based Weaning Food

Animal products are rich source of protein, vitamin A and easily absorbable iron and folate. Meat and fish are best sources of zinc, while dairy products are rice source of calcium.

1. Meat: Meat is the rich source of protein of high biological value. It is Important source of highly bioavailable minerals such as iron and zinc.

2. Fish and sea food: Fish and sea food is the important source of good quality protein. Rich source of essential amino acid. These are the good source of iron and zinc.

3. Eggs: Egg protein contain amino acids essential to growth and development. Richin phospholipids with a high ratio of polyunsaturated to saturated fatty acids.

4. Milk and other dairy products: Foods in the dairy group provide nutrients that are vital for health and maintenance of body. Milk includes nutrients like calcium, potassium, vitamin D and protein. Used for building bones, teeth and maintaining bone mass.

Risk Involved During Weaning Food

1. Obesity.
2. Allergy.
3. Celiac disease.
4. Tooth decay.
5. Obesity.

Celiac Disease

Ivarsson et al. (2002) studied the epidemiology of this epidemic and found that the risk for the development of CD was reduced in children younger than 2 years if they were still being breast-fed when dietary gluten was first introduced. A further decrease in the risk for the development of CD was observed when children continued to be breast-fed after dietary gluten was introduced.

Tooth Decay

Children under the age of 2 are particularly susceptible to Early Childhood Caries (ECC), a serious public health problem. In some communities, the incidence of ECC can range from 20% to 50%. Children with ECC appear to be more susceptible to caries in permanent teeth at a later age. Dental caries can be caused by many factors, including prolonged use of a bottle and extensive use of sweet and sticky foods. Sugar intake is the major dietary risk factor for the formation of dental caries. Sucrose is the most cariogenic sugar because it can form glucans that enable bacterial adhesion to teeth and limit diffusion of acid and buffers in the plaque (Bowen et al.1997).

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Artificial Intelligence: Building Innovative Opportunities in Food Processing Industries

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Introduction

In recent year's human's dependency on the computer system is increasing day by day. Most of our needs are fulfilled by the online market. From a basic program to creating a system which can replicate a human brain and can take decisions by itself, computer programming has changed a lot. Artificial intelligence system is deeply interwoven with computerized systems, complex interaction, reasoning approaches and modelling. AI offers vast application in the food processing industry. Food industries have to deal with non-uniform, variable raw material with uneven shapes. There are several factors which are dealt with while processing such as flavour, texture, nutrient concentration and other properties. In addition to that biochemical changes inside the food, the product is dependent on temperature and moisture change. Food properties such as viscosity, thermal properties, electrical properties and density are a function of temperature, moisture and composition hence are difficult to control and predict the condition for best output. Artificial intelligence makes such properties easy to understand and gives the condition for best output. AI can deal with ambiguous and noisy data by use of fuzzy logic.

Artificial Intelligence

Artificial intelligence is an area of science in which we emphasize on creating a computer machine which can work and react like a human. Today we are seeing many examples of artificial intelligence around us such as speech recognition, face recognition in mobiles. Apart from them, artificial systems are being used for learning, planning and problem-solving. Artificial intelligence involves first training the system to perform the task and the system sets its algorithm accordingly after that similar to human mind while performing work it keeps on increasing its consistency. That means the system is updating itself related to the work it is doing. It is much like we train our dog first or as we teach our infants to learn several things.

Artificial Intelligence in Food Processing

In the food industry, we deal with a lot of variable data which is sometimes even difficult for humans to understand. Due to versatile data, it generates opportunities for artificial intelligence. There are a few examples where artificial intelligence is being used in the field of agriculture.

1. Improved Sorting: Non-uniform feedstock is one of the major aspects of the food processing industry. Sorting is usually done based on size, shape, and colour to increase the quality of the product. As Sorting is a laborious and time-consuming process it creates an opportunity for automation for a large reduction in labour costs, increases in speed, and improving yields. Artificial intelligence is playing a great role in sorting by using systems which use cameras, Near Infra-Red (NIR) spectroscopy, x-rays, and lasers to measure and quickly analyse every aspect of the vegetable (Walker, 2019).

2. Improved Packaging: Packaging of many food products cannot be done mechanically and they need human as helping hand which generates requirement of labour hence increases processing time. Artificial intelligence aided robots are being used to pack the food commodity. They not only pack the food but also keeps control on quality (Walker, 2019).

3. Improved Cleaning: Cleaning is one of the important unit operations to avoid product contamination cleaning. Manual cleaning is time-consuming and is not efficient due to human limitation. Moreover, manual cleaning requires more water as compared to machine systems. An artificial intelligence system named SOCIP (Self-optimizing clean in place) which uses Ultrasonic sensing and optical fluorescence imaging to locate the dust and clean the equipment efficiently. Use of this technology can reduce 20-40% cleaning time and resources and Saves 30% water (Anonymous, 2019).

4. Drying Using AI: Drying can result in to change in the colour, shrinkage and structure of dried food which can affect the quality of the product. Computer vision analyses the effect of drying condition such as temperature, power intensity, and airflow velocity, browning components, on food to improve the drying process. AI ensure high-quality dried products by collecting the data and providing a reasonable output condition for drying (Sun et al., 2019).

5. In deciding new product: Food processing industry have to face challenges to offer an endless variety of options. Recipes can be tweaked in an unimaginable number of ways to create a new product. Artificial intelligence helps in figuring out what exactly is the demand of customers. AI is being used by Coca-Cola who has installed many soft drink fountains in which they can customize their drink which generates data for peoples liking and is processed by AI for deciding their new product (Anonymous, 2020).

6. Classification of milk: support vector machine (SVM) neural approach is used for the calibration of the electric nose which can classify the milk based on odour. The odour is sensed by the electrical nose which sends the data in SVM neural network which classify the milk (Brudzewski et al., 2004).

7. Identification of Different Varieties: Several kinds of research are done in the field of identification of varieties by using computer vision. In one of the researches, a model was developed to distinguish the tea leaves of five verities were identified using linear discriminant analysis which results in 98.33% correct in the prediction test (Chen et al., 2008).

Conclusion

Artificial intelligence shows a vast opportunity in food processing which will increase the quality of the product and reduction in the processing cost and time. The market demand for rapid, on-site, highly sensitive, specific and quantitative measurement systems of varying quality, as well as processing parameters, can be fulfilled by AI but the ability to deploy and its usage need to overcome cultural and technological barriers along with cost-effectiveness.

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Irradiation: A Novel Food Processing Technique

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Introduction

The food industry has changed in recent years, as they have to focus on varying consumer demands. Now consumers are much concerned about the health benefit and risk associated with the food. The demand for natural flavours without preservatives is increasing as it is being considered that fresh food is healthier than heat-treated foods. Most of the processing techniques, for increasing shelf life we have to sacrifice our nutritional value, Flavours or both. These quality demands are fulfilled by minimal food processing techniques which use no or less heat and preservative. Food irradiation can complete many demands which are listed above. It is one of the recent techniques which is being used by many countries to reduce postharvest losses.

Irradiation

Irradiation is a physical process which includes applying low levels of radiant energy to a food material to sterilize or preserve it. Irradiation uses radiant energy of gamma rays, X-rays or electrons. Irradiation can be used for sterilisation or radappertisation, Reduction of pathogens or radicidation, for pasteurization or radurisation. Source for gamma radiation is cobalt-60 and cesium-137 are used, which are driven by neutron bombardment of cobalt-59 and for X-rays generated from 5MeV or 10 MeV is used for food irradiation (Suresh et al., 2005). The electron beam is created using high energy electrons which are accelerated to 99% of the speed of light (Fellows, 2018).

Mechanism of Ionizing Radiation

Irradiation works on the DNA level to increase the shelf life of the product. As we all know that harmful microorganisms present in the food keep on increasing their number by replicating themselves. DNA present in the chromosome is most sensitive to the ionising radiation. Effect of the ionising irradiation at the cellular level may vary with microorganism. Irradiation can affect DNA directly or indirectly leading to cell damage. Irradiation either hits them directly which led to cell damage or death or indirectly it creates free radicles of water present in the cell into hydroxyl and alkoxy which are highly reactive due to presence of an unpaired electron. These highly reactive pair react with DNA molecule, leading to the structural damage. These highly reactive products also generate hydrogen peroxide, is also considered toxic to the DNA molecule. Majority of the irradiation damages cells (70%) with the indirect attack (Desouky et al., 2015). In. Apart from these methods cellular damage also caused by reactive nitrogen species and can also occur due to ionisation of atoms. Irradiation causes chemical damage to the purine and pyrimidine bases, deoxyribose sugar which results in disruption of strands in both single and double-stranded molecules. If the cell survives the ionising radiation it can lead to carcinogenesis or other abnormalities. Irradiation effectively damages the DNA hence gives promising results in the food processing industry (Farkas, 2007).

Irradiation Facility

1. Gamma irradiation facilities: Sources for gamma irradiation used for irradiation are cobalt-60 and cesium 137. The facility for treating consist of a concrete structure and the radiation source is kept in a water pool. Proper precautions are taken while working in the facility as gamma radiations are harmful to human beings. The radiation source is brought out of the water pool for treating food else it is kept behind the barrier of water (Hvizdzak et al., 2010).

2. X-ray facility: X-rays are produced by accelerating electrons using a high-voltage electrostatic field on metallic targets such as tungsten and gold. X-rays technology is being used for only some foods hence the diversification of x-rays is still required (Follett, 2004).

3. Electron beam facility: Electron beam is produced by accelerating stream of the electron using a high-voltage electrostatic field. The product to be irradiated is kept perpendicular to the beam. Electron beam offers advantages over irradiation. As it is a machine source which can be turned on or off, hence eliminated the requirement of radioactive material and proper structures to enclose radioactive material. The electron beam has lower penetration but effectively inactivate pathogen on the surface of the food. Moreover, there is the least negative effect on food (Suresh et al., 2005).

Application

1. Irradiation of dose range 7-10 kGy is used for sterilisation of herbs and spices. Sterilisation using radiation is also known as radaappertisation. For 12D reduction of *clostridium botulinum*, a dose of 48kGy is required which is currently out of permissible range (Lewis, 1990).
2. Radicidation which is a term used for the reduction of the pathogen using irradiation requires less doses. Food poisoning bacteria are generally less resistant to irradiation hence low doses of range 3-10 kGy are sufficient to destroy such bacteria (Guise, 1986).
3. Irradiation is used to increase the shelf life of the product as it can deal with most of the mould, yeast, non-spore forming bacteria and vegetative cells. Prolonging the shelf life of the product using irradiation is known as radurisation (Gould, 1986).
4. Irradiation can control the ripening of fruits and vegetables by inhibiting the cell division and hormone production. Two to three-fold increase in the shelf life of the product is noted after irradiation. The product needs to ripen before irradiating the product as the ripening process is inhibited later.
5. Irradiation is extensively used in japan for inhibition of sprouting in potatoes. This has led the researchers to find its compatibility with other crops too (Stevenson, 1990).
6. Irradiation is used for disinfestation of fruit, grain, cocoa beans and dry foods. Low doses of range 0.1-2 kGy are required for infestation purpose.

Conclusion

Consumer demand for fresh food with minimal processed and low added preservatives increases the opportunity for irradiation. It's a promising technology which can increase shelf life, control ripening, disinfect and inhibit sprouting etc. with low levels of processing. The technology offers alternative technology of many processing techniques present in the market. But the technology still needs a trust factor in common people as radiation effect had its negative image for a long duration.

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Freeze Drying: A Promising Drying Technique

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Introduction

Drying is an ancient process used to increase the shelf life and preserve the food commodity. Drying is a process of removal of water to decrease the water activity of the food to increase the shelf life of the product. The conventional drying process involves heat transfer to achieve the latent heat of the water to evaporate it. Such drying methods involve heat and mass transfer which comes with the cost of a decline in quality. Popular methods of drying are conduction drying, sun drying, convection drying, radiation drying, Osmotic drying, and freeze-drying which have further subcategories in them. As per current demand, consumers are giving preference to the quality of the product. Whereas conventional drying methods result in volatile loss, structure loss, increase or decrease in porosity and are not able to regain their actual quality after rehydration due to hygroscopic shrinkage. Contrary to conventional drying process freeze drying offers vast opportunities to the above-mentioned problems. It has now become the most popular drying method for heat-sensitive foods.

Freeze Drying

Freeze drying which is also known as lyophilization is a drying process in which the solvent and the suspension medium are crystallized at low temperature and thereafter sublimated from solid-state to directly vapor phase. Sublimation is a process of phase transition that involves the conversion of a solid phase into the vapor phase without passing through the liquid phase. Small pieces of food material are crystallized at low temperatures which results in the formation of small ice crystals within the food which is then removed by sublimation hence the structure of the food is not damaged. If the water pressure of frozen food kept below 610.5 Pa and the food is heated then the solid ice directly sublimes into vapours without melting (Fellows, 2009).

Freeze Drying Process

The freeze-drying process usually consists of three steps: Freezing, Primary drying, secondary drying (Liu et al., 2008). The process involves first freezing the food sample on a cold surface and maintaining the constant temperature in an enclosed chamber. Once the required temperature and crystallization of solvent in the sample are attained then the pressure inside the chamber is dropped which results in sublimation of the water present in the food while the temperature of the shelf is still maintained at constant low temperature (Franks, 1998). The water vapours so created are continuously removed by vacuum pressure. At the end of the process, the water physiosorbed to the semi-dried mass is removed by increasing the shelf temperature (Zhai et al., 2003). The vapours removed from the chamber are condensed and can be used to recover volatile elements from them. Hence, the whole freeze-drying process involves freezing, sublimation, desorption, vacuum pumping, and vapor condensation. There is various literature that explains the recovery rate dependency on shelf temperature. Too low temperature affects the intracellular dehydration whereas too high temperature can result in critical damage of food which includes glass transition, diversification, and recrystallization (Rindler et al., 1999). While transferring heat to the food materials to achieve sublimation following methods are usually adopted: Heat transfer through the frozen layer, Heat transfer through the dried layer and use of microwaves for heating of the product.

Freeze Drying Equipment

Equipment used for freeze-drying is named as lyophilizer which consists of a vacuum chamber that has trays to hold the food during the process and heaters to supply latent heat of sublimation. The equipment consists of refrigeration coils for freezing the product and vapor condenser to condense the vapours removed. Lyophiliser is available in both batch and continuous type. Contact freeze drier, accelerated freeze drier, radiation freeze drier, microwave and dielectric freeze driers are some examples of lyophilizers (Fellows, 2009).

Application

1. The freeze-drying method is compatible with most of the food products but is used for the products which are difficult to dry by other methods.
2. This method causes minimum structural change with minimal solute movement (Dincer, 2002).
3. The product resulted from the freeze-dried method have lower density hence less weight in the same volume which makes the product fit for astronauts. Freeze-dried products especially ice cream was sent to space for astronauts.
4. Freeze-dried product rehydrates rapidly.
5. Minimal changes to odour and flavours. Aroma retention of 80-100% is possible, which means better volatile retention property (Karel, 1975 and Mellor, 1978).
6. Minimum loss of nutrients and colour is seen in freeze-dried products.
7. Due to its high cost, the product is generally used only for exotic products.
8. Powder products from the freeze-drying process are readily soluble in water (High rehydration capacity (Fellows, 2009).
9. The freeze-drying method can be used on both cooked and raw materials.
10. Freeze-drying is also used in biotechnology labs to preserve bioactive molecules such as DNA, enzymes and proteins, etc. (Kusakabe & Kamiguchi, 2004).
11. Freeze drying can be used for making the instant mix, packed spices, etc.

Conclusion

Freeze drying process unlike other drying methods offers better retention of nutrients, flavours and structural properties. The product dried by this method has high rehydration capacity with lower density. The only problem with the method is the cost associated with it. Intensive researches are needed in the field as it is the only method which can be used on almost all the food products and gives the best result. Market demand is only restricted due to its high cost which is almost four times the cost of the product by any other method.

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Review on Fungal Sex Hormones and Morphogens

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Introduction

The term hormone, as originally defined by Bayliss and Starling (1902), is product of internal secretion. The term pheromone was coined by Karlson and Luscher (1959). Dyer et al. (1992) prefer to distinguish sex hormones as a) Pheromone – induce gametangia or gamete attraction b) sex morphogens – trigger fruiting body formation in Asco and Basidiomycetes. Van den Ende (1976) has defined sex hormone as a diffusible substance playing a specific role in the sexual reproduction of the organism that produces it. Overall, it is a chemical substance produced in one portion of an organism and moves by diffusion or transport to another portion of same individual or to other individual of same species where it induce specific response is called a hormone. Hormones are chemical compounds that act on same individual that produce them. Fungal sex hormones produced in small quantity and play specific role in sexual reproduction in fungi. Machlis (1972) coined the terms erotactins, erotropins and erogens. Erotactins: attracts motile cells ("sperm attractant"). Erotropins: includes chemotropic growth of sex organs. Erogens: controls the induction and differentiation of sex organs. There is evidence of existence of number of sex hormones in fungi, but few are identified and chemically characterized such as Sirenin, Antheridiol, Oogonial and Trisporic acid.

Sirenin

Sirenin was the first fungal sex hormone to have its structure determined. It is a sperm attractant produced by female gamete of Allomyces arbuscula (water mold) which is characterized by isomorphic alternation of generation. The gametothalli produce male and female gametangia in pairs. The male gametangia are small, active, orange coloure and depending on the species, lie above or below the large, sluggish and colourless female gametangia. The matured motile male and female gametes are released into the water from the gametangia. The male gametes are attracted by the female gametes, which are twice as big as the male gametes. The female gametes release sirenin, diffuses into the surrounding water and male gametes start collecting around the female gametangia. The female gametes, by anisogametic copulation, give rise to diploid motile zygotes. The synthesis of sirenin by female gametes and their "sperm attractant" activity was demonstrated by Machlis (1958). The female-attracting hormone is produced by the male has been named as "Parisin" (Pommerville, 1990).

Antheridiol

The only completely characterized steroid sex hormone outside the animal kingdom is antheridiol, the female hormone of the water mould *Achlya.* Antheridiol, originally termed hormone A, was discovered by John Raper during a study on mating in the oomycete water mould *Achlya*. The hormone, which is produced by the female and induces the development of antheridia in the male, was postulated by Raper in 1939, its existence proved in 1940 and obtained by Raper and the chemist Haagen-Smit in a highly concentrated state by 1942. Raper, in his classical studies (1939-1959), demonstrated multi-hormonal regulatory system in *Achlya ambisexuals* and *A. bisexualis*. He envisaged 4 hormones (A, B, C and D) but now it has been conclusively proved that only 2 hormones *viz*., antheridiol and oogonial. Vegetative hyphae of a female strain produce a hormone A (known as antheridiol). This brings about the formation of numerous slender branches, the antheridial initials, near the tips of vegetative hyphae of a nearby male strain. Then the male produces hormone B (known as oogoniol), which causes the tips of vegetative hyphae of the female strain to swell to become oogonial initials. These then produce hormone C which causes the antheridial initials to grow towards them and on contact, to develop cross walls and become antheridia. The antheridia, it produces hormone D, which causes the oogonial initials to form cross walls to become oogonia. McMorris and Barksdale (1967) isolated the hormone in a crystalline form and named it antheridiol. The structure was proposed by Arsenault *et al*. (1968). In overall, female hyphae produce antheridiol and elicits the induction of antheridial hyphae, chemotropic stimulation of male hyphae to produce Oogoniol and delimitation of antheridia.

Oogoniol

It is produced by the male isolates of *Achlya* spp. only in the presence of antheridiol. Oogoniol is produced by some hermaphrodite strains without the stimulus of antheridiol (Barksdale *et al*., 1974). Two crystalline sterols isolated from the culture filtrates of *Achlya heterosexualis*, which possess oogoniol activity (Mc Morris *et al.*, 1975).

Trisporic Acid

Trisporic acid, a terpenoid triggers sexual reproduction of several *Mucorales e.g*., *Mucor mucedo, Blakeslea trispora* and *Phycomyces blakesleeanus.* Sexual interactions involve mutual stimulation for zygophore formation. The hormone is synthesized only in presence of the compatible partner otherwise, only asexual reproduction takes place. It suppresses the formation of asexual spores and triggers sexual reproduction. The trisporic acids are formed when there is free interchange of soluble materials between the two mating types, but the exact mechanism of this collaborative biosynthesis is still in doubt.

Yeast Alfa Factor

The alpha factor pheromone arrests yeast in the G1 phase of their cell cycle. Alpha factor mating pheromone induces the expression of mating genes, changes in nuclear architecture and polarizes growth toward the mating partner. The haploid cells are of two mating types ('alfa' and 'a'), which conjugate and give rise to diploid cells. Levi, 1956 showed that the 'alfa' cells produce a diffusible chemical, the alfa factor, which induces the formation of copulatory processes by 'a' cell. The 'a' cell, under the influence of the alfa factor, stop growth and budding. They instead swell and turn into giant cells of various shapes; occasionally 10 or more times bigger than the normal cells. The alfa factor is specifically acting only on 'a' cells and has no effect on the alfa cells. It inhibits DNA replication in the 'a' cell.

Some Sex Hormones with their Details

Hormones	Produced by	Emperical formula	Mol. Wt.	Site and control of synthesis	Morphogenetic action
Sirenin	*Allomyces* sp.	Sesquiterpene ($C_{15}H_{24}O_2$)	236	Female gamete	Chemotaxis of male gametes
Antheridiol	*Achlya* sp.	Sterol ($C_{29}H_{24}O_5$)	470	Female cells	Antheridia formed by male hyphae attracts anthridial branches
Oogoniol	*Achlya* sp.	Sterol ester ($C_{25}H_{54}O_6$)	500	Male cells in response to antheridiol	Oogonia formed by females
Trisporic acid	Several mucorales	Apocarotenoid ($C_{18}H_{28}O_4$)	306	+ or – cells in collaboration	Zygophores formed by (+) and (-) hyphae
Yeast α factor	*Saccharomyces* sp.	Peptide	1400	α Yeast cells	Elongation of 'a' cells

Sex Morphogens

They are second group of sex hormones trigger the formation of ascocarp, basidiocarp, ascoma and basidioma.

Types

1. SF morphogen: Lipid produced by mated cultures of *Pyrenopeziza brassicae*. This switch asexual to sexual growth and triggers the development of ascocarp (Ascomycetes).

2. PSI (Precocious Sex Inducing factor): Long type fatty acids produced in *Aspergillus nidulans (Emericella).* Prevents formation of asexual spores and triggers the development of ascocarp.

3. Cerebrocide: Lipid, which can trigger the sporocarp development in *Schizophyllum communae.*

4. Linolic Acid – triggers the sporocarp development.

5. Cyclic AMP.

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Plant Disease Management in Organic Cultivation

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Introduction

A disease is the impairment of the normal physiological functioning of a plant or plant part, caused by the continued irritation of a primary factor or factors. Disease management is an essential component of the commercial farming. Disease tends to reduce the potential production levels of a crop as per its time of incidence and intensity. The loss can be occurring at any time between sowing and consumption of the harvest from the field.

Why? Organic Cultivation

It is recognized globally as a priority area in view of the growing concerns on environmental pollution due to increased awareness about the fallouts of the indiscriminate use of Agro-chemicals. Demand for safe and healthy food has been increasing with every passing day. The ill effects of plant protection chemicals on the flora, fauna, humans and environment as a whole are the major concerns. Unjustified overuse of chemical pesticides to control various insect pests and diseases over the years has decimated many naturally occurring effective antagonistic microorganisms.

The Specific Advantages of Organic Farming

1. Organic matter supplies all the essential macro and micro plant nutrients.
2. It improves physico-chemical and biological properties of soil.
3. Organic matter recycling is renewable and thus energy resources can be made available for organic production.
4. Organic farming improves agro eco-system and helps stopping environmental degradation.
5. Organically grown crops are preferred most by people as it is believed to be more nutritious compared to the conventional ones.
6. Organic produce fetches more prices in the national and international market.
7. In the long term, organic farms save energy and protect the environment.
8. Organic food has no harmful chemicals such as insecticides, fungicides and herbicides.

Disease Management Strategies in Organic Farming

Occurrence of a disease requires a balanced interaction of host, pathogen, and environment. Aim to disrupt this balance and disallow the pathogen to cause disease beyond economic injury level. Pathogens need suitable environmental conditions - humidity, temperature, moisture, host exudates to germinate, survive and infect. Interfere with the micro-environmental conditions to make them uncongenial for pathogen propagation, multiplication and initiating infection.

1. Growing disease resistant varieties: For low external input organic farming, resistant crops represent an important alternative to pesticides. Exploiting the diversity and variability in the host genetic constitution for resistance against a pathogen in a crop is the best strategy for disease management without application of hazardous pesticides. It can individually restrict the incidence of a particular disease in a crop. Remain disease free for a long period of time owing to morphological manifestation of their genetic constitution in form of leaf and stem toughness, time of maturity, nutrient content and plant architecture, growth habit which can deter growth of pathogen, their reproduction and host preference.

2. Exclusion of pathogen: It helps in preventing the potent and viable disease propagules to interact with the host results in reduction in disease incidence. Use of disease-free seeds and planting material prevent seed borne disease. Management of vectors and *in situ* destruction of soil borne pathogens through soil solarization or Anaerobic soil disinfestations (ASD) is possible. ASD is the reductive soil disinfestation method developed by Shinmura consists of incorporation of organic matter (wheat bran, rice bran, and molasses), irrigating the soil to saturation and covering the soil with plastic film. Totally it involves the incorporation of fresh organic material in moist soil under airtight plastic for

3-6 weeks. Today ASD is applied at commercial level in both open field and greenhouse, in organic and conventional farms in Japan.

3. Application of organic amendments: Soils with low microbial diversity promote establishment of plant pathogenic organisms. Healthy soil is the mainstay of organic agriculture. Improved soil biological activity is known to play a key role in suppressing weeds, pests and diseases. Application of composts and organic amendments increase the quantity and diversity of soil microbiota and consecutive disease suppressiveness. Organic amendments are biodegradable and are generally available on the farmers' fields. Neem cake used for soil amendment @ 0.25 to 0.5 t/ha contributes significantly in control of nematodes and soil borne pathogens.

4. Cultural method: It promotes healthy soils and healthy plants. Date of planting to field sanitation and weed management, the specific cultural measures reduce the initial load of inoculum and favorable conditions for growth of pathogens. The development and implementation of well-designed crop rotations is central to the success of organic production systems. Ensuring good drainage in the fields to avoid rapid multiplication of pathogen under poor drainage system. Removal of debris, weeds and deep summer ploughing also play major role in reducing the pathogen inoculum.

5. Orchard bio-intensification: Habitat modification for beneficial organisms through development of healthy and biologically active soils, maintaining uncultivated lands for diversity of flora and fauna, developing entomophagy parks within orchard for food and shelter to diverse beneficial insects, weed strips, hedge rows, wind breaks, inter crops and conservation of insect bio diversity.

6. Physical methods: It includes soil solarization of nursery beds to reduce soil borne inoculum, pruning of diseased plant parts to increase light into canopy, hot water/steam treatment of seeds/planting material to exclude the pathogen.

7. Botanicals, essential oils, baking soda, butter milk: Spraying of neem oil, cow urine, panchagavya and fermented butter milk are some of the most predominant methods of controlling pests and diseases by the organic farmers in India. Application of plant extracts and horticultural grade oils may reduce incidence of foliar diseases. Baking soda has been used to control mildew and rust diseases on plants. Butter milk sprays have been popular against blights, mildew, mosaic viruses and other fungal and viral diseases. Application of soft soap solutions and neem oil against viral vectors like aphids and other sucking insects is also effective. Cow dung ferments like 'Amrit-Paani' are widely used by organic farmers for enhancing crop growth and disease management.

8. Application of biocontrol agents: Commercial bio-fungicides are containing beneficial living organisms are can be locally produced and used for disease management in organic farming. They can be available as powders for seed treatments, as granules for soil application and as suspensions for root drenches and foliar sprays. Some of them are *Trichoderma* spp., *Pseudomonas* spp. and *Bacillus* spp. have proven their worth in managing a range of plant diseases and promote plant growth.

9. Application of mineral based fungicides: Prophylactic sprays of Sulphur are mostly used against plant diseases like powdery mildew, downy mildew and other diseases by preventing spore germination. Copper hydroxide and copper oxychloride are accepted in organic farming provided that the number of applications is moderated to prevent copper accumulation in the soil.

General Control Tactics and Specific Measures Used at Different Stages of Pathogen Invasion in Organic Crop Production

1. Prevention of colonization:

a. Sanitation - Pathogen-free seed, debris destruction, flaming and steaming.

b. Temporal asynchrony - Late or early planting/harvest with respect to pathogen or vector arrivals.

c. Non-conducive conditions - Crop rotation, repellent cultivars, enhanced soil suppressiveness by organic amendments.

d. Synthetic chemical barrier.

e. Spatial isolation - Crops sown distant from pest/pathogen hosts, weeds, non-crop hosts removed and barrier crops or natural strips.

f. Prevent landing - Vector trapping, reflective mulches, oil sprays.

2. Population regulation:

a. Host plant resistance - Suboptimal plant quality (low fertilization), classical genetic resistance, crop spacing.
b. Intercropping.
c. Competition and antagonism - Enhanced microbial activity and diversity to reduce pathogen populations.
d. Unsuitable environment - Ventilation, humidity and temperature control, humidity control by irrigation.

3. Curatives after establishment:

a. Organics - Soaps, oils, compost teas.
b. Botanicals - Plant extracts.
c. Inundative biological control- Parasitoids (*e.g*. parasitic wasps), bacteria (*e.g*. *Bacillus thuringiensis*, *B. subtilis*, *Pseudomonas*), fungi (*e.g. Trichoderma*).
d. Physical removal - Trapping, handpicking.
e. Synthetic pesticides -Various systemic and contact insecticides and fungicides.

Climate Smart Agriculture

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Introduction

Climate change is emerging as a major threat on agriculture, food security and livelihood of millions of people in many places of the world (IPCC, 2014). Due to Global warming changes in rainfall and temperature patterns affect agricultural production and increase the risk of people dependent on agriculture for their livelihoods, which includes most of the world's poor. The estimated impacts of both historical and future climate change on cereal crop yields in different regions indicate that the yield loss can be up to −35% for rice, −20% for wheat, −50% for sorghum, −13% for barley, and −60% for maize depending on the location, future climate scenarios and projected year (Porter et al., 2014). Changes in crop cultivation suitability and associated agriculture biodiversity decrease in input use efficiency, and prevalence of pests and diseases are some of the major causes of climate change impacts on agriculture (Norton, 2014). Climate change disrupts food markets, posing population-wide risks to food supply. Threats can be reduced by increasing the adaptive capacity of farmers as well as increasing resilience and resource use efficiency in agricultural production systems. In the World Bank's version, climate-smart agriculture includes integrated planning of land, agriculture, fisheries, and water at multiple scales (local, watershed, regional) (World Bank 2011).

Climate Smart Agriculture

Climate Smart Agriculture is defined as "an approach that guides actions needed to transform and reorient agricultural systems to effectively support development and ensure food security in a changing climate".

Objectives

Three main objectives are:

1. Increasing agricultural productivity and incomes in a sustainable way.
2. Adapting and building resilience to climate change.
3. Reducing greenhouse gas emissions.

Need of Climate Smart Agriculture

Population increasing day by day and the food security challenges are huge. The UN Food and Agriculture Organization (FAO) estimate that feeding the world population will require a 60 % increase in total agricultural production. At the same time climate change is already negatively impacting agricultural production globally and locally. Climate risks to cropping, livestock and fisheries are expected to increase in coming decades, particularly in low-income countries where adaptive capacity is weaker. Impacts on agriculture threaten both food security and agriculture's pivotal role in rural livelihoods and broad-based development. Also, the agricultural sector, if emissions from land use change are also included, generates about one-quarter of global greenhouse gas emissions.

History of Climate-Smart Agriculture

FAO coined the term CSA (Climate Smart Agriculture) in the background document prepared for the 2010 Hague Conference on Food Security, Agriculture and Climate Change. The CSA concept was developed with a strong focus on food security, for now and the future, including adaptation to climate change. The CSA concept now has wide ownership among, governments, regional and international agencies, civil society and private sector.

Elements of Climate Smart Agriculture

CSA is not a set of practices that can be universally applied, but rather an approach that involves different elements embedded in local contexts. CSA relates to actions both on-farm and beyond the farm, and incorporates technologies, policies, institutions and investment.

Different elements which can be integrated in climate-smart agricultural approaches include:
1. Management of farms, crops, livestock, and aquaculture and capture fisheries to manage resources better, produce more with less while increasing resilience.
2. Ecosystem and landscape management to conserve ecosystem services those are key to increase at the same time resource efficiency and resilience.
3. Services for farmers and land managers to enable them to implement the necessary changes.

Implementation of Climate-Smart Agriculture

Governments and partners seeking to facilitate the implementation of CSA can undertake a range of actions to provide the foundation for effective CSA across agricultural systems, landscapes and food systems.

CSA approaches include four major types of actions:
1. Expanding the evidence base and assessment tools to identify agricultural growth strategies for food security that integrate necessary adaptation and potential mitigation.
2. Building policy frameworks and consensus to support implementation at scale.
3. Strengthening national and local institutions to enable farmer management of climate risks and adoption of context-suitable agricultural practices, technologies and systems.
4. Enhancing financing options to support implementation, linking climate and agricultural finance.

Conclusion

Institutional mechanisms for achieving climate-smart agriculture include multi-stakeholder planning processes; supportive governance systems including resource tenure; harmonized financial mechanisms that enable the funding of initiatives with multiple, interrelated objectives; and monitoring and evaluation systems that account for a variety of impacts at a lower scale.

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The Farmer Producer Organisation: Collaboration for a Cause

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Introduction

Primary producers such as farmers, milk producers, fishermen, rural artisans, weavers, craftsmen unite together and form producer organization for betterment of their lives. The main aim of the producer organization is to improve the livelihood of farmers and help them earn more income. There is both farm produce organization and non-farm produce organization. A farm produce organization is a registered body formed by a group of farm producers. It is meant to help small and marginal farmers to have a sound bargaining power.

Evolution of FPO

There has been a gradual decline in the GDP (Gross Domestic Product) contributed by the agriculture sector since 1950. India is an agricultural country filled with small and marginal farmers whose average land holdings are noted to be less than 2 hectares. As the size of operational land holdings was continuously declining in India with every successive generation, the land holders were only able to produce very little quantity and so they lost their bargaining power and economies of scale.

The farmers suffered from many inherent problems such as accessing the market, availability of funds, accessing information etc. The General Agreement on Tariff and Trade (GATT) came into force to ensure competition in commodity trade through the removal or reduction of farm barriers to bring all round economic prosperity. After the force of this agreement the agricultural cooperatives, self-help groups, commodity interest groups, contract farming and direct marketing were worked to aggregate the small holders to the markets (input and output).

Finally, the instrument named Farmer Producer Company (FPC), registered under Indian company's act was emerged as the most effective means of Farmer Producer Organization (FPO) in expectation to cater the needs of small farmers at the grass root level.

The Year of FPO

An expert committee led by noted economist, Y.K. Alagh recommended for setting up the FPO in 2002 under the companies act of 1956. The year 2014 was observed as the "year of farmer producer organization (FPO)" by the Government of India.

FPO is one of the important initiatives taken by the Department of Agriculture and Cooperation under Ministry of Agriculture to mainstream the idea of promoting and strengthening member-based institutions of farmers. The FPO's should register themselves under Indian companies Act. The organizations can be created both at state, cluster, and village levels.

Objectives of FPO

The objectives of producer companies shall include the production, harvesting, procurement, grading, pooling, handling, marketing, selling, export of primary produce of members or import of good or services for their benefits, processing including preserving, drying, distilling, brewing, venting, canning and packaging of produce of the members of FPO, rendering technical services, consultancy services, training, education, research, and development and all other activities for the promotion of the interests of its members.

Generation, transmission and distribution of power, revitalization of land and water resources, their use, conservation and communications relatable to primary produce, manufacture, sale or supply of machinery, equipment or consumables mainly to its members are also their objectives. They also promote mutual assistance, welfare measures, financial services, insurance of producers or their primary produce.

FPO Promotion and Development Process

A cluster of 8,000 to 10,000 farmers are identified and formulated as a group covering 80 to 120 contiguous villages within one or two blocks. After cluster identification, a diagnostic study is conducted by the resource institutions. It is conducted to analyse the preliminary situation of the farmers and the level of agriculture in that area. The study will also help in identifying the potential interventions required for the implementation of specific project.

Following diagnostic study, research institutes and other technical experts carry out analysis to check the feasibility for the formation of FPC. The analysis is done by covering all streams such as financial, technical, legal, political, socio-cultural, environmental, and economic and resource feasibility. Succeeding the feasibility analysis basal assessment is carried out by research institutes.

This assessment will help in generating the data related to current farming situation existing in the lives of small, marginal and tenant farmers. Stratified random sampling through structured household level interviews and open-ended focus group discussion is carried out with the stakeholders to collect the data of basal assessment. The figure collected is considered as the important inputs to understand the level from which products and services for farmer members should be developed.

The collection of data in business planning is carried out with the help of selected farmer's representatives. Strategic and operational orientation of an emerging FPO is shaped through the business planning which is used for the future visualization. Hence the business plan with proper projections on various aspects should be developed. The key is to develop business plans in detail with at least 10 per cent of member farmers to provide clear vision. Once the business is planned the research institutes mobilize farmers into FIG.

Mobilization is done through variety of communication aids like pamphlets, documentary movies, posters and regular village level meetings. FIGs are an aggregated cluster together form FPOs. Habitually, around 50-70 FIGs can come together to form an FPO which can register under the provision of producer company under the companies act. The FIGs can settle down and understand the implications of aggregation between 18 to 24 months. Only after settling down, the FIGs strive for FPO registration.

Following registration, the FPOs are organized and formalized. Before initiating the operations of FPO, resource mobilization is undergone by the research institutes with the help of FPO representatives and board of directors. After mobilizing the resources, the management systems are developed by research institutes.

Guidelines for management systems should be able to address all requirements related to financial services, input and output management services. Systems related to finance management, human resources, stock and inventory, procurement and quality management, marketing, internal audit, internal conflict resolution and other important functional areas should be developed.

After developing management systems, research stations should carefully train both governing and operational structures of the FPO in order to ensure smooth functioning of business operations. Business operation is the commencement of procurement, production, processing, marketing and financial service activities of FPO.

Finally, assessment and audit are carried out by the research institutes for constant assessments of performance of various stakeholders like farm members, governing body of directors and service providers.

Structure of FPO

The FPOs are designed with a general body followed by an executive body with 2 representative per Farmer Interest Group below which there exist Board of directors, general managers, FPO staff and few local resource persons.

The board of directors, general manager and FPO staff have involved themselves in planning, implementation and monitoring.

Conclusion

Producer organizations can be promoted by any individual or institution. They may promote the organization using their own resources out of goodwill or with the noble objective of socioeconomic development of producers. This is therefore a platform to facilitate better access to government services, like PDS (public distribution system), MNREGA (Mahatma Gandhi National Rural Employment Guarantee Act), Scholarships and Pensions. It can have liaison with the Government Departments for convergence of programs, like drinking water, sanitation, health and hygiene. As FPC's are the only model in India to deal with the problem of small farmers, it is to be reassessed and should be made as the best bet. It is the only way to treat agriculture as a business and commercialization is not so far.

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Entomopathogenic Fungal Endophytes for Insect Pests Management

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Abstract
Entomopathogenic endophytes are microorganisms that inhabit the interior of a healthy plants by natural or inoculation methods. They offer greater potentials, which can be exploited to maintain healthy crops. Both cultivated and wild type plants have been investigated for endophytic entomopathogenic fungal metabolites which include bassianin, beauvericin, bassianolide, beauveriolide, bassiacridin, oosporein, and tenellin. These metabolites show beneficial effects to crop plants, which possess pesticidal and antimicrobial activity pest population.

Introduction
Pest affecting cultivated plants has gained considerable attention in the past decades as a way of reducing the use of chemical products in agriculture with the help of natural and biological control. The use of endophytic entomopathogen in the biological control has become an utmost important tool for Integrated Pest Management.

Use of microorganisms that act antagonize insects as biological control agent results in enhancement of resident antagonist and is risk free. Antagonistic microorganisms mostly extract from the rhizosphere or the phyllo sphere, while few are also endophytes.

Endophytic Fungi
Endophytic entomopathogic fungi that live in internal tissues of all higher plants are of growing interest as promising sources of biologically active agents. They can act as important regulators of insect populations with considerable potential as mycopesticides. The ecological function of endophytic fungal entomopathogens remains largely unknown, but some studies have implicated them in plant growth, herbivore resistance and disease resistance.

Table 1. Endophytic fungal entomopathogen isolated from various host plant

S.No	Host plant	Endophytic fungi	Reference
1.	Sugarbeet roots	*B. bassiana* *Metarhizium anisopliae (Metschn.)*	Fuller-Schaefer et al. (2005)
2.	Araceae	*Verticillium (=Lecanicillium) lecanii*	Petrini, 1981
3.	*Carpinus caroliniana* bark	*Verticillium (=Lecanicillium) lecanii* *Paecilomyces farinosus*	Bills and Polishook, 1991
4.	*Musa acuminata*	*Paecilomyces sp.*	Cao et al., 2002
5.	Rice	*Paecilomyces sp.*	Tian et al., 2004
6.	Mangroves	*Paecilomyces varioti Bain*	Ananda and Sridhar, 2002

Beauveria bassiana (Balsamo) Vuillemin has been reported as an endophyte in maize potato, cotton, cocklebur, tomato, cocoa, opium poppy, on date palm, in bananas (Akello et al., 2007), and in coffee (Posada et al., 2007).

Endophytic Metabolites as Source of New Pesticides
Endophytic fungi produce several metabolites, which shows pesticidal activity have been isolated and characterized. *Balansiae* endophytic fungi produce ergot alkaloids *viz*. ergonovine, ergotamine, ergocryptine, agroclavine and elymoclavine which caused reduction in *Spodoptera frugiperda* larval weight and leaf area consumption at concentrations of 77 - 100 mg liter $^{-1}$

Table 2. Production several metabolites by endophytic entomopathogenic fungi:

S. No	Endophytic fungi	Metabolites	Reference

1.	*Beauveria spp.*	bassianin, beauvericin, bassianolide, beauveriolide, bassiacridin, oosporein, and tenellin	Moraga and Vey, 2004
2.	*Paecilomyces fumosoroseus (Wize) Brown & Smith (=Isaria fumosorosea)*	beauvericin and beauverolides	Jegorov et al., 1994
3.	*Verticillium lecanii (=Lecanicillium lecanii)*	bassionalide	Suzuki et al., 1977
4.	*Isaria spp.*	isariin	Briggs et al., 1966
5.	*Hirsutella thompsonii*	Phomalactone hirsutellin A	Omoto and McCoy, 1998
6.	*Oospora destructor*	destruxins	Poprawski et al., 1985
7.	*Metarhizium* spp.	destruxins and cytochalasins	Roberts, 1981
8.	*Paecilomyces tenuipes*	tenuipesine	Kikuchi et al., 2004

Conclusion

Endophytic fungi offer greater potential in plant protection, which gives tolerance against several biotic and abiotic stress factors. However, endophyte-host interactions may turn to a pathogenic interaction, if susceptibility of host and/or virulence of the endophyte increase.

However, if the metabolites responsible for the beneficial effect can be isolated and exploited, then the risk of pathogenicity can be avoided. Structural elucidation of secondary metabolites will help in defining modes of action as well as in preparation of right formulations for field application. Standard protocols for isolation of bioactive molecules will be of great importance for production on large scale by fermentation technology.

This will reduce the extra expenditure incurred in synthesis of chemical compounds. Most of the plant species need to be explored for their endophytic fungi and their corresponding secondary metabolites.

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Epidemiology and Management of Late Blight Disease Caused by *Phytopthora infestans*

Article ID: 30655

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Introduction

Late blight is the most destructive disease of tomato and potato worldwide. Potato blight caused by *Phytopthora infestans* (De bary) has historically been a devastating disease. In Mid 1800 this disease was responsible for Irish famine that caused death of a million people due to starvation and more than 1.5 million people were migrated. Migration of highly virulent strains of the pathogen from Mexico, favourable climatic conditions for the epidemic development, lack of resistance against pathogen in potato and complete dependence of Irish people on potato for sustenance are the major reasons for this disaster. Late blight not only adversely affects the fruit yield but also disrupts the physiological activities of the plant. Unfavourable conditions such as high humidity and low temperature favours the disease development and affects the production and productivity both in terms of quantity and quality that causes 100% yield loss.

Host crops: Tomato, Potato, Petunias etc.

Symptoms

1. Late blight disease infects all the above ground parts of the plant such as leaves, stem, petioles and fruit.
2. Leaf lesions are likely to begin at the tip than in the middle of the leaf. Water soaked irregular lesions surrounded by pale green to yellow halo are observed on the leaf.
3. During heavy infestation white mycelium can be seen growing on the underside of infected leaves.
4. Light to dark brown lesions covered with white mycelium appears on the stem and petioles.
5. The infected stem and petioles become weak and collapse.
6. Entire crop gives blighted appearance during heavy infestation under favourable environmental conditions.
7. Fruits and tubers infected with late blight shows irregular reddish brown to purplish sunken patches that extend to the internal tissues.

Disease Cycle

Phytopthora infestans is an obligate parasite that survives in tubers, seeds and plant debris as mycelium.
1. Low temperature, high humidity, and rainy weather favour the disease development.
2. The pathogen reproduces both asexually by zoospores and sexually by oospores.
3. Primary inoculum is airborne sporangia survive in infected tubers, seeds and plant debris.
4. Asexually, sporangia germinate either through zoospores or directly through germ tube emerging from sporangium.
5. Sexually, oospores survive as primary inoculum in soil or plant debris and survive for 6-8 months even in extreme temperature.
6. Zoospores are biflagellate and short lived compared to oospores.

Epidemiology

1. Several climatic factors affect the growth, survival, germination, penetration and sporulation of the pathogen.
2. Wind and water are responsible for the spread of inoculum.
3. Temperature between 15-20°C, high humidity and cloudy weather are responsible for the disease initiation.
4. The reproduction of the pathogen can be restricted at temperature above 30°C but survival might be possible.
5. Excessive soil moisture also favours the pathogen to survive.

Management

1. Removal of plant debris, volunteer plants and alternate hosts which are responsible for the pathogen to survive.
2. Highly infected plants are collected and burnt.
3. Use of disease-free seeds and tubers, seed treatment should be done to avoid the inoculum.

4. Time of planting helps to escape disease infection and planting on hills reduce the contact of inoculum.
5. Use of resistance varieties that reduce the rate of disease development.
6. Use of bio control agents such as *Trichoderma, Bacillus*, *Pseudomonas*.
7. Mancozeb, metalyxyl, are the fungicides found effective in controlling the disease.

Conclusion

Taking quick initiative methods to control late blight can decrease disease incidence. Removing of diseased leaves and picking of highly infected plants reduces the spread of disease.

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Process Followed in Sericulture for the Production of Silk from Mulberry Silkworm

Article ID: 30656

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Introduction

Silk is known as the "Queen of textiles". There are five types of silk produced around the world they are Mulberry silk, Eri silk, Oak tasar, Muga silk and Tasar among these mulberry silks contributes 90% of the silk production. India is the second largest producer of silk; Andhra Pradesh, Tamilnadu, Karnataka, west Bengal and Jammu and Kashmir are the five major Indian states that produce mulberry silk.

Procedure

There are three steps to be followed for the production of silk they are:

1. Moriculture.
2. Silkworm rearing.
3. Silk reeling.

Moriculture

Moriculture is the process of cultivation of mulberry plants. The silkworm feeds on the mulberry leaves from larval to cocoon stage. The mulberry plants can be grown by direct sowing of seed, root grafting and stem grafting. Root and stem grafting can be done by cutting the root and stem up to 22cm length from mature mulberry plant and grown in nursery or directly planted in field. 1kg mulberry leaves are sufficient to feed 50 silkworms.

Silkworm Rearing

Rearing of silkworm begins with laying eggs on a cardboard/paper by a female silkworm moth. The trays and the rearing room are disinfected with 2% formalin to avoid contamination. The fresh mulberry leaves are placed on the trays and the hatched larvae are transferred onto the tray by brushing method. Then the larvae feed on the mulberry leaves and start losing their appetite. After attaining maturity, the larvae find a place to start its pupation. The larvae get shrink, becomes translucent and excrete saliva through their salivary glands and starts wrapping around them. This saliva solidifies and form into silk when comes in contact with air. The cocoon will be spun in 2-3 days.

Silk Reeling

After completion of cocoon formation silkworm undergoes pupal stage. These cocoons are collected and boiled to kill the pupae by exposing to steam for 15 min this process is called stifling. Then the silk filaments are removed from the dead cocoon. These filaments are twisted into a thread with the help of guides and pulleys. Then the silk is recoiled to improve its lustre. 900m of silk is obtained from single cocoon.

Conclusion

Use of fresh mulberry leaves for feeding, cleaning of trays and other equipment in the rearing room with 2% formalin these measures lead to decrease in disease incidence.

Milk: The Masked Hero of COVID–19

Article ID: 30657

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Introduction

These are not normal times. The simple things we've been doing all our lives, we can't do anymore. We can't hug our friends, shake hands or enjoy each other's company because of a silent enemy called COVID-19. This virus has changed how we live and think around the world.

At times of crisis people turn to things they really need and rely on every day. The everyday essentials. As more and more people are spending time at home due to the very necessary state sanctioned lockdowns or self-imposed social isolation in an effort to stop the spread of COVID-19, it is not surprising that the very basic need for food is a top priority in many people's minds.

Billions of people around the world rely on "milk" for their day to day nutritional requirements and it's not hard to understand why; considering "milk and milk products" are nutrient dense foods, supplying significant amounts of energy, protein and micronutrients, including calcium, magnesium, selenium, riboflavin, and vitamins B5 and B12.

How Milk Helps in Developing the Immunity to Fight COVID -19

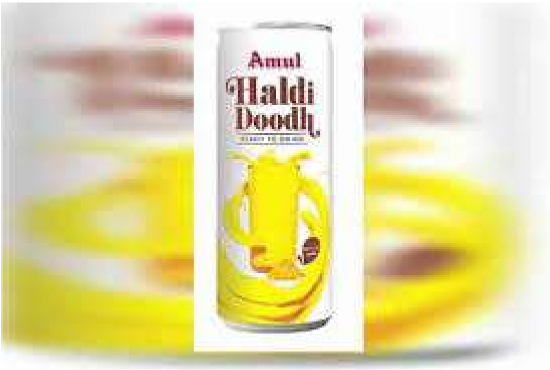
While milk can be a part of a healthy varied diet, the claims that it can prevent, or cure coronavirus are unfounded and potentially dangerous. The basis of these claims seems to be based on two immune-supporting components found in milk: lactoferrin and vitamin D.

Lactoferrin is a protein found in most secretions from mammals which is especially high in milk. This protein has some antimicrobial properties and research suggests that the transfer of lactoferrin from mother to baby via breastmilk might provide some immune support to the infant's still developing immune system. While concentrated lactoferrin is promoted as a dietary supplement in foods such as infant formulas, there is no evidence to suggest that the lactoferrin found in cow's milk imparts any specific immune benefits to humans who drink it.

The second component of milk that is being suggested as beneficial is vitamin D. In the United States, milk is fortified with vitamin D, a fat-soluble vitamin associated with many functions in the body including growth and immune response. The claim that the vitamin D in milk somehow protects against coronavirus appears to be based on a meta-analysis published in 2017 in the British Medical Journal which found that vitamin D supplementation decreased the risk of acute respiratory infection. It's important to note that this study investigated vitamin D supplementation at much higher doses than what is found in milk products. It also did not include COVID-19 in its definition of acute respiratory infection. In both cases, the suggestion seems to be that by consuming milk you are providing your body with specific immunity from the virus.

Recent Advancements in Dairy Industry

Recently, many giants of the dairy industry (including Amul, Mother Dairy and many others) have come forward converting such treacherous times into a perfect opportunity to launch their immunity boosting products such as " Haldi Doodh {Haldi Latte}, Tulsi Doodh {Tulsi Latte}, Ginger Doodh {Ginger Latte} with Ashwagandha Milk and Honey Milk still in milk and can be launched any soon. The Soul purpose of launching such products are not only in terms of incentives received by the sales of the products but is also a step towards the benefit of mankind as these products contains such ingredients which are mentioned in our "Holy Vedas" for their therapeutic benefits, which hence develops 'Zero' hesitation in people in using such products. Once these superfoods i.e., "Turmeric, Holy basil, Ginger, Ashwagandha and Honey" are mixes with the goodness of milk their overall health value increases manifold.



Conclusion

While milk may not impart specific immune benefits to ward off coronavirus, it can be part of a healthy diet that will optimize your health and your body's readiness to fight off infections of any kind as prevention is always better then cure and let's hope such vicious pandemic ends as soon as possible.

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Cereal Cyst Nematode: A Threat to Wheat Production

Article ID: 30658

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Introduction

Cereal cyst nematode, *Heterodera avenae* Wollenweber is a species of cyst nematodes belongs to the family Heteroderidae of phylum nematoda. It was first reported as parasite of cereals by Kuhn (1874) in Germany. He regarded as biotype of *H. schachtii* Schm., beet eel worm. Later in 1924 it was the Wollenweber who separated from the beet eel worm by demonstrating morphological and physiological differences. Franklin et al. (1959) reviewed the nomenclature and proposed the adoption of *H. avenae*. It has been recorded from many countries like Australia, Israel, Japan, South Africa, Morocco, Tunisia, Pakistan and most European countries. While in India, Vasudev for the first time reported from sikar district of Rajasthan (1958). After that it has also been reported from different parts of the country like Punjab, Delhi, Uttaar Pradesh, Harayana, Jammu &Kashmir and Himachal Pradesh. Basically, *H. avenae* is the parasite on temperate cereal crops (Rivoal & Cook, 1993), but has more impact on Wheat and Barley. The disease caused by the nematode is known as "Molya" (means "deformed" and disease gets its name due to characteristically deformed root system).Economically CCN causes 28.5% wheat crop losses amounting to Rs. 8967.52 million in Rajasthan and Haryana (kumar *et al* 2020).

Biology and Life cycle

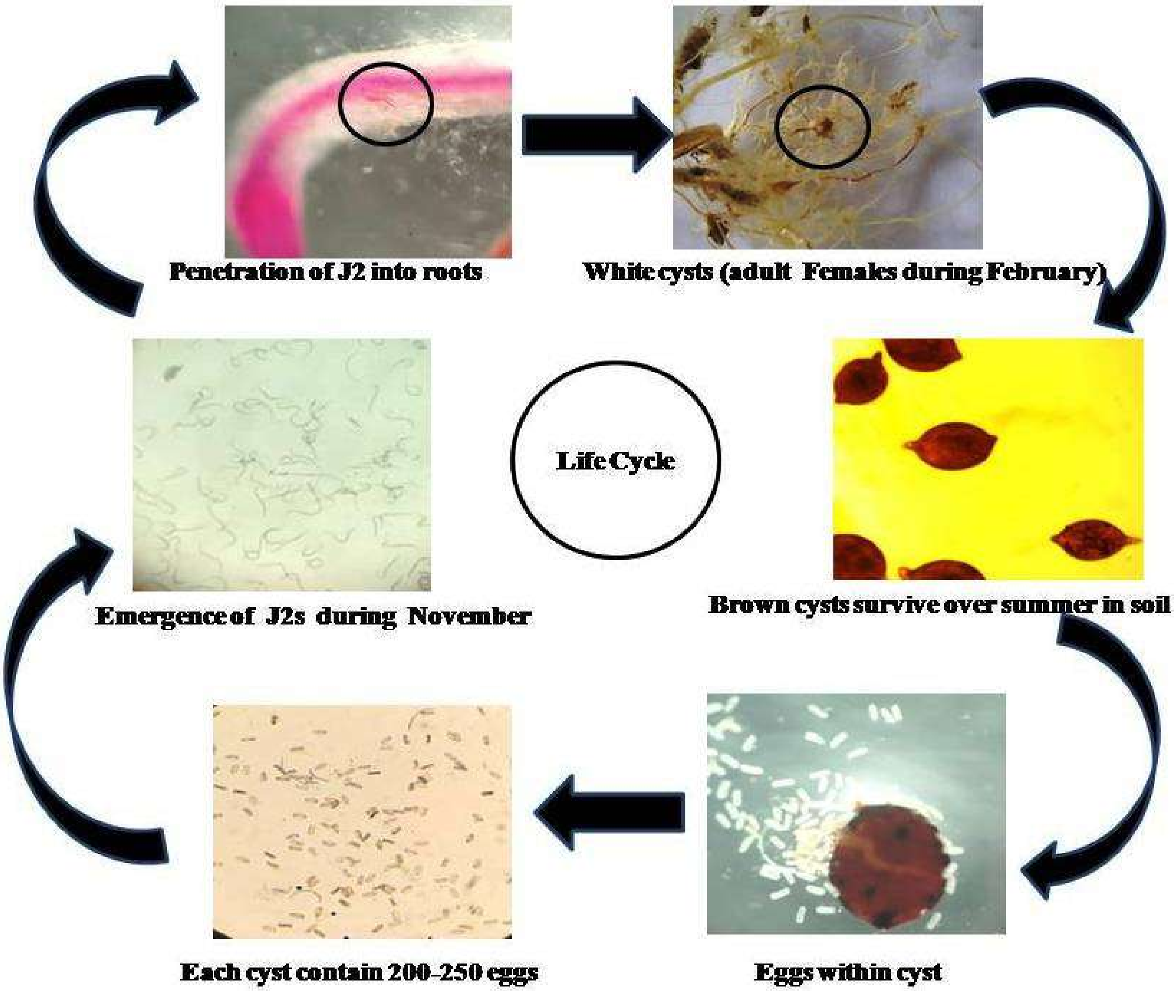

Fig: 1 Life cycle of Cereal cyst nematode, *Heterodera avenae*

The life cycle of *H. avenae* involves only one generation during a cropping season, irrespective of geographic region. There is sexual dimorphism, with males remaining vermiform, whereas females become lemon shaped and spend their -life inside or attached to a root. Eggs are retained within the female's body and, after the female has died, the body wall hardens to protect the eggs and juveniles. The eggs within a cyst remain viable for several years. Second stage juveniles are emerges in November and penetrates the host root just behind the growing tip, moving through the cortical cells and stellar region where the larvae remain parallel to the stellar tissues and start feeding on the specialized cells called syncytium surrounding the head, The development of nematode inside root involves three moults. The larvae that become females swell to lemon-shape with the enlargement of body and protrude out of the root tissues. Those larvae which are destined to become males remain vermiform and move out of the root tissues into the soil and fertilize the females. Females start laying eggs which fill up the whole body. At this stage, females die and body cuticle changes colour from white to brown. On an average, a cyst may contain 200-250 eggs and larvae. The brown colour cyst will detach from the host root and will remain dormant in the soil up to next crop season.

Symptoms

The above-ground symptoms of damage can be seen within a month after sowing, uneven patches of poorly growing plants, randomly distributed throughout a field. Infested plants exhibit stunt, thin and narrow leaves, reduced number of tillers, delayed emergence of ears, reduced number of spikelet's and grains. Symptoms produced on roots are different, depending on the host. Root system becomes bushy, bunchy, and shallow due to their proliferation and has slight swelling near the root-tip. Wheat attacked by *H. avenae* shows increased root production such that the roots have a "bushy-knotted" appearance with several females visible at each knot. In the month of mid-February white cysts can be observed on the roots they turn brown in March.

Uneven patchy growth, yellowing and stunting of wheat fields due to infestation *Heterodera avenae*

Appearance of bushy-knotted wheat root system **Appearance of white cysts (adult females) on wheat root**

Fig: 2 various kinds of symptoms produced by the cereal cyst nematode, *Heterodera avenae*

Management

Attempts have been successfully made to manage the high population of H. avenae through cultural practices like two-three deep summer ploughings during May/June and crop rotation with non-host crops like mustard, carrot, fenugreek, and gram. Early sowing is a key strategy because nematode needs 18°C to hatch. Application of potassium can be useful instead of only applying the nitrogen. Resistant varieties such as Raj MR-1 of wheat has been identified from Rajasthan and released for cultivation. AICRP on wheat & barley recommended, soil application of 5q neem cake/ha and pre-sowing seed treatment with 10 ml neem oil /kg reduced CCN cysts from 40.4 to 7.2 cysts/plant and increased wheat yields by 93% over untreated control under sick plot conditions. Chemicals such as carbofuran (Furadan 3G) can be applied @ 13kg/acre is found to increase the yield of the wheat in the Molya affected areas.

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Cultural Practices: Important Aspect of Integrated Pest Management in Plants

Article ID: 30659

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Introduction

Integrated pest management is currently widely adopted management practice for controlling pest and diseases in the field level. IPM helps in reducing pathogen by balancing host and surrounding environment (Fig. 1). IPM includes practices such as physical, chemical, biological and cultural practices are included under the principal of control. Among all practices cultural practices are age old, most convenient and cost friendly practices. Over the centuries cultural practices continuously showing their remarkable performance to restrict the pathogen as well as supporting the plant system, which includes following examples below.

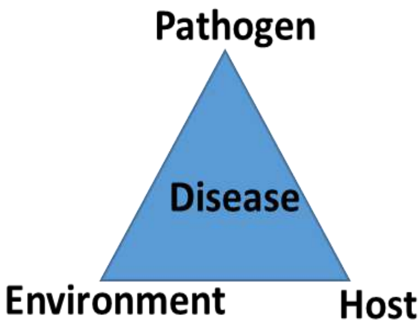

Fig 1. Disease triangle

Crop Rotation

This is the practice where crops of different nature are grown one after another. Such as cereals followed by legume crops. Take-all of wheat (caused by *Gaeumannomyces graminis*) is an example of soil borne diseases that are easily managed by short rotations of one year.

Rotation with Unrelated Crops

Possibly the most explored cultural practice for disease management. This helps keep populations of pathogens from building up to damaging numbers. Rotation does not to eliminate disease development completely, but it certainly effective in damage reduction from most diseases.

Deep Ploughing

Deep ploughing results in exposure of propagules to elevated temperatures and physical killing of the pathogen. This can also be called as dry soil solarisation. In tomatoes, the incidence of the southern blight disease was lower after deep ploughing (25 cm depth), compared with shallow tillage by means of a harrow. Summer ploughing was effective at reducing populations of cyst nematodes and increasing wheat yield.

Flooding

This practice resembles soil disinfestation. The harmful effect on soil borne pathogen may be associated with lack of O_2, increased CO_2 or various microbial activities under anaerobic conditions, e.g. production of substances that are toxic to the pathogen. This practice was known in ancient civilizations in the near and far East. A classic case of control on a large scale was demonstrated with the Panama wilt disease of bananas caused by *F. oxysporum f. sp. Cubense.*

Flooding also apparently destroys *Pseudomonas solanacearum*, and the nematode Radopholus similis as well. Long-term summer soil flooding, with or without paddy rice culture, decreased populations of wilt pathogen *Verticillium dahliae* and therefore, incidence of *Verticillium* wilt in cotton.

Destruction of Crop Residues

Dry plant residues in the field/burnt are fired to clean the area. Burning of rice stubble and straw is common practice throughout the world for management of rice blast and brown spot of rice.

Burning of Crop Residue

It has been discouraged because of destruction of valuable organic matter and creation of an air pollution problem. However, it is a highly effective measure of eradicating some important plant pathogens associated with crop residue.

Irrigation

Irrigation alleviates the water stress which pre-disposes the plants to certain diseases. Water stress had a pre-disposing effect on the severity of Phytophthora root rot in safflower and on disease caused by *Macrophomina phaseolina* and an adequate irrigation regime reduced disease incidence.

Fertilizer Usage

Fertilizers may have some bearing on development of certain diseases. It varies with each crop and disease but, in general, nitrogen imbalance along with other nutrients enhances foliage disease progression and predisposes plants to other diseases. On the other hand, potash, helps disease reduction when it is in balance with other elements.

Deep Burial of Crop Residue

Burial of left-over crop residue helps managing certain diseases by placing the pathogen along with the residue at a depth which subsequently leads to oxygen deficiency. This helps in population reduction of the pathogen and allows the crop to escape much of the damage.

Planting on a Raised Bed

It helps in preventing certain diseases such as Southern blight and certain of the wilt diseases. This practice is recommended for leguminous crops such as peanuts, soybeans, and guar, and vegetable crops which are grown in tight and poorly drained soils.

Time of Sowing

Sowing timing has an important bearing on disease prevention in many cases. Delayed planting of wheat helps in escaping the chances of wheat streak mosaic virus. Early spring planting of cotton may also effectively help to escape cotton root rot.

Removal of Undesirable Plants

Undesirable plants might serve as a host reservoir for virus diseases that attack cultivated crops aid in preventing infection. Infected rhizomes of Johnson grass are the primary overwintering host for the maize dwarf mosaic virus that attacks grain sorghum, forage sorghum, and corn. Wild *Solanaceae* weeds, such as jimson weed, horse nettle and silver leaf nightshade harbour viruses that attack potato and tomato.

Rouging (Removal) of Diseased Plants

Some plants which appears diseased, removal of such plants or their infected parts often results an effective method in reducing the spread of a destructive disease. Virus diseases of stone fruits and bacterial wilt of cucurbits are examples where rouging is worthy of consideration.

Volunteer Plants

Self-grown plants from a harvested crop are often means of carrying a disease organism from one crop season to the next. Rusts of cereal crops and spinach constitute an example of this type disease dissemination.

Insect Pests Managed by Crop Rotation

Cultural practices are equally effective in controlling the plant pests and reduces huge losses caused by insect damage (Table 1).

Table 1. Examples of cultural practices effective in management of insect damages:

Insect Pest	Practice to be avoided	Overwintering stage and location	Cultural management
Corn root worms (*Diabrotica* spp.)	Corn following corn	Eggs in soil in the field	In the northeast US, a single-year rotation with a non-host should be adequate, but rootworms in the Midwest are adapting to defeat repeated corn-soybean rotations. Western corn rootworm strains have adapted by laying more eggs in soybean fields, and a small percentage of northern corn rootworms have adapted by extending egg diapause to two years.
Wireworms (*Melanotus communis, Limonius* spp.)	Highly wireworm-susceptible crops (e.g., root crops, corn, melons) following grassy sod or small grain crops	Larvae in soil in the field	Wireworms can continue to be damaging in a particular field for many years, since some species remain in the larval stage for 3–6 years. Ploughing in late summer or fall exposes the larvae to predation. Baiting can be used to detect wireworm infestations before planting.
White grubs (*Phyllophaga* spp.)	Highly grub-susceptible crops (e.g., corn, potatoes, strawberries) following grassy sod	Larvae in soil in the field	*Phyllophaga* grubs remain in soil as larvae for 3–4 years. Late summer or early fall ploughing kills grubs through physical damage and by exposing them to predation. Annual white grub species, such as European chafer, oriental beetles, Japanese beetles, and Asiatic garden beetles, all of which are pests of turf, also spend the winter as larvae and may be confused with *Phyllophaga*. Because the annual species are short lived and highly mobile as adults, crop rotation is not an effective control for them.
Colorado potato beetle *(Leptinotarsa decemlineata)*	Potatoes, tomatoes, or eggplant following potatoes, tomatoes, eggplant, or high densities of horse nettle	Adult beetles in soil or on the edges of the field	Planting as little as 200 meters (~650 feet) from previous solanaceous host crops delays infestation by 1–2 weeks, reduces initial population density, and causes emergence of most summer adults to be too late to produce a 2nd generation in Massachusetts. However, a distance of 0.8 km (½ mile) or major barriers to movement may be needed for adequate control. Barriers include plastic-lined trenches; reusable plastic troughs; or dense plantings of wheat, rye, or other cover crops. Straw mulch can also delay host finding by the beetles and reduce their survival.

Summary

Cultural practices are adopted to promote broad objectives of increasing crop production by supporting growth or management of damages. Modifying practices like crop rotation, deep ploughing, flooding, destruction of crop residues, burning of crop residue, irrigation, fertilizer usage, deep burial of crop residue, planting on a raised bed, time of sowing removal of undesirable/ volunteer/ rouging plants can result in tremendous gain in over-all production. Therefore, cultural practices are cheaper, easier and effective option for sustainable agriculture system.

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Grafting: A potential Approach for Root-Knot Nematode Management in Vegetable Crops

Article ID: 30660

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Introduction

Vegetables are main constituents of diet and play a key role in ensuring nutritional and livelihood security to the increasing Indian population. However, vegetable production is seriously hampered by biotic stresses which pose greater challenge to meet future vegetable demands. Among different biotic stresses, root-knot nematodes (*Meloidogyne* spp.) cause significant economic damage to vegetable production. In India, RKNs cause to the tune of 14,461.22 million rupees of monetary loss in different vegetable crops (Kumar et al., 2020).

Root-knot nematode (RKN) is an obligate, sedentary endoparasite belonging to one of the most economically important plant parasitic nematode genera. Among vegetables, crops belonging to solanaceae and cucurbitaceae families are highly prone to this nematode damage. *Meloidogyne incognita*, *Meloidogyne javanica*, *Meloidogyne arenaria* and *Meloidogyne hapla* are the four root-knot nematode species economically important in vegetable production. *M. incognita*, *M. javanica* and *M. arenaria* are found worldwide, mostly in tropical and subtropical areas but are also present in temperate areas specially in protected cultivation. *M. hapla* is typically present in temperate areas and at higher altitude in tropics.

Besides the direct damage, RKNs acts as predisposing agent for entry of soil borne fungal and bacterial pathogens leading to development of disease complexes. Traditional management of nematode largely depends on chemical nematicides. However, use of nematicides is discouraging due to their toxic hazard on beneficial organisms, human beings and environment. Thus, search of an alternative safe approach is paramount importance. In this context, grafting is a unique horticultural technology presently being exploited for curtailing plant parasitic nematodes and other soil borne pathogens like fungi, oomycetes, bacteria and viruses.

Grafting as an Alternative Approach

Grafting is a vegetative, asexual plant propagation technique in which shoot part called as "scion" and root part called as "rootstock" are united together. This technique has ancient history and has been practiced for many centuries with fruit, forest trees and ornamental plants. In early 20th century, grafting technique was practiced with vegetable crops and the primary concern was to manage soil borne pathogens. Grafting was mainly practiced in vegetable crops belonging to cucurbitaceae and solanaceae families.

Of late, the technique is being tried to mitigate several abiotic and biotic stresses in vegetable crops. To mitigate biotic stresses two grafting approaches are commonly practiced i.e. intraspecific grafting and interspecific or intergeneric grafting. Intraspecific grafting is union of root stock and scion of same species where interspecific or intergeneric grafting uses combinations of rootstock and scion that are of different species or genera, respectively (Louws et al., 2010).

Grafting for Root-Knot Nematode Management

Several rootstocks for suppressing RKN incidence in solanaceous and cucurbitaceous crops have been known. In tomato (*Solanum lycopersicum* L.) some of the interspecific hybrids (ISHs) are utilized as rootstocks for managing RKN. Similarly, highly resistant brinjal (*Solanum melongena* L.) and chilli (*Capsicum annum* L.) rootstocks are identified from World Vegetable Centre, Taiwan for RKNs management. *Solanum torvum* is a wild brinjal species recognised as promising rootstock for RKNs. Sellaperumal et al. (2019) demonstrated the greater compatibility of *Solanum torvum* with tomato cultivars (Kashi Aman and Kashi Vishesh) and its ability in significantly reducing the RKN incidence in grafted tomato plants. In cucurbitaceous vegetable crops, limited information is available on resistance germplasms against RKN.

Information on reported resistant rootstocks against root knot nematodes in different vegetable crops has been provided in Table 1.

Resistance reaction against RKN by *Solanum torvum* rootstock grafted on tomato cultivar (Kashi Aman) Scion

Advantages of Grafting

1. Grafting is an eco-friendly strategy that can protect vegetables from root knot nematodes and other soil borne diseases.
2. Grafting offers abiotic stress tolerance in vegetable crops.
3. Grafting helps in multiple and/or successive cropping.
4. Grafting enhances water uptake and nutrient uptake.
5. Grafting saves time, money and space.

Table 1. Resistant Rootstocks Against Root Knot Nematodes in Different Vegetable Crops

Vegetable crops	Resistant rootstocks	References
Tomato	Maxifort, Beaufort and Big Power	Rivard et al., 2010
Brinjal	VI046103 (EG195), VI046101 (EG190), VI034845 (TS03), VI046104 (EG219)	https://avrdc.org/seed/improved-lines/rootstock
Chilli	VI064659 (PP0237 7502), VI037556 (PBC535) and VI014995 (PI201232)	https://avrdc.org/seed/improved-lines/rootstock
Cucurbits	Wild watermelon (*Citrullus lanatus* var. *citroides*) Pumpkin (*Cucurbita moschata* L.), African horned cucumber (*Cucumis metuliferus* L.), Colocynth (*Citrullus colocynthis* L.), *Cucumis callosus*, Wild Cucumis species (*Cucumis pustulatus* L.)	Thies et al., 2010 Thangamani et al., 2018 Liu et al., 2015

Conclusion

Grafting is becoming an important integrated nematode management strategy in solanaceous and cucurbitaceous crops. Intraspecific selections with specific major resistance genes and interspecific and intergeneric selections with non-host resistance mechanisms or multigene resistance can be tried as rootstocks.Nevertheless, rootstock selection for grafting is site specific depending on the population structure and dynamics of nematodes, as well as edaphic, environmental and anthropogenic factors.

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e-Pest Surveillance: A Innovative Approach for Integrated Pest Management

Article ID: 30661

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Introduction

The launch of World Wide Web in 1991 revolutionizing global information system and the National e-Governance plan of 2006 followed by Digital India project of 2014 to transform India into a digitally empowered society facilitates wider dissemination of knowledge and technological products and processes for integral development of our nation.

The systematic and rigorous approach to pest surveillance using ICT, referred as e-pest surveillance.

Why Necessary to e-Pest Surveillance?

1. The rural economy of Maharashtra is predominantly based on rainfed agriculture.

2. Cultivation of kharif crops such as cotton, soybean, rice and pigeonpea besides the major rabi crop of chickpea are the mainstay of the State.

3. During 2008-09, there was a severe pest outbreak of *Spodoptera litura* (Fabricius) coupled with *Helicoverpa armigera* (Hubner) and other leaf eating caterpillars in cotton-soybean based cropping system where in an area of 14.56 lakh ha of soybean was affected and losses to the tune of Rs. 1392 crores were encountered. Financial assistance of Rs. 450 crores were provided to the farmers. Despite the increased area under soybean during 2008, pest epidemics occurred mainly due to the lack of supervision on the buildup of the pests in the initial stages of attack.

4. In 2010, the first time in India, the National Centre for Integrated Pest Management (NCIPM), a wing of Indian Council of Agricultural Research (ICAR), is going to launch e-pest surveillance programme in **Balangir** district to prevent pests from damaging paddy crop.

5. Around **45 farmers** who have been selected as 'elite' will be receiving advice on pest control through SMS on their mobile phones for which the Agriculture Department will give **Rs 150 a month**.

THE NEW INDIAN EXPRESS

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e-pest surveillance system in Balangir dist soon

BALANGIR: For the first time in India, the National Centre for Integrated Pest Management (NCIPM), a wing of Indian Council of Agricultural Research (ICAR), is going to launch epest surveillan

Published: 25th July 2010 04:51 AM | Last Updated: 16th May 2012 01:47 PM

BALANGIR: For the first time in India, the National Centre for Integrated Pest Management (NCIPM), a wing of Indian Council of Agricultural Research (ICAR), is going to launch epest surveillance programme in Balangir district to prevent pests from damaging paddy crop.

Following reports of pest attack on paddy crop from across the district, the Agricultural Department had sought support from ICAR, which planned to launch epest surveillance to guide farmers and lowerrung agricultural supervisors called 'Pest Monitors'. A technical officer from NCIPM has been deputed to design esurveillance.

"The main objective of launching the surveillance is to facilitate speedy response towards pest menace. There will be pest monitors at the block level, who will collect data regarding the kind of pests and the economic threshold limit to use pesticide. After their data is validated by plant protection officer, it will be sent to ICAR, where scientists will despatch advisory notes on the action to be taken." said S Satyakumar, technical officer of NCIPM.

Latest

- Heatwave to continue in Northern India till Wednesday
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- Economists fear of 2020 recession in US: Report

Objectives

1. Monitor trends and estimate magnitude of disease-pest problems
2. Epidemic (outbreak) detection and prediction
3. Monitor progress towards control objectives
4. Monitor programme performance
5. Evaluate interventions
6. Understand characteristics of pest events: distribution and spread as well as natural history
7. Facilitate farm planning
8. Impact monitoring.

CROPSAP: A Role Model for an e- Pest Surveillance

1. Funded under Rashtriya Krishi Vikas Yojana (RKVY).
2. To develop surveillance program for four to five districts.
3. Maharashtra is the CROPSAP implementation authority with the funding through RKVY of Central Government till 2012 followed by Government of Maharashtra from 2013 till date.

Salient Features

1. e-Pest surveillance and digital delivery of pest management advisories.
2. Awareness creation among farmers.
3. Implementation of IPM including the supply of critical inputs. Area of cultivation (m.ha) of the target crops in Maharashtra under CROPSAP.

e-Pest Surveillance

1. Recently, ICAR-National Centre for Integrated Pest management work regarding e-pest surveillance on below project.
2. Rice in Tripura
3. Basmati rice in Haryana.
4. Horticultural crop Haryana.

Pest and Disease Surveillance Functions

PRIME MINISTER'S AWARD FOR EXCELLENCE IN PUBLIC ADMINISTRATION 2012-13

Crop Pest Surveillance and Advisory Project (CROPSAP) - for pest management in major crops in Maharashtra was awarded 'Prime Minister's Award for Excellence in Public Administration' for the year 2012–13. Shri Prabhakar Deshmukh, then Commissioner of Agriculture, Maharashtra received the award on the Ninth Civil Services Day held on 21 Apr 2015 organized by the Department of Administrative Reforms and Public Grievances.

E GOVERNANCE GOLD MEDAL

Crop Pest Surveillance and Advisory Project (CROPSAP) – Maharashtra was an award winner for exemplary use of ICT-based solutions at the 15th National Conference on e-Governance held during 9-10 Feb 2012 at Bhubaneshwar, Odisha.

Categorized into core functions and supportive functions:

1. Core functions:

a. Reporting.

b. Detection.
c. Investigation and confirmation.
d. Analysis and interpretation.
e. Action and response.

2. Support functions:
a. Training.
b. Supervision.
c. Resources.
d. Standard guidelines.

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Composition and Factors of Soil Organic Matter

Article ID: 30662

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Soil Organic Matter

Substances containing carbon are organic matter. Soil organic matter consists of decomposing plant and animal residues. It also includes substances of organic origin either leaving or dead.

Soil organic matter plays an important role in deciding / maintaining soil physical conditions. It also influences soil chemical properties especially cation exchange capacity. Organic matters supply the energy sources for soil micro-organisms. Soil development is another aspect which is influenced by the soil organic matter.

Plant tissue is the major source. Animals are considered as the secondary sources. They attack original plant tissues, contribute waste products and leave their own bodies after death.

Factors Affecting Soil Organic Matter

1. Climate
2. Natural vegetation
3. Texture
4. Drainage
5. Cropping and Tillage
6. Crop rotations, residues and plant nutrients.

Climate

Temperature and rainfall exert a dominant influence on the amounts of N and organic matter found in soils.
1. Temperature: The organic matter and N content of comparable soils tend to increase if one moves from warmer to cooler areas. The decomposition of organic matter is accelerated in warm climates as compared to cooler climates. For each 10°C decline in mean annual temperature, the total organic matter and N increases by two to three times.

2 Rainfall: There is an increase in organic matter with an increase in rainfall. Under comparable conditions, the N and organic matter increase as the effective moisture becomes greater.

Natural Vegetation

The total organic matter is higher in soils developed under grasslands than those under forests.

Texture

Fine textured soils are generally higher in organic matter than coarse textured soils.

Drainage

Poorly drained soils because of their high moisture content and relatively poor aeration are much higher in organic matter and N than well drained soils.

Cropping and Tillage

The cropped lands have much low N and organic matter than comparable virgin soils. Modern conservation tillage practices help to maintain high OM levels as compared to conventional tillage.

Rotations, Residues and Plant Nutrients

Crop rotations of cereals with legumes results in higher soil organic matter. Higher organic matter levels, preferably where a crop rotation is followed.

Composition of Organic Residues

Plant residues contain 75% moisture and 25% dry matter. This 25% is made up of Carbon (10-12%), Oxygen (9-10%) , Hydrogen (1.5-2.5%), N(1-2%) and mineral matter (1-3%).

Composition of Plant Tissues

Carbohydrates
- Celluloses 20-50%
- Hemicellulose 10-30%
- Starch, Sugar 1-5%

Proteins 1-15%
Fats, waxes, tannins 1-10%
Lignins 10-30%
Inorganic residues (mineral matter)

Nitrogenous
1. Water insolubles
   Proteins, Peptides
   Peptones and S containing materials
2. Water solubles
   (NO_3^-, NH_4^+ compounds)

Non-Nitrogenous
Carbohydrates (celluloses, Hemicellulose, Starch, Sugar etc)
Ether solubles (Fats, oils, waxes, resins etc) Lignins

The organic matter is also classified on the basis of their rate of decomposition:
1. Rapidly decomposed : Sugars, starches, proteins etc.
2. Less rapidly decomposed : Hemicelluloses, celluloses etc.
3. Very slowly decomposed: Fats, waxes, resins, lignins etc.

Role of Organic Matter

1. Organic matte creates a granular condition of soil which maintains favourable condition of aeration and permeability.
2. Water holding capacity of soil is increased and surface runoff, erosion etc., are reduced as there is good infiltration due to the addition of organic matter.
3. Surface mulching with coarse organic matter lowers wind erosion and lowers soil temperatures in the summer and keeps the soil warmer in winter.
4. Organic matter serves as a source of energy for the microbes and as a reservoir of nutrients that are essential for plant growth and also hormones, antibiotics.
5. Fresh Organic matter supplies food for earthworms, ants and rodents and makes soil P readily available in acid soils.
6. Organic acids released from decomposing organic matter help to reduce alkalinity in soils; organic acids along with released CO_2 dissolve minerals and make them more available.
7. Humus (a highly decomposed organic matter) provides a storehouse for the exchangeable and available cations.
8. It acts as a buffering agent which checks rapid chemical changes in pH and soil reaction.

Soil Organic Matter - Decomposition, Mineralization and Immobilization

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Decomposition of Soil Organic Matter

Different organic residues contain different organic compounds. There is great variation in the rate of decomposition of organic residues. Sugars, starches and simple proteins are very rapidly decomposed. On the other hand, Fats, waxes and lignin are very slowly decomposed. Hemicellulose, celluloses and protein are intermediate. Even though the composition may vary the end products are more or less the same.

The general reactions taking place during decomposition are:

1. Enzymatic oxidation of the bulk with the release of CO_2 , water, energy and heat
2. Essential elements are released (N, P, S etc) and immobilized by a series of reactions.
3. Formation of compounds which are resistant to microbial action.

Molecules very resistant to microbial action is formed either through modification of compounds or by microbial synthesis.

Under Aerobic Conditions the Products Formed

CO_2, NH_4, NO_3, H_2PO_4, SO_4, H_2O and essential plant nutrients like Ca, Mg, Fe, Cu, Zn etc.

Under Anaerobic Conditions

CH_4, organic acids like lactic, propionic, butyric, NH_4, various amine residues ($R\text{-}NH_2$) H_2S, ethylene ($CH_2{=}CH_2$) and humic substances.

Decomposition of Soil Soluble Substances

When glucose is decomposed under aerobic conditions the reaction is as under:

$$\textbf{Sugar + Oxygen} \rightarrow \mathbf{CO_2 + H_2O}$$

Under partially oxidized conditions,

Sugar + Oxygen → Aliphatic acids (Acetic, formic *etc.*) or Hydroxy acids (Citric, lactic etc.) or Alcohols (ethyl alcohol etc.)

Some of the reactions involved may be represented as under:

$$C_6H_{12}O_6 + 2O_2 \rightarrow 2CH_3.COOH + 2CO_2 + 2H_2O$$
$$2C_6H_{12}O_6 + 3O_2 \rightarrow C_6H_8O_7 + 4H_2O$$
$$C_6H_{12}O_6 + 2O_2 \rightarrow 2C_2H_5OH + 2CO_2$$

Ammonification → organic N → Polypeptides → Peptides → amonoacids → NH_3 or NH_4

1. Ammonification: The transformation of organic nitrogenous compounds (amino acids, amides, ammonium compounds, nitrates etc.) into ammonia is called ammonification. This process occurs as a result of hydrolytic and oxidative enzymatic reaction under aerobic conditions by heterotrophic microbes.

2. Nitrification: The process of conversion of ammonia to nitrites (NO2) and then to nitrate (NO_3^-) is known as nitrification. It is an aerobic process by autotrophic bacteria.

$$\text{Ammonia} \xrightarrow{\text{Nitrosomonas}} \text{Nitrite} \xrightarrow{\text{Nitrobacter}} \text{Nitrate}$$

The net reactions are as follows:

$$NH_4^+ + O_2 \rightarrow NO_2^- + 2H^+ + H_2O + \text{energy}$$
$$NO_2^- + O_2 \rightarrow NO_3^- + \text{energy}$$

3. Denitrifi1cation: The process, which involves conversion of soil nitrate into gaseous nitrogen or nitrous oxide, is called Denitrification. Water logging and high pH will increase N loss by Denitrification.

$$\text{Nitrate} \xrightarrow{\text{Pseudomonas / Bacillus}} N_2 \text{ gas}$$

Under Anaerobic Conditions

$C6H_{12}O_6$ (Glucose) - Lactic acid, butyric acid Ethyl alcohol are formed Protein and other N compounds are converted into elemental N.

Decomposition of Insoluble Substances

1. Breakdown of Protein: During the course of decomposition of plant materials, the proteins are first hydrolysed to a number of intermediate products.

Aminization: The process of conversion of proteins to amino acids.
Ammonification: The process of conversion of amino acids and amides to ammonia.

2. Breakdown of cellulose: The decomposition of the most abundant carbohydrates. Hydrolysis oxidation

$$\textbf{Cellulose} \xrightarrow{\text{cellulase}} \textbf{Cellobiose} \xrightarrow{\text{cellobiase}} \textbf{Glucose} \rightarrow \textbf{Organic acids} \rightarrow CO_2 + H2O$$

This reaction proceeds more slowly in acid soils than in neutral and alkaline soils. It is quite rapid in well aerated soils and comparatively slow in poorly aerated soils.

3. Breakdown of Hemicellulose: Decompose faster than cellulose and are first hydrolysed to their component's sugars and uranic acids. Sugars are attacked by microbes and are converted to organic acids, alcohols, carbon dioxide and water. The uranic acids are broken down to pentose and CO_2. The newly synthesized hemicelluloses thus form a part of the humus.

4. Breakdown of Starch: It is chemically a glucose polymer and is first hydrolysed to maltose by the action of amylases. Maltose is next converted to glucose by maltase. The process is represented as under:

$$(C_6H_{10}O_5)n + nH_2O \rightarrow n\,(C_6H_{12}O_6)$$

Decomposition of Ether Soluble Substances

Fats →glycerol + fatty acids
Glycerol →CO_2 + water

Decomposition of Lignin

Lignin decomposes slowly, much slower than cellulose. Complete oxidation gives rise to CO_2 and H_2O.

Sulphur Containing Organic Compounds

Converted to SO_4^{-2}+ H^+ + energy by sulphur oxidizing bacteria.

P Containing Organic Compounds

Various microorganisms mineralize phospholipids and other organic P compounds in the presence of phosphates enzymets H_2PO_4 and HPO_4^{-2} depending on soil pH.

Mineralisation

The biological conversion of organic forms of C, N, P and S to inorganic or mineral forms is called mineralization.

Immobilization

The conversion of inorganic forms of C, N, P and S by the soil organism into organic forms is called Immobilization.

Factors Affecting Decomposition

1. Temperature: Cold periods retard plant growth and organic matter decomposition. Warm summers may permit plant growth and humus accumulation.
2. Soil moisture: Extremes of both arid and anaerobic conditions reduce plant growth and microbial decomposition. Near or slightly wetter than field capacity moisture conditions are most favourable for both processes.
3. Nutrients: Lack of nutrients particularly N slows decomposition.
4. Soil pH: Most of the microbes grow best at pH 6 to 8, but are severely inhibited below pH 4.5 and above pH 8.5.
5. Soil Texture: Soils higher in clays tend to retain larger amounts of humus.
6. Other Factors: Toxic levels of elements (Al, Mn, B, Se, Cl), excessive soluble salts, shade and organic phytotoxins in plant materials.

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Invasive Tomato Pin Worm, *Tuta absoluta* (Meyrick) Infestation under Polyhouse Tomato Crop in Udaipur Region

Article ID: 30664

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Introduction

Polyhouse farmers are informed that their polyhouse tomato crop may be invading by an introduced notorious pest, tomato pin worm, Tuta absoluta (Meyrick). This belongs to the Gelechiidae family of the Lepidoptera order. This pest is originated from South America and known for various other names in the different parts of world viz., tomato leaf miner, South American tomato moth, South American tomato pinworm, tomato borer, American leaf miner etc. It has been accidently introduced into India in the year 2014 in Pune, Maharashtra first and thereby other states of the country. It was earlier known to a pest of tomato crop in open field conditions only, but recently, it has been observed under polyhouse conditions in the Udaipur region of Rajasthan in a low incidence. However, now a days, it is found to invade the polyhouses tomato crop in a devastating way and becoming notorious pest for the farmers.

Host Plants

Tomato prefers primarily but known to feed on other solanaceous plants like brinjal and potato.

Identification of the Pest

The eggs of this pest are elliptical, and oyster-white to bright yellow in colour. The female moths mostly laid eggs on the upper side of the tomato leaves. The first-instar larvae are whitish soon after hatching, become greenish or light pink in the second to fourth instars according to food (leaflet or ripe fruit, respectively). There are usually four instars. Last instars leave the mines and build silk cocoons on the leaflets or in the soil for the pupation. Pupation takes place in soil or on plant parts such as leaves and stem. Pupae are obtect with greenish coloration at first, turning chestnut brown and dark brown near adult emergence. Adult moths are about 10 mm long, with silverish-grey scales, filiform antenae, alternating light or dark segments and recurved labial palps which are well developed.

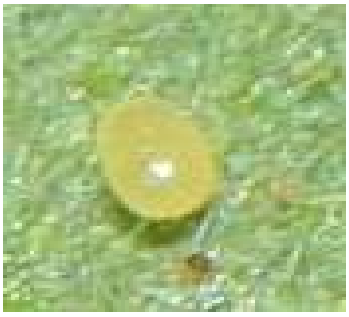

Fig 1. Egg

Fig 2. Larva

Fig 3. Adult

Symptoms of Damage

Larvae mine in the mesophyll of leaves and make irregular, papery mines. The larvae also mine apical buds and stems. In cases of heavy infestation, both green and red fruits are attacked and infested fruits show small pin holes on the surface of the fruits and the larvae tunnel below the surface.

Fig 4. Infested leaves

Fig 5. Infested fruit

Management Includes

$C6H_{12}$ O_6 (Glucose) - Lactic acid, butyric acid Ethyl alcohol are formed Protein and other N compounds are converted into elemental N.

Decomposition of Insoluble Substances

1. Collect and destroy the affected plants and fruits.
2. Avoid cultivation solanaceous crops after tomato like brinjal, potato etc.
3. Use healthy seedlings for transplanting.
4. Install pheromone traps @ 16 nos./acre to attract and kill the adult moths.
5. Install yellow sticky traps above the crop canopy to attract the moths.
6. Install light trap @ 1/ha to kill adult moths.

7. Conserve the natural enemies of *T. absoluta* such as *Trichogramma exiguum*, *Trichogramma pretiosum* (Trichogrammatidae: Hymenoptera) and *Nesidiocoris tenuis* (Hemiptera: Miridae) etc.
8. Spray biopesticide like Neem formulation (Azadirachtin 1% or 5%) @ 400-600 ml/acre or *Bacillus thuringiensis* 0.5 kg/ha during initial infestation.
9. If case of high incidence, spray chemical insecticides such as Spinosad 45% SC 0.25 ml/L or Flubendiamide 20% WG @ 0.20 ml/L or or Indoxacarb 14.5% SC @ 100 ml/ha. During the peak emergence of the adult moths, spray decamethrin 2.5 EC @ 1 ml/l for killing adults.

Future Impacts

Following its introduction into Europe, North Africa and the Middle East, *T. absoluta* has already caused extensive economic damage. The impact of the pest includes severe yield loss reaching up to 100%, increasing tomato prices, bans on the trade of tomato, increase in synthetic insecticide applications, disruption of integrated management programs of other tomato pests, and an increase in the cost of crop protection would be observed.

Various Trap Used in Integrated Pest Management

Article ID: 30665

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Introduction

Insect traps are used to monitor or directly reduce populations of insects or other arthropods, by trapping individuals and killing them. They typically use food, visual lures, chemical attractants and pheromones as bait and are installed so that they do not injure other animals or humans or result in residues in foods or feeds. Visual lures use light, bright colors and shapes to attract pests. Chemical attractants or pheromones may attract only a specific sex. Insect traps are sometimes used in pest management programs instead of pesticides but are more often used to look at seasonal and distributional patterns of pest occurrence.

Traps for Flying Wind-Blown Insects

1. Light trap: Light traps, with or without ultraviolet light, attract certain insects. Light sources may include fluorescent lamps, mercury-vapor lamps, black lights for armyworm, bugs, cutworm, flies, gnats, bollworm, leafhoppers, planthoppers, stem borers. One light trap sufficient for one hectare.

2. UV – light trap for grain storage godowns: The UV light trap mainly consists of an ultraviolet source (4 W germicidal lamp). The lamp produces ultra-violet rays of peak emission around 250 nano meters. The light is fitted at the centre of a funnel of 310 mm diameter at the top and 35 mm diameter at the bottom. The bottom end of the funnel is attached with a transparent plastic container for collecting the trapped insects. To hang the unit at desired points, three hooks have been provided at the periphery of the funnel.

The unit is also provided with a tripod stand. The UV light trap can be placed in food grain storage godowns at 1.5 m above ground level, preferably in places around warehouse corners, as it has been observed that the insect tends to move towards these places during the evening hours.
Interception traps

Commonly used for surveys in ecological studies, although they can also have pest management applications. In its simplest form, it is a suspended net with an invagination along the top that leads to a collecting tube. The Malaise trap is an example of an interception trap. Fixed interception traps have been used to study insect migration, with separate collecting tubes for north-bound versus south-bound insects. Or, the trap may be used with a wind vane attachment so that the flat surface of the net swivels to face into the wind. Large, funnel-shaped nets have been mounted on moving trucks for sampling flying insects such as biting midges (Ceratopogonidae) or attached to a suction device to sample Russian wheat aphids, *Diuraphis noxia* (Mordvilko).

3. Sticky Traps: Panels, cylinders or spheres covered with sticky material are probably the most commonly used traps for surveys in agricultural studies. In the simplest form, they may be clear panels that are coated with a material that will retain insects that are blown onto the panel or fly into it. Panels may also be used with a color and/or a shape and a chemical attractant. Very small insects will be retained by a thin coating of motor oil, larger insects may escape this substance.

Large insects, sticky material such as Tangle-trap is applied to the surface. The traps can be serviced by using a small tool to scoop insects of interest off the trap and onto a card, or the entire trap can be replaced. For transport, the panel with sticky material can be covered with clear plastic wrap or the panel can be placed in a box with spacers to keep panels from touching other surfaces. To reuse the trap, a paint scraper or thinner can be used to remove sticky material from the surface so that new material can be applied. The advantage of this trap is that it is next to inexpensive and will capture a variety of insects that are moving through the area.

4. Yellow sticky trap, Blue sticky trap and White sticky trap: Make new or used sheet of plywood board or hardboard or card board. Paint it with respective colour (yellow or blue or white) oil paint. Allow it for drying. Apply grease or glue on the painted board. Erect these traps above crop canopy with the help of bamboo poles:

Trap	Target insect
Yellow sticky trap	white flies, aphids, leaf miners
Blue sticky trap	Thrips
White sticky trap	Flea beetles, plant bugs

5. Pit fall traps: Pitfall traps are useful for collecting insects and other arthropods that are walking across a surface like larvae of Army worm, cut worm, white grub and invertebrates in ground nut, sugarcane, fruit crops, banana, coffee etc. Upper funnels can be made from disposable plastic funnels with the bottoms removed to enlarge the hole. Take new or used sheet of plywood board or hardboard or card board. Paint it with blue colour oil paint. Allow it for drying. Apply grease or glue on the painted board. Erect traps above crop canopy with the help of bamboo poles.

6. Ant trap: Make a hole in pan (plastic or aluminium) about one-foot length and six inches width. Push pan into the sloping downwards. Coat the bottom of the pan with sticky materials. Check the pans regularly to make sure that the baits are sticky enough to trap the ants. Barriers prevent ants from attacking the sown seeds and seedlings that are grown in free standing seedbeds.

7. Rat glue trap: Rat glue traps are non-poisonous sticky glue spread over card boards and place them where rats make their route frequently. When rat passes over trap it gets stuck over glue trap. The rat will subsequently die from dehydration. Bait may also be placed on the cardboard to attract them. Cut card board in size of 30X30 cm. Cover the trap with colour papers on all the sides leaving one side. Fix brown sheet on card board. Spread glue on card board sheet.

8. Rat cage trap: A rat cage trap is a metal cage box-shaped device that is designed primarily to catch rats without killing them. Food bait (not poisoned) is put in the cage trap. When an animal enters the cage and moves toward the bait, the mechanism triggers and closes door over the entry point. Rat is caught alive and without injury. The rat can be released in far from field in forest area.

9. Pheromone traps: Sex pheromones (Septa) are insect specific produced artificially in laboratories and used separately. American boll worm, spotted boll worm, pink boll worm, Dimond back moth, white grubs are control by it.

10. Field application of this trap: Lures containing sex pheromones are placed into insect trap and erected in the field at a recommended spacing. The lure will release the sex pheromone at a constant rate over a period of 2-4 weeks. Male moths are attracted and while attempting for mating, fall into a container having pesticide. Thus, the female moths in the field are deprived of successful mates and fail to reproduce or lay viable eggs.

11. Caution while using pheromone traps: Always label the trap with detailed information of the species to be trapped and the date of fixing the lure. Change lure once in 15-20 days. Dispose properly the lure wrappers/covers. Wash hands before/after handling baits. Remove all captured adults during each visit. Put live ones into a bucket with soap solution to drown.

Grass Pea (*Lathyrus sativus* L.): A Prized Commodity

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Introduction

Grasspea (*Lathyrus sativus* L.) is a diploid (2n=14), annual, herbaceous branched underutilized pulse crop of Fabaceae family. It is considered to one of the oldest cultivated crops and assumed to be originated in the Balkan Peninsula. It was domesticated around 7,000-8,000 years ago in Eastern Mediterranean region. It is known by several names i.e., Khesari, sabberi, batura, Lakhori, blue sweet pea, white pea, chickling pea, chickling vetch. It is an important crop among poorer sections of the society.

The genus lathyrus has more than 160 species disseminated worldwide grown as food, forage, fodder and ornamental purposes. Globally total area under khesari accounts for 1.50 mha with annual production of 1.20 mt. India accounts for 0.48 mha area with 0.35 mt of production and 701 kg/ha Productivity. Major growing areas in India are Chhatisgarh, Bihar, West Bengal, Maharashtra and Madhya Pradesh while Chhatisgarh ranks first with 67.26 % area and 59.52% production followed by Bihar (13.62 % and 20.09%). It is a robust, climate resilient legume which is grown and consumed as dhal in Northern India and has potential of food and nutritional security. Grass pea is rich in protein (27-29 %) and nutrients like calcium, phosphorus.

It has been saviour for vast population under severe famine and drought conditions around the globe. Cultivation of grass pea is likely to increase due to climate change and increased demand for nutritional security in the post COVID-era. It is highly tolerant to abiotic stresses such as drought, salinity, alkalinity, heat, flood and water logged conditions (Malek et al. 2000). It is also resistance to insect-pest and diseases, has high water use efficiency as it can extract the available soil water more efficiently due to its deeper and extensive root system. Due to its survival nature under harsh situations it is regarded as contingent and insurance crop.

In general, sowing various winter pulse crops like lentil (Lens culinaris L.), lathyrus (*Lathyrus sativus* L.), chickpea (Cicer arietinum L.) and pea (Pisum sativum) in the standing rice crop field, just before the harvest to ensure germination using the residual moisture and to avoid tillage operations during pulse growing. Such a relay cropping operation (known by the terms utera or paira) is very popular for growing lathyrus between rice growing farmers. Subsequently due to high ODAP content of local land races and also with the advent of irrigation facilities, the farmers tended to shift from relay cropping of lathyrus to more remunerative crops like rapeseed, mustard, potato, other vegetables and winter rice which require more water. Thus, the area under lathyrus, in particular, diminished drastically from 54,000 ha during 1981-82 to 40,000 ha during 2000-01 (Anonymus,2003).

Neurolathyrism

Grass pea is deficient in methionine and cysteine (sulphur-containing amino acids), but is rich in lysine and has high level of polyunsaturated fatty acid (Chinnasamy et al. 2004). β-ODAP content and low methionine, an essential amino acid content in seeds are responsible for increasing vulnerability to neurolathyrism. Over consumption of lathyrus as a monotonus diet for longer duration of 3-4 months is associated with neurodegenerative disease and neurological disorders in humans and animals due to presence of non-protein amino acid β-N-oxalyl-L-α, β-diaminopropionic acid (β-O DAP) toxin (Campbell et al. 1994).

Symptoms includes muscular paralysis below knees, stiff and weak legs, muscular rigidity, back pain, failure of reproduction and degenerative arthiritis. Damage due to neurolathyrism in human beings is associated with its method of cooking, β-OADP content in its seeds, consumption quantity and nutritional status of individual. Susceptibility to lathyrism varies from person to person. Pre-soaking of seeds for 7-8 hours and decanting off the water, proper cooking is related with reducing toxicity. Some researchers have found the increased incidence of lathyrism during drought situations and in zinc deficient soils due to the more toxin accumulation in the seeds. Wider adoption and cultivation of grass pea has been neglected in India since ages due to presence of neurotoxin. Old landraces have higher β-ODAP content ranges from 0.5% - 0.25%.

Nutritional Composition of Lathyrus Sativus Seeds

Parameters	Content (%)
Moisture	7.5-8.2
Protein	31.9
Fat	0.9
Ash	3.2
Carbohydrate	41
Energy(Kcal)	362.3
Crude Fiber	5.5-6.0
Total dietary fiber (TDF)	17

Plate: Grass pea (*Lathyrus sativus* L.) flower, pods and seeds

Scenario of Lathyrus in India

In India during 1960's, ban was imposed on the production and sale of lathyrus under rule 44-A of the Prevention of Food Adulteration Act, 1954 which led to the sharp decline in the area and production of this multipurpose legume. In recent years Indian Council of Medical Research (ICMR) has articulated the consumption of lathyrus in recommended dosage due to its low cost, rich protein content, nutraceutical and other therapeutic properties. The problem of lathyrus can be avoided by developing and cultivation toxin free or low toxin varieties.

National Bureau of Plant Genetic Resources (NBPGR, New Delhi) is the nodal agency which is responsible for collection and conservation of germplasm. Development of low ODAP content high yielding improved cultivars such as Bio L-212 (Ratan), Prateek which contains < 0.10 % β-ODAP, has been found to be safer for both animal and human food. Utility of lathyrus as a part of cereal based diet or normal balanced diet like other legumes is unquestionable. Lathyrus has potential to become a wonder crop if the double stigma on its stature as a toxic plant and as food of the poor is overlooked. It can provide lathyrus becoming a potential protein legume crop of economic significance.

Nitrogen Fixation

Being a hardy crop with deep penetrating root system, it is suitable to be grown on wide ranges of soils (Lambein et al. 1990). Grass pea has symbiotic association with certain group of soil microorganisms which forms root nodules and fixes nitrogen efficiently upto 108-125 kg/ha which is used either for its growth or for the succeeding crop. Lathyrus thrives well as paira/utera crop in standing paddy fields, as it can withstand the waterlogged condition. Rice- lathyrus (relay) cropping is practiced in North Indian states to utilize the available soil moisture and farmers believe that nitrogen fixed by grass pea is not only benefiting itself but also enhancing the yield of succeeding crop.

Therapeutic Potential of Lathyrus

1. In grass pea presence of homoarginine (source of potent vasodilator nitric oxide), has potential to cure cardiovascular disease and hypertension.
2. It helps to overcome the consequences of hypoxia, i.e., the inadequate oxygen supply at the tissue level, associated with cancer tumor development.

3. It is a rich in polyphenol and antioxidant which is useful for treating jaundice, high fever, diabetic problems.
4. β-ODAP presence in lathyrus has healing property, acts as natural wound-curative agent.
5. It is used in treatment of Alzheimer's disease.

Other Uses

1. It is used to adulterate high value legumes such as chickpea and pigeon pea flour to fetch good market price.
2. In European countries it is used to restore the soil fertility overexploited by cereal cultivation.
3. It provides a source of income to resource poor farmers under adverse situation. Hence, named as life saver or insurance crop.
4. Used as cover crop, green manuring crop and controls herbicide resistant weeds.
5. Green plants are used as forage for animals and seeds are used for animal feed in India, Pakistan and other countries.
6. It can be used to revitalize marginal and degraded lands.
7. In Bihar and Nepal, splitted grains are used to make pakoda and tender stem and leaves are preferred for saag.
8. Plants of some species i.e. *Lathyrus odoratus* is used as a source of essential oil for manufacturing perfume and cosmetics.
9. Some species are cultivated as ornamentals in gardens.
10. It is used to make chapattis, soup, curry and grinded flour is used as besan.
11. Green leaves and stems of grass pea is suitable for feeding lactating cattle.

Varietal Development in Lathyrus

The extensive research led to the development of six additional varieties (LSD1, LSD2, LSD3, LSD6, Pusa-305, and Selection 1276) with less (0.2%) β-ODAP content. Two varieties (LSD1 and LSD2) were recommended for upland cultivation and the remaining four (LSD3, LSD6, Pusa-305, and Selection 1276) were found to be suitable for rice fallows. Later varieties named as Prateek (LS 157-14) and Mahateora (RLS 4595) were released with very low ODAP content (< 0.1%) and yield upto 1.5 t ha-1 (Dixit et al. 2016).

Low ODAP Varieties:

Variety	ODAP content (%)	Yield (Kg/ha)	Growing areas
Prateek	0.08	1450	Maharastra, Madhya Pradesh, Chhatisgarh
Mahateora	0.08	1600	Maharastra, Madhya Pradesh, Chhatisgarh
Ratan (Bio L 212)	0.06	1530	Madhya Pradesh, Maharashtra, Bihar, Chhattisgarh, Orissa, West Bengal

Developmental Needs for Lathyrus

1. With respect to the global climate change, this highly nutritious orphan crop and neglected legume is gaining more attention. There is need to develop more early maturing (<100 days), high yielding (upto 1.5 tons/ha) and low ODAP content (<0.2%) lathyrus line region and season wise.

2. Government should promote the cultivation of lathyrus by providing good quality, low ODAP, widely adapted seeds to farmers.

3. In order to supply quality seed to farmers without delay, seed multiplication programmes should be strengthening.

4. Price of lathyrus should be fixed prior to harvesting of crop and procurement of seeds should be done by government agencies in order to benefit poor farmers by fetching good price of their produce.

5. More research needs to be done on genetic detoxification (breeding cultivars with low toxin content) or near to zero level ODAP genotypes.

6. Breeding for increased fodder and forage production should be concerned.

7. Investigation and identification of interspecific hybrids which will allow the transfer of desirable traits in Lathyrus sativus.

8. Assessment of germplasm for anti-nutritional factors such as tannins, phenolics and trypsin inhibitors.

9. Expansion of molecular research work in identification of different species and their proper utilization in grass pea breeding.

Conclusion

In Indi, grass pea is only grown as an alternative crop after rice. Most acreage of grass pea lies in rice growing region. Several studies conducted on the nutritional status of grass pea stated that the balanced consumption of seeds does not lead to any neurological disease and disorders. It can serve as health promoting nutraceutical if the value of this pulse crop is effectively utilized. So, there is an urgent need to realize its unexplored prospects, conserve the existing germplasm and develop less BOAA or ODAP cultivars. Elimination of neurotoxin from its seeds through breeding programmes can make it a great value legume which can provide food and nutritional security to the over increasing population. Promotion and adaption will help in exploiting the full potential and the entire perception of community regarding grass pea and the stigma associated with this crop would be changed and removed.

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Farming Systems in India (Short Review Paper)

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Introduction

Farming Systems in India are strategically utilized, according to the locations where they are most suitable. The farming systems that significantly contribute to the agriculture of India are subsistence farming, organic farming, industrial farming. Regions throughout India differ in types of farming they use; some are based on horticulture, ley farming, agroforestry, and many more. Due to India's geographical location, certain parts experience different climates, thus affecting each region's agricultural productivity differently.

India is very dependent on its monsoon cycle for large crop yields. India's agriculture has an extensive background which goes back to at least 9 thousand years. In India, Agriculture was established throughout most of the subcontinent by 6000–5000 BP. During the 5th millennium BP, in the alluvial plains of the Indus River in Pakistan, the old cities of Mohenjo-Daro and Harappa experienced an apparent establishment of an organized farming urban culture. That society, known as the Harappan or Indus civilization, flourished until shortly after 4000 BP; it was much more comprehensive than those of Egypt or Babylonia and appeared earlier than analogous societies in northern China. Currently, the country holds the second position in agricultural production in the world. In 2007, agriculture and other industries made up more than 16% of India's GDP.

Despite the steady decline in agriculture's contribution to the country's GDP, agriculture is the biggest industry in the country and plays a key role in the socio-economic growth of the country. India is the second-largest producer of wheat, rice, cotton, sugarcane, silk, groundnuts, and dozens more. It is also the second biggest harvester of vegetables and fruit, representing 8.6% and 10.9% of overall production, respectively. The major fruits produced by India are mangoes, papayas, sapota, and bananas. India also has the biggest number of livestock in the world, holding 281 million. In 2008, the country housed the second largest number of cattle in the world with 175 million.

Climate Effects on Farming Systems

Each region in India has a specific soil and climate that is only suitable for certain types of farming. Many regions on the western side of India experience less than 50 cm of rain annually, so the farming systems are restricted to cultivate crops that can withstand drought conditions and farmers are usually restricted to single cropping. Gujarat, Rajasthan, south Punjab and northern Maharashtra all experience this climate and each region grows such suitable crops like jowar, bajra, and peas. In contrast, the eastern side of India has an average of 100–200 cm of rainfall annually without irrigation, so these regions have the ability to double crop. West Coast, West Bengal, parts of Bihar, UP and Assam are all associated with this climate and they grow crops such as rice, sugarcane, jute and many more.

Climate Regions of India

There are three different types of crops that are cultivated throughout India. Each type is grown in a different season depending on their compatibility with certain weather. Kharif crops are grown at the start of the monsoon until the beginning of the winter, relatively from June to November. Examples of such crops are rice, corn, millet, groundnut, moong, and urad. Rabi crops are winter crops that are sown in October -November months and harvested in February - March. Its typical examples are wheat, boro paddy, jowar, nuts, etc. The third type is Zaid crops which are summer crops. It is sown in February - March and harvested in May - June. Its examples are aush paddy, vegetables, jute, etc.

Irrigation Farming

Irrigation farming is when crops are grown with the help of irrigation systems by supplying water to land through rivers, reservoirs, tanks, and wells. Over the last century, the population of India has tripled. With a growing population and increasing demand for food, the necessity of water for agricultural productivity is crucial. India faces the daunting task of increasing its food production by over 50 percent in the next two decades, and reaching towards the goal of sustainable agriculture requires a crucial role of water.

Empirical evidence suggests that the increase in agricultural production in India is mostly due to irrigation; close to three-fifths of India's grain harvest comes from irrigated land. The land area under irrigation expanded from 22.6 million hectares in FY 1950 to 59 million hectares in FY 1990. The main strategy for these irrigation systems focuses on public investments in surface systems, such as large dams, long canals, and other large-scale works that require large amounts of capital. Between 1951 and 1990, nearly 1,350 large- and medium-sized irrigation works were started, and about 850 were completed.

Problems from Irrigation

Because funds and technical expertise were in short supply, many projects moved forward at a slow pace, including The Indira Gandhi Canal project. The central government's transfer of huge amounts of water from Punjab to Haryana and Rajasthan contributed to the civil unrest in Punjab during the 1980s and early 1990s. Problems also have arisen as groundwater supplies used for irrigation face depletion. Drawing water off from one area to irrigate another often leads to increased salinity receiving water through irrigation are poorly managed or inadequately designed; the result often is too much water and water-logged fields incapable of production.

Geography of Irrigation in India

Irrigation farming is very important for crop cultivation in regions of seasonal or low rainfall. Western U.P., Punjab, Haryana, parts of Bihar, Orissa, A.P, Tamil Nadu, Karnataka, and other regions thrive on irrigation and generally practice multiple or double cropping. With irrigation, a large variety of crops can be produced such as rice, sugarcane, wheat and tobacco.

Shifting Cultivations

Shifting cultivation is a type of subsistence farming where a plot of land is cultivated for a few years until the crop yield declines due to soil exhaustion and the effects of pests and weeds. Once crop yield has stagnated, the plot of land is deserted and the ground is cleared by slash and burn methods, allowing the land to replenish. Crops like yarn cassava, maize, potatoes are mostly grown This type of cultivation is predominant in the eastern and north-eastern regions on hill slopes and in forest areas such as Assam, Meghalaya, Nagaland, Manipur, Tripura, Mizoram, Arunachal Pradesh, Madhya Pradesh, Orissa, and Andhra Pradesh.

Crops such as rain-fed rice, corn, buck wheat, small millets, root crops, and vegetables are grown in this system. Eighty-five percent of the total cultivation in northeast India is by shifting cultivation. Due to the increasing requirement for cultivation of land, the cycle of cultivation followed by leaving land fallow has reduced from 25–30 years to 2–3 years. This significant drop in uncultivated land does not give the land enough time to return to its natural condition. Because of this, the resilience of the ecosystem has broken down and the land is increasingly deteriorating.

Impacts of Shifting Cultivation

Frequent shifting from one land to the other has affected the ecology of these regions. The area under natural forest has declined; the fragmentation of habitat, local disappearance of native species and invasion by exotic weeds and other plants are some of the other environmental consequences of shifting agriculture. Areas that have a fallow cycle of 5 to 10 years are more vulnerable to weed invasion compared to 15-year cycles, which have more soil nutrients, a larger variety of species, and higher agronomic yield.

Commercial Agriculture

In a commercial based agriculture, crops are raised in large scale plantations or estates and shipped off to other countries for money. These systems are common in sparsely populated areas such as Gujarat, Tamil Nadu, Punjab, Haryana, and Maharashtra. Wheat, cotton, sugarcane, and corn are all examples of crops grown commercially.

Types of Commercial Agriculture

Intensive commercial farming: This is a system of agriculture in which relatively large amounts of capital or labour are applied to relatively smaller areas of land. It is usually practiced where the population pressure is reducing the size of landholdings. West Bengal practices intensive commercial farming. Extensive commercial farming: This is a system of agriculture in which relatively small amounts of capital or labour investment are applied to relatively large areas of land. At times, the land is left fallow to regain its fertility. It is mostly mechanized because of the cost and availability of labour.

It usually occurs at the margin of the agricultural system, at a great distance from the market or on poor land of limited potential and is usually practiced in the tarai regions of southern Nepal.

Crops grown are sugarcane, rice and wheat-Plantation agriculture: Plantation is a large farm or estate usually in a tropical or sub-tropical country where crops are grown for sale in distant markets rather than local consumption. Commercial grain farming: This type of farming is a response to farm mechanization and it is the major type of activity in the areas of low rainfall and low density of population where extensive farming is practiced. Crops are prone to the vagaries of weather and droughts and monoculture of wheat is the general practice.

Ley Farming

With increases in both human and animal populations in the Indian arid zone, the demand for grain, fodder, and fuelwood is increasing. Agricultural production in this region is low due to the low and uneven distribution of rainfall (100–400 mm yr"1) and the low availability of essential mineral nutrients. These demands can be met only by increasing production levels of these Aridisols through the adoption of farming technologies that improve physical properties as well as the biological processes of these soils. Alternate farming systems are being sought for higher sustainable crop production at low input levels and to protect the soils from further degradation.

In India's drylands, ley farming is used as a way to restore soil fertility. It involves rotations of grasses and food grains in a specific area. It is now being promoted even more to encourage organic farming, especially in the drylands. Ley farming acts as insurance against crop failures by frequent droughts. Structurally related physical properties and biological processes of soil often change when different cropping systems, tillage, or management practices are used. Soil fertility can be increased and maintained by enhancing natural soil biological processes. Farming provides balanced nutrition for sustainable production through continuous turnover of organic matter in the soil.

Plantation Farming

This extensive commercial system is characterized by the cultivation of a single cash crop in plantations of estates on a large scale. Because it is a capital cantered system, it is important to be technically advanced and have efficient methods of cultivation and tools including fertilizers and irrigation and transport facilities. Examples of this type of farming are the tea plantations in Assam and West Bengal, the coffee plantations in Karnataka, Kerala, and Tamil Nadu, and the rubber plantations in Kerala and Maharashtra.

Forestry

In contrast to a naturally regenerated forest, tree plantations are typically grown as even-aged monocultures, primarily for timber production. These plantations are also likely to contain tree species that would not naturally grow in the area. They may include unconventional types of trees such as hybrids, and genetically modified trees are likely to be used in the future.

Plantation owners will grow trees that are best suited to industrial applications such as pine, spruce, and eucalyptus due to their fast growth rate, tolerance of rich or degraded agricultural land, and potential to produce large quantities of raw material for industrial use. Plantations are always young forests in ecological terms; this means that these forests don't contain the type of growth, soil or wildlife that is typical of old-growth natural ecosystems in a forest.

The replacement of natural forests with tree plantations has also caused social problems. In some countries, there is little concern or regard for the rights of the local people when replacing natural forests with plantations. Because these plantations are made solely for the production of one material, there is a much smaller range of services for the local people. India has taken measures to avoid this by limiting the amount of land that can be owned by someone. As a result, smaller plantations are owned by local farmers who then sell the wood to larger companies.

Teak and Bamboo

Teak and bamboo plantations in India are a good alternative crop solution to farmers of central India, where conventional farming is popular. Due to rising input costs of farming, many farmers have grown teak and bamboo plantations because they only require water during the first two years. Bamboo, once planted, provides the farmer with output for 50 years until its flowers. Production of these two trees positively impacts and contributes to the climate change problem in India.

Crop Rotation

Crop rotation can be classified as a type of subsistence farming if there is an individual or communal farmer doing the labour and if the yield is solely for their own consumption. It is characterized by different crops being alternately grown on the same land in a specific order to have more effective control of weeds, pests, diseases, and more economical utilization of soil fertility. In India, leguminous crops are grown alternately with wheat, barley, and mustard. An ideal cropping system should use natural resources efficiently, provide stable and high returns, and avoid environmental damage.

Different Sequences of Crop Rotation

Rotation of two crops within a year i.e.:
Year 1: Wheat
Year 2: Barley
Year 3: Wheat again.

Three crop rotation i.e.:
Year 1: Wheat
Year 2: Barley
Year 3: Mustard
Year 4: Wheat again.

Pearl Millet

Pearl millet crop is mostly grown as a rainfed monsoon crop during kharif (June–July to September–November) and also as an irrigated hot weather (February–June) crop in central and south India. Pearl millet is often grown in rotation with sorghum, groundnut, cotton, foxtail millet, finger millet (ragi), castor, and sometimes, in the south India, with rice. On the red and iron-rich soils of Karnataka, pearl millet and ragi rotation are practiced although pearl millet isn't always grown annually.

Cluster bean – Pearl millet crop sequence with crop residue incorporation has significantly increased the productivity in the arid zone of Western Rajasthan where Fallow – Pearl millet/Pearl millet after Pearl millet crop sequence is practiced. In Punjab, the dryland rotation may be a small grain-millet-fallow. In irrigated lands, pearl millet is rotated with chickpea, fodder sorghum, and wheat. In the dry and light soils of Rajasthan, southern Punjab and Haryana, and northern Gujarat, pearl millet is most often rotated with a pulse-like moth or mung bean, or is followed by fallow, sesame, potato, mustard, moth bean, and guar. Sesame crop may be low-yielding and may be replaced by castor or groundnut.

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Biology and Management of Citrus Fruit Fly

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Introduction

Fruit fly is a serious pest of citrus fruits especially in cooler subtropical regions. Fruit flies are pests of *Ambia* (spring) season Nagpur mandarin crop. Of the nine fruit fly species responded to parapheromones, *Bactrocera zonata*, *Bactrocera dorsalis* and *Bactrocera invadens* and *Bactrocera correcta* were reared out of mandarin fruits. *Bactrocera zonata*, the dominant one in trap catches, had two peaks; July-August and September-October, the second one coinciding with colour breaking stage of mandarins.

Damage

Fruit flies in general cause fruit drop in mandarins and sweet oranges. The adult fly punctures the ripening fruit by penetrating its ovipositor. It lays eggs inside the rind. On hatching, the maggots of fruit fly bore the ripening fruit and feed on soft pulp and makes the fruit unfit for consumption. The infested fruits show depressions with dark greenish punctures, get deformed and due to bacterial and fungal activity, fruits rot and fall down.

***Bactrocera zonata* adult**

Fruit fly infested

Fruit fly larva feeding on pulp

Life Cycle

Eggs are laid below the rind of the half-matured fruit. These hatch within 1–3 days and the larvae feed for another 4–5 days. Pupation is in the soil under the host plant and adults emerge after 1–2 weeks. Adults occur throughout the year. The pest overwinters in the larval or pupal stage.

Management

1. Collection of fallen fruits and their destruction at regular intervals would prevent the development of puparia and thus reduce the fly population for the next year.
2. Install methyl eugenol traps at the rate of 20 /ha for mass trapping.
3. Systemic insecticide cover sprays during fruit maturity at 15 days interval.

Biology and Management of Citrus Fruit Sucking Moths

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Introduction

Fruit sucking moths are regular and serious pests of ripening citrus fruits of *Ambia* (spring) season crop causing heavy fruit drop in Nagpur mandarins particularly during August – December with their peak activity during September - October. The fruit piercing moth species, *Eudocima materna* (Linnaeus), *Eudocima homaena* (Hubner), *Eudocima phalonia* Linnaeus, *Parallellia stuposa* Fabricius, *Chalciope mygdon* (Cramer), *Ericeia inangula* (Guenèe), *Trigonodes hyppasia* (Cramer), *Achaea janata* L are found infesting Nagpur mandarin fruits.

Damage

Female moth lays-eggs on wild plants like Gulvel, *Tinospora cardifolia*, *T. smilacina* Benth; Vasanvel, *Cocculus villosus hirsutus* L.; Chandvel, *Cirampelos pareira* L., *Convolvulus arvensis* L., *Trichisia pattens* Oliv. and *Pericampylus glaucus* L.B. etc. where larval stages survive. The adults puncture the ripening fruits. Such fruits drop prematurely as a result of rottening due to fungal and bacterial infections introduced through punctures causing considerable fruit loss up to 40%.

***Eudocima materna* adult**

***Eudocima phalonia* adult feeding on mature**

Fruits punctured by fruit sucking moth

Life Cycle

A female lay about 200 to 300 eggs on wild plants like gulvel, vasanvel, chandvel etc. Larva emerges after 3 to 4 days of incubation period, feeding through 5 instars within 13 to 17 days before full grown and pupates in soil for about 12 to 18 days. A generation is completed in 30 to 40 days.

Management Practices

1. Destroy fallen fruits by burying in the ground.
2. Clean cultivation of the orchard is must to avoid the pest development.
3. Generation of smoke in the late evening hours in orchards repels the pest
4. Systematic destruction of larval host plants during rainy season in the vicinity and surrounding the orchards in a mass campaign mode.
5. Poison baiting with malathion 50 EC @ 10 ml + 100 g jaggary +100 ml mandarin juice + 900 ml of water (two bottles containing poison bait per 25-30 trees).
6. Foliar application of neem oil 1% or malathion 50 EC @ 2 ml or carbaryl 50 WP @ 2 g/l at 10 -15 days interval during fruit maturity till harvest.

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Simple Homemade Tests for the Identification of Adultered Spices

Article ID: 30670

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Introduction

Adulteration usually refers to the mixing of inferior and sometimes harmful quality substances with food or drink intended to be sold. As a result of adulteration, food or drink becomes impure and unfit for human consumption. India produces a variety of spices and it is a must in every Indian kitchen. Generally, most of the people tend to buy loose spices from the local grocery store if branded and packaged spices are not available. This increases the risk of consuming adultered spices, for example, sometimes low-quality semolina (sooji) is mixed with poppy seeds (posto or khaskhas) to increase the quantity. Unlike this particular adulterant which is not unhealthy (but illegal), most of the adulterants are unhealthy and can cause serious and fatal damage to our system if consumed regularly. These can be distinguished from the pure forms by performing these below small tests.

Turmeric Powder (Haldi)

Artificial colouring materials and fillers such as corn flour (starch), yellow coloured talk or sawdust, lead chromate (a carcinogen used in paints), or melanil yellow dye are the common adulterants used in turmeric powder. To test this at home, you can take ¼ of turmeric powder in a test tube. Add 3ml alcohol to it and shake vigorously. Then add 10 drops of hydrochloric acid to it. If it turns pink or violet, the presence of the chemical is confirmed.

Black Pepper (Kali Mirch)

Papaya seeds are the common adulterant used in black pepper as they are almost similar in size but tasteless (sometimes bitter). You can take a glass of water and drop some black pepper and papaya seeds. The black pepper will drop into the bottom, whereas the papaya seeds will float.

Red Chilli Powder (Lal Mirch Powder)

Brick Powder and artificial colours like Sudan Red are the common adulterants used in this spice. Take a glass of water and mix 1 tsp of chilli powder. Change in the water colour will prove the presence of adulterant. Alternatively, sprinkle some chilli powder on a glass of water. Artificial colours will leave a coloured streak as the particle goes down due to gravity.

Cumin (Jeera)

Sawdust is the common adulterant used in the spice. Add 1 tsp to a glass of water, the sawdust will float and the spice will sink in. In case of whole spice, grass seeds coloured with Charcoal dust are contaminated with the pure form. You can rub the cumin seeds into your palms. Colouring of your palms will indicate impurity of the spice. You can use this similar method to test the purity of Coriander or Dhania.

Mustard Seed (Sarso)

Argemone seeds are the common adulterant for this spice. At a quick glance it appears similar but when observed closely they can be easily differentiated. Mustard seeds have a smooth appearance, whereas the argemone seeds have a rough, grainy appearance which is black in colour. You will find a yellow core in a mustard seed when pressed, whereas in argemone seed it is black.

Fennel Seed (Sounf)

Fennel, a very common Mouth freshener, is generally adulterated with exhausted Fennel. The alcohol–exhausted Fennel looks like fresh Fennel and contains 1-2% volatile oil. The steam-exhausted fennel fruits are darker in appearance. They contain little volatile oil and are heavier than water. It is also adulterated with undeveloped or mould-attack fruits. Fennel is sometimes adulterated with Malachite Green Dye for the bright green colour. Adulterated fennel is easily identified by its bland or bitter taste.

Cinnamon (Dalchini)

Cinnamon is very commonly replaced with Cassia Bark, which is much cheaper. Cinnamon bark is very thin and can be easily rolled around a pencil or a pen and also have a distinct smell. Cassia barks are tougher and thicker. They rarely give out any aromatic smell.

Other Blended Spices

Generally, visual examination helps to distinguish impure whole spices. In case of ground spices, added starch is the common adulterant used. You can add a few drops of iodine solution in the spice. If the colour changes to blue, it is adultered.

Indian spices have been famed around the world for their medicinal properties. But consumption of adultered spices can lead to the opposite and harm your system in the long run. Thus, if you want pure spices to keep yourself and your loved ones healthy, choose from the range of Health buddy Pure & Fresh Spices as they are free from any adulteration, hygienically processed and also add up the savings of households.

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Aerobic Rice: A System of Water Saving

Article ID: 30671
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Introduction

Rice is an important staple food crop of the world. Annual rice production should be increased to meet the demand of ever-growing population. This increase in production has to come despite the declining resources like land and water, which is a daunting task. Water is becoming scare for agriculture at present situation. Rice consumes more than 50% of the water used for irrigation in Asia.

About 4000-5000 litres of water is consumed for production of one kg rice. Rice cultivation is a water intensive enterprise. However, lowland rice fields have relatively high-water requirements and their sustainability is threatened by increasing water shortages. Hence, it is imperative to develop technology to increase the water use efficiency in rice cultivation. It is grown like an upland crop in soil that is not puddled, non-flooded or saturated. It is a sustainable rice production methodology for immediate future to address water scarcity and environmental safety arising due to global warming.

Aerobic Rice

Aerobic rice cultivation system is the method of cultivation, where the rice crop is established by direct seeding (dry or water-soaked seed) in non-puddle field and un-flooded field condition. The usual way of planting aerobic rice is the same as we would plant the other cereal crops like wheat or maize by direct seeding. It is the most promising approaches for saving water and labour. This system uses input-responsive specialized rice cultivars and complementary management practices to achieve at least 4-6 t/ha using only 50-70% of the water required for irrigated rice production. This is recommended in areas where water is too scarce or expensive to allow traditional irrigated rice cultivation.

Aerobic rice is a projected sustainable rice production methodology for the immediate future to address water scarcity and environment safety in the scenario of global warming.

Aerobic Rice: A Water Saving System

Aerobic rice is a water-saving rice production system in which potentially high yielding, fertilizer responsive adapted rice varieties are grown in fertile aerobic soils that are non-puddle and have no standing water. Supplementary irrigation, however, can be supplied in the same way as to any other upland cereal crop. In Asia, upland rice is aerobically grown with minimal inputs and it is usually planted as a low yielding subsistence crop in the adverse upland conditions.

With predictions that many Asian countries will have severe water problems by 2025, aerobic rice gives hope to farmers who do not have access to enough water to grow flooded lowland rice. Water requirements can be lowered by reducing water losses due to seepage, percolation, and evaporation. Promising technologies include saturated soil culture and intermittent irrigation during the growing period. However, these technologies still use prolonged periods of flooding, so water losses remain high.

The water use efficiencies of the aerobic varieties under aerobic conditions were higher than that of the lowland variety under lowland conditions. Aerobic rice maximizes water use in terms of yield and is a suitable crop for water limiting conditions. Aerobic rice cultivation will curb methane production and saves water without affecting the productivity. It is the time to save water from the irrigated system of rice cultivation by adopting the aerobic rice cultivation.

As the aerobic rice concept is in the initial development stage, little research has been done so far and most of the researches are confined to establish management practices like weed and nutrient management for this new system. Planned breeding experiments are very much lacking in this area and only limited studies have been made with few varieties for their response under aerobic rice cultivation.

Difference Between Aerobic Rice and Upland Rice

1. Upland rice:

a. Grown on rain fed and naturally well-drained soils that are usually on sloping land with erosion problems.
b. Upland rice varieties are low yielding but drought- and low-fertility-tolerant.
c. High levels of fertilizer application and supplemental irrigation to upland rice lead to lodging and thus reduce yield.

2. Aerobic rice :

a. Grown where land is flat or terraced, and soil can be frequently brought to water field capacity by rainfall or supplemental irrigation.
b. Aerobic rice varieties are more input-responsive and higher yielding than traditional upland ones.

Where to Grow Aerobic Rice?

1. Favourable uplands:

a. Flat or terraced land required
b. Sufficient rainfall or supplemental irrigation
c. No serious problem of salinity
d. External inputs like fertilizer have access by farmers

2. Fields in the upper top sequence of rain fed lowlands:

a. Deep ground water table.
b. Well-drained, coarse-textured soil.

Advantages

1. Submergence and puddling is not applied.
2. Seed sowing directly.
3. No requirement of nursery and transplanting.
4. Up to 80% saving of seeds.
5. Labour requirement is less.
6. Up to 60% saving of water.
7. Efficiently fertilizer utilized.
8. Pest and disease incidence is less.
9. Reduced methane gas emission leading to lower environment pollution.
10. Profuse rooting and high tilling, less lodging and high grain and fodder yield.
11. Retention of soil structure and quality.

Limitations

1. Lower yield compared with lowland rice
2. Difficult to control weeds
3. Insufficient extension support to the farmers
4. Difficult to market new varieties
5. Poor crop stand and Crop lodging
6. High percentage of panicle sterility
7. Alternate wetting and drying can lead to high N losses
8. Soils become deficient in P and K.
9. Most damaging soil borne pathogen for aerobic rice is root knot nematode.

Package of Practices for Aerobic Rice Cultivation

1. Seed bed preparation: Minimum Tillage is enough for aerobic rice cultivation. Dry direct seeding ensures that fields are well harrowed and levelled. Field should be thoroughly prepared by using disc plough, cultivator and motivator.

2. Seed rate and sowing method: Sowing can be done either by using manual seeding or drum seeder.
Seed rate: manual dropping - 60 to 80 kg/ha

seed drill - 40 to 50 kg/ha
20-25 cm row spacing should be maintained.

Nutrient Management

150-60-40 kg NPK kg/ha (50% at sowing, 25% at tillering and 25% at anthesis).

Irrigation Management

It can be also grown entirely on rainfall in wet season with a well distributed rain. Water management is done to keep soil moist alternate wetting and drying. Maintain water at just soil saturation level by intermittent light irrigation coinciding with appearance of hair line cracks or when see the visual condition of the rice plant.

Conclusion

The concept of aerobic rice holds promise for farmers in water-short irrigated rice environments where water availability at the farm level is too low or where water is too expensive to grow flooded lowland rice. Aerobic rice technology is better remedy for future climate change under drought condition with lesser greenhouse gas (GHG) emission. Aerobic rice should be recognized as a special crop type (different from lowland and upland rice) and should be promoted with a complete understanding of the system.

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Phosphorus Management Strategies in Soil

Article ID: 30672

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Summary of the Article

Phosphorus (P) management strategies vary according type of dominant cations present in soil. In acidic soils, flooding has shown to increase the soil P content. Also, P availability is positively correlated with Soil Organic Matter and hence fertilizing the soil with organic supplements like cow dung is very important to maintain the Soil phosphorus pool. This is also true for calcareous soils. Therefore, a combination of organic supplement with phosphatic fertilizer is sustainable.

However, to boost the availability of P, Phosphate solubilizing bacteria (PSB) is advocated as seed inoculant. A legume crop as an intercrop in a cereal- legume cropping system has shown to boost P availability. It also increases the N_2 fixation capacity of legume crops thereby increases the B:C ratio of the whole system. A strategic and analytic approach towards P management by complementing Chemical P fertilizers with organic supplements and employing correct cultural practices are sustainable in long term and can strengthen the available Phosphorus in soil.

Introduction

Phosphorus (P) was discovered in year 1669 by an alchemist Hennig Brand, in Hamburg, Germany. Brand called the substance 'cold fire' because it was luminous, glowing in the dark. Brand became the first person in history to discover an element. Phosphorus is vital for life. It is the sixth most abundant elements in living organisms and the 10th most abundant element in the earth crust which constitutes about 0.12% of earth's crust.

The usual P content in soil varies from 0.013% to 0.115% and insoluble fraction of P constitutes 95-99% of total P in soil. However, it is unevenly distributed throughout the soil profile. The top soil (15 cm) contains about 500-800 mg P/ kg of soil which is equivalent to 1100-1800 kg P/ha. Indian soils, the total P content ranges from 120 mg/kg of soil in the arid regions of Rajasthan to 2166 mg/kg in the sub-humid temperate highlands of Himachal Pradesh. Phosphorus is a vital nutrient for plant growth and development and hence its concentration in soil and its availability is important for plant uptake and thereby increase in crop yield.

Phosphorus is one of the three primary nutrients required by plants for growth and development. It plays a major role in energy transactions of cell. It is an integral component of Adenosine triphosphate, which is regarded as 'energy currency' of a cell. ATP is involved in most of the metabolic reactions and is produced during photosynthesis. Phosphorus is a structural component of genetic material DNA and RNA of all organisms on earth; therefore, phosphorus is a vital element for any lifeform on earth. It stimulates root development as well as fruit and seed maturity in plants.

Phosphorus Management Strategies Under Different Soils and Cropping Systems

India consists of 21 agro-climatic zones with different soil characteristics which determine the type of crop grown and fertilization methods used in each agro-climatic zone. North-eastern regions receive heavy and evenly distributed rainfall throughout the growing season. Therefore, soils are mostly acidic and suffer from P deficiency. In contrast to this, the northern regions of India receive scanty rainfall.

Therefore, soils of those regions are mostly calcareous. P dynamics in different soils are different which directly determine quanta of fertilizers use, methods of P fertilizations and P use efficiency. So, to ensure better use efficiency, proper methods must be employed to study the characteristics of different soils in different locations to find out location specific fertilization methods. In acidic soils, phosphorus is fixed onto the soil colloids as Iron phosphates and Aluminium phosphates.

This fraction of P is missing from the soil solution and is unavailable for plant uptake. Soils of heavy rainfall areas are poor in base cations like Ca and Mg and contain higher amounts of Fe and Al sesquioxides that hold phosphate ions strongly. Adsorption can take place by protonation of hydroxyl groups at low pH. Studies have shown that flooded soils have increased availability of P in the soil solution. Under lower oxygen, submergence conditions, cations like Fe, Al and Mn is reduced to their lower oxidation states. For example, Fe^{3+} is reduced to Fe^{2+}. The reduction of Fe oxides during flooding and the liberation of sorbed and co-precipitated P increased the levels of extractable P in flooded acidic soils (Willet, 1989).

The chemically bonded Phosphate ions are released into the soil solution and consequently there is an increase in the concentration of water soluble and available Phosphorus. This availability is more in sandy soil over clay soil. Therefore, under submergence of acidic soils, a marked increase in concentrations of water-soluble P results from a) Hydrolysis of Ferric and Aluminum phosphate b) Phosphate release by anion exchange from hydrous oxides of Fe(III) and Al c) Reduction of Ferrous with liberation of sorbed and chemically bonded P.

In a study conducted by Abolfazi and his co-workers, they found that in general upland soils, soil phosphorus concentration is positively correlated to soil organic carbon content and found that a combination of cow dung manure or Municipality Soil Waste Compost (MSWC) with Di ammonium phosphate (DAP) strengthens the soil Phosphorus content (Abolfazli et al., 2012). In alkaline soils, Phosphorus is mostly present in the form of Ca bound P. Ca-bound P in calcareous soils is in three pools, namely di-calcium phosphate (Ca_2-P), Octa-calcium phosphate (Ca_8-P) and apatite type (Ca_{10}-P).

Phosphorus present in the soil solution that is available for plant uptake is referred to as Olsen-P (Olsen's method of extraction). Olsen-P is significantly correlated with Ca_2-P and Ca_8-P but it had no significant correlation with Ca_{10}-P. Soil organic matter increases the soil microbial biomass of the soil. The nucleic acids absorbed by clay minerals can be dissolved into the soil solution under submerged conditions with increasing pH. Tillage also exposes occluded organic matter and enhances its decomposition.

Hence proper tillage operation during land preparation is very important for aeration and decomposition of organic matter for elevated microbial activity and P liberation. Application of cow dung manure promotes microbial activity. Hence application of Cow Dung Manure (CDM) or Municipality solid waste compost (MSWC) can increase the concentration of Olsen-P (Abolfazli et al., 2012). In case of submerged soils, the dominant form of Phosphorus is ortho-phosphoric ion. When acid soil is submerged, there is a marked increase in concentration of Phosphorus. Similarly, Phosphorus uptake in flooded alkaline soils also improves due to liberation of Phosphorus from calcium phosphate and calcium carbonate resulting from a decrease in pH.

In a mono-cropping system, phosphatic fertilizers are applied as basal before final land preparation. However, application of phosphorus along with PSB, improves phosphorus uptake by plants and yields indicating that the PSB are able to solubilize phosphates and to mobilize phosphorus in crop plants. Inoculation of the soybean seeds with rhizobium and PSB resulted in a significant increase in the growth parameters (plant height, dry matter production and number of nodules) and B: C ratio (Rana et al., 2014).

The influence of Phosphorus on symbiotic N_2 fixation in leguminous plants has been studied intensively and many researchers have reported that phosphorus improved nitrogen fixation in legumes (Tang et al.,2001). Studies of Hauggard et al., (2009) showed that accumulation of nutrients such as phosphorus, potassium and sulphur may be enhanced by the nutrient complementarity of intercropped pea and barley and further postulated that these might have influenced the overall crop yield and thereby increasing competitive ability of capturing and utilization of other resources. P uptake has been reported to be influenced by intercropping in many studies. Specifically, it was reported that there was an increased uptake of P in white lupin intercropped with wheat (Gardner and Boundy, 1983; Cu et al., 2005).

Another study by Ae et al., (1990) showed that pigeon pea influenced the uptake of P in the sorghum in an intercropping system where Pigeon pea was grown as an intercrop. A nutrient complementarity of main crop and intercrop in a cereal-legume cropping system is essential for better P use efficiency and higher productivity. Cropping sequences are primary factors that impacts P resources, efficiency of crop P, crop yield and yield stability. In a cereal based sequence, inclusion of an oilseed crop has shown to increase the availability of phosphorus is soil. Studies have shown that oilseed crops like rapeseed improves soil Phosphorus and yield stability in the entire cropping sequence (Lukowiak et al., 2016). Use of oil seed crops in a cropping sequence can therefore reduce the need for external P sources such as FYM and inorganic P fertilizers.

Conclusion

Phosphorus is a primary nutrient required by plants for energy transactions, and the deficiency of which causes severe decrease in crop yield. Therefore, an approach towards management of Phosphorus in soil must be holistic which includes analytical as well as proper agronomic practices at the right time and right cropping system to counter the problem of Phosphorus deficiency and escalate the yield potential of crops.

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Cryopreservation of Plant Genetic Resources

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Introduction

Plant genetic resources consist of a diversity of genotypes or populations of cultivars (landraces, advance/ improved cultivars), genetic stocks, wild and weedy species, which are maintained in the form of plants, seeds, tissues, etc. The depletion of these resources poses a severe threat to the world's food security in the long term. To ensure crop production and to meet growing environmental challenges and climate change, urgent action is needed to collect and preserve irreplaceable genetic resources (Frankel, 1974).

Conservation strategies are often dependent on plant species and explant to be conserved, availability of techniques and resources, and feasibility for specific needs. Two basic conservation strategies (in situ and ex situ) are envisaged for efficient and cost-effective conservation of any gene pool. Ex-situ conservation of spices in field gene banks is prone to high labour cost, vulnerable to hazards like natural disasters, pests and pathogens attack (especially viruses and systemic pathogens) and require large areas of space. Such limitations can be overcome by using invitro, seed banks and cryopreservation for long term storage.

For long-term conservation of the germplasm, cryopreservation is the only current method without subculture conferring genetic stability with minimum space and maintenance requirements.

Cryopreservation

Cryopreservation is the term used for the process of storage of living material at ultralow temperatures in liquid nitrogen (−196 °C) or its vapour phase (−150 °C). At this temperature, all cellular, metabolic and biochemical events stop and the plant material can be stored without any changes or deterioration for extended periods (Reed 2017). It emerged as an important biotechnological tool for storing a wide range of plant germplasm, especially those which are difficult-to-store due to high moisture content and high desiccation and freezing sensitivity.

This technique ensures the safe and efficient long-term conservation of different types of seeds and vegetative tissues. Using conventional storage methods, orthodox seeds can be successfully stored at −20°C after desiccating to 5-7% moisture content without loss of viability (Singh et al., 2001).

Cryopreservation Techniques

Natural dehydration is observed in the case of orthodox seeds or dormant, so it can be cryopreserved without any pre-treatment. However, most of the cryopreservation methods employed (cell suspensions, calluses, shoot tips, embryos) contain high amounts of cellular water and are thus extremely sensitive to freezing injury since most of them are not inherently freezing tolerant.

The techniques employed and the physical mechanisms upon which they are based are different in classical and new cryopreservation techniques (Withers and Engelmann 1998).

Classical Cryopreservation Techniques

Classical freezing procedures include the following successive steps: pre-growth of samples, cryoprotection, slow cooling (0.5–2.0°C/min) to a determined pre-freezing temperature (usually around −40°C), and rapid immersion of samples in liquid nitrogen, storage, rapid thawing and recovery.

These techniques are complex and require sophisticated and expensive programmable freezers. These techniques have been successfully applied to undifferentiated culture systems (cell suspensions and calluses) and apices of cold-tolerant species.

New Cryopreservation Techniques

This technique has been developed for apices, cell suspensions and somatic of numerous different species. Different vitrification-based procedures identified are: (a) encapsulation–dehydration (b) a procedure termed vitrification, (c) encapsulation– vitrification, (d) dehydration, (e) pre-growth, (f) pre-growth–dehydration and (g) droplet–vitrification.

1. Encapsulation-dehydration: The encapsulation-dehydration technology developed for the production of artificial seeds. Explants are encapsulated in sodium alginate beads, pre-grown in liquid medium enriched with sucrose for 1 to 7 d, partially desiccated in the air current of a laminar airflow cabinet or with silica gel to a water content around 20% (fresh weight basis), then frozen rapidly.

2. Vitrification process: It involves treatment of samples with cryoprotective substances, dehydration with highly concentrated vitrification solutions, rapid cooling and rewarming, removal of cryoprotectants and recovery.

3. Encapsulation–vitrification: This method is a combination of encapsulation– dehydration and vitrification procedures, in which samples are encapsulated in alginate beads, then subjected to freezing by vitrification. It has been applied to apices of an increasing number of species

4. Dehydration: It is the simplest procedure since it consists of dehydrating explants, then freezing them rapidly by direct immersion in liquid nitrogen.

5. The pre-growth technique: It consists of cultivating samples in the presence of cryoprotectants, then freezing them rapidly by direct immersion in liquid nitrogen. This technique has been developed for Musa meristematic cultures (Panis et al. 2002).

6. In a pre-growth–dehydration procedure: Its explants are pre-grown in the presence of cryoprotectants, dehydrated under the laminar airflow cabinet or with silica gel and then frozen rapidly.

7. Apices are pre-treated with vitrification solution: When placed on an aluminium foil in minute droplets of vitrification solution and frozen rapidly in liquid nitrogen. Droplet–vitrification is the latest technique developed

Conclusion

The major advantage of these new techniques is their operational simplicity, since they will be mainly applied in developing tropical countries where the largest part of genetic resources of problem species is located. And its broad applicability, which is of particular relevance to conservation of wild species, for which large amounts of genetic diversity need to be conserved. For many vegetative propagated species, cryopreservation techniques are sufficiently advanced to envisage their immediate utilization for large-scale application.

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Impact of Covid-19 Outbreak of Indian Agriculture

Article ID: 30674

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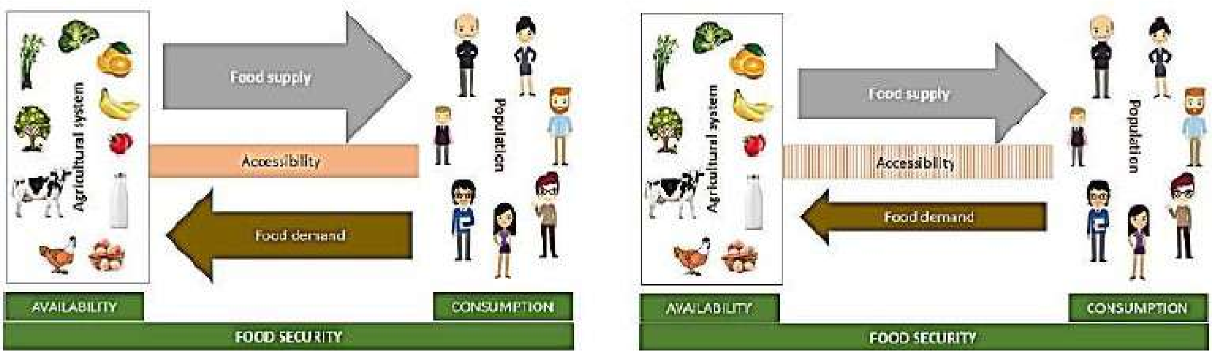
Introduction

In Wuhan, China, on December 31, 2019, the first cases of infection is identified of COVID-19 (Corona Virus of Infection Diseases). In India first case of COVID- 19 was reported on January 30, 2020, then after consult with expert give report in which the infection cases increased so rapid. On March 22, 2020, India observed a 14- hour voluntary public curfew and further Indian government followed it up with lockdown in 75 districts where COVID-19 cases had occurred. Further, on March 24, 2020, the prime minister ordered a nationwide lockdown for 21 days, affecting the entire 1.3 billion population of India. On April 14, 2020, the prime minister further extended the ongoing nationwide lockdown till 3 May. A majority of India's farmers (85%) are small and marginal farmers with less than two hectares of land. More than nine million active fishers directly depend on fisheries for their livelihood, 80% of which are small scale fishers; the sector as a whole employ over 14 million people.

Recently, the report of globally confirmed cases growth is increased with high rate that is affecting the normal development of country directly or indirectly. COVID-19 is the contagious diseases that disturbs and fear humanity. In COVID-19, patient is quarantines or isolation for several days has an impact on human activities, economic growth and agricultural activities. When, the COVID-19 outbreak all over the world faces more difficulties in relation to food security and malnutrition. The situation is complicated as the diseases progresses and making restriction on movement causes shortage of labour for the harvest or difficulties for farmer to bring their product to market.

Agriculture is one of the most important sectors in human development and food security. The Food and Agriculture Organization states that COVID-19 is directly affecting agriculture sector by two significant aspects may include the supply and demand of food. The rabi crop stood ready for harvest in many fields when the COVID-19 crisis brought everything to a halt; this is also the time for harvest of plantation crops like wheat, mustard, pepper, coffee, banana. In the aftermath of the lockdown, harvest of the rabi crops has been delayed due to non-availability of labour, machinery (harvesters, threshers, tractors), transport facilities and restrictions on movement; farmers of perishable commodities like fruits, vegetables, and flowers in particular have been incurring losses. Harvest of crops in India has been similarly delayed, affecting the cash flow of farmers and farm labour. Agriculture labourers are not able to go to work due to lack of transport.



Government Efforts

The Centre and State governments have done a great job to allay the fear and quickly announced exemptions for the agriculture sector – seeds, labourers, and farm related activities. Special packages have also been announced for different sectors. Indian Council of Agriculture Research (ICAR) has also issued an agro-advisory to maintain hygiene and social distancing. Despite exemption orders, the seed and allied sectors are experiencing harassment and in some cases violence at the local levels. Vigilantes in certain areas are blocking roads and not allowing the movement of labour. Transport services are not allowed to operate either. Significant resources and institutional implementation capacities are required for input and production subsidies to be sustainable and effective. The viability of this approach depends on access to financial services by the poor and rural.

Guidelines issued by the Ministry of Home Affairs, Government of India on 15 April 2020 following extension of lockdown till 3 May 2020, exempt agriculture, horticulture, animal husbandry, poultry and fishery, and allied activities from lockdown restrictions; labourers can go to work, markets are to open, procurement is to happen and agri-input shops and agro-processing centres are to function.

Precautionary measures like maintaining social distancing and hand washing will have to continue as COVID-19 continues. Proactive measures by the state with humanitarian perspective are called for as we begin operating in a 'new normal': more relief in kind and cash (e.g. increasing the amount under the PM Samman Kisan Nidhi from the present INR 6,000/- to INR 15,000/- and releasing the first instalment before kharif); measures to curb charging of exorbitant interest by informal sector lenders, waiver of interest for the quarter on term loans and overdraft agriculture.

Conclusion

The current global outbreak of COVID-19 has disrupted agricultural and food systems around the world. The pandemic called COVID-19 disease has a great impact on the actions and activities of humanity, agriculture is not outside this impact. The current global outbreak of COVID-19 has disrupted agricultural and food systems around the world. Timely and credible information is imperative in avoiding panic-driven reaction that can aggravate these disruptions, deteriorating food and nutrition security of the most vulnerable. Food demand and thus food security are greatly affected due to mobility restrictions, reduced purchasing power, and with a greater impact on the most vulnerable population groups. As cases of contagion increase, governments take more drastic measures to stop the spread of the virus, also influencing the global food system. The premise of any measure adopted should be to protect the health and food security of the population and detriment of economic growth.

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Effects of Red Light on Plant Pathogenic Microbes

Article ID: 30675

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Introduction

Light is an abundant signal that many organisms use to assess the status of their environment. Species from all kingdoms have evolved the capacity to sense and respond to wavelengths across the visible spectrum. Light has long been linked to disease. Light (or its absence) represents an environmental signal that is known to regulate many properties of a microbial cell, which may indirectly or directly influence the development of disease. A role for photo perception is likely to emerge as a common theme in microbial pathogenesis (Idnurm and Crosson, 2009).

Light is electromagnetic radiation having electromagnetic spectrum. The word usually refers to visible light, which is visible to the human eye and is responsible for the sense of sight. The main source of light on Earth is the Sun. Sunlight provides the energy that green plants use to create sugars, which release energy into the living things. Plants get energy from light through a process called photosynthesis. Phytochromes is the Photosensory proteins that detect red light (620–700 nm) and far-red light (700– 800 nm).

History

A role for bacteriophytochromes in plant associated bacteria was first found in a stem modulating symbiont of *Bradyrhizobium* sp. strain ORS27A encoding the BrBphP bacteriophytochrome and Fungal phytochromes are present in many ascomycetes and basidiomycetes but are absent in ascomycetous yeasts. Some ascomycetes and basidiomycetes have one phytochrome. The first functionally characterized fungal phytochrome in *Aspergillus nidulans.*

Terminologies Related to Light

1. Photoperception: The ability to perceive light.
2. Photosensing: The activity of detecting and responding to light.
3. Chromophores: Molecules responsible for light absorption.
4. Photosensory proteins: Proteins that detect light.
5. Visible spectrum: Wavelengths from (400–700 nm).

Phytochromes have been characterized in plants, algae, fungi , and bacteria. Plant and green algae phytochromes (Phyfamily) bind phytochromobilin, cyanobacterial phytochromes (Cph1 and Cph2 families) bind phycocyanobilin. In contrast, fungal phytochromes (Fph family) and bacteriophytochromes (Bph family) bind biliverdin IV α via a conserved cysteine that is distinct from that found in plants and cyanobacteria.

Domain structures of phytochromes of (Fig. 1) (a) the modular nature of phytochromes. Phytochromes consist of two functionally separable regions: an aminoterminal photosensing domain and a carboxy-terminal domain that is involved in dimerization of phytochrome polypeptide chains and in generating the output signal. (b) Conserved phytochrome domains are NTE, PLD (PAS-like domain) GAF, a domain distantly related to PAS and found in phytochromes and cGMP-specific phosphodiesterases; PHY, a domain distantly related to PAS and specific to phytochromes; HKD, histidine kinase domain containing a phosphoacceptor.

His residue and motifs characteristic of functional histidine kinases; HKRD, histidine kinase related domain lacking a phosphoacceptor His residue and motifs characteristic of histidine kinases; HisKA, histidine kinase A domain-related; HisK-ATPase, histidine kinase ATPase superfamily domain. The response regulator (RR)-like domain shown bracketed in Cph and Bph is found in a minority of these proteins but is common in Fph proteins (Sharrock, 2009). Its structure determines the absorption spectrum of the Pr form. For comparison, the photoreversible fragment containing the PHY domain is also diagrammed. Its structure will provide information about the nature of the conformational change between Pr and Pfr.

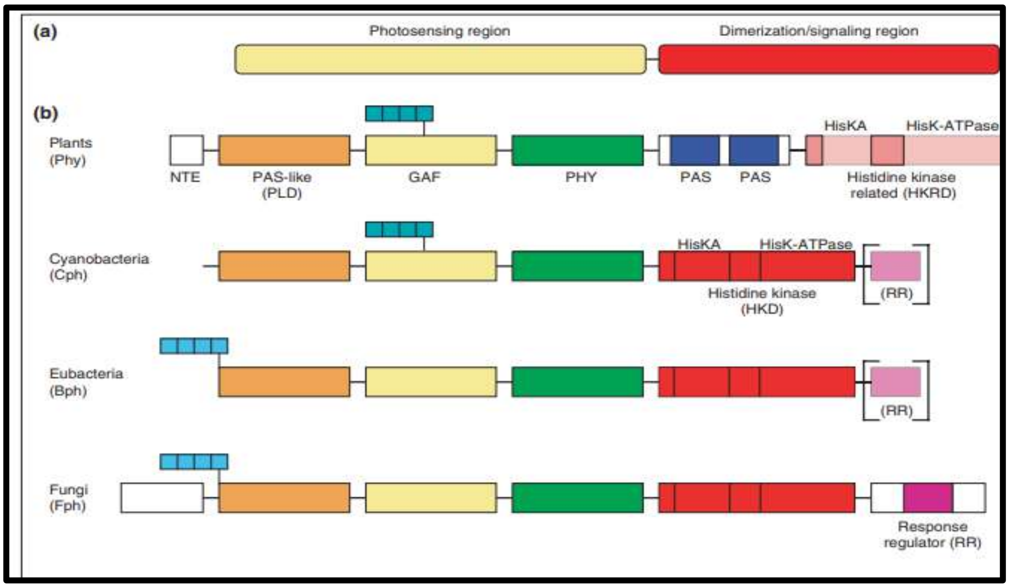

Fig. 2: Domain structures of phytochromes

Effect of Light on Swarming Motility in *Pseudomonas syringae*

The light-mediated repression of swarming motility in *P. syringae* strain B728a may enable it to remain motile on leaves in the dark, which is a period when leaf surfaces are generally moist. In contrast to decreased survival in the hours after inoculation, the loss of bphP1 was associated with eventual increases in populations on leaves; this growth was likely in epiphytic and internal leaf sites. Increased populations could be due to hyper swarming enabling greater access to nutrients, since nutrients are relatively localized on leaf surfaces. Hyper swarming could additionally enhance access to internal leaf sites. Importantly, Bsi and Smp both contribute to regulation of swarming motility, but neither affected early or late-stage leaf colonization (Fig. 2).

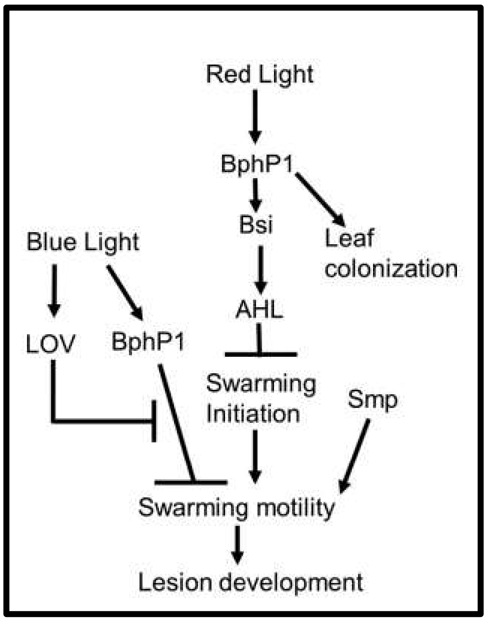

Fig. 2: *Pseudomonas syringae* Bacteriophytochrome regulates colonization

Phytochromes in Phytopathogenic Fungi

1. Inactivation of the *Botrytis cinerea* phytochrome slows growth, increases susceptibility to cell wall stress, and reduces cell wall chitin content and virulence, with the disruption to chitin synthesis

2. *Neurospora crassa* has genes for two phytochromes, Phy-1 and Phy-2, *and* Phy-2 in particular contributes to light-mediated repression of sexual development**.**

3. *Beaveria bassiana, an* entomopathogen used for the biocontrol of many insects, inactivation of the phytochrome BbPhy significantly alters conidiation, growth, and stress tolerance (Hu *et al*., 2014).

Aspergillus nidulans

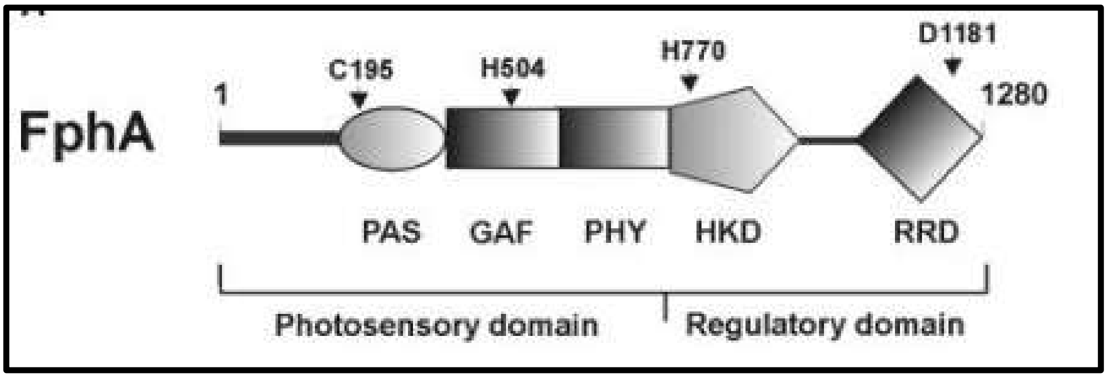

Fig. 12: Domain organization of the fungal phytochrome FphA

1. C195 biliverdin binding residue.
2. H504 essential for chromophore coordination.
3. H770 autophosphorylation site.
4. D1181 trans-phosphorylation site.

In *Aspergillus nidulans*, red light is perceived by the phytochrome FphA. In the cytoplasm, light-dependent activation of FphA probably leads to dephosphorylation of the phosphotransferase protein YpdA , causing activation of the high osmolarity glycerol (HOG) pathway and, via phosphorelay , activation of the MAP kinase stress-activated kinase (SakA). Phosphorylated SakA shuttles into the nucleus to phosphorylate the transcription factor AtfA, which activates gene expression. Chromatin remodelling through acetylation of lysine 9 in histone H3 (H3K9Ac) is also involved in light signalling (Rangel et al., 2011).

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Metabolomics - A Powerful Tool in Crop Improvement

Article ID: 30676

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Summary of Article

To feed the ever-increasing population with limited inputs and in a rapidly changing environment is the biggest challenges that the world agriculture faces today. To achieve such challenges the breeding strategies for high-yielding varieties and identifying germplasm resistant to abiotic and biotic stresses are already popular. Henceforth, new approaches are needed to discover and deploy agronomically important gene or genes that can help crops to withstand better in extreme weather condition and producing high yield with improve quality.

In this context, metabolomic engineering technology looks the best option, which has immense potential to develop the future crops. Metabolomics is the key to understand the chemical footprints during different phases of growth and development of plants. It is the best technology for the analysis of large mutant or transgenic libraries of model experimental plants, such as Arabidopsis, rice, etc. It is the study of metabolites, small biomolecules (carbohydrates, lipids, amino acids and organic acids) present in a biological sample. Metabolomics tools include chromatography for separating metabolites and spectroscopy techniques for their identification.

Integration of metabolomics with other approaches such as quantitative genetics, transcriptomics, proteomics and genetic modification can guide to pinpoint the functional gene(s) and the characterization of massive metabolites, in order to prioritize the candidate gene and offer the trait specific markers to improve commercially important traits. Integration of omics approaches helpful in assigning functions to a large class of function-unknown genes and their interactions with other pathways which leads to better crop improvement of yield and quality and also useful in assessment of GM plants.

Introduction

Today's unsustainable use of fossil fuel reserves or green fuel is predicted to destabilize the global climate and lead to reduced food security. The key challenge for the coming decades is to meet local needs for food, in terms of both quantity and quality, while conserving natural resources and biodiversity (Ruane & Sonnino, 2011).

Nevertheless, the diverse omics platforms have great potential in improving the current understanding of important traits and enabling us to develop new strategies for plant improvement. Among omics approaches, the metabolomics is the most complex and has received in adequate attention in crop science, particularly for trait mapping and plant selections. Metabolomics is the study of metabolites, small molecules that occur in biological samples such as cells, biological fluids or tissues. They are the products of metabolism and include, sugars (or carbohydrates), fats (or lipids), amino acids and their derivatives. The collection of all metabolites within a cell is called the metabolome. In recent years, metabolomics approach has been extended in crop plants to ascertain gene functions.

Metabolome has ability to serve as an ultimate phenotype of a cell renders it immensely promising for advancing crop-breeding gains. Plant metabolomics has become a powerful tool to explore various aspects of plant physiology and biology, which broadens significantly our knowledge of the metabolic and molecular regulatory mechanisms regulating plant growth, development and stress responses, and the improvement of crop productivity and quality.

Table 1. Classification of Metabolomics

Classification	Definition
Target compound analysis	Quantification of specific metabolites
Metabolite profiling	Quantitative or qualitative determination of a group of related compounds or of specific metabolic pathways

Metabolomics	Qualitative and quantitative analysis of all metabolites

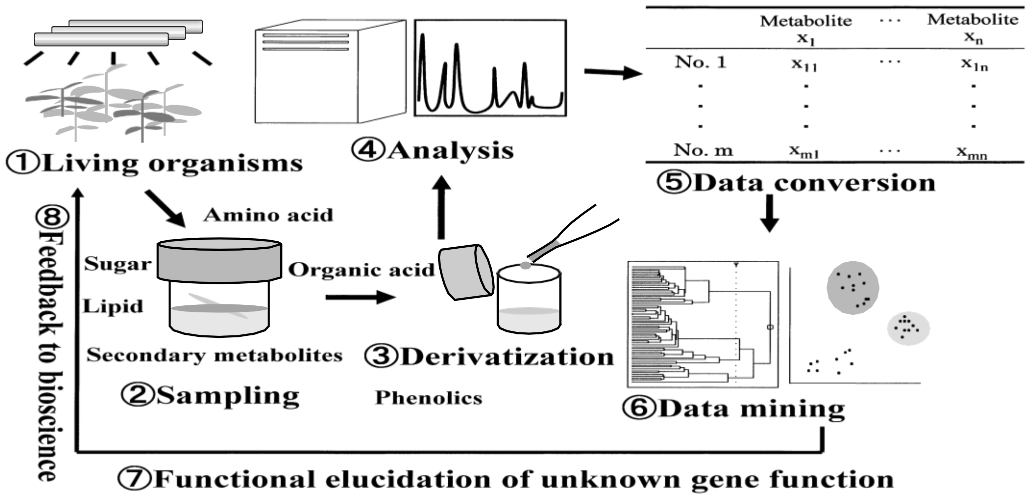

Fig. 1 General Scheme of Metabolomics

Application of Metabolomics

Metabolomic studies have provided greater insights in fruit biology specially related to ripening and quality. Through metabolomic engineering a number of fruits have been targeted for improvement.

1. Tomato (*Solanum lycopersicum*) is a rich source of carotenoids, antioxidants and flavonoids (Tohge and Fernie, 2015). In tomato, color and aroma are targets for improvement. A majority of pigments in tomato are isoprenoids, such as carotenoids, while others are polyphenolics (e.g., flavonoids). Traditionally, liquid chromatography (LC) with commercial standards is used for carotenoid profiling.

However, LC–MS is to be used for more complete estimate of metabolomes especially for isoprenoids. NMR spectroscopy could also be for isoprenoid profiling, which is effective in distinguishing E and Z isomers and aren't possible from MS analysis. This is important as different carotenoid isomers may have different biological activities, hence, nutritive qualities.

2. In **Apple**, the cultivar 'Golden Delicious' contains a high load of myo-inositol, sugars and succinic acid; whereas, the cultivars 'Red Delicious' and 'Fuji' show relatively higher abundance of triterpene/sterols, flavonoids, phenolic acids, stearic acid, anthocyanins and carbohydrates.

3. Orange (*Citrus* spp.) The quality and taste of orange (*Citrus* spp.) fruit depend on the composition of metabolites such as organic acids, sugars, vitamins, flavonoids, and carotenoids. The metabolomics study of orange bud mutant 'Hong Anliu' (accumulates higher levels of lycopene and sweeter than wild type) led to the identification of 130 metabolites that include acids, sugars, flavonoids, alkaloids, limonoids, coumarins, amino acids, and plant hormones.

4. In **Rice,** there is drastic induction of certain compounds such as allantoin, galactaric acid, glucose, gluconicacid, glucopyranoside and salicylic acid, under drought condition which are metabolite markers to address drought stress in rice.

5. In **Maize**, drought stress is regulated by amino acid metabolism (Obata et al., 2015). Photorespiration is tightly regulated under drought as the two amino acids involved in this pathway, glycine and serine are rendered up-regulated. Further, accumulation of glycine and myo-inositol are related with grain size of maize under drought, indicating these metabolites as potential markers for identifying drought tolerant maize.

Future Aspect

Future studies in this area will help in the investigation into molecular and biochemical mechanisms of metabolic variations in plants using both non-targeted and targeted approaches, to increases the understanding of plant metabolism in growth and development under both normal and stressed conditions, and the application of metabolomics to plant breeding for better crop yield and quality. Thus, enabling rapid development of high-performing crop genotypes that adequately meet the challenges in the agriculture field.

Conclusion

Plant has ability to produce a vast array of metabolites, far greater than that produced by animals and micro-organisms that is why metabolomics is receiving attention in the plant research. Secondary metabolites are a complex topic for the variety of metabolites and their derivatives which are usually synthesized with low numbers of gene clusters. Among various omics approaches, metabolomics is of particular importance, because the metabolites are more relevant to the plant phenotype (both physiological and pathological phenotypes) as compared with DNAs, RNAs or proteins.

The combination of various approach such as bioinformatics, molecular biology, and metabolomics aid in understanding the biosynthesis of important secondary metabolites with their biological activity. Metabolomics in combination with transcriptomics produce a large amount of data which can be integrate with the use of new bioinformatics and statistical tools accelerate the discovery of novel gene in crops, vegetables, and medicinal plants.

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The Forthcoming Nourishment Ingredients Represent the Future of Our Food

Article ID: 30677

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Ever wonder about what people will be eating 10 years from now? Specialists say the diet of 2030 will revolve less around meat and more around bugs.

If we go back in time, the "Future of Food" notion commenced nearly 15 years ago, when genetically modified foods (GMOs) were familiarized in the United States. In 2018, the query of what and how will we be eating in the future is endlessly evolving. As stated by CSIRO, Australia, food demand is likely to continue to increase by 14% per decade, meaning food production needs to be nearly twofold of its current rate in order to sustain.

Diet trends and patterns have changed significantly in the last decade, due to the advent of the internet and various other factors. People now prioritize health over budget or money. Here is how diet patterns and trends may change in the coming decade, and what India will be eating by the year 2030.

Here are five forthcoming nourishment ingredient novelties that will represent the future of our food and, perhaps, boost food security, aid feed the world's growing food demands, and encourage a sustainable global food production.

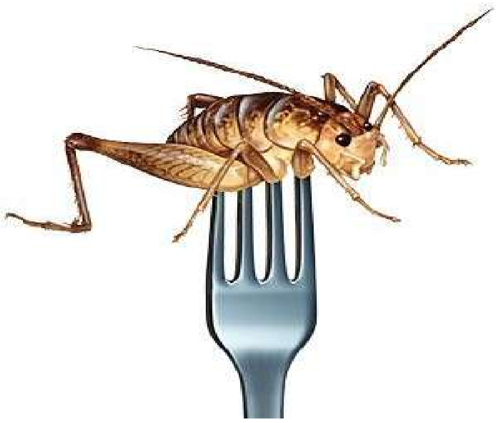
High Protein Insects

How would you feel about consuming burgers, flour, and snack bars made out of insects? Yes, insect-eating, also known as entomophagy, signifies the future of food. In fact, it is already a common practice in Thailand, China, Brazil, Mexico, and some African countries.

In India, as many as 303 insect species are consumed by tribal communities in 10 states. Khajuri poka or date palm worm is a delicacy in Odisha's Rayagada district, inhabited by Khond and Sora tribes. "Around March every year, they harvest the larvae of this mouth-watering insect, which is found in the roots of the date tree," in a Rayagada. They saute the larvae and eat it with rice.

The community also consumes red ant eggs called kaionda, which is mixed with ragi powder and eaten along with rice. In Nagaland, woodworm, locally called lipa, is harvested from oak trees. For food security purposes, insect farming is actually considered a sustainable way to provide an ecologically viable food source to the world's population. Certain species of insects, typically crickets, grasshoppers, and mealworms, are becoming the hot talk of the town in the field of high-protein food products.

The aim of this innovation is two-fold:
1. Primarily challenge the war on malnutrition in under-developed countries.
2. Significantly reduce the environmental impact of the meat-heavy western diet.



Allergen-Free Nuts

A characteristic example of an allergen-free nut is the gluten-free tiger nut. As showcased at the Ingredient Show 2018 in Birmingham, UK, Ani de la Prida, cofounder of The Tiger Nut Company, explained the functional benefits of tiger nuts, remarking:

"Tipped to be the next gluten-free superfood, tiger nuts are high in fibre and can be used as an additive-free, minimally processed ingredient in gluten-free baking."

The tiger nut, or *Cyperus esculentus*, a crop of the sedge family or weed plant, is widespread in Southern Europe, Africa, and Madagascar, as well as the Middle East and Indian Subcontinent. Resembling sweet almond-like tubers, they are known for their high nutritive value, particularly high fibre content, oleic acid, vitamins C and E, and minerals like potassium and phosphorus. Importantly, tiger nuts are mainly used for the production of milk, which is suitable for consumers who are intolerant to gluten (celiac disease) and lactose.

Plant-Based Meat Substitutes

Swiftly realizing the impact meat production has on the global ecosystem and biodiversity. As everyone moving towards a meat-free dinner plate and the trend is shifting. The health-aware generation is asking for more plant-based foodstuffs on the market, with clean labelling & some companies are increasingly making foods that taste just like meat.

All of these plant-based innovations will reduce the necessity to raise and slaughter cattle and other livestock for human consumption. This could go a long way towards reducing animal cruelty, as well as tackling the issue of climate change.

Moving to plant-based substitutes could outcome in 15 times less water utilization, a reduction in methane gas emission, and saving our lovely rainforests from further destruction. However, we should still consider the consumption of less processed foods and more real cooking, with nutrient-dense foods, to prevent nutritional deficiencies.

Algae

Algae farming could signify a potential game-changer in the way we eat food. Abundantly produced in both marine and freshwater environments, algae are seen as an answer for the problem of food scarcities. An agricultural training that has already begun in Asia, algae can be used to feedstuff both humans and animals and could become the world's biggest crop industry.

Terramino Foods

This start-up, based in San Francisco, developed a process to grow fungi that can be turned into a 'salmon' burger. It tastes, looks, and smells like the actual fish. Kimberlie Le, Co-Founder and CEO of Terramino Foods, said that it is actually the addition of algae and other plant-based ingredients that make the burger taste similar to salmon. With the growing problem of overfishing, as well as the accumulation of pollutants such as mercury and microplastics in fish, Terramino's algae-based seafood could potentially serve as a sustainable seafood replacement.

Lab-Grown Meat

So, what's in stock for meat lovers? In the hope to curb global warming, while still providing meat for people who love their meat products, scientists have come up with the idea of producing synthetic meat grown in the lab. This scientific innovative technology began as early as 2013 and involves the culturing of ground beef from cow stem cells. Lab-grown meat, also known as cultured or in-vitro meat, apparently looks, cooks, smells, and tastes like ground beef.

The Take-Away

In inference, the need to guarantee food security, prevent food scarcities and malnutrition, avoid food intolerances and allergies, shield global biodiversity, advocate for clean food production, and minimalize animal cruelty, these types of novelties will be driving the way we will be eating in the decades to come. Algae, synthetically grown meat, plant-based meat alternatives, edible insect burgers, and protein bars could well be on the global menu. Importantly, it is yet to be seen what sorts of regulations will be enforced in various countries regarding the claims and supply of these innovative food products.

Organic Farming: Significance of Liquid Organic Manures on Crop Production: A Review

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Introduction

Article is based on experiment conducted on wheat during Rabi season of 2019 at certified organic farm SMOF (SHIATS Model Organic Farm), Department of Agronomy, Naini Agricultural Institute, Sam Higginbottom University of Agriculture, Technology and Sciences, Prayagraj (Allahabad), Uttar Pradesh.

Organic rice cultivation, various external indigenous technical knowledge (ITK's) including organic preparations viz., panchagavya, amirthakaraisal, amrithpani, fish amino acid (FAA), egg amino acid (EAA) and vermiwash etc., are being used for improving the crop growth and development. Application of egg lime mix with panchagavya on crops such as paddy, wheat, banana, vegetables, greens and fruit trees remarkably increased the yield and longevity of the plants (Prabu, 2008).

Organic farming is responsible for enhanced crop production with a minimal environmental load with keeping ecological balance, contains the general meaning of the holistic production and management system for enhancing health of agricultural ecosystem (Otto Schmid, 2003).

Exclusive use of chemical fertilizers and pesticides in agriculture not only shattered the hope of farmers, but also received severe criticism from environmentally conscious people who reveal that increase in agricultural production achieved at the cost of soil health (Cooke 1982).

The long-term effect was reduction of crop yields. The damaged soil was easily eroded by wind and water. The eroding soil needed use of continuously increasing quantities of fertilizers, much of which was washed/leached into surface and underground water sources, (Narayanan 2005).

Fish Amino Acid (FAA)

1. Preparation: It is prepared from fish waste obtained from local fish market. Equal amount of fish waste and jaggery were taken (1 kg of each fish waste and jaggery). The fish waste was taken an air tight plastic jar/bottle and jaggery was added. The materials were mixed well and stored in a cool dry place. It was kept away from direct sun light. After 10 days, the liquid portion was filtered and used for spraying, (Maghirang, 2011).

2. How is FAA used: FAA is applied as a source of Nitrogen during the early (or) vegetative stage of development to boost growth and size. Do not apply FAA if plants are at the reproductive stages of their production cycle when flowering or fruiting is desired.

3. Uses:

a. FAA is rich in nitrogen
b. FAA will help to active the microorganism
c. By fermenting fish parts from the kitchen, you are practicing zero waste in at least two ways. First, fish parts that are not being used for food become FAA instead of landfill. Second, homemade FAA can be made and stored in upcycled containers.
d. FAA is of great value to both plants and microorganisms in their growth, because it contains abundant amount of nutrients.
e. Spraying of manure at an interval of 7 to 10 days.
f. FAA is preserved optimum temperature 23-25 oC

4. Success stories:

a. Fish manure in Rabi oat crop (year 2014-15) with the emergence of Bali in cereals and pulses crops.
b. Spraying of FAA increased 20% yield and 4% of protein is obtained.

Source: Amarjeet Kujur, Dr. Thomas Abraham, Dr. (Mrs.) Priyanka Sing, 2014

Fig.1:1st Fish amino acid is sprayed at 42 DAS

Fig.2: 2nd spraying at 57 DAS.

Panchagavya

Panchagavya is an organic formulation, which in Sanskrit means the blend of five products obtained from cow i.e. milk, ghee, curd, dung and urine. The components like cow dung and cow urine enhances the insecticidal activity of pachagavya which can reduce the number of application hazardous chemicals on crops. It is a mixed culture of naturally occurring, beneficial microbes' mostly lactic acid bacteria (Lactobacillus), yeast *(Saccharomyces)* actinomyces *(Streptomyces)*, photosynthetic bacteria *(Rhodopsuedomonas)* and certain fungi *(Aspergillus)* which promotes the growth and yield in different crops and provides high B:C ratio. So, panchagavya can be effective organic growth-promoter for small and marginal farmers. Panchagavya is an organic product having the potential for promoting growth and providing immunity in plant system. (Source: Shaon Kumar Das,2014).

Main Ingredients

1. Cow dung slurry- 4kg.
2. Fresh cow dung- 1kg.
3. Cow urine- 3L.
4. Cow milk- 2L.
5. Curd- 2L.
6. Ghee- 1kg.
7. Well ripened poovan banana – 12 nos.

NOTE: Sugarcane juice and coconut water are reported to accelerate fermentation, also helps in minimizing the bad odour.

Method of Application

1. 3L Pachagavya diluted in 100L water
2. 3% solution was found to be most effective compared to the higher and lower concentrations investigated

Uses:

a. Seed and seedling treatment

b. As a soil fertility enhancer by applying through irrigation water

c. The rooting is profuse and dense. Further they remain fresh for a long time. The roots spread and grow into deeper layers were also observed. All such roots help maximum intake of nutrients and water

d. Helps in decreasing the use of Chemical Fertilizers. By reducing or replacing costly chemical inputs, Panchagavya ensures higher profit and liberates the organic farmer from loan.

Time of application:

Pre flowering phase: Once in 15 days, two sprays depending upon duration of crops.

Flowering and pod setting stage: Once in 10 days, two sprays.

Fruit/Pod maturation stage: Once during pod maturation.

Fig.3: Sediments are to be filtered when sprayed with hand operated sprayer or power sprayer, the nozzle with higher pore size has to be used

Figure.4: Result of after spraying Panchagavya 3% + vermiwash 5%, showing good tillers and profuse root system.

Vermiwash

Vermiwash is a liquid that is collected after the passage of water through a column of worm action and is very useful as a foliar spray. It is a collection of excretory products and mucus secretion of earthworms along with micronutrients from the soil organic molecules. Earthworm has an efficiency to consume all types of wastage viz, that kitchen waste, temple waste, animal house waste, industrial waste, hospital waste and other organic wastes etc. Earthworms play a vital role in converting organic wastes to useful vemicompost. The dead worm's tissue discharges nitrogen in form of nitrates-25%, ammonia 45%, organic soluble compound 3% and other material 27%. These materials improve the nutrient quality of vermiwash. These are transported to the leaf, shoots and other parts of the plants in the natural ecosystem. The basic principle of vermiwash preparation is very simple Earthworm worked soils have burrows formed by them called as drilosphere.

Uses

1. Mix vermiwash with cow urine and dilute it with water to use it as a pesticide (foliar spray 1litre vermiwash + 1litre cow urine+ 8litres water) or dilute with 10 percent cow urine or neem extract or garlic extract to use it as a natural biopesticide).
2. Useful microbes such as heterotrophic bacteria, fungi, actinomycetes including nitrogen fixing bacteria like Azotobacter spp., Agrobacterium spp., Rhizobium spp., phosphate solubilizers are present.
3. Vermiwash at 5-10 percent dilution inhibits the mycelial growth of pathogenic fungi.
4. Vermiwash foliar spray, it was reported to initiate flowering and long-lasting inflorescence.
5. It acts as a plant tonic and thus helps in reducing many plant pathogenic fungi.
6. It increases the rate of photo synthesis in crops.

Personal Opinion

Compare to organic manure(solid), liquid manures have high capacity to activate beneficial microbial activity, maintain soil health, environment eco-friendly.

Conclusion

Organic farming techniques are to achieve good crop yield without harming the environment and human beings. this increase profits of farmers via reduced water use, lower expenditure on fertilizers and increase retention of top soil, organic farming establishes best relationship between earth and men.

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Coconut Cultivation Cheers to Farmers

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Introduction

The coconut palm (*Cocos nucifera* linn.) is the most useful palm in the world. Every part of the tree is useful to human life for some purpose or the other. Hence, the coconut palm is endearingly called 'kalpavriksha' meaning the tree of heaven. Origin of coconut is South East Asia. Coconut, botanically Cocos nucifera has only one species under the genus Cocos. It is tall, stately unbranched palm growing to a height of 12m to 24m. The stem is marked by rings of leaf scars which are often not prominent at the base. The palm has an adventitious root system, having numerous thick roots from the base of the stem almost throughout its life.

Coconut growing an area of Tamil Nadu nearly 461.06 thousand hectares of production 6,570.63 Million nuts. In world production about third rank in area (2,088 thousand hectares) and first rank in production (22,167 Million nuts) followed by Indonesia and Philippines. In India major production contributors nearly 85% are Kerala, Tamil Nadu and Karnataka followed by Andhra Pradesh. At present, in Tamil Nadu, there are eight crore coconut trees across 10.74 lakh acres. Around 1.5 lakh growers are spread over 13 major coconut growing districts in Tamil Nadu- Coimbatore, Thanjavur, Tirupur, Kanyakumari, Krishnagiri, Theni, Vellore, Dindigul, Tirunelveli, Erode, Salem, Pudukkottai and Virudhunagar.

Importance

Coconut is the most important crop in the world and it is an important palm. Coconut is one of the most important commercial crops in many tropical countries and it is contributing significantly to their economy. Post-harvest processing of coconut is now being changed from the edible and inedible traditional products to several other value-added products. Presently several food products are developed from coconut kernel like desiccated coconut, coconut milk powder, coconut milk and virgin coconut oil which are having high demand and prospects for commercial production and marketing.

Hence high kernel output per hectare has now emerged as an important factor in coconut. A fast-growing consumer demand is recorded for coconut kernel-based products especially in those areas where fresh coconut is not readily available and in cities where people do not have enough time in grating coconut for various culinary purposes. Kernel based ready to eat products like coconut milk powder and edible coconut gratings are now acceptable and are widely used by different categories of consumers for usage in households, bakery and confectionary units, hotels and other fast food eating centres.

Tender coconut is a refreshing drink and a delicious food across the globe. It's valuable sweet water and gelatinous kernel is a tasty and healthy food. Value added products made from tender coconut are also available in the country. Another important value-added product is Neera, the unfermented sap from coconut inflorescence. Several value-added products from Neera such as Neera sugar, honey, chocolate and jaggery are also available now which are having fast growing demand.

FPOs Contribution

The Farmer Producer Organizations (FPOs) are getting deep rooted in coconut sector India. Through these FPOs, the entire coconut sector can be revolutionized and each and every farmer in the coconut sector can reap the benefit of being a part of FPO.

For making this happen, the Coconut Producer Companies and Federation in the country has to kick start their activities immediately for value addition of their product. Time is now ripe for the Farmer Producer Organizations in Tamil Nadu to tap the potential of Tamil Nadu market extensively and make available all products in shelves of stores.

Value Added Products from Coconut

1. Coconut oil: The major commercial product of coconut. Coconut oil is used as a cooking fat, hair oil, body oil, and industrial oil. Refined coconut oil is prepared exclusively for industrial purposes and is widely used in the manufacture of biscuits chocolates, ice creams, margarine, and confectionery items. It is also used for the manufacture of paints and pharmaceutical agents. Desirable properties such as a low melting point, resistance to rancidity, pleasant flavor and easy digestibility make it an ideal ingredient in the food industry. Coconut oil is a source of many oleo chemicals such as fatty acids, methyl esters, and fatty alcohol. Coconut oil is a rich source of saturated fatty acids, and short- and medium-chain fatty acids account for 70% of these fatty acids. It has a low content of unsaturated fatty acids with a negligible content of polyunsaturated fatty acids.

2. Tender coconut water: It is valued both for the refreshing drink and gelatinous kernel, which is a delicious food. The tender nut water is rich in potassium and minerals. Glucose content is maximum in seven months old nuts and hence the best stage for drinking.

3. Coconut milk: Coconut milk refers to the milky fluid, freshly extracted from the coconut kernel with or without added water and coconut cream to the high-fat cream-like material obtained from the coconut milk by either gravitational separation or centrifugation. Coconut milk was prepared by blending skim milk powder with coconut milk, obtained from freshly grated coconut and pasteurized at 70-720C for 10min. It contains 6 percent skim milk powder and 9.65 percent total solids. Coconut milk, a generic term for the aqueous extract of the solid coconut endosperm, plays an important role in the cuisines of South East Asia as well as in other parts of the world. The ready-to-drink fermented beverage concentrate (diluted at 1:3) contains protein (1%), fat (0.74%), sugar (18.70%) and water (79.25%). The fermented beverage concentrate was found to be stable even after 2 months of storage and coconut skim milk can be utilized successfully.

4. Coconut candy: Coconut candy was prepared from grated coconut meat mixed with coconut milk. The grated coconut was moistened with a portion of the milk. The remaining milk and the molasses were poured in a cooking pan, and the mixture was heated to boiling. Refined sugar was added and the mixture was cooked until it gets hardened when dropped into cold water. It was then poured in butter-greased pans, allowed to cool slightly, cut into desired sizes and individually wrapped in cellophane sheets.

5. Coconut jiggery: Sweet toddy if carefully collected in sterile glass vessels remains unfermented for a considerable time. It can be strained and boiled down to the crystallizing point, to obtain 12-15 per cent jaggery with nutritional and medicinal value. The reducing sugars and minerals made it more nutritious and health friendly.

6. Palm sugar: The application of palm sugar offers huge potential owing to its important health attributes the low Glycemic index and its high nutrient content. It can be the most suited alternative sweetener.

7. Neera: (Coconut Flower Sap): Neera is the non-alcoholic and nutritious drink from the immature inflorescence of coconut tree. Neera is popular as a delicious health drink. It is good for digestion, facilitates clear urination and prevents jaundice. The nutrient-rich "sap" has low Glycemic Index (GI of only 35) and hence diabetic-friendly since very low amounts of the sugar is absorbed into the blood. It is an abundant source of minerals, amino acids, vitamin C, broad-spectrum B vitamins and has a nearly neutral ph. Treated Neera can be preserved in cans upto two months at room temperature.

8. Virgin coconut oil: Virgin coconut oil (VCO), extracted from fresh coconut meat without chemical processes is said to be the "mother of all oils". It is rich in medium chain fatty acids, particularly lauric acid and is a treasure trove of minerals, vitamins, antioxidants and is an excellent nutraceutical. It has about 50% lauric acids, having qualities similar to mother's milk, thus confirming its disease-fighting ability. When lauric acid enters human body, it gets converted to Monolaurin, which has the ability to enhance immunity. Several studies have confirmed that this compound has the ability to kill viruses including herpes and numerous other bacteria. Its antiviral effect has the ability to considerably reduce the viral load of HIV patients. VCO is not subjected to high temperatures, solvents or refinement procedures and therefore retains the fresh scent and taste of coconuts. It is rich in vitamin E, is non-greasy, non-staining and is widely used in soaps, lotions, creams and lip balms. The health benefits of VCO are second to none; ranging from speeding up body metabolic system and providing immunity against a horde of commonly prevalent diseases.

9. Coconut Vinegar: Coconut vinegar is made from fermented coconut water and is used extensively as a preservative and flavouring agent in pickles, salads, sauces and many other condiments. Coconut vinegar is also made from the sap of coconut tree and is similar to fresh coconut water. Naturally fermented coconut vinegar is rich in minerals and vitamins such as Beta carotene, calcium, iron, magnesium, phosphorous, potassium and sodium. Coconut vinegar helps in digestion and improves the quality of cooked meat and fish. It is a healthier alternative to synthetic vinegar. Vinegar has extensive use as a preservative in pickle industry and flavouring agent in food processing sector.

10. Coconut milk powder: Coconut milk powder was prepared by dehydrating the milk under controlled conditions. The composition of the milk was adjusted with fat percentage in the range of 50-60 per cent of the total solids. The emulsifiers and stabilizers were also added to the formulation. The most crucial step was the dehydration stage for which spray drier was employed at high temperature (around 180oC).

11. Coconut cream: The concentrated milk extracted from fresh matured coconuts can either be used directly or diluted with water to make various curry preparation, sweets, desserts, puddings etc. Processed and packed coconut cream had a shelf life of six months and once opened it should be stored in refrigerator for subsequent use. Coconut cream, a concentrated form of coconut milk, which is a convenient product prepared from mature and fresh.

Coconut By-Products

1. Activated Carbon: Shell charcoal on activation is transformed into activated carbon which is having the ability to observe effectively even trace quantities of both unwanted or valuable liquids and gases. Activated carbon is used in solvent recovery processes, water and effluent treatment and the treatment of flue gas before discharge into the atmosphere.

2. By-Products from husk: About 30 percent of the husk is fibre a 70 per cent is coir dust. Coir and coir products from the major output from the coconut husk. Coir pith is used as manure (After composting), mulch material and for making briquettes.

3. Other products:

a. Handicrafts items like ladles, forks, show piece, shell buttons, ice creams cup are prepared from coconut shells.
b. The coconut wood is used for making wall panels, furniture's
c. Coconut leaves are plaited for thatching houses and sheds. It is also used for making baskets, temporary fences. Midribs of the leaves are used to make brooms.

Conclusion

Tamil Nadu, plays a vital role in coconut production, but at the mean time it slowly losing its position because of unremunerative price, severe pest and diseases now pandemic issue. In this situation, the policy makers and other stakeholders are urging to take necessary steps to boost up coconut cultivation practices.

As the consumer price for a coconut farmer is getting very low, it clearly shows that the marketing system is not favourable to the farmers. If the government takes necessary steps to regulate coconut marketing process and gives, financial assistance to make value added products from core products it may encourage the coconut production.


Coconut cream


Tender coconut


Coconut cake

Coconut oil

Coconut milk

Coconut chips

Coconut sugar

Coconut Neera

Value added products from Coconut

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Package and Practices for Integrated Pest and Disease Management of Mango through ICAR-AICRP on Fruits Findings

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Introduction

Mango (*Mangifera indica* L.), is an important fruit crop in tropical and sub-tropical regions of India. It is known its delicious taste, attractive colour, savouring flavour and high nutritive value which is rich in vitamins A and C, mineral and fibre content. India is one of the main mangos producing country in the world with nearly 41% of world total mango production.

Among Indian states, Gujarat covers 153 thousand hectares area with total 1.24 million tonnes of production and 8.10 tonnes/ha productivity (NHB; 2017). Various biotic and abiotic stresses play an important role for its low productivity. Insect-pest and disease infestations are the major biotic stress causing factors reported in India. More than 400 insect-pest species have been recorded on mango in different parts of the world. Of these, 188 species have been reported from India (Tandon and Verghese 1985). Among them, major sucking pest viz., hopper and thrips are considered major pest of mango and attack on both reproductive and vegetative stages of the crop.

Fruit flies are also major pest and its population recorded throughout the year wherein maximum catches observed during April-July which coincided with fruiting and harvesting stages of the crop. Apart from these pests, powdery mildew and anthracnose are recorded major disease of mango in south Gujarat ecosystem. Keeping this in view, brief information of major pest and diseases of mango and their integrated pest and disease management strategies through ICAR-AICRP on fruits research findings are presented here under.

Major Pests

1. Hopper: It is monophagous, regular and serious pest of mango and causing significant yield losses in south Gujarat ecosystem. Activity was recorded more or less throughout the year except rainy months. Both nymphs and adults of hoppers aggregate on the underside of leaves puncture and suck the sap of young leaves and inflorescence (Fig. 1). They also excrete huge quantities of honey dew which promotes the development of sooty mould (*Capnodium mangiferae*) on the dorsal surface of leaves, inflorescence, branches and rachis of the fruits which affects the photosynthesis activities of the plant resulting in non-setting of flowers, dropping of immature fruits and reducing the yield (Bana *et al.*, 2018; Rahman and Kuldeep, 2007)

2. Thrips: Other than hoppers, thrips are also serious pests at new flush, flowering and fruiting stages of mango and affecting significant economic losses to the production. Nymph and adult of thrips suck the sap from the tender shoots, young leaves, inflorescence and fruits of the mango which result in silvery shine with upward curling of the leaf, and panicles resulting in malformation and bronzing of the fruit surface with feeding scars on fruits (Fig. 2).

3. Fruit fly: Fruit flies are recorded as major pest of mango throughout the year in south Gujarat ecosystem wherein maximum damage was observed during April-July which coincided with fruiting and harvesting stages of the crop (Fig. 3). Female fruit fly lays eggs in the fruit skin with the help of ovipositor and after hatching, the maggots start feeding inside the fruit pulp and causes internal discoloration, off flavours, pulp rotting and fruit drop on the ground and pupates in the soil (Sarwar *et al.,* 2014). Patel *et al.,* 2013 reported that fruit flies cause up to 40 per cent yield loss in heavy rainfall zone of south Gujarat.

Major Diseases

1. Powdery mildew: It is an important, serious and widespread disease of mango in India and causes up to 90 per cent loss when observed in epidemic (Misra et al., 2016; and Nelson, 2008). Symptoms of this disease can be noticed on leaves, inflorescences and young fruits (Fig. 4). The typical symptom of powdery mildew disease is characterized by appearance of white superficial powdery growth of the fungus on affected plant parts resulting in shedding of flowers and pea size fruits at later stage. The affected flowers usually fail to open and may fall prematurely resulting into no fruit set on diseased inflorescence stalk (Palti et al., 1974).

2. Anthracnose: It is major pre- and post-harvest disease of mango causing significant yield losses in south Gujarat agro-climatic conditions. Pre-harvest phase of anthracnose directly linked to the field and post-harvest affects marketable fruits. Disease symptoms appear at all the growing parts including leaves, twigs, flowers, and fruits. Primary characteristic symptoms are as irregular shaped black necrotic spots and rounded brown to black lesions on fruit surface at post-harvest phase (Fig. 5).

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Fig. 1: Hopper population on inflorescence/panicle, and sooty mold on panicle

Fig. 2: Thrips infested new flush, pea and full grown fruits

Fig. 3: Fruit flies pucnture the fruits, nauroji-stonehouse fruit fly trap and infested fruit

Fig. 4: Powdery mildew infected panicle/pea size fruits and twig

Fig. 5: Anthracnose symptoms on mango leaves and fruits

Integrated Pest and Disease Management (IPDM) for Mango

Phenological Stages	Pest/diseases	Recommended Technology/Package of Practices (PoP)	Recommended by
Flowering stages (Jan.-March)	Sucking pests (hopper, thrips and midge)	Farmers of South Gujarat are advised to monitor hopper and thrips on mango during flowering and fruit setting period in general and pea cum marble sized fruit stage of the crop in particular and if population of these pests becomes high (Economic threshold level of 5 hoppers per panicle and 10 per cent thrips damage) due to prevalence of high humidity, they are advised to adopt recommended measures (adoption of need based plant protection schedule, application of imidacloprid @ 0.005% or 2.8 ml or thiamethoxam @ 0.008% or 3.2 gm /10 liters of water) to avoid crop loss due to these pests.	ICAR-AICRP on Fruits, AES, Paria centre
	Mango hopper and thrips	IPM package consisting of first spray of spinosad 45 SC, 0.004%, 0.88 ml/10 1iter of water at panicle emergence stage followed by second spray with thiamethoxam 25 WG, 0.008%, 3.2 g/10 liter of water at 21 days after first spray and third need based spray of azadirachtin 1 EC, 30 ml/10 liter of water found effective for the management of mango hopper and thrips.	

	Mango hopper	Mango growers are advised to spray Lecanicillum (Verticillium) lecanii 1.15 WP @ 50 g/10 liter of water (1x108cfu/g) or Beauveria bassiana (ICAR-IIHR liquid formulation) (1x109cfu/ml) @ 10 ml/10 liter of water with following schedule for effective management of mango hoppers. I at panicle initiation stage II spray 7 days after 1st spray III spray 7 days after 2nd spray IV spray at pea size stage V spray at marble size stage	
	Powdery mildew	For the effective and economical control of powdery mildew of mango farmers are advised to spray Penconozole 10 EC 0.005% (5 ml/ 10 liter of water) four times from panicle emergence stage at 15 days interval.	
Fruiting stages (April-July)	Fruit fly	Monitor fruit fly in mango orchards during April to July in general and second fortnight of June to second fortnight of July in particular which coincides with fruiting and late harvest period of the crop as prevalence of low sunshine and high humidity, rainfall period and wind velocity during the period may result in abundance of high population of fruit fly and if fruit fly damage persists above threshold level (10 per cent fruit damage) farmers are suggested to adopt recommended measures (installation of methyl eugenol or wooden plywood trap @ 10/ha followed by collection and disposal of fallen fruits during April to July).	
	Fruit fly	Mango growers of South Gujarat are advised to install commercially available methyl eugenol impregnated wooden block in plastic bottle used for mineral water as a trap @10/ha at marble stage of fruits to trap higher number of male fruit flies in mango orchard.	
Vegetative stage (Oct.-Dec.)	Anthracnose	Three sprays of carbendazim 12%+mancozeb 63% (ready mix formulation) @ 0.2% (20 g/ 10 liter of water) or carbendazim @ 0.1% (10 g / 10 liter of water) at 10 days interval starting from initiation of disease for economical and effective control of anthracnose in mango.	

Accentuating the Hidden World of Microbiome During Covid-19

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"ALL DISEASES BEGIN IN THE GUT": Hippocrates

Why the Gut Microbiome Is Crucial for Your Health?

We now know the trillions of bacteria living within our gut, referred to as the gut microbiome, preform a wealth of vital functions for our bodies, from vitamin production, aiding digestion, toxin removal and indeed, education of our immune system. With respect to gut bacteria, maintaining a high level of bacterial diversity is key. A loss of diversity results in a physiological change within our gut that can initiate or perpetuate common infections and inflammation. We also know that the diversity of the gut microbiome can decrease with age and frailty, both important factors in COVID-19 infections. The risk of severe COVID-19 infection is more common in those with high blood pressure, diabetes and obesity, conditions that are all associated with changes to the composition of the gut microbiome — the community of bacteria, viruses and fungi that live in the intestines. This raises the question of whether the gut microbiome has a role in dictating COVID-19 severity.

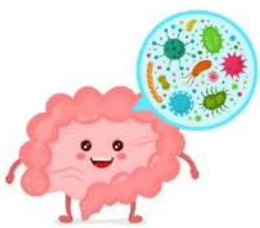
Let's recap what we know about COVID-19. COVID-19 is a new disease caused by a very contagious virus called SARS-CoV-2.

In most infected individuals, the virus does not cause serious illness. However, it causes a very serious respiratory disease — and even death — in a minority of patients. Through many studies of people with COVID-19 over the past few months, we have learned what characteristics are more likely to be linked to mild versus severe forms of the disease. This article serves as a guide to the gut microbiome and explains why it's so important for your health.

What is the Gut Microbiome?

Bacteria, viruses, fungi and other microscopic living things are referred to as microorganisms, or microbes, for short. Trillions of these microbes exist mainly inside your intestines and on your skin. Most of the microbes in your intestines are found in a "pocket" of your large intestine called the cecum, and they are referred to as the gut microbiome. Although many different types of microbes live inside you, bacteria are the most studied. In fact, there are more bacterial cells in your body than human cells. There are roughly 40 trillion bacterial cells in your body and only 30 trillion human cells. That means you are more bacteria than human.

What's more, there are up to 1,000 species of bacteria in the human gut microbiome, and each of them plays a different role in your body. Most of them are extremely important for your health, while others may cause disease. Altogether, these microbes may weigh as much as 2–5 pounds (1–2 kg), which is roughly the weight of your brain. Together, they function as an extra organ in your body and play a huge role in your health.



How Does it Affect Your Body?

Humans have evolved to live with microbes for millions of years. During this time, microbes have learned to play very important roles in the human body. In fact, without the gut microbiome, it would be very difficult to survive. The gut microbiome begins to affect your body the moment you are born. You are first exposed to microbes when you pass through your mother's birth canal. However, new evidence suggests that babies may come in contact with some microbes while inside the womb. As you grow, your gut microbiome begins to diversify, meaning it starts to contain many different types of microbial species. Higher microbiome diversity is considered good for your health. Interestingly, the food you eat affects the diversity of your gut bacteria.

As your microbiome grows, it affects your body in a number of ways, including:
1. Digesting breast milk: Some of the bacteria that first begin to grow inside babies' intestines are called Bifidobacteria. They digest the healthy sugars in breast milk that are important for growth.

2. Digesting fibre: Certain bacteria digest fibre, producing short-chain fatty acids, which are important for gut health. fibre may help prevent weight gain, diabetes, heart disease and the risk of cancer.

3. Helping control your immune system: The gut microbiome also controls how your immune system works. By communicating with immune cells, the gut microbiome can control how your body responds to infection.

Who is Susceptible to Serious COVID-19?

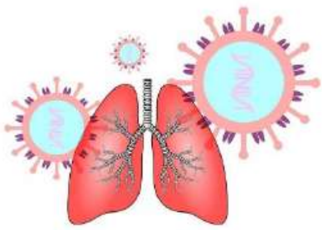
Children and young adults are less likely to develop symptomatic COVID-19, although infection readily occurs in young people with equally high viral loads in the airway, suggesting that they can certainly infect others. In contrast, people of older age and those with pre-existing chronic conditions are highly at risk and very likely develop symptomatic, severe disease.

What Conditions are Linked to Severe COVID-19?

The information collected by researchers from many countries all points to similar characteristics and health conditions that are more commonly seen in patients with severe disease. These include older age, high blood pressure, diabetes and obesity. The strength of these associations is even more prominent among younger individuals, as younger patients with obesity and diabetes are more likely to have serious disease.

In New York City, 5,279 patients tested positive for COVID-19 between March 1 and April 8, 2020. Of these, 22.6 per cent had diabetes and 35.3 per cent were obese. Obesity was associated with an increased rate of hospital admission and critical illness. Similar findings were provided by investigators in the United Kingdom about the outbreak in Britain, where obese patients were twice as likely to develop severe disease.

Do these findings raise the possibility that the mechanisms underlying high blood pressure, diabetes and obesity may help explain why these conditions lead to severe COVID-19 disease? Before exploring this question, let’s zoom in on cellular and molecular mechanisms known to be involved in COVID-19 disease.

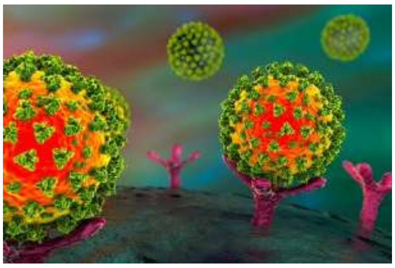


How does the body fight COVID-19 infection?

When the virus enters the body, it mostly goes to the airways and the gastrointestinal tract. The virus then binds to specific receptors present on the surface of epithelial cells to enter these cells. Viral replication within the cells leads to cell damage and cell death. This results in the release of specific signalling molecules that alert the local immune system.

Armies of immune cells are then dispatched to initiate an antiviral response. Some of these cells are specialized to locate and identify the virus, while others mount a specific immune attack. The immune response results in the release of cytokines, chemokines and antibodies, which in many cases can defeat the virus, and the patient recovers. Sometimes the immune system is dangerously at high alert and overreacts. In this case, the immune cells mount an especially strong inflammatory response — one that goes beyond what is required to kill the virus. This extra-strong attack releases cytokines and chemokines on a massive scale throughout the body, resulting in a cytokine storm, which causes widespread inflammation and tissue damage in patients with severe COVID-19.

One of the reasons for an abnormal, overreactive immune response lies in the gastrointestinal tract. Millions of interactions are constantly occurring between the immune system and trillions of non-dangerous microbes that live within the body. These interactions educate the immune system in how to function and, importantly, in how not to overreact to infectious microbes. Could this help explain why some people are more likely to develop uncontrolled inflammation upon COVID-19 infection?

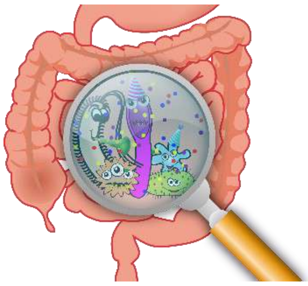


Trillions of Micro-Organisms that Call Your Gastrointestinal Tract Home

The gut microbiome is the community of micro-organisms living inside the gastrointestinal tract, mostly in the large bowel. The microbiome contains bacteria, fungi (yeast), viruses and protozoa, all of which contribute to maintaining a balanced ecosystem and human health. These microbes collectively perform many beneficial functions, including educating the immune system.

When studying the microbiome, scientists examine the composition (what is there) and function (what are they doing) of this ecosystem. We have learned that both composition and function of the gut microbiome are important features linked to human health. In certain conditions, the balance of the gut microbiome composition and function is disrupted in a way that leads to disease, a phenomenon called microbiome dysbiosis.

There is accumulating evidence from animal and human studies that gut microbiome dysbiosis has a causal role in metabolism dysregulation manifested as diabetes and obesity — the risk factors of severe COVID-19 disease.



Is Gut Microbiome Predisposing Patients to Severe COVID-19?

The gut microbiome regulates host defences against viral infections including respiratory viruses, such as influenza virus. This occurs through the activation of immune antiviral mechanisms and the prevention of excessive inflammation. Different species of the gut microbiome have pro- or anti-inflammatory properties and play different roles in regulating the immune system.

In the context of COVID-19, a recent preprint study (not yet peer reviewed) showed that specific members of the gut microbiome were associated with severe disease and with immune markers known to be elevated in severe disease. The association of these gut bacteria with the immune markers was even higher than that of the known risk factors of COVID-19 severity: age and obesity.

Further work is needed to confirm that pro-inflammatory microbial species can contribute to the immune responses that make severe COVID-19 more likely, but based on what we know about the microbiome, this is certainly a possibility. This also could mean that beneficial gut microbiome species, the type that promote low inflammation, have the potential to prevent or remediate the immune alterations that lead to severe COVID-19.

How Can You Improve Your Gut Microbiome?

There are many ways to improve your gut microbiome, including:

1. Eat a diverse range of foods: This can lead to a diverse microbiome, which is an indicator of good gut health. In particular, legumes, beans and fruit contain lots of fiber and can promote the growth of healthy *Bifidobacteria*.

2. Eat fermented foods: Fermented foods such as yogurt, sauerkraut and kefir all contain healthy bacteria, mainly *Lactobacilli*, and can reduce the amount of disease-causing species in the gut.

3. Eat prebiotic foods: Prebiotics are a type of fiber that stimulates the growth of healthy bacteria. Prebiotic-rich foods include artichokes, bananas, asparagus, oats and apples.

4. Breastfeed for at least six months: Breastfeeding is very important for the development of the gut microbiome. Children who are breastfed for at least six months have more beneficial *Bifidobacteria* than those who are bottle-fed.

5. Eat whole grains: Whole grains contain lots of fiber and beneficial carbs like beta-glucan, which are digested by gut bacteria to benefit weight, cancer risk, diabetes and other disorders.

6. Eat foods rich in polyphenols: Polyphenols are plant compounds found in red wine, green tea, dark chocolate, olive oil and whole grains. They are broken down by the microbiome to stimulate healthy bacterial growth.

7. Take a probiotic supplement: Probiotics are live bacteria that can help restore the gut to a healthy state after dysbiosis. They do this by "reseeding" it with healthy microbes.

Vitamin D and Health

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Summary of Article

Vitamin D is an essential micronutrient which is required for several regulatory processes in the body. The most important function of the vitamin is to maintain the mechanism of bone health in the body. It is the main nutrient which facilitates processes such as bone mineralization and burn turnover, thereby preventing bone diseases like osteoporosis. Vitamin D regulates insulin sensitivity and insulin resistance, beta cell proliferation and is used as an important supplement in both Type 1 and Type 2 diabetes mellitus.

With the help of the various vitamin D receptors present in the body, vitamin D also regulates other chronic diseases such as cardiovascular diseases, cancer, infectious diseases, auto immune diseases and skin disorders. The multidimensional role of vitamin D demands for more research to combat the prevalent vitamin D deficiency and discover ways to improve utilisation and availability of the vitamin

Introduction

Vitamin D is a fat-soluble vitamin which has grown significance in the areas of health research. It is produced subcutaneously from 7-dehydrocholesterol as a result of exposure to ultra violet light. Vitamin D has been recognised as an important nutrient impacting pleiotropic roles in the pathogenesis of several diseases. The role of vitamin D is no longer confined to bone health, but is also essential in the various regulatory processes in the body.

It is linked to the treatment and pathogenesis and/or progression of several disorders including cancer, hypertension, multiple sclerosis, rheumatoid arthritis, osteoporosis, muscle weakness and diabetes. In recent times, vitamin D deficiency has seen a serious spike and is being recognised as a major epidemic with a global prevalence of over a billion, affecting 70-90 per cent of the population. The significance of vitamin D merits consideration for more in-depth research in the various aspects of improving utilisation of vitamin D, including fortification and intervention to mitigate the deficiency as well as the occurrence of the associated diseases and disorders.

Vitamin D and Bone Health

Vitamin D has a significant role in the maintenance of bone health. The major function of vitamin D is to optimize intestinal calcium and phosphorus absorption for proper formation of the bone mineral matrix (Oliai et al., 2015).Calcium is transported across the intestine by a paracellular or transcellular pathway. The transcellular process is highly regulated by vitamin D. Several vitamin D–dependent calcium transport proteins regulate the intestinal calcium absorption. Optimal vitamin D levels are necessary to increase the efficiency of calcium absorption. Without adequate vitamin D, the body absorbs no more than 10% to 15% of dietary calcium and often lead to bone demineralization. Continuous bone turnover and resorption weakens the architecture of bones and increases fracture risk via secondary hyperparathyroidism ultimately leading to the development of osteomalacia and osteoporosis (Basil et al., 2013).

Vitamin D and Diabetes Mellitus

In certain populations, the development of Type 1 diabetes mellitus is associated with polymorphisms in the vitamin D receptor gene type 1 and 2, as Vitamin D receptors have strong immuno modulating effects, thus early intake of vitamin D in infants reduces the risk of development of Type 1 diabetes mellitus (Menon et al., 2013). In Type 2 diabetes mellitus, Vitamin D levels have been associated with defects in pancreatic cell function, insulin sensitivity, and systemic inflammation.

Intracellular calcium, which is regulated by vitamin D, is a key factor of peripheral insulin resistance. Vitamin D is known to improve pancreatic beta-cell function, decrease insulin resistance and improves systemic inflammation. It directly acts on pancreatic beta cells by binding beta cell vitamin D receptor to produce insulin and fat cells to improve insulin resistance (Bawaskar et al., 2017).

Vitamin D and Cardiovascular Diseases

The role of vitamin D in the treatment and management of cardiovascular disorders like coronary artery diseases, angina pectoris and cardiomyopathy has been reported in many studies. Vitamin D receptors (VDR) are present in vascular smooth muscle, endothelium, and cardiomyocytes and have an impact on cardiovascular disease. Several cells and tissues of the cardiovascular system abundantly express vitamin D receptors (VDR) which include cardiomyocytes, and vascular and endothelial cells. In cardiomyocytes, vitamin D regulates cell maturity and differentiation.

Vitamin D has been found to regulate macrophage maturation and infiltration into the vasculature, subsequently regulating the expression of pro-inflammatory cytokines and adhesion molecules, which are critical components in the progression of cardiovascular diseases like atherosclerosis. Hypertension is a manifestation of an imbalance between vasoconstriction and vasodilation, which is controlled by the interaction of genetic and epigenetic factors. Vitamin D deficiency is said to disturb these epigenetic factors. (Pereira et al., 2005).

Vitamin D and Cancers

The vitamin D–cancer prevention hypothesis has been evaluated through several types of studies, including geographical ecological studies related to indices of solar ultraviolet-B (UVB) dose (the primary source of vitamin D for most people), observational studies related to UVB exposure or serum 25-hydroxyvitamin D concentrations, laboratory studies of mechanisms, and clinical trials. Low levels of vitamin D are associated with cancers of breast, prostate as non-skeletal receptors of vitamin D code for more than 200 genes.

The mechanism of action of vitamin D in cancer is related to its role in the regulation of cell growth and differentiation. Vitamin D acts like a transcription factor that influences central mechanism of tumorigenesis: growth, cell differentiation, and apoptosis. The biologically active form of vitamin D, 1, 25-dihydroxyvitamin D is known to modulate gene expression, inhibit cellular proliferation, induction of differentiation and apoptosis which contribute to inhibiting the cell growth of cancer. (Baig et al., 2013).

Vitamin D and Auto Immune Disorders

Vitamin D is associated with autoimmune disorders and is used as supplementation in the treatment and management of the autoimmune disorders such as arthritis, psoriasis and multiple sclerosis. Vitamin D binds to vitamin D receptors on various cells which participate in immune responses and modulate activation and deactivation of the innate and adaptive responses. Vitamin D is known to induce innate tolerance by the promotion of dendritic cells and induces robust macrophage response to infections. (Hagenau et al., 2009).

Vitamin D and Infectious Diseases

Vitamin D regulates immune function and cytokine production which regulates the onset and treatment of infections (Husemoen et al., 2012). During infection, vitamin D receptors present in immune cell and bronchial and pulmonary epithelial cells are up- regulated, following the ligation of specific toll-like receptors by extracellular pathogens, implicating role of vitamin D in innate immunity.

Vitamin D and Skin Diseases

Vitamin D has known to be associated with cutaneous disorders including skin cancer, psoriasis, ichthyosis, sclerodema and systemic lupus erythematosus, as well as atopic dermatitis, acne hair loss and photo dermatoses (Mauss et al., 2015). Several findings reveal the role of vitamin D in the prevention of the initiation and progression of lethal skin cancers is the involvement of vitamin D in regulation of multiple signaling pathways that have implications in carcinogenesis. Furthermore, vitamin D induces cellular arrest, triggers apoptotic pathways, inhibits angiogenesis and alters adhesion. Vitamin D also plays an important role in prevention of certain molecular events involved in tumor progression.

Conclusion

With the recognition of vitamin D in the regulation of different diseases, it is now of utmost importance to assess its deficiency and enhance its availability and utilization. The paradigm entailing mere dependence upon cutaneous photosynthesis for adequate vitamin D levels does not stand true. Perusal of several research findings in the recent past shows lifecycle changes, availability of vitamin D rich foods, mandatory vitamin D fortification of the foods, vitamin D supplementation programs, sufficient sun exposure, reduced environmental pollution and facilities for inexpensive and accessible diagnosis of vitamin D deficiency would help mitigate the gravity of the prevalence of vitamin D deficiency and the associated diseases.

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Sucrose-Starch Metabolism in Plants Under Drought Stress

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Introduction

Drought is multidimensional stress that causes changes in morphological, physiological. biochemical and molecular traits in plants resulting in limited crop growth and production globally. Studies suggested that the severity of drought stress depends on the duration and intensity of the stress as well as on the developmental stage of the plants in which drought stress occurs.

There are many reasons for drought stress in plants; these include low rainfall, high and low temperature, salinity, high light intensity etc. Most of the plants are exposed to drought as transitory or terminal stress, which may result in various changes in their physiological and biochemical processes. If drought stress occurs during the vegetative stage, the stress is mostly transitory and remains until rainfall comes back and causes restoration of the plant growth. Due to these conditions, the plant growth may become slow and they even start wilting, while suppressed tillering limits the yield of the crops.

When drought stress occurs during the reproductive stage, it leads to a decrease in biosynthesis of photo assimilates and hence lesser assimilate partitioning. Extreme drought stress can further result in a shortening of grain filling period which eventually lowers crop productivity. Plants have developed some common adaptive mechanisms to cope with environmental stresses. Metabolomic solutes, such as proline, betaine, fructose and sucrose, contribute to drought stress tolerance. Stress can reduce water-soluble carbohydrates and its mobilization to the developing grains and also leads to an imbalance between photosynthetic electron transport processes and carbon assimilation processes resulting in enhanced photoinhibition and thermal energy dissipation.

Generally, regulation of photosynthetic apparatus to high CO_2 is limited by either a lower activation of ribulose-1,5-bisphosphate carboxylase/oxygenase (Rubisco) and a lower content or limited activation of photo-oxidizable photosystem I (PS I). In leaves, drought stress leads to stomatal closure associated with reduced CO_2 uptake resulting in an imbalance between photosynthetic electron transport processes and carbon assimilation. As a result of this dehydration among cells occur and even leads to the formation of reactive oxygen species (ROS) and ROS scavenging enzymes like thioredoxin (Trx) isoforms in case of drought treated sugar beet.

Sucrose Metabolism in Cereals During Drought Stress

Sucrose plays an important role in plant growth and development by transferring carbon from source to the sink organs of the plant. The impact of drought stress on source-sink relationships results in a decrease in the rates of carbon assimilation and respiration, as well as partitioning and redistribution of carbon and nitrogen within the plant. This altered availability of C and N affects starch and protein metabolism in leaves, finally resulting in distinct grain yield and quality. It has been studied that drought response in spikes of cereals mostly concentrated on the awn or entire spikes as a collective unit.

Sucrose Synthesis

Sucrose {α-D-glucopyranosyl-(1,2)-β-D-fructofuranoride}, the major product of photoassimilated carbon, can be utilized directly by glycolysis or translocated within the plant as a soluble carbohydrate via the phloem. It can be used for the maintenance of cellular metabolism, cell wall biosynthesis, respiration, or converted into starch for later use. Sucrose is unloaded from the phloem, once it flows out into the apoplasts it is taken up by parenchymal cells and then accumulates in vacuoles. Its synthesis is mainly regulated by cytosolic fructose-1,6-bisphosphatase (cFBPase) and sucrose phosphate synthase (SPS). Cytosolic fructose-1,6-bisphosphatase converts fructose-1,6-bisphosphate (Fru1,6bisP) to fructose-6-phosphate (Fru6P).

Sucrose phosphate synthase converts UDP-glucose (UDP-Glc) and Fru6P to sucrose-6-phosphate and is regulated by allosteric effectors and multisite phosphorylation. In leaves, changes in SPS activity often correlate with changes in the rate of sucrose synthesis and export. In a source organ, during sucrose biosynthesis, sucrose-6-phosphate is dephosphorylated by sucrose phosphate phosphatase (SPP) to produce sucrose.

However, in sink organs, translocated sucrose is either stored or degraded and can also be used for energy metabolism, organ formation, synthesis of stored carbohydrates such as monosaccharides, starch and re-synthesis of sucrose takes place. There are two distinct mechanisms to control the enzymic activity of the SPS protein. First is allosteric control by Glc6P (activator) and Pi (inhibitor), and second is the covalent modification of protein through phosphorylation. Generally, sucrose synthesis is considered to be catalysed by SPS (in conjunction with SPP), whereas sucrose breaks down is largely catalysed by sucrose synthase (SuSy).

It is also important that SPS is not confined to photosynthetic tissues but also occurs in non-photosynthetic tissues that are active in sucrose biosynthesis, e.g. ripening fruits. Stem reserves contribute to grain filling by 20-30% of the final grain weight in control conditions. Under drought stress, remobilization of these stems reserves to the developing grain plays a vital role in the grain yield of the plants.

Sucrose Degradation

Under drought stress, kernel abortion correlates with depleted sucrose, reducing sugar levels, and reduced sucrose degrading enzyme activity and increased starch consumption in the kernels. At that period sink tissues have limited reserves of starch that lead to starvation in crops. However, there is a less amount of starch to support the ovary for an extended period. For example, in wheat, high temperature and drought stress can lead to altering the pits and channels in its starch granules. Studies suggested that pitting is due to the imbalance in starch hydrolase and synthase that result in premature autolysis.

In-plant roots, glycolysis substrates, namely glucose, fructose and UDP-Glucose, are provided mainly through sucrose degradation, in which invertase and SuSy have a major role. Sucrose is generally used as a transportable substance to sink organs which is hydrolyzed by invertases or SuSy and thus able to provide carbon and energy for growth and storage reserves and also act as a signal for the root growth. Sucrose is imported by SUT1-like transporters into epidermal and/or endosperm transfer cells (ETCs) by energy-dependent H+-co-transport and is subsequently degraded by sucrose synthase in endosperm cells.

Sucrose synthase catalyses the cleavage of sucrose, the main transported form of assimilates in wheat plants to form UDP-glucose and fructose, which is thought to be the first step in the sucrose-to-starch conversion. Reduced starch content resulting from decreased activity of sucrose-to-starch metabolizing enzyme accounts for most of the reduction in grain dry matter and thus yield under conditions of post-anthesis drought stress. Water deficit stress has been shown to increase the SuSy activity in the seeds of both drought-sensitive and resistant wheat cultivars, and this result suggests the significance of SuSy in inducing osmotic adjustment and providing more substrates for glycolysis in response to drought stress.

Sucrose is also hydrolysed by invertase which can exist in various forms. Invertases are involved in the distribution of carbohydrates to sink organs, regulation of source-sink transitions and amplification of signals that control source-sink relationships. Grain filling in cereals is dependent on the remobilization of stored reserves from stems, leaves and other parts. Mainly, the stored form of reserves is starch which is cleaved off by various starch hydrolytic enzymes. However, sucrose phosphate synthase and sucrose synthase (synthesis direction) contribute to the resynthesise of sucrose and thereby help in its remobilization from the sucrose tissues to sink.

Starch Metabolism During Drought Stress in Plants

Accumulation of starch occurs in leaf during the day for transitory metabolism and during the grain and tuber development, to conserve energy. This polysaccharide should be hydrolysed to release glucose. Starch synthesis from the sucrose in the leaves of crop plants occurs in two different pathways. The first pathway involves the conversion of fructose-6-phosphate (F6P) produced from triose phosphates, an important intermediate in the Calvin cycle, to glucose-6-phosphate (G6P) within the plastid via phosphoglucose isomerase, and utilization of the G6P for starch synthesis.

The second pathway involves the transport of triose phosphate from the plastid to the cytosol where it is converted to G6P or sucrose that are transported back to the plastid and utilized for starch biosynthesis. Sucrose synthase, ADP Glucose pyro phosphorylase, starch synthase and starch branching enzyme are four important enzymes that have the main role in grain filling. Sucrose is degraded to fructose and uridine diphosphate glucose (UDPG) which are the main precursors of starch synthesis by sucrose synthase. Soluble Starch Synthase (SSS) activity is reported to be positively correlated with the rate of starch synthesis in wheat grains and thought to play an important role in the elongation of amylase and amylopectin.

Studies suggested that reduction of SSS activity in water-stressed wheat plants lead to a reduction in grain growth rate, whereas growth cessation was mainly due to the inactivation of ADP Glucose pyro phosphorylase (AGPase). Moreover, changes in starch accumulation in barley seeds under varying drought conditions appear to be associated with SNPs in SuSy1 and SuSy2 genes, suggesting the contribution of these genes in mediating the response of sucrose hydrolysis to drought. Starch accumulation is mainly responsible for grain size and crop yield, accounting for 60-75% of the dry matter at the end of maturation, while soluble sugars such as glucose and fructose are present at this stage in very low amounts.

Conclusion

Drought stress decreases the nutrient uptake and translocation of assimilates to shoots in plants and severity depends on the duration and intensity of the stress as well as on the developmental stage of the plants in which they are exposed to water deficit conditions. Different stresses induce disturbances in cellular homeostasis resulting in an imbalance of plant water regime as well as in cellular metabolic pathways, mainly in aerobic respiration and photosynthesis. Carbohydrate metabolism in terms of sucrose and starch is severely affected due to drought stress.

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Ways to Improve Hybridization Efficiency in Pulses

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Photo courtesy: tcmwiki.com

Pulses are assuming importance in Indian agriculture owing to their economic and nutritional significance. The main advantages of legumes include early duration, nitrogen fixing ability and fodder value. Pulses are the best contingent crops in water deficit situations. The raising issue of population explosion warrants increased pulses production with the available resources to eradicate protein malnutrition.

The demand of pulses doubled in the last 25 years. The policy makers are visualizing pulses as important import crop as the tune of import is increasing in the recent years. In Indian sub-continent Vigna complex comprising of green gram, black gram and cow pea are the major legume crops grown in different seasons. In addition, red gram supports the demand in a prominent way. The yield and quality of green and black gram are challenged by numerous biotic and abiotic stresses. Few of them are borer complex, leaf eaters, mung bean yellow mosaic virus (MYMV), powdery mildew (PM), root rot, wilt, and drought.

This necessitates evolution of high yielding pulse varieties combined with multiple resistance to stresses. The wild relatives of Vigna complex have source for disease and pest resistance. Therefore, the varietal evolution programmes involving inter-specific and inter-generic hybridization followed by selection is the order of the day. However, such hybridization is hampered by two main reasons cross ability and flower dropping.

Flowers in these crops appear as axillary or terminal racemes. The racemes have a cluster of 5 to 20 cleistogamous flowers, of which 60% wither and drop immediately after anthesis / hybridization. The flower dropping is seasonal and variety dependant. Based on the species, the out-crossing percentage varied from 2 to 5. To increase the hybridization success percentage, the research findings of several previous plant breeding experiments are compiled and furnished below.

In hybridization between green and black gram, mung bean shall be used as female parent to avoid flower abscission and non-viable seeds. The parents shall be sown in a staggered fashion based on their duration so as to have flowering synchrony. For emasculation, a total of 8 - 12 flowers per plant per day shall be considered and others be removed. Unopened green buds with optimum size shall be emasculated in the previous day evening in the mild sunlight to avoid bud desiccation.

The ideal weather parameters for emasculation are 22 - 23˚C and lower relative humidity (45.0-55.0 %). To increase the pollination success percentage during emasculation, the upper half of the standard, wing and keel petals shall be opened with needle or forceps No. 5. This method causes fewer disturbances to style and ovary. Due consideration shall be devoted for the time of pollination as perfect weather is required for effective pollination and seed set. Pollination shall be affected in the next day morning between 6.30 and 8.30 a.m. based on sunshine.

For pollination, the wing and keel of the selected optimum sized buds shall be removed and the fully dehisced pollen grains are rubbed on the emasculated stigma. For enhanced pod set, a good sunshine (>8.5 hours), and relative low humidity is required. The pollinated buds can be covered with white butter paper covers to avoid the negative influence of wind and dew. To increase the efficiency, it is suggested to attempt the crossing in a raised platform at polyhouse / green house.

The Locust Attack in 2020 – 'Tiddi Dal' and their Control

Article ID: 30685

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In recent years the global climate changes rapidly on the earth. Climate change is the major reason to most serious locust attacks in continuously on crops. The Rising sea temperature due to increased greenhouse gas emission are expected to create more favourable conditions for locust swarms in the coming years. In last many years the continue locust attack are reported in Indian agriculture mainly in Rajasthan, Gujarat, Haryana, Madhya Pradesh, and Punjab. At present 2020 the most of areas of Rajasthan, Madhya Pradesh, Gujarat, Punjab, Haryana and Maharashtra suffering a saviour locust attack so here we discussed about what is locust and different practices to locust control. In India, locusts come from Pakistan.

Introduction

Locust is a one of most devastating migratory pests in the world. Desert locusts (Schistocerca gregaria) are belonging to order Orthoptera and family of Acrididae. Locusts constitute a major problem for agricultural crops (Latchininsky 2013; Zhang and Hunter 2017). They can transform reversibly between two extreme phases, solitary and gregarious. The locusts differ in both of these phases in terms of their morphology, physiology and behaviour (Steed-man 1988; Uvarov 1966).

The distribution of gregarious locusts extends from Africa through the Middle East to Asia, South and Central America, Australia and Southern Europe. When these species transform into the gregarious phase, they form locust swarms that can devour entire felds and cause extensive crop damage over a very short period of time. A small swarm of locusts contains thousands of individuals that spread over several hundred square meters, but large swarms contain up to 80 million individuals per km2 and can infest more than 1000 km2. Since a swarm can cover a distance of 100 km per day (Steedman 1988), farmers regard gregarious locusts as one of the pest breeds during the spring season in the costal and other areas of West African countries most destructive plagues on earth.

Locust Species in India

Only four types of locust viz., Desert locust *(Schistocerca gregaria),* Migratory locust *(Locusta migratoria)* Bombay Locust *(Nomadacris succincta)* and Tree locust (*Anacridium* sp.) are reported in India. The desert locust is most important pest in India as well as in intercontinental context.

Life Cycle

The life Cycle of locust consists of eggs, nymphs and adult. The eggs take about two weeks during favourable condition to hatch into nymphs. Both nymphs and adults are feeder. However, the nymphs (also known as hopper) do not wings and became adult 30-40 days after hatching. The young adult takes about three weeks before they are ready to mate and lay eggs. Adults live for 3 to 5 months.

Breeding Regions

The like Parsia where the winter rains bring about the required degree of soil moisture and vegetation. The adults emerging from this breeding stage migrate eastward to Pakistan and India by about the beginning of the monsoon.

How much do they Eat?

A locust adult can consume roughly its own weight in fresh food per day, that is about two gram daily. A 1 km2 size swarm contains 40 million locusts. Which eat the same amount of food in one day as about 35000 people 20 camels or 6 elephants.

What do they Eat?

Locust devour leaves, flowers, fruits, seeds barks and growing points and also destroy plants by their sheer weight as they descend on them in massive numbers.

Locust Attack in India 2020

Swarms of locusts have invaded vast swathes of land in India since April 11th this year. They entered several districts of Rajasthan via Pakistan's Sindh province. Few days later, they entered the neighboring State of Madhya Pradesh. Many districts in Uttar Pradesh have now been put on alert. This locust attack has affected about 90,000 hectares across 20 districts in Rajasthan. Favorable rain-bearing winds aided their transport towards India. This quickly growing swarm is now threatening to amplify into an agrarian disaster.

When was the Last Big Outbreak?

The last big infestation was in 2010. There were 13 locust plagues between 1964 and 1997. From 1997 to 2010, there were five outbreaks that were controlled. From 2010 to 2018, there were no major swarms or breeding reported, according to the Locust Warning Organization (LWO), in Jodhpur. In 2019, Gujarat and Rajasthan reported a significant surge in locust infestations. Nearly 3.5 lakh hectares of cumin, rapeseed and mustard were damaged, and officials had then said that it was the worst attack since 1993. This was partly due to an unusually long monsoon but also because pest-control operations were inadequate; therefore, nascent populations of the insect had not been wiped out.

Spread of the Global Crisis - The Locust Attack

1. The Food and Agriculture Organization (FAO) of the United Nations has currently identified three hotspots of threatening locust activity, where the situation has been called "extremely alarming" — the Horn of Africa, the Red Sea area, and southwest Asia.
2. The Horn of Africa has been called the worst-affected area
3. In southwest Asia, locust swarms have caused damage in Iran, India, and Pakistan
4. In India, locust attacks emanating from the desert area in Pakistan have struck parts of Rajasthan and Gujarat in the past few weeks, causing heavy damage to standing crop.
5. The last outbreak in India was reported in 1993.
6. However, not much damage to crops is reported as sowing has not taken place in most of the areas and harvest of winter crops is over.
7. Cotton crops in some areas of Rajasthan and Punjab besides pulses and vegetables have been affected by locust attack.

Locust Control Organisations in the World and in India

1. In India: Locust warning organization of the Govt. of India was established from April 1939. In 1942, a coordination Anti locust Scheme was put into operation.

2. In the world: United Nations Special Fund Desert Locust Project, which was sponsored by the F.A.O. in 1960. This is being subscribed by several countries including India. Its purpose is to develop more effective and less expensive control of the desert locust.

Ways to Prevent Locust Attack / Control

1. Destruction of eggs: Locating the egg laid areas is always important, then trench them round, so as to entrap the young hoppers as they move out after hatching. Even actual destruction of eggs on organised scale may be carried out by ploughing, harrowing and hand digging.

2. Hopper Control: The mechanical methods included entrapping making hopper bands in 2' x 2' trenches and burrying. The chemical method includes use of poison baits and dusting of insecticides.

3. Apply a Garlic Spray: Garlic odor can help deter locust and other common garden pests. To make the garlic spray, blend two bulbs of garlic with 10 cups of water then heat up the mixture until it starts to boil. Next, p the mixture sit overnight. To use the garlic spray, fill a spray bottle with one part of garlic solution and three part of water. Once ready, spray the solution onto the leaves of affected plants. Be sure to spray the undersides of the leaves as well.

For example, Sharaby et al. (2012) suggested that the essential oils of garlic, eucalyptus and mint could be used in the integrated pest management (IPM) against the locust.

4. Make noise: through drums, loudspeakers or other things.

5. Poison baits: 5% BHC or pairs green or sodium fluosilicate & 2 Dusting 5 to 10% BHC against hoppers 25 to 30kg/ha has seen found to bring a complete control of the pests. Aldrin 4% dust can also be effectively use.

6. At the place where the locusts laid its eggs, sprinkle 25 kg of 5% malathion or 1.5% quinalphos per hectare.

7. To prevent locust crew from moving, mix 100 kg of paddy husk with 0.5 kg of fenitrothion and 5 kg of jaggery and put it in the field. and 5 kg of jaggery and put it in the field.

8. Tiddi Dal changes its camp only after 10:00 AM. Therefore, sprinkle 5% malathion or 1.5 percent quinalphos to prevent it from proceeding.

9. Locust are not able to be eaten crops by spraying 500 g of neem seed extract or 40 ml of neem oil with 10 g of washing powder, or by mixing 20 to 40 ml of neem with 10 liters of water.

10. Linseed oil also be used as botanical pesticides against desert locust it is toxic for locust.

Conclusion

At present year 2020 many states of India suffer with a serious locust attack. It was a serious issue of Indian agriculture and national economy because the at time India also suffering a serious disease corona. The summer season rain also increases the risk of locust attack in this year. So, farmers use integrated pest management practice to control locust attack and their effective control during this year.

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Entomopathogenic Bacteria for Insect Pest Control

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Entomopathogenic bacteria are unicellular prokaryotic organisms having size ranging from less than 1 µm to several µm in length. Bacteria with rigid cell walls are cocci, rod-shaped and spiral while bacteria without cell walls are pleomorphic. More than 100 bacteria have been identified as arthropod pathogens among which, *Bacillus thuringiensis*, *B. sphaericus*, *B. cereus* and *B. popilliae* have received most attention as microbial control agents. The majority of bacterial pathogens of insect-pests occur in bacterial families Bacillaceae, Pseudomonadaceae, Enterobacteriaceae, Streptococcaceae, and Micrococcaceae. These families of bacteria usually represent epiphytes or weak pathogens; however, some of them are highly virulent to their respective hosts. Among the entomopathogenic bacteria, much attention has been given to the family Bacillaceae.

Symptoms and Pathology

Bacterial infections in insects can be broadly classified as bacteremia, septicemia, and toxemia. Bacteremia occurs when the bacteria multiply in the insect's hemolymph without the production of toxins. Septicemia occurs most frequently with pathogenic bacteria, which invade the hemocoel, multiply, produce toxins, and kill the insect. Toxemia occurs when the bacteria produce toxins and the bacteria are usually confined to the gut lumen,Eg: Brachytosis of the tent caterpillar.

Symptoms of bacterial infections on insects:
1. Loses its appetite, becomes diarrheic, discharges watery feces, and may vomit.
2. The invasion of the bacteria into the hemocoel results in septicemia and death of the insect.
3. Insects killed by bacteria, especially in the larval stages, rapidly darken in colour and are often very soft.
4. The internal tissues and organs are rapidly broken down to a viscid consistency, accompanied sometimes by a putrid odour. The integument remains intact.
5. The cadaver shrivels, dries, and hardens.

Portals of Entry

Bacteria infect insects mostly through the mouth and digestive tract, and less commonly through the egg, integument, and trachea. They may also enter an insect by means of parasitoids and predators.

1. Through Enzyme Production:

a. Lecithinase is produced by many bacteria including some varieties of *Bacillus cereus* and *Bacillus thuringiensis.*
b. Chitinase and phospholipase A in the bacterium Aeromonas punctata may facilitate in producing wounds that form black lesions in the cuticle and in the digestive tract of a larva of the mosquito *Anopheles annulipes.*

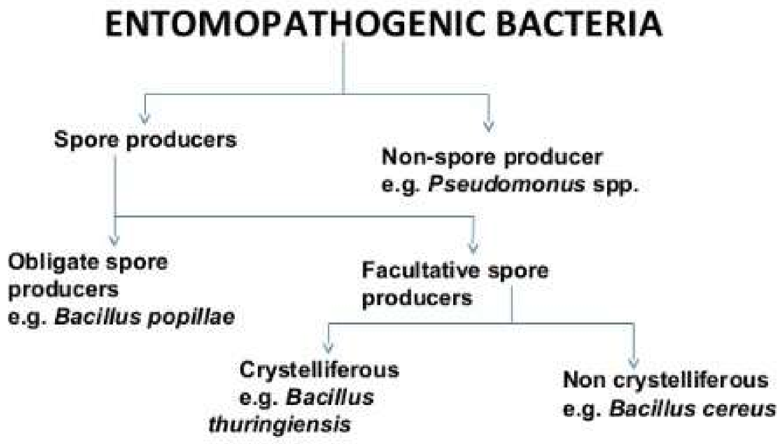
2. Through natural openings and wounds: Only a few cases are known of direct bacterial invasion through the trachea and integument

a. Northrup (1914) has reported that *Micrococcus nigrofaciens* invades the June beetles (*Lachnosterna* spp.) through the joints, spiracles, and white soft portions of the integument, which turn black and oily.
b. In the bark beetle *Scolytis multistriatus*, several species of bacteria are transmitted through a larva biting other larvae under crowded conditions.

3. Through parasitoids and predators: Some bacteria are transmitted to insects by parasitoids and predators. The adult parasitoids puncture the digestive tract and thereby enable the bacteria in the lumen to enter the hemocoel.

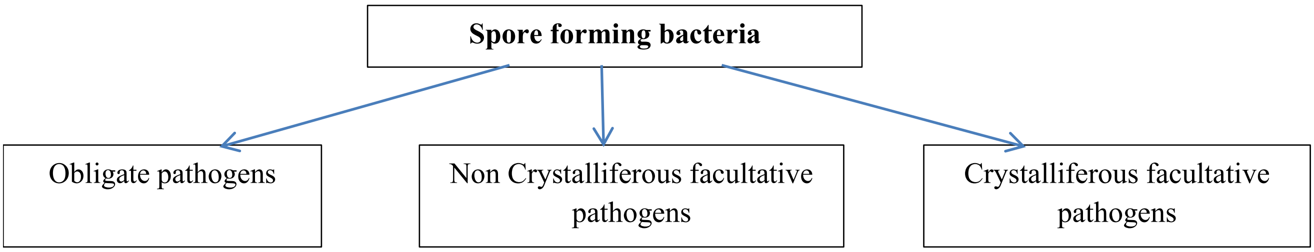
An example of parasitoid transmission is the ichneumon *Itoplectis conquisitor*, which can inoculate with its ovipositor *Serratia marcescens* and *Proteus mirabilis* from infected to healthy pupae of *Galleria mellonella.*

Classification of Entomopathogenic Bacteria



Spore Forming Bacteria

widely used as viable biocontrol agents. They are gram positive, large, rod shaped cells . All spore forming bacteria produce endospores which allow them to persist in a dormant state outside the host. Upon ingestion, the spore germinates in the gut of the host.



1. Obligate pathogens: Most Important Species – Paenibacillus popillae Dutky and Paenibacillus lentimorbus Dutky causing milky disease to scarabaeidae family

2. Non-Crystalliferous facultative pathogens: Important members -Bacillus sphaericus Neide and Bacillus cereus Sensu Strict.

Bacillus sphaericus

a. Heterogenous group including spherical endospore producing bacteria Aerobic, rod shaped, gram variable bacterium

b. Produces mosquitocidal toxins known as Mtx proteins.

c. Sphericide is a Wettable Powder formulation against mosquito larva.

d. Vectolex (Abott) and Mospherix are two recently commercialized products for control of Culex and Anopheles vectors.

Bacillus cereus

a. Spore forming bacteria.

b. Does not produce inclusion bodies.

c. Produces Phospholipase sufficient to damage gut cells of susceptible species aiding entry to the hemocoel and cause lethal septicemia.

3. Crystalliferous facultative pathogens: All spore forming bacteria produce endospores which allow them to persist in a dormant state outside the host. In addition to endospore, Crystalliferous Spore Formers produce a proteinaceous parasporal crystal in the sporangium.

Important species- *Bacillus thuringiensis*- Main feature of this bacterium is the production of parasporal bodies(crystals) containing specific insecticidal endotoxins (Cry Proteins) acting by ingestions through a pore-forming mechanism of action detrimental for the insect gut epithelium.

Non-Spore Forming Bacteria

Usually reside in the digestive system of most insects. They are harmless in the midgut, but pathogenic in blood. They are less utilized as microbial control agents.

Some Non-Spore forming bacteria are:

1. *Serratia entomophila*: A pathogen of the New Zealand grass grub, *Costelytra zealandica* White and is the only non-Bacillus bacterial microbial insecticide, currently registered. The bacterium was firstly applied as a liquid product Invade but has recently been developed for application as a solid granule Bioshield.

2. *Serratia marcescens*: Pathogen of the desert locust, *Schistocerca gregaria* Forskal; Pea aphid, *Aphis craccivora* Koch; and *Riptortus pedestris* Fabricus.

Entomopathogenic Bacteria Other Than *Bacillus*

1. *Clostridium bifermentans* serovar Malaysia - active against mosquitoes and blackflies. The toxicity is associated with a protein homologous to Bt delta endotoxins.

2. *Pseudomonas entomophila*, a ubiquitous bacterium showing insecticidal properties against insects in different orders, has the capacity to trigger a systemic immune response in *Drosophila melanogaster* Meigen after ingestion.

3. *Photorhabdus* or *Xenorhabdus* (Family: Enterobacteriaceae) are two genera of entomopathogenic bacteria having a symbiotic relationship with nematodes, *Heterorhabditis* and *Steinernema*, which invade the larvae of the insects.

Conclusion

Entomopathogenic bacteria and their toxins are the most commercially successful microbial insecticides. These organisms enter the host through ingestion and produce toxins and other pathogenic factors that disrupt the midgut epithelium to allow access to the nutrient-rich hemocoel, where they proliferate to cause septicemia and death of the insect host. Most commercialized microbial products are based on gram-positive bacteria in the genus *Bacillus* because of their long-term stability; methods are being developed to improve long-term storage of gram-negative bacterial pesticides.

The most successful microbial pesticide to date is *Bacillus thuringiensis*, which has dominated the microbial pesticide market worldwide. Current goals include the identification and development of novel pathogens/strains and toxins that increase efficacy and extend activity range. Challenges to further widespread commercialization and uptake of bacterial entomopathogens include the need for cost-effective products with extended stability in storage and following application and more suitable registration and legislative environments.

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Conservation Agriculture: Conserving Natural Resources and Enhancing Farmer Production

Article ID: 30687

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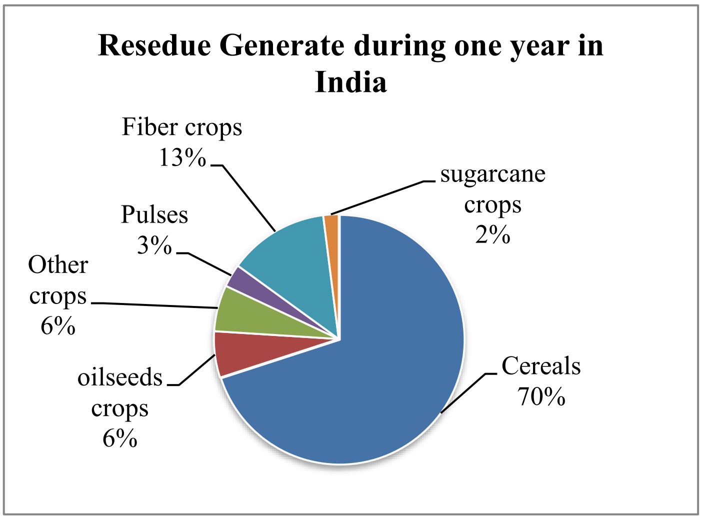
Introduction

Attaining food security for a growing population and alleviating poverty while sustaining agricultural systems under the current scenario of depleting natural resources, negative impacts of climatic variability, spiraling cost of inputs and volatile food prices are the major challenges before most of the agriculture base countries. In addition to these challenges, the principal indicators of non-sustainability of agricultural systems includes: soil erosion, soil organic matter decline, salinization.

These are caused mainly by: (i) intensive tillage induced soil organic matter decline, soil structural degradation, water and wind erosion, reduced water infiltration rates, surface sealing and crusting, soil compaction, (ii) insufficient return of organic material, and (iii) monocropping (Bhattacharyya et al. 2012). Therefore, a paradigm shift in farming practices through eliminating unsustainable parts of conventional agriculture (ploughing/tilling the soil, removing all organic material, monoculture) is crucial for future productivity gains while sustaining the natural resources. How to manage all this thing? Answer is Conservation Agriculture.

In India, efforts to develop, refine and disseminate conservation-based agricultural technologies have been underway for nearly two decades and made significant progress since then even though there are several constraints that affect adoption of conservation technology. The problem of on-farm burning of crop residues is intensifying in recent years due to shortage of human labour, high cost of removing the crop residues by conventional methods and use of combines for harvesting of crops.

The residues of rice, wheat, cotton, maize, millet, sugarcane, jute, rapeseed-mustard and groundnut are typically burnt on-farm across different states of the country. Burning plant residues and ploughing the soil is mainly considered necessary for phytosanitary reasons: to control pests, diseases and weeds. Burning crop and weed residues destroys important source of plant nutrients and soil improvement potential. In a system with reduced mechanical tillage based on mulch cover and biological tillage, alternatives have to be developed to control pests and weeds.



Conservation "arable" agriculture is normally based on soil tillage as the main operation. The most widely known tool for this operation is the plough, which has become a symbol of agriculture. Soil tillage has in the past been associated with increased fertility, which originated from the mineralization of soil nutrients as a consequence of soil tillage. This process leads in the long term to a reduction of soil organic matter. Soil organic matter not only provides nutrients for the crop, but it is also, above all else, a crucial element for the stabilization of soil structure.

Mechanization of soil tillage, allowing higher working depths and speeds and the use of certain implements like ploughs, disk harrows and rotary cultivators have particularly detrimental effects on soil structure. Structural degradation, loss of organic matter, erosion and falling biodiversity are all to be expected. Keeping the soil covered with crop residue is important in conservation agriculture. But it can be difficult. Farmers have many uses for crop residues: as fodder, fencing, roofing and fuel.

The Principles of Conservation Agriculture

Conservation Agriculture offers farmers an array of practices, but at its core are three interlinked principles that can be applied in a variety of combinations to meet the needs of resource poor farmers:
1. Continuous minimal mechanical soil disturbance,
2. Permanent organic soil cover,
3. Diversified crop rotations of annual crops and plant associations of perennial crops.

Conservation agriculture is more than a zero-tillage-based cropping system. Farmers following the Conservation Agriculture principles use low-cost tools and equipment and traditional crop varieties without herbicides or herbicide-tolerant varieties.

What are the Benefits of Conservation Agriculture (CA)?

1. Benefits on soil life: Soil erosion resulting from soil tillage has forced us to look for alternatives and to reverse the process of soil degradation. Most tillage operations are, however, targeted at loosening the soil which inevitably increases its oxygen content leading in turn to the mineralization of the soil organic matter. This inevitably leads to a reduction of soil organic matter which is the substrate for soil life.

Thus, agriculture with conservation tillage, reduced, or zero, mechanical tillage is only possible when soil organisms are taking over the task of tilling the soil. This, however, leads to other implications regarding the use of chemical farm inputs. Synthetic pesticides and mineral fertilizer have to be used in a way that does not harm soil life. This led finally to movements promoting conservation agriculture. In a soil that is not tilled for many years, the crop residues remain on the soil surface and produce a layer of mulch. This layer protects the soil from the physical impact of rain and wind but it also stabilizes the soil moisture and temperature in the surface layers (Ghosh et al. 2010).

Thus, this zone becomes a habitat for a number of organisms, from larger insects down to soil borne fungi and bacteria. These organisms macerate the mulch, incorporate and mix it with the soil and decompose it so that it becomes humus and contributes to the physical stabilization of the soil structure. At the same time this soil organic matter provides a buffer function for water and nutrients. Larger components of the soil fauna, such as earthworms, provide a soil structuring effect producing very stable soil aggregates as well as uninterrupted macropores leading from the soil surface straight to the subsoil and allowing fast water infiltration in case of heavy rainfall events. Keeping the soil covered and planting through the mulch will protect the soil and improve the growing environment for the crop.

Soils under this system have very high-water infiltration capacities reducing surface runoff and thus soil erosion significantly.

a. Improved infiltration and retention of soil moisture resulting in less severe, less prolonged crop water stress and increased availability of plant nutrients.
b. Source of food and habitat for diverse soil life: creation of channels for air and water, biological tillage and substrate for biological activity through the recycling of organic matter and plant nutrients.
c. Increased humus formation.
d. Reduction of impact of rain drops on soil surface is resulting in reduced crusting and surface sealing and enhances groundwater resources.
e. Consequential reduction of runoff and erosion.
f. Soil regeneration is higher than soil degradation.
g. Mitigation of temperature variations on and in the soil.

h. Better conditions for the development of roots and seedling growth.

2. Benefit to economic and agronomic practices: Tilling land is a laborious and time-consuming operation. It has been estimated that on an average about 30% of the total expenditure of crop production is incurred on the tillage operations. Economic benefits that improve production efficiency and agronomic benefits that improve soil productivity.

Reduction of costs of cultivation, e.g. fuel, machinery operating costs and maintenance, as well as a reduced labour cost can possible. The positive impact of conservation agriculture on the distribution of labour during the production cycle and, even more important, the reduction in labour requirement are the main reasons for farmers to adopt conservation agriculture, especially for farmers who rely fully on family labour.

The labour and time saving under these enables farm families to invest their time in more rewarding activities than tilling the soil to produce a crop. As the main objective of agriculture is the production of crops, changes in the pest and weed management become necessary with Conservation Agriculture. Conservation agriculture is by no means a low output agriculture and allows yields comparable with modern intensive agriculture but in a sustainable way. Yields tend to increase over the years with yield variations decreasing.

3. Benefit to environment: Conservation agriculture represents an environmentally-friendly set of technologies. Because it uses resources more efficiently than conventional agriculture, these resources become available for other uses, including conserving them for future generations.

The significant reduction in fossil fuel use under no-till agriculture results in fewer greenhouse gases being emitted into the atmosphere and cleaner air in general. Global climate change mitigation by sequestering soil organic carbon can be achieved through CA (UNEP, 2013).

Conservation Agriculture, understood in this way, provides a number of advantages on global, regional, local and farm level: It provides a truly sustainable production system, not only conserving but also enhancing the natural resources and increasing the variety of soil biota, fauna and flora (including wild life) in agricultural production systems without sacrificing yields on high production levels.

As CA depends on biological processes to work, it enhances the biodiversity in an agricultural production system on a micro- as well as macro level. No till fields act as a sink for CO_2 and conservation farming applied on a global scale could provide a major contribution to control air pollution in general and global warming in particular.

Farmers applying this practice could eventually be rewarded with carbon credits. CA reduces the vulnerability of crops against unexpected extreme climatic events. It reduces crop water requirements by 30%, making better use of soil water and facilitating deeper rooting of crops, so that drought periods can be tolerated better. The yield variability under CA is reduced regardless of whether the years are dry, wet or normal.

Limitation of Conservation Agriculture

The most important limitation in all areas where conservation agriculture is practiced is the initial lack of knowledge. There is no blueprint available for conservation agriculture, as all agro-ecosystems are different.

Disadvantages in the short term might be the high initial costs of specialized planting equipment and the completely new dynamics of a conservation farming system, requiring high management skills and a learning process by the farmer.

Long term experience with conservation farming all over the world has shown that conservation farming does not present more or less but different problems to a farmer, all of them capable of being resolved (Bhan and Behera, 2014).

Conclusion

Conservation agriculture offers an opportunity for arresting and reversing the downward spiral of resource degradation, decreasing cultivation costs and making agriculture more resource - use-efficient, competitive and sustainable. "Conserving natural resources and enhancing farmer's productivity" has to be the new mission.

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Benefits of Mulches in Agriculture

Article ID: 30688

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Mulch provides many benefits to crop production through soil and water conservation, enhanced soil biological activity. Effectively controlled the weed growth and increased soil temperature resulting in faster emergence and early canopy development.

Mulch has a great role in soil moisture conservation through modification of microclimatic soil conditions. It also helps to prevent weed growth, reduce evaporation, and increase infiltration of rain water during growing season. Mulch provides numerous benefits to crop production by improving the physical, chemical, and biological soil properties. Different research result showed mulch increase soil moisture through increasing infiltration, reducing evaporation, and modifying water retention capacity of the soil. Severe research resulted that high soil moisture content up to a depth of 60 cm in grass-mulched soil.

On the other hand, water holding capacity of the soil improved through mulch decomposition and humus formation. A mulch is a layer of material applied to the surface of soil. Reasons for applying mulch include conservation of soil moisture, improving fertility and health of the soil, reducing weed growth and enhancing the visual appeal of the area. A mulch is usually, but not exclusively, organic in nature. It may be permanent (e.g. plastic sheeting) or temporary (e.g. bark chips).

It may be applied to bare soil or around existing plants. Mulches of manure or compost will be incorporated naturally into the soil by the activity of worms and other organisms. The process is used both in commercial crop production and in gardening, and when applied correctly, can dramatically improve soil productivity. Materials used for mulching as follows.

Organic Residues

Grass clippings, leaves, hay, straw, kitchen scraps comfrey, shredded bark, whole bark nuggets, sawdust, shells, woodchips, shredded newspaper, cardboard, wool, animal manure, etc. Many of these materials also act as a direct composting system, such as the mulched clippings of a mulching lawn mower or other organics applied as sheet composting.

Compost

Fully composted materials are used to avoid possible phytotoxicity problems. Materials that are free of seeds are ideally used, to prevent weeds being introduced by the mulch.

Old Carpet (Synthetic or Natural)

Makes a free, readily available mulch.

Rubber Mulch

Made from recycled tire rubber.

Plastic Mulch

Crops grow through slits or holes in thin plastic sheeting. This method is predominant in large-scale vegetable growing with millions of acres cultivated under plastic mulch worldwide each year (disposal of plastic mulch is cited as an environmental problem). Rock and gravel can also be used as a mulch. In cooler climates the heat retained by rocks may extend the growing season.

Benefits of Mulches

1. It is used to retain soil moisture, regulate soil temperature, suppress weed growth and for aesthetics purposes.
2. They are applied to the soil surface, around trees, paths and flower beds to prevent soil erosion on slopes and in production areas for flower and vegetable crops.
3. Mulches serve initially to warm the soil by helping it retain heat which is lost during the night.
4. It allows early seeding and transplanting of certain crops, and encourages faster growth.
5. Mulches stabilizes the soil temperature and moisture and prevents the growing of weeds from seeds.
6. Mulches can also prevent water from reaching the soil by absorbing or blocking water from light rains.

Impact of Agronomic Bio-fortification in Crops

Article ID: 30689

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Food security of the country has been improved due to green revolution and enhancement of cereal production. However, recent surveys showed that 35.8% of children suffer from malnutrition in India. Indian Council of Agricultural Research has taken lead for the biofortification of cereal crops based on earlier national and international research efforts, targeting the enhancement of nutrients in staple food crops.

Conventional strategies to combat malnutrition include dietary supplements and food fortification programmes. Efforts are now being made to fortify rice and wheat flour for iron (Fe), vitamin B12 and folic acid. Some of the constraints with these interventions include poor dissemination to the target population especially those residing in rural areas; sustaining them over a period of time and addressing the symptoms rather than the cause of the problem. Dietary diversification is the ideal solution to alleviate malnutrition but not viable in the Indian situation considering the inadequate purchasing power of the poor people.

Thus, the long-term solution lies in increasing the essential nutrient contents of the staple food crops, viz. cereals through crop biofortification strategy (Neeraja et al., 2017). Malnutrition is the main cause of global human mortality, with over 50% of deaths attributed to diet-related diseases. Micro-nutrient deficiencies, notably iron (Fe), zinc (Zn), selenium (Se), iodine (I) and certain vitamins are widespread globally affecting about 60% of the world's population, and in many areas multiple deficiencies occur (Lyons and Cakmak, 2012).

Agronomic biofortification offers the easiest and the quickest way for biofortification of cereal grains with zinc, iron or other micro mineral nutrients in developing countries especially Asia and Africa, where cereals form the staples. It is the only approach to reach the poorest of the poor rural masses, who can't afford to buy mineral supplements nor can afford animal by-products. From the agronomic biofortification viewpoint, foliar application is better and requires lesser amount of zinc and iron fertilizers than their soil application. Even when cultivars or GM crops with higher zinc and iron content in grains are developed, adequate zinc and iron fertilization will be necessary. Thus, for the long term, agronomic biofortification is a complimentary approach to plant breeding as well as modern biotechnology for increased micronutrients in the food basket (Nissar et al., 2019).

The application of mineral micronutrient fertilizers to soils or plant leaves to increase micronutrient contents in edible parts of crops and its potential to fight hidden hunger. There is evidence that agronomic biofortification can increase yields and the nutritional quality of staple crops, but there is a lack of direct evidence that this leads to improved human health. Micronutrient fertilization is most effective in combination with NPK, organic fertilizers and improved crop varieties, highlighting the importance of integrated soil fertility management. Agronomic biofortification provides an immediate and effective route to enhancing micronutrient concentrations in edible crop products, although genetic biofortification may be more cost effective in the long run (Velenca et al., 2017).

Impact of Agronomic Biofortification with Se, Zn and Fe on Yields and Nutritional Quality of Crops

Agronomic biofortification has so far been most effective with Zn and Se. Evidence is accumulating that Zn fertilization can increase both yields and nutritional quality of crops. Most research has been done worldwide, where Zn fertilization in various cereals (maize, sorghum, barley, wheat) and dicotyledonous (soybean, safflower, pea, common bean, canola, common vetch) crops showed increased yields and grain Zn concentrations. Iron is the third most studied element, but soil application of Fe-enriched fertilizers is more difficult than with Zn and Se, because Fe is precipitated in insoluble forms in the soil which cannot be absorbed by plants.

Bio-Fortified Crops in Human Nutrition

Even though it is shown that agronomic biofortification has the potential to increase micronutrient contents in crops. The sole purpose of biofortification is to improve the nutrient quality of food grains. Zn bio-fortified rice improved the Zn status in healthy adults, to comparable levels to that of Zn fortified food, implying that biofortification is equivalent to that of food fortification. The potential of bio-fortified crops in improving the targeted nutrient status, and therefore serving the intended benefit. Biofortification can complement existing interventions for malnutrition with its far-reaching implications in achieving the nation's nutritional security.

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Carambola *(Averrhoa carambola)* - An Oxalic Acid Rich Fruit

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Introduction

A curious, attractive fruit of the Oxalidaceae, the carambola, *Averrhoa carambola* L., has traveled sufficiently to have acquired a number of regional names in addition to the popular Spanish appelation which belies its Far Eastern origin. In the Orient, it is usually called *balimbing, belimbing,* or *belimbing manis* ("sweet belimbing"), to distinguish it from the bilimbi or *belimbing asam, A. bilimbi* L. In Ceylon and India, the carambola has the alternate names of *kamaranga, kamruk,* or other variants of the native *kamrakh.* There are different species of carambola out of that some of specier are *Averrhoa bilimbi A. carambola, Oxalis barrelier, Oxalis corniculata, Biophytum sensitivum etc.*

Carambola is good source of vitamin A.B & C, minerals specially Fe, K, Mg and P. It is used as a dessert fruit or for preparing juice, jam, jelly and pickles. It has medicinal value also. Ground leaves and shoots for chicken pox, root extract as antidote for poisoning and pulp of immature fruits for cleaning brassware. It is used as an alternative to tamarind in cooking.

Origin and Distribution

Malaysia, Popular in China, Taiwan, Malaysia, Thailand, Pakistan, Indonesia and India. Distributed within 30 o N and south of equator..The carambola is believed to have originated in Ceylon and the Moluccas but it has been cultivated in Southeast Asia and Malaysia for many centuries. It is commonly grown in the provinces of Fukien, Kuangtung and Kuangsi in southern China, in Taiwan and India. It is rather popular in the Philippines and Queensland, Australia, and moderately so in some of the South Pacific islands, particularly Tahiti, New Caledonia and Netherlands New Guinea, and in Guam and Hawaii.

Varieties

There are 2 distinct classes of carambola–the smaller, very sour type, richly flavoured, with more oxalic acid; the larger, so-called "sweet" type, mild-flavoured, rather bland, with less oxalic acid. Some of varieties were Tean Mah, Arkin, Maha, B10, Thai Knight, Wheeler, B16, Jungle Gold, B6 etc.

Climate

Carambola grows well in both tropical and subtropical climate free from frost. But it prefers warm and moist conditions optimum temperature range is 21-32 oC, 1800- 2500mm annual rainfall is best. It can be grown up to 1200m. It can be grown in any type of soil. But well drained, deep clay soils are preferable optimum pH is 5.2 to 6.2. Calcarious soils are not suitable. It cannot with stand wate logging.

The carambola should be classed as tropical and sub-tropical because mature trees can tolerate freezing temperatures for short periods and sustain little damage at -2.78oC. In Florida, the tree survives in sheltered sites as far north as St. Petersburg on the west coast and Daytona Beach on the east. It thrives up to an elevation of 4,000 ft (1,200 m) in India. In an interior valley of Israel, all trees succumbed to the prevailing hot, dry winds. The carambola needs moisture for best performance and ideally rainfall should be fairly evenly distributed all year.

Propagation

The carambola is widely grown from seed though viability lasts only a few days. Only plump, fully developed seeds should be planted. In damp peat moss, they will germinate in one week in summer, require 14 to 18 days in winter. The seedlings are transplanted to containers of light sandy loam and held until time to set out. They are very tender and need good care. Seedlings are highly variable. Air-layering has been practiced and advocated. However, root formation is slow and later performance is not wholly satisfactory. Inarching is successful in India, shield-budding in the Philippines and the Forkert method in Java.

Trees can be top-worked by bark-grafting, a popular technique in Java. For mass production, side-veneer grafting of mature, purplish wood, onto carambola seedlings gives best results for most workers. The rootstocks should be at least 1 year old and 3/8 to 5/7 in (1-1.5 cm) thick. One Florida farmer prefers cleft-grafting of green bud wood and has 90% success. Grafted trees will fruit in 10 months from the time of planting out. Mature trees can be top-worked by bark-grafting.

Planting

Spacing 7-9mx 5-7m or high-density planting with 7x3m or 4.2x 3.6m is also practiced in some countries depending upon the cultivar. 1 m cube pits are dug and filled with mixture of soil and manure. Planting can be done throughout the year but monsoon season is best for good establishment.

Manuring

1-ton carambola fruit is reported to remove 1.28 kg N; 0.12 kg P, 1.58 kg K. No recommended fertilizer dose is available. Addition of 'N' fertilizer improves the yield. Normally organic manures are only applied.

Irrigation

Irrigations are given during fruit development only if the weather is dry. Trees may be provided 200 litre/ tree/ weak in dry periods. Mulching will be very helpful in reducing weed growth and irrigation needs.

Training and Pruning

In carambola pruning of low hanging, unthrifty and crossing branches are desirable and young trees are trained by retaining 4-6 sturdy wide crotch angle branches to build the tree frame work. The more vigorous, upright narrow crotch angle types may be trained to a vase or palmette system.

Flowering

Carambola blossoms in rainy season and ripen in December- January in India flowering observed in 3 flushes April-May, July-August and September-October and harvesting at July-September, November-December and January- February.

Harvesting and Yield

In India, carambolas are available in September and October and again in December and January. In Malaya, they are produced all the year. In Florida, scattered fruits are found through the year but the main crop usually matures from late summer to early winter. Some trees have fruited heavily in November and December, and again in March and April. There may even be three crops. Weather conditions account for much of the seasonal variability.

The fruits naturally fall to the ground when fully ripe. For marketing and shipping they should be hand-picked while pale-green with just a touch of yellow. Trees that receive adequate horticultural attention have yielded 100 to 250 or even 300 lbs (45-113-136 kg) of fruit.

Post-Harvest Handling and Storage

1. Ripening and storage: Carambola is excellent in its keeping quality. Even under room temperature they store well for many weeks. They can be stored at 50 C for 12 weeks.

2. Pests and diseases: Fruit fly, borers, fruit piercing growth, aphids, mealy bugs, scales. Leaf spot and anthracnose- any fungicide can be used.

Zero Budget Natural Farming (ZBNF): Transforming Agriculture and Increasing Self Sustainability of Farmers

Article ID: 30691

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Introduction

Zero budget does not literally mean that costs are 'zero', but rather implies that the need for external financing is zero, and that the costs incurred can be offset by diverse source of income which comes via farm diversification rather than dependence on one monoculture while natural farming means farming with Nature and without chemicals.

Man Behind Zero Budget Natural Farming

Indian agriculturist SUBASH PALEKAR is the creator of 'Zero budget natural farming' in India. For twenty years he studied forest vegetation, and applied forest principles on his farm from 1989 to 1995 in 154 research projects. After six years of verified research work, he got the package of technique about 'Zero Budget Natural Farming.' The method patented by him is well known as Subhash Palekar Natural Farming.

Palekar is considered as 'Krishi ka Rishi'. He has awarded with BASAVA SHRI AWARD (2005), GOPAL GAURAV AWARD (2007) and India's fourth highest civilian award the 'PADMA SHRI' (2016). His model eliminates the cost of fertilizers, pesticides and seeds. Hence, he titled it as ZERO BUDGET NATURAL FARMING. He believes in a method of cultivation which makes use of already existing nutrients in the soil such as Phospahte, potash, zinc and calcium available in absorbable form to the plants.

In Zero Budget Natural Farming nothing has to be purchased from the outside. All commodities required for the growth of the plant are available around the root zone of the plants. 98 to 98.5% nutrients are taken from air, water & solar energy. Remaining 1.5% nutrients taken from the soil are also available free of cost as it is taken from the prosperous soil which is enriched with these nutrients.

Why Zero Budget Natural Farming?

Privatized seeds, inputs, and markets are inaccessible and expensive for peasants and because of these conditions Indian farmers increasingly find themselves in a vicious cycle of debt, due to high production costs, high interest rates for credit, the volatile market prices of crops, the rising costs of fossil fuel-based inputs, and private seeds. Most recent available figures by the government of India show that about 52% of the agricultural households in the country are in debt. Among the major states, Andhra Pradesh had the highest share of indebted agricultural households (92.9%) while Karnataka is at 77%.

Due to this indebtedness, high cost of inputs (cost of chemicals and seeds, agricultural equipment, labour etc) water crisis, ZBNF acts as a solution wherein it promises to end reliance on loans and drastically cut production costs as it makes use of available inputs and no chemicals and fertilizers are used.

Principles of ZBNF

1. Crop diversity (Crop rotation, mixed and multiple cropping to keep ground covered all the time)
2. Dung from the Bos indicus (humped cow) is most beneficial and has the highest concentrations of micro-organisms as compared to European cow breeds such as Holstein.
3. Production of own seeds of indigenous varieties
4. Hybrids and GM varieties not permitted, promotion of indigenous seeds
5. Residue management and mulching.
6. Nutrient recycling, increasing beneficial biological interactions
7. Bhumi Annapurna- Soil innately has all the nutrients necessary for plant growth, and thus no external inputs need to be added; instead, the existing nutrients have to be "unlocked" and made bioavailable via jeevamrutha.

Four Wheels of ZBNF

1. Beejamrutha (Treatment used for seeds, seedlings or any planting material): This treatment is effective in young roots from fungus and seed-borne diseases that commonly affect plants after monsoon period. Cow dung is a powerful natural fungicide, and cow urine is a strong anti-bacterial liquid, lime, and soils are the materials used in preparation. Add Beejamrutha to the seeds of any crop, coat them, mix them by hands, dry them well and use for sowing. For leguminous seeds, just dip them quickly and let them dry.

2. Jeevamrutha: A fermented microbial culture provides nutrients, but most importantly, acts as a catalytic agent that promotes the activity of microorganisms in the soil, as well as increases earthworm activity. During the 5-6 days fermentation process, the aerobic and anaerobic bacteria present in the cow dung and urine multiply as they eat up organic ingredients (like pulse flour). A handful of undisturbed soil is also added to the preparation, as inoculate of native species of microbes and organisms. It also helps to prevent fungal and bacterial plant diseases. Palekar suggests that Jeevamrutha is only needed for the first 3 years of the transition, after which the system becomes self-sustaining.

3. Acchadana- Mulching:

a. Soil Mulch: This protects topsoil during cultivation and does not destroy it by tilling. It promotes aeration and water retention in the soil. Palekar suggests avoiding deep ploughing as it damages the soil health.

b. Straw Mulch: Dried biomass waste of previous crops and dead material of any living being (plants, animals, etc) that provides dry organic material which will decompose and form humus through the activity of the soil biota which is activated by microbial cultures.

c. Live Mulch (symbiotic intercrops and mixed crops): It is essential to develop multiple cropping patterns of monocotyledons and dicotyledons grown in the same field, to supply all essential elements to the soil and crops.

4. Waaphasa- Moisture: According to Palekar, what roots need is water vapor. Whapasa is the condition where there are both air molecules and water molecules present in the soil. He encourages reduced irrigation and irrigation only at noon in alternate furrows. ZBNF farmers report a significant decline in need for irrigation in ZBNF.

Insect Pest Management via ZBNF

Agniastra	Neemastra	Brahmastra
It is prepared by green chilli, garlic, neem, tobaco by crushing them in cow urine and boiling in water and filtering via cloth followed by fermentation for 24 hours. It can be sprayed on leaf roller stem and fruit pod borer.	It is prepared by 100L water, 5L of cow urine, 5kg of cow dung, 5kg of neem leaves, add the pulp in 100L water, ferment for 24hrs (Stir twice a day) and filter using a cloth and spray for sucking pests and mealy bug.	It is prepared by neem leaves, custard apple leaves, camellia leaves, guava leaves, pomegranate leaves, papaya leaves and white dhatura leaves. All these leaves are crushed and boiled in cow urine and sprayed to control sucking pests, pod borer, fruit borer etc.

Table 1 Comparison of ZBNF V/S Chemical Farming (APZBNF-2018)

	Cost of cultivation		Net Income	
Food crops	ZBNF	Non ZBNF	ZBNF	Non ZBNF
Paddy	30,983	43,839	60,743	40,335
Guli Ragi	7,375	8,125	42,789	27,717
Ragi	6,875	7,625	31,590	25,195
Blackgram	15,775	18,595	39,034	27,243

Conclusion

To summarise, we can say that ZBNF is attaining wide scale in India among more and more farm families because of the following advantages:

1. Savings on cost of seeds, fertilizers and plant protection chemicals has been substantial.

2. Because of continuous incorporation of organic residues and replenishment of soil fertility IT helps to maintain the soil health.

3. The new system of farming has freed the farmers from the debt trap and it has instilled in them a renewed sense of confidence to make farming an economically viable venture.

Message from Farmer to Farmers

1. "I had 5-6 loans during my chemical farming days- a loan for my daughter's marriage, others for seedlings, stems, and fertilizers. Now my farm expenses are so low, and everything I get is an income for the family. I owe nothing to anyone." — ZBNF farmer, Bijapur.

2. It doesn't matter what the yield is, I still make a profit because my costs are negligible. Plus, I've added intercrops to this, so I get income from many crops, not just one. Yield is not an important concept for us." — ZBFN farmer, Belgaum, 2016.

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4. Palekar S (2006). The principles of spiritual farming II. 2nd ed. Amravati: Zero Budget Natural Farming Research, Development & Extension Movement, Amravati, Maharashtra, India. "In ZBNF our expenses are very low.

Conservation Agriculture Based Sustainable Intensification: A Radical Approach for Indian Farming System

Article ID: 30692

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Conservation Agriculture

Conservation Agriculture is a sustainable approach to agricultural production which aims to protect soil from erosion and degradation, improves its quality and biodiversity and contributes to the preservation of natural resources like water and air, whilst optimizing yields.

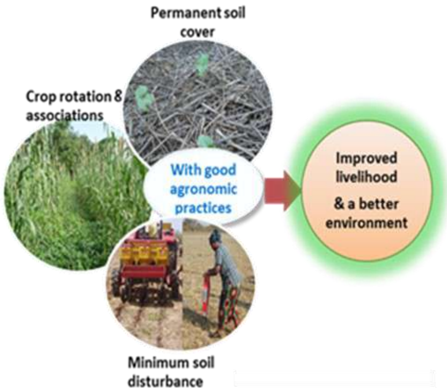

Fig 1: Conservation Agriculture

History of Conservation Agriculture

The origin of Conservation Agriculture based Sustainable Intensification or Conservation Agriculture was back in the 20th century. During 1930 in the United States of America, it was strongly felt that when farmers plough their field massive amount of dust particles were carried out into their cities through cyclone/hurricanes which made the lives in cities extremely discomforting. To resolve this problem, many researches and discussions were carried out. As a result, a conclusion was made that a new farming system without tillage was necessary. Therefore, Conservation Agriculture started in 1930 and it didn't gain popularity till 1950.

From 1930 to 1950, when conservation agriculture was applied as a piloted research, it garnered many positive results which quickly lead farmers to adopt conservation agriculture practice. But from 1950 to 1990, conservation agriculture was practiced in only 2-million-hectare land. From 1990 to 2015, conservation agriculture was practiced in almost 180-million-hectare land with 10 million hectares annually around the world. The places where conservation agriculture is practiced the most is Brazil, next is America followed by Australia. In India, we practice conservation agriculture in 3 million-hectare farms.

Principles of Conservation Agriculture

Conservation Agriculture mainly has mainly three principles:
1. Minimum soil disturbance (not more than 30%) – Conservation Tillage
2. Soil coverage with organic biomass (to mulch soil with the residue of harvest)
3. Crop diversification (to sow different crops using different methods at different times on a rotation in a one-year crop cycle on same piece of land).

Complications in Adapting Conservation Agriculture

The successful adoption of conservation agriculture is in the rainfed areas or the areas where only one crop is harvested in a year. But South Asia has complex farming system because the agriculture is linked with animal farming and fisheries and 2-4 crops in a cycle are followed that include cereals and vegetables and it keeps on changing according to farmers demand and requirements.

So, it is very complicated to apply all three principles of conservation agriculture in South Asian region. For which Conservation Agriculture is not enough to sustain agriculture but an improved method called Conservation Agriculture based Sustainable Intensification needs to be followed.

Fig 2: Conservation Tillage

Fig 3: Straw Mulching

Problems of Indian Agriculture

There are certain inherent problems in Indian agriculture. The source of problems that Indian agriculture is currently facing dates back to few decades. In 1960 when Green Revolution started, we were successful in increasing productivity which came with a price. We unleashed a lot of problems which can be arranged in two categories: man-made and nature.

1. Man-made problems: Under man-made problems comes mono-cropping system in which only one type of crop is sown continuously. Second problem is to adopt new crops and cropping system in new location where it does not fit with available resources. The third one is residue burning which is becoming a great problem these days. Fourth one is intensive tillage which is to plough field repeatedly that results in deterioration of the nutrition of soil. And flood irrigation is yet another big problem. There are many such problems created by human interventions.

2. Natural problems: Another category of problems are the natural problems that include climate change issues like flood, cyclones, other variations in climate, abiotic stresses that we are facing these days like drought, flood, salinity, acidity etc. along with biotic stresses like new diseases. And it can get really complicated if we put them together. The impact they have is very devastating- the water level is decreasing; soil health is deteriorating; global warming is increasing; and our crop produce is getting low.

Now the challenge we face is to increase our productivity, sustain it and protect it from climatic stress. There are many solutions to counter the inherent agricultural problems but the best one is Conservation Agriculture based Sustainable Intensification.

Conservation Agriculture Based Sustainable Intensification

Conservation Agriculture based Sustainable Intensification is broader than Conservation Agriculture and goes beyond. Conservation Agriculture only deals with tillage, residue and crop diversification but the components of Conservation

Agriculture based Sustainable Intensification includes Conservation Agriculture practices along with efficient use of external inputs and natural resources. It is economic and viable to farmers, and appropriate to our farming system that addresses our livestock, fish and soil.

This makes our farming system more resilient, saves energy for our future generation, creates cleaner environment, brings biodiversity back in soil and thus in our ecosystem. In addition, it brings more income to the farmers, improves nation's economic condition and livelihood, increases food security and better nutrition is attained.

Benefits of Conservation Agriculture Based Sustainable Intensification

Conservation Agriculture based Sustainable Intensification in farm trials yielded positive results as listed below.
1. 5-10% increase in production from crop diversification.
2. 8-17% of irrigation water saved.
3. 26-42% labour saved.
4. 46-62% fuel consumption/energy saved.
5. 16-56% increase in farmer's income.
6. 11-16% reduction in Co2 emission.

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Major Diseases of Coffee

Article ID: 30693

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Coffee Leaf Rust - *Hemileia vastatrix*

1. Symptoms: Small pale-yellow spots on the lower surface of infected leaves, orange-yellow spore mass appears, defoliation and die-back. Results in serious crop loss and causes fluctuations in production.

2. Pathogen: The mycelium is intercellular and sends haustoria into the cells. The mycelium sends out erumpent stalks through stomata which bear the uredospores. The uredospores are reniform or orange segment like in shape. The convex side of the spores are echinulated and the lower side is smooth and measure 26 – 40 x 20 – 30-micron meter. The telial stage succeeds the uredial stage in the later stage.

3. Mode of spread and survival: One lesion produces 1.5 lakhs uredospores which are spread by rain splash and wind. Many animals (insects, birds etc.,) can also carry spores over long distances. Infection requires the presence of water for uredospores germination and only occurs through stomata, which are on the underside of the leaf.

4. Management: Three applications of 0.5% Bordeaux mixture for susceptible varieties.

Black Rot - *Koleroga roxia*

1. Economic Importance: In India it occurs in Karnataka and Tamil Nadu. In south India the disease is severe only in those areas growing with *C. arabica*. It is influenced by south west monsoon period from June – Sep.

2. Symptoms: Blackening and rotting of affected leaves, young twigs and berries. Affected leaves get detached and hang down by means of slimy fungal strands. Defoliation and berry drop occur.

3. Pathogen: The hyphae are hyaline when young and turn light brown with age. Fructifications arise with numerous basidia and basidiospores. Basidia are simple, oval rounded or pyriform. Basidiospores are hyaline, elongated, rounded at one end, slightly concave on one side. At a later stage the fungus forms sclerotia or hyphal clumps by repeated branching of short cells.

4. Mode of spread and survival: The pathogen penetrates the leaves through the stomata on the lower side and the hyphae invade intercellularly in the palisade tissue. The fungus mostly spreads by contact from leaf to leaf through the vegetative mycelium.
The pathogen spread through infected plant debris. Mycelium lies in twigs throughout year.

5. Management: Remove and burn affected parts. Apply 1% Bordeaux mixture close to the south westerly monsoon if needed. Centre the coffee bushes, regulate the overhead canopy.

Berry Blotch - *Cercospora coffeicola*

1. Symptoms: Necrotic spots on the exposed surface of green berries enlarge and cover the major portion. Fruit skin shrivels and sticks fast.

2. Pathogen: Conidiophores are short, fasciculate and olivaceous. Conidia are subcylindrical, hyaline, 2-3 septate and 40-60x 3.5-micron meter in size.

3. Mode of spread and Survival: The pathogen is seed borne and conidia are spread by wind.

4. Management: Spray 1% Bordeaux mixture during June and late august, maintain medium shade overhead.

Damping Off / Collar Rot – *Rhizocotonia solani*

1. Symptoms: It caused pre emergence damping off and post emergence damping off. In post emergence damping off collar region near soil level is infected leading the rotting of tissue and death of seedlings.

2. Mode of spread and survival: The disease is soil borne.

3. Management: Soil drenching with Copper oxychloride 0.25%.

Die Back or Anthranose – *Collectorichum coffeanum*

1. Symptoms: On leaves circular to greyish spots of 2-3 m in dia. On berries small dark coloured sunken spots are farmed. Beans become brown. Die back also occurs.

2. Mode of spread and survival: The fungus occurs as a saprophyte on dead tissue on the outer layer of the bark, which provides the major source of inoculum. It releases large numbers of water borne conidia during the wet season. Conidia are spread by rain water percolating through the canopy and rain splash can disperse conidia between trees. Long distance dispersal occurs primarily by the carriage of conidia on passive vectors such as birds, machinery etc.

3. Management: Spraying Mancozeb 0.25%.

Impact of COVID-19 on Food Industries

Article ID: 30694

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Introduction

The spread of novel corona virus has been devastating globally. This outbreak came into light on Dec 31, 2019 as informed by World Health Organization (WHO) in Wuhan City in Hubei Province. Gradually this disease spreader to the rest of the entire world. On Mar 11, 2020, WHO has declared nCoV outbreak as a global pandemic. The virus has been named "Severe Acute Respiratory Syndrome – Corona Virus 2" (SARS-CoV2) and the disease is now called "Corona Virus Disease 2019" (COVID-19) or "2019 novel Corona Virus" (2019-nCoV).

The COVID-19 Pandemic is defining the global health and financial crisis of our time and the greatest global humanitarian challenge. Besides on health issues, it also triggers a great loss in the economic system. It has affected our whole biodiversity including many food industries and also humans. This corona virus has seized all its essence and now farmers including food industries are struggling. Farmers seemed set for a pick-up this year, as bountiful rains had brought a bumper crop then India was put under a national lockdown since last more than two months in a bid to stop the spread of corona virus. This has affected the food industries also. Globally confirmed cases surpassed 9 billion where as in India 4,41,643(confirmed case), 2,48,450(recovered), 14,027(deaths) has been reported on 23 June, 2020 by world meter.

Impact on Food Industries During COVID-19

The effects of COVID-19 are felt around the world. Food industries are facing significantly reduced consumption and supply chain disruption challenges. As a precaution, the government has issued advisories to close all the malls, restaurants, shops, factories in all states. Food service providers are now claiming that their business has seen a drastic drop. About 91% of the total workforce is from the informal sector, they include agricultural, migrant and other workers who entirely depend on daily wages as a mode of living. These vulnerable groups and their families will be the hardest hit during the unprecedented times. The fear of the virus spread faster than the virus leading to the following consequences.

The worst part of the countrywide lockdown was that it coincided with the country's peak harvesting time of a variety of crops of the season. Summer vegetables and fruits were ripened, ready to pick; wheat, paddy &barley crops were ready for harvest but the all farmer's hard work went in vain due to sudden halt of the country. The temporary workers in cities had to leave to get back to their villages as surviving in the city without regular salaries was implausible. As transportation froze, these people were left with no choice but to walk, resulting in chaos. This mass departure of the migrants to their homes instantly brought the farming activities to a standstill owing to the shortage of labourers. The farmers were forced to sell their produce for a lower price as storage facilities were absent. But the retailers took advantage of the lockdown situation by improving exorbitant prices on existing stocks.

As Farmer is The God Father of the company. Shortage of raw materials resulted in low production rate. The retailers lacked the manpower due to the absence of transportation workers to procure finished goods to supply it to respective shops. The supply chain, which is the connector between the producer and consumer lacked in communication. It has been observed that there was a huge surge in demand for processed foods like instant noodles, biscuits & snacks. But in the meantime, all food processing companies alike Nestle, Britania, ITC, Parle & PepsiCo are running at low capacity labourers.

Response of the Central and State Governments

The Central Government announced relief packages. On May 13, 2020 Union Minister Nirmala unveiled the fourth tranche of government Rs. 20 lakh crore economic package to provide relief to various segments of the economy battered by corona virus lockdown. The third tranche of the measures was announced under the "Atmanirbar Bharat Abhiyan" focuses on agriculture & allied activities. This includes that the fund worth Rs. 1 lakh crore to be given to agricultural cooperative societies, farmer producer organization and start-ups; Rs.10, 000 crore for micro food enterprises; Rs. 20,000 crores for fisherman; Rs. 4000 crores for promotion of herbal cultivation. Government has taken a great step to provide relief to the food industries. The central government has announced the payment of the first instalment of Rs.2000 of the PM-Kisan scheme to farmers. The government has raised daily-wages under the MNREGA scheme from Rs. 182 to Rs. 202 per day. RBI has released a suspension order of interest costs on agricultural loans for the next 3 months. The government has ensured the distribution of food grain, other household items and cash support of Rs. 500 to all BPL cardholders on a priority basis for next 3 months for "Jan-Dhan" account holders. RBI allowed a 3 months moratorium on all term loans, agricultural loans, retail and crop loans,3% concession on the interest rate of crop loans. The above package is a booster to the food industry.

Challenges for All Business

The primary challenge is obvious that to recover the costs. In recognition to this, some government have passed stimulus programs to assist business with these challenges. Employees need to remain healthy for a business to continue. It includes introducing social distancing measures, changing personal protective equipment (PPE) requirements, regularly wiping downs equipment &surfaces, limiting visitors and changing delivery protocols. In addition to these, more rules are to be found. Food Safety is still the primary concern of all manufacturers. There is currently no evidence that the virus has been transmitted via food or food packaging, but there is evidence that it can remain viable on certain substances for longer period of time.

It is essential to keep personnel healthy ensuring all the hygiene protocols are followed. Food operatives also need to consider the importance of their product. All should maintain social distancing of 1 meter among themselves and try to avoid maximum contact. Food Safety Management system should be updated and readily available for upcoming audit.

It consists of updated policies surrounding management of crisis, risk assessment, purchasing, emergency management & contingency plans, personnel records, deviations, change control, internal audits, documentation, complaints & recalls.

Conclusions

Overall, the COVID-19 pandemic is a crucial juncture in the Indian history. The evident trails from the rest of the world were helpful for the Indian officials to take preparedness & response measures at the right time to tackle the pandemic. The bold & decisive leadership of the central, as well as the state government has implemented remarkable strategies to protect the livelihood of millions. The Indian government has taken huge steps to feed the entire nation & protect their lives &livelihoods amid the corona virus outbreak. Hoping this cloud has a silver lining, in reshaping the society's potential for greater food security &food sovereignty, thus paving the waving the way to efficient food system. And again, we can feel free to enjoy our favourite, scrumptious & mesmerizing dishes at the same rate we used to enjoy initially.

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Climate Smart QTL Breeding for Cereal Crops

Article ID: 30695

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Introduction

The forecast of a world population of 9.6 billion by 2050 imposes great challenges to plant breeders to fulfill the human demand sustainably. The impact of urbanization results in shrinking land availability, climate change along with population explosion will threaten global food security. Due to the continuous evolution of modern technology in agriculture, it leads to increase yield and productivity earlier time.

But recent day's climate change like erratic rainfall, increasing summer temperature, extreme adverse winter along with nutrient deficiency and high salinity become the key barrier in crop production and productivity. So many counties affected by adverse climate change which lead to a shortage of food grains result lead to poverty and malnutrition. To overcome these problems breeders, need to develop climate-smart crop varieties. Traditional breeding methods coupled with advanced molecular and biotechnological approach plays a significant role in developing climate-smart crop varieties.

In the last few decades, there is a rapid evolution of molecular markers and sequencing technologies results lowering in genotyping cost which ultimately leads to the development of high-resolution genetic mapping and identification of minor and major quantitative trait loci (QTLs) for different abiotic stresses. QTLs for the trait of interest are introgressed through marker-assisted selection to develop climate-smart crops.

Physio-Chemical Basis for Abiotic Stresses

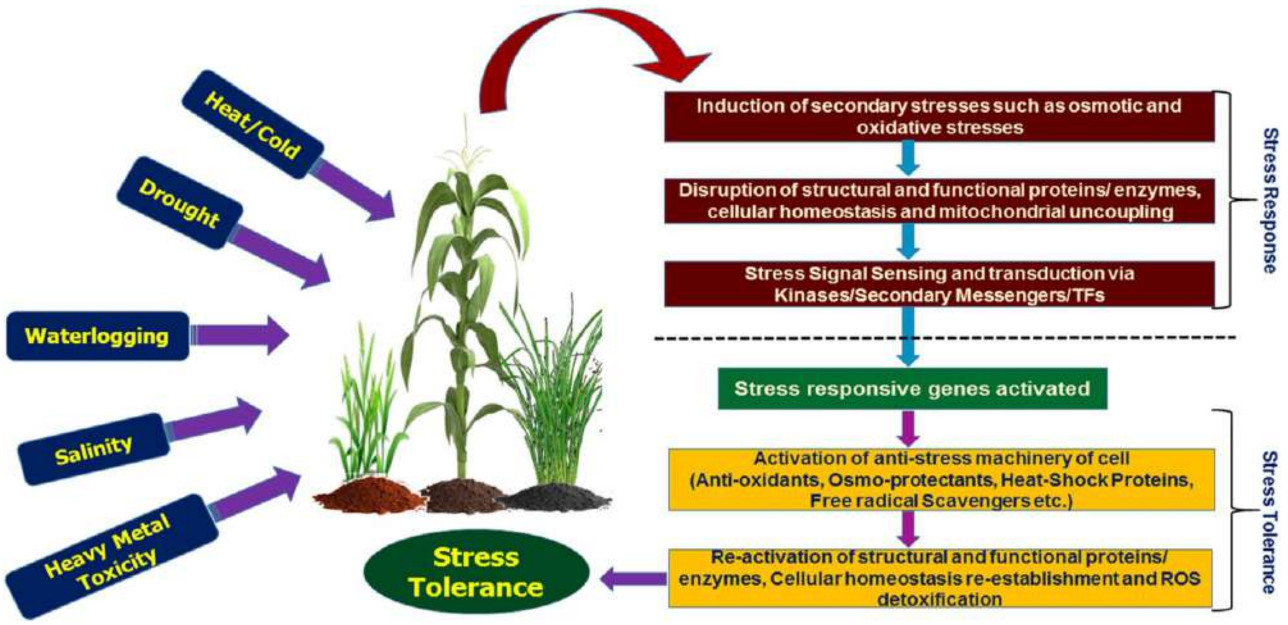

Fig. 1 Mechanism of abiotic stress response and tolerance development in major cereals

Breeding Approaches for Developing Climate Smart Crop

1. Conventional breeding approach: The basic mechanism in breeding for plant abiotic stress initiates with the selection of desired genotypes in a characterized targeted environment. There is a need to understand the gene action and heritability of physiological and morphological traits associated with abiotic stress for effective breeding practice. Through the back cross breeding method abiotic stress gene can be transferred to the recipient high yielding genotypes to maintain the sustainability in food production.

2. Molecular breeding approach: In the conventional approach, effective phenotyping is very much tedious and time-consuming. To overcome the barrier of conventional breeding, molecular approaches play a significant role which enhances the speed and efficiency of climate-smart breeding. Molecular breeding methods like MABB coupled with advanced breeding approaches, such as marker-assisted recurrent selection (MARS) and genomic selection (GS) are used to accelerate the selection procedure for the identification of genes of interest in genotypes.

QTL Mapping Study for Various Abiotic Stress

1. For drought resistance: In the rainfed system, drought creates a huge threat to food and nutritional security. For that numerous QTLs have been screened in various cereal crops for drought tolerance through marker-assisted backcross breeding (MABB)-based Introgression.

The DRO1 (Deep Rooting gene1) leads to enhance crop production due to higher photosynthesis rate and grain filling. Through backcross-mediated Introgression of DRO1 gene into shallow rooting rice cultivars to develop drought avoidance cultivars. In rice, there are 3 QTLs i.e. RM8085, I12S and RM6836 in chromosome 1, 4 and 6 respectively through SSR-based QTL mapping develop from a recombinant inbred line (RIL) population by crossing of IR20 and Nootripathu.

In wheat, three QTLs in chromosomes such as 1BL, 2BS, and 7AS for yield and biomass were identified. In durum wheat, another three major QTLs such as QRga.ubo-6A, QRga.ubo-2B and QRga.ubo-4B were screened for the seminal root angle. In maize, a total number of 62 and 83 QTLs identified for ASI and grain yield Wani et. al., (2018).

2. For Heat/cold resistance: African rice *(O. glaberrima)* is a reservoir of heat tolerance genes and has been utilized for screening of five QTLs for traits associated with thermotolerance in chromosome segment substitution lines (CSSLs) and TT1 was identified in chromosome 3 first QTL. For spikelet fertility and pollen shedding, three novel QTLs, namely qPSLht4.1, qPSLht7, and qPSLht10.2 were identified for the first time in CSSLs under heat stress.

In maize, twenty-seven QTLs for early growth and germination were mapped onto chromosomes 1, 2, 3, 4, 5, 6, 7, 8, and 9 in two different RIL populations. Three QTLs associated with chlorophyll content are identified through genome-wide association studies (GWAS).

3. For Submergence/waterlogging Submergence resistance: Submergence and waterlogging are serious problems for wheat and maize. The SUB1 gene is utilized to overcome submergence in rice. For long term submergence, there is a need to develop novel QTLs which confers the SUB1 gene. In triticale, a total of 36 and 10 QTLs mapped under the International Triticale Mapping Initiative. In maize, there is no such evidence of QTLS regarding submergence tolerance Gonzaga et. al., (2016).

4. For Salinity resistance: Total of 16 QTLs onto chromosomes 1, 7, 8, and 10 associated with various traits, such as Na+ concentration, Na/K ratio and pollen fertility. A salinity tolerance rice variety have been developed through the Introgression of major QTL saltol in rice through MABB. In wheat, a single QTL has been identified through SSR-based association study of 119 wheat varieties. In maize, 15 QTLs were mapped in chromosomes 1, 2, 4, 5, 6, 7, 8, 9, and 10 for the salinity tolerance Babu et. al., (2017).

New QTLian Breeding Approach for Accelerated and Efficient Climate-Smart Crop Development

New and advance approaches are applied to speed up the identification of consistent stable QTLs. For this purpose, meta-QTLs studies are conducted to locate exact marker and QTL positions in the genome and hence reducing the confidence interval for putative QTLs.

In some cases, genes from wild relative introgressed to cultivated varieties through MABC. Now QTLs from different sources can be transferred through marker-assisted gene pyramiding. Marker-assisted gene pyramiding reported in different species for different abiotic stress like drought, salinity and submergence. In rice, three SNPs linked with ABA content and carbohydrate accumulation are identified through GWAS studies under water deficit rice-growing conditions. A candidate haplotype locus namely OsNRT2.2 identified through haplotype studies for salt tolerance. GWAS coupled with cross-validation of GS will higher accuracy and prediction value hence enhance the speed of rice breeding.

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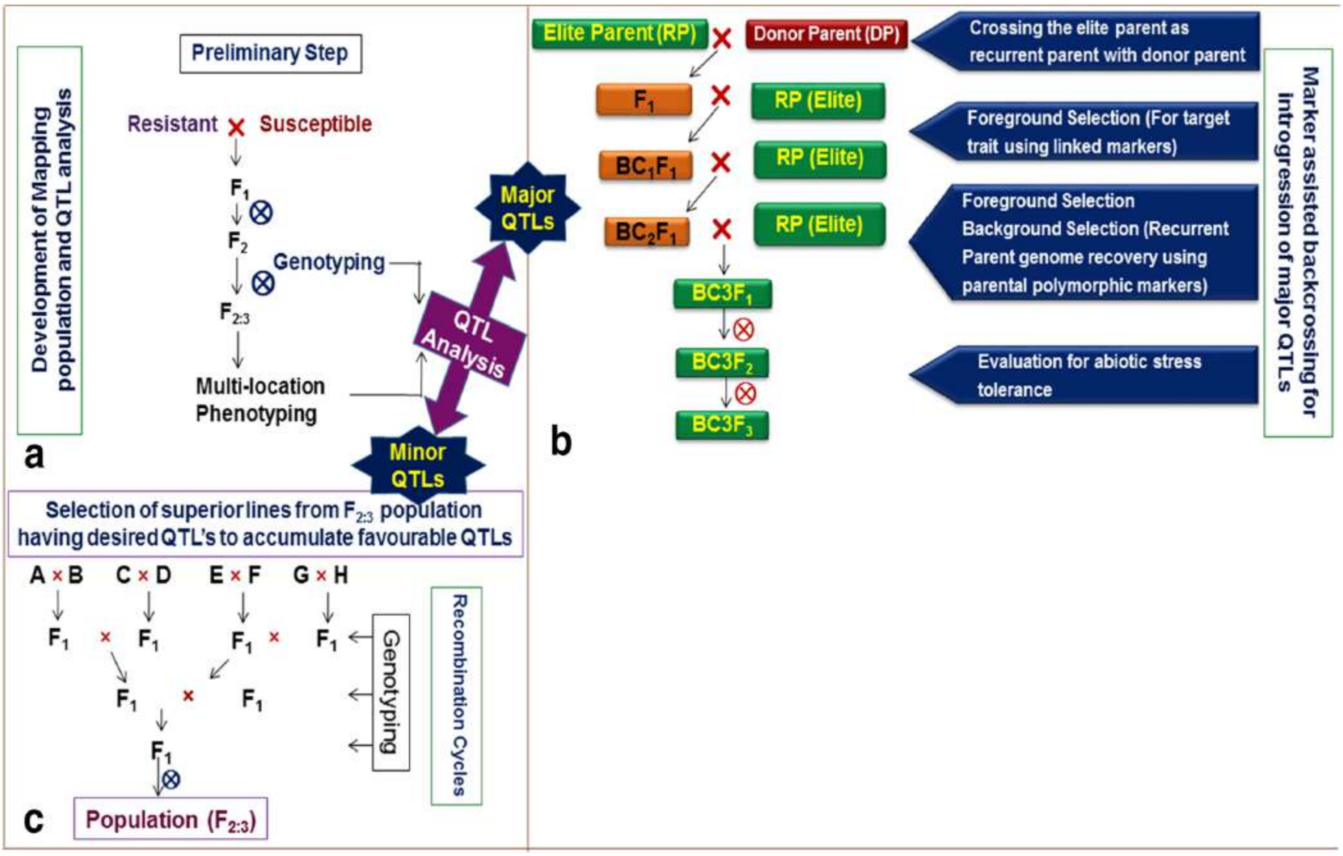

Fig. 2 Generalized scheme for harnessing the identified QTLs (QTLian breeding). a. Generation of mapping population and QTL identification. b. MABB scheme for introgression of major QTLs. c. MARS scheme to accumulate desired minor QTLs in a population [Choudhary et.al., (2019)]

Conclusion and Future Perspectives

The use of advance molecular breeding approaches like MABB, GWAS, genomic selection (GS) combined with a high-throughput Phenotyping platform plays a significant improvement in climate-smart breeding to ensure food and nutritional security. GS-based studies have achieved a higher position to pinpoint detection of responsible SNPs for abiotic stress tolerance- linked traits. Mutation detection, omics, microarrays, exome sequencing and gene discovery high-throughput genotyping of crops for root system architecture and physiological traits linked to abiotic stress should be exploited at a broader level to harness the fruitfulness of climate-smart breeding.

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Concept of Rural Industry: Types, Challenges & Recommendations

Article ID: 30696

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Introduction

INDIA lives in rural, as 65% of our people live in rural area dominated by agriculture, which are in trouble all over the world and lack behind from other communities that is why rural development inevitably is a major challenge for these countries. Rural development project which only aimed at only improvement of agricultural structure have not been very successful to reach the general national development targets. So rural development strategy focusing on rural industrialization not only agriculturally based and also other small and medium scaled industries can bring about significant, and mostly positive, change not only in the lives of rural people but also in the structure of the rural economy.

Meaning of Rural Industry

1. Rural industries and business organisations in rural areas generally associated with agriculture and allied activities to agriculture.

2. According to KVIC (Khadi and Village Industry Commission), "Village industries or Rural industry means any industry located in rural areas, population of which does not exceed 10,000 or such other figure which produces any goods or renders any services with or without use of power and in which the fixed capital investment per head of an artisan or a worker does not exceed a thousand rupees".

3. According to Government of India, "Any industry located in rural area, village or town with a population of 20,000 and below and an investment of Rs. 3 crores in plant and machinery is classified as a village industry."

4. For development of INDIA, we have to develop Rural-India first.

5. The problems of lower productivity, lower income and under-employment have also accelerated migration from rural areas to urban centres.

6. So the only solution for increasing productivity, earning, life style and overall development there is only one option left i.e. Rural Industry.

Types of Rural Industry

1. On the basis of scale of production:

- a. Small-scale cottage activities.
- b. Medium-scale village enterprises.
- c. Large-scale rural industries.

2. On the basis of type of products:

- a. Agro Based Industries like:
  - i. Sugar industries
  - ii. Oil processing from oil seeds
  - iii. Fruit juice
  - iv. Spices
  - v. Dairy products etc.
- b. Forest Based Industries like:
  - i. Wood products

ii. Bamboo products
iii. Honey
iv. Making eating plates from leaves.
v. Coir industry

3. Mineral Based Industry like:

a. Stone crushing
b. Cement industries
c. Wall coating powders etc.

4. Textile Industry like:

a. Spinning
b. Weaving
c. Colouring
d. Bleaching

5. Engineering and Services like:

a. Agriculture equipment.
b. Tractors and pump sets repairs etc.

Challenges

Rural industries are constrained with several problems. The growth of rural industries is not very healthy due to the following challenges:

1. Lack of infrastructural facilities: Rural areas are characterized by poor infrastructural farcicalities in the field of roads, electricity, street lighting, road transport etc. which hampers the smooth movement of various industrial activities. This is a major problem faced by rural industries.

2. Financial constraints: Most of the rural entrepreneurs face financial crunch in setting up rural industries because of the non-supportive attitude of financial institutions and banks which work more on papers. The procedures and conditions to avail a loan is so time consuming that its delay often disappoints the entrepreneur. Due to this, the entrepreneurs are forced to take credit from village money lenders who charges exorbitant rate of interest.

3. Lack of technical know-how: Lack of technical know-how, appropriate technology and training create immense problem in the growth of rural industries. Without this, productivity and increased profit is a distant dream.

4. Irregular supply of raw material: The problems arise due to faulty and irregular supply of raw materials. Non-availability of sufficient quantity of raw materials, sometimes poor quality of raw materials, and increased cost of raw material and lack of knowledge of entrepreneurs regarding government policy are other few hindrances for small-scale sector.

5. Lack of machinery and equipment: Small-scale units are striving hard to employ modern machineries and equipment in their process of production in order to compete with large industries. Most of the small units employ outdated and traditional technology and equipment. Lack of appropriate technology and equipment create a major stumbling block for the growth of small-scale industries.

6. Lack of adequate knowledge and information: Though information technology has substantially developed in the modern world and has penetrated into the rural areas through internet, rural people hardly availed its benefits. Because, rural people do not have adequate information avenues. They are not knowledgeable, trained and motivated to achieve more and more in their own sphere.

7. Absence of organised marketing: Promotion, distribution and implementation of customer feed-back is lacking. Rural industries cannot compete with their urban counterparts. Dealers exploit the rural industries in the traditional sector. Lack of proper communication facilities and marketing information adds to the problem to large extent.

8. Problem of skilled manpower and labour scarcity: Because inefficient human factor and unskilled manpower create innumerable problems for the survival of small industries. Non-availability of adequate skilled manpower in the rural sector poses problem to small-scale industries.

9. Other problems: Poor quality standards, lack of quality management, managerial inadequacies, lack of communication, transportation and lack of training programs etc.

Recommendations to Boost up Rural Industry

1. Modernisation of rural industrial sector and up gradation of rural skills.
2. Supply of raw material at reasonable rate. Specific action to link the production centres to market in the urban areas.
3. Training in government schemes. Training institution needs to be strengthened. Eliminate middle men in marketing business.
4. Exemption from excise and sales tax.
5. Micro finance organisation should be set up to easy access to loan.
6. Marketing complex should be developed & eliminate middle men in marketing business.
7. Growth of entrepreneurship, managerial skills can be made possible through training programmes.
8. Efforts should be made to have a permanent retail stall in local shanties and pilgrim centres and participate at festival gathering to market rural products.

Conclusion

The gradual increase of machine-made cheap consumer goods restricted the growth of rural industries and thus created unemployment & the rural population began to migrate to urban areas. Thus, if properly planned and implemented the industries developed in our rural segments, will usher in a new era of hope among rural masses, a majority of who live below the poverty line. Last but not least, any attempt to industrialize rural spectrum would end in fiasco if a full-fledged infrastructural facility is not created in those areas. One should not forget that it is the fundamental pre-condition essential for realizing this noble idea.

Importance of Village and Cottage Industry in India

Article ID: 30697

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Introduction

There are more than 100 categories of village industries, which include mineral based, forest based agro based and food industries. These are set up either directly by the KVIC through 4777 registered institutions and 30100 industrial cooperative societies through the 30 State Khadi Boards.

Cottage Industry

When a worker produces something with his simple tools, with the help of his family members only, then he is said to be running a cottage industry. The absence of big machines, electric power and hired labour are the features of cottage industries.

Example:

1. Spinning and weaving cloth is the main cottage industry of our country.
2. Pottery, wood-work, metal-work, leather-work, basket-making, crushing of sugarcane, etc., are some other important handicrafts of our country.

Importance of Cottage Industry

1. The importance of cottage industries is very great for rural as well as urban areas.
2. In villages, farmers can carry on their cottage industries side by side with their main occupation of agriculture.
3. They are important for them as they provide opportunities for part-time employment.
4. In urban areas also the poor can start some cottage industries with their own limited resources.
5. They are indispensable for a poor country like India.
6. In cottage industries the question of the exploitation of workers does not arise.
7. The worker and his family being both the employer and the employee themselves, get all the earning from their business.
8. Even if in some cases hired labourers are employed, the relations between them and the employer remain healthy.
9. Big machines are labour saving devices are not used in cottage industries.
10. So, if they are encouraged, more and more people get employed.
11. Besides this, they are good means for providing part-time employment.

Problems in Big Industry

1. The tendency towards centralisation is inherent in large scale industries.
2. This leads to over-crowding and congestion in the towns.
3. Children and women are employed in big industries. Corruption becomes rampant.

Handicrafts Solve All these Problems Arise

1. They are mostly run in the homes of the workers. So, the housing problem does not arise, other social ills are also removed.
2. Further, the independence of the worker is maintained.
3. The work can be begun and stopped according to his convenience.
4. No rigid-routine is necessary. So, in cottage industries the workers enjoy a marked sense of freedom.
5. Another important advantage of developing small units is that they not only do not require much foreign exchange earnings of the country.

6. They can bring about awakening among the people. They can make them self-confident and self-reliant.
7. Govt. also provides sufficient opportunities for the development of the village and cottage industry.

Conclusion

The products of the KVI sector are marketed through 15431 sales outlets, benefiting a large number of people, almost 32% of which are in the SC/ST categories and 46% are women. In reference to KVIC annual report 2003-2004, total KVI production is Rs. 9681.77 crores, sale is Rs. 11575.21 crores and employment to 71.19 lakhs persons.

Weed Management in Paddy: Quality Improvement by Promoting Hand Weeding Over Herbicides During Corona Period

Article ID: 30698

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Abstract
Weed control is one of the most difficult and labor-intensive cultural practices in rice cultivation. This calls for an urgent need for their management keeping in mind the ill effects of herbicide application on crop yield as well as the soil health. Considering the recent state of emergency due to corona virus, there has been a huge influx of labors from various cities of the country to their village. This paper focuses on how we can cumulate them in the practice of weed management with an objective of promoting chemical-free rice cultivation.

Introduction
Rice is one of the important staple foods for world's population. It acts as a deciding factor for the food security all over the world. Various advances in the field of research work in rice cultivation have led to an increase in its production as well. But the current trends in paddy cultivation use an extensive amount of chemicals for its cultivation leading to the declining food quality and disturbed soil-nutrient composition. It is also estimated that 40% of more rice production will be required by 2030 to satisfy growing demand with no increases in cropping areas (Khush 2005).

In the view of present scenario, it would be very difficult by then to harness the same yield index from the same piece of land with current decline in soil health due to various pre-emergence and post-emergence herbicides. Weeds compete with the main crop for space, nutrients, moisture and sunlight. To prevent this, various weed management practices are adopted in rice cultivation. This can be achieved through mechanical and hand weeding by using various implements such as sickle, hoe etc. and chemical application as herbicides.

Weed Management in Rice
Weed management in rice can be done by mechanical, cultural or chemical methods. The emerging weeds compete with rice mostly at the tillering stage reducing the number of panicles. About 15-20 % of the weed population emerges in the period between one month and two months after transplanting and 20-25% of weeds emerge later and are not important in yield reduction (Zhang 1996).

Application of Butachlor (1-2 kgai/ha); Alachlor (1-2 kg ai/ha); Thiobencarb + 2, 4D; Isopropyl (0.75) ester (0.5 kg ai/ha); Metsulfuron methyl (20 WP) (0.008 kg ai/ha) has been practiced since a long period. The major weeds for puddle lowland rice include *Echinochloa colona, Chloris barbata, Cynodon dactylon* etc. Although weed management in many parts of the world is still dominated by herbicide usage, there is a strong need to alter this practice for a sustainable form of farming. The herbicides now have a tendency to develop herbicide resistance by noxious weeds which renders the cropping systems under paddy quite vulnerable.

Widespread concern about the environmental side effects of herbicides combined with increasing public awareness have resulted in the banning of several herbicides in some countries and an increasing pressure on farmers to reduce the use of herbicides (Matteson, 1995).

Ill Effects of Herbicides on Rice Yield
Since the herbicide application is cheaper than manual weeding, it solves the problem of labour shortage. But there are few negative impacts of such herbicides on soil health, human health and of course, on the rice yield.

For example, Butachlor slightly affects rice leaf chlorophyll and amino acid contents. 5 ppm butachlor and 2,4-D also are said to exhibit some phytotoxic effects on crop plants, however, the symptoms disappeared 14days after seeding. Sundaru (1983) found that 'japonica' cultivar was generally less susceptible to 2, 4-D injury than 'indica' and adapted more readily in low temperature (about 21°C) and high altitude (about 1140 m) conditions. De Datta and Baltazar (1996) reported that herbicide selectively plays a critical role in rice weed control. With most herbicides, rice may suffer no more than 30% initial injuries through chlorosis and stunting which disappears within 2 to 4 weeks.

Table: Toxicity rating of herbicide (mean± SD) on paddy var. Radha 7 and Khumal 5

Treatments	Rate of application (kg/ha)	Radhe 7				Khumal 5			
		Toxicity rating scale of 0-100 DAT							
		21	42	63	84	21	42	63	84
Butachlor	1.5	14.0 ±1.7a	5.0 ±0.9a	2.0 ±0.1a	0.0a	16.0 ±1.9a	6.0 ±1.0a	3.0 ±0.3a	0.0a
2, 4 D	1.0	17.0 ±1.9b	6.0 ±1.0b	3.0 ±0.2b	0.0a	19.0 ±2.1b	8.0 ±1.7b	3.0 ±0.4a	0.0a

Mean ±SD in each column followed by the same letter do not differ significantly at P = 0.05 by Duncan's Multiple Range Test (DMRT) followed after ANOVA.

Source: Nepalese Journal of Biosciences2:5-9 (2012)

Thus, it was concluded through this experiment that hand weeding was better to control weeds, especially narrow leaved monocot weeds, in two transplanted varieties of rice instead of using herbicides such as Butachlor or 2,4 D. Similar results have also been reported by Zhang(1996, 2001).

Cumulating More Labours in Hand Weeding (In View of Coronavirus)

With the current exodus of migrant labours from cities to villages due to the coronavirus spread across globe can prove to be beneficial to take a step towards the quality production of rice during the kharif season. The panic of spread of infection has forced them to travel to the rural areas at the time of harvesting (rabi), which are carried out over March and April in different parts of the country.

It is estimated that about 68.84% of the total or 833 million people (Census 2011) live in rural areas which can prove be a bonus during the harvesting period of Rabi season and during the Kharif season for weed management in rice cultivation. This can be achieved by minimal or no use of herbicides for weed management in paddy and promoting the practice of hand weeding by labours.

Generally, hand weeding increases the total cost of cultivation of crop as it is a costly affair as compared to the chemical use. But in the present times, the coronavirus spread has led to a large availability of labours in the rural areas and thus, giving an opportunity to harness their availability for cheap rates in return for a sustained form of weed management in paddy. This might prove to be fruitful for the soil health as well as for chemical free production of rice in country.

Conclusion

In spite of being a really old practice of weed management, hand weeding still proves to be a very sustainable form of weed eradication method. It not only gives time to soil to recharge itself with nutrients but also protects the cultivated paddy from harmful chemicals and decline in toxic residue.

An opportunity worth catching became the sudden huge amount of exodus of the labours back to the rural areas, to their home, due to the coronavirus epidemic. This should be seen as an emerging right set of circumstances for low chemical paddy cultivation for this kharif season and should be applied on ground zero with immediate effect.

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Fig – The Fruit of Heaven

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Introduction

Fig was an important food crop for the ancient civilization of the eastern Mediterranean region. It is a highly nutritious fruit valued as fresh fruit as well as in a dried state. The fruit has a laxative property. The main countries that produce fig are Afghanistan, Greece, Iraq, Syria, Spain, Portugal etc.

Climatic and Soil Requirements

The fig is a subtropical fruit the optimum temperature for its good growth being 15.5 to 210C. Buds of most cultivars requires some winter chilling. In mild tropical and subtropical areas, figs exhibit continuous growth without a distinct rest period. However, the tree usually has a semi- deciduous habit and enters into mild dormancy during October-January. Fruit qualities are also got influenced by climate. A dry climate with temperature especially at the time of fruit development and maturation produces the best quality figs. High temperature like 35 to 380C will result in premature ripening of fruits. Similarly, very low temperature will result in splitting and poor-quality fruits.

Fig can be grown on a wide range of soil type. But deep, clay-loams are the best suited. Well drained alluvial clay loams or medium black soils are also good for fig cultivation. The fig is one of the most drought tolerant crops. It can tolerate sulphate and chloride salts. Soils having a high lime content produce fruits of better quality suitable for drying. But even a small amount of sodium carbonate in soil is injurious to fig. Major portion of the root system is distributed within 50-60 cm depth and hence the fig can also be grown in shallow soils of 2 feet where other fruit trees cannot be accommodated.

Types and Cultivars

The figs are classified into four types based on the nature of flowers and the methods of pollination:

1. Common Fig: The flowers are pistillate, Fruits develop by parthenocarpy viz., without the stimulation of pollination and fertilization. Kadota, Mission, Adriatic, Brown Turkey, Celeste and Conadria are some cultivars of this type. Poona is one of the most important commercially grown fig. Introduction and evaluation of exotic figs from California at IIHR Bangalore reveals that varieties like 'Deann', 'Conadria' and 'Excel' have uperior fruit and plant characters. These new varieties when grown on 'Brown Turkey' root stock (through chip budding) hold great promise for exploiting marginal lands in arid and semiarid regions.

2. Capri fig: This type has short styled pistillate and functional staminate flowers. Most caprifigs are not edible, but are grown because they harbour a small wasp viz., *Blastophaqa psenes* which is necessary for pollination and fruit set in other types like Smyrna fig by transferring the pollen grains from caprifig.

3. Smyrna fig: It is commercially the most important one. However, the fruits develop only when the flowers are pollinated with pollen from the male flowers of the caprifig transmitted by the Blastophaga wasp. Calimyrna is the common cultivar of this type.

4. Sanpedro fig: In this type, the first crop is completely parthenocrpic, but the second crop develops only if the flowers are pollinated. The common cultivars of this type are Sanpedro, King and Gentile. In India, common fig is mostly grown. Some of the cultivars grown are Black Itchier, Brown Turkey, Turkish White, Kabul and Marseilles. Yercaud Timla fig is a drought tolerant cultivar. Fruit are large and reddish purple in colour.

Propagation and Plantings

Rooting of hard wood cuttings is the common method of propagation in fig. Rooting was the best in cuttings from 3-year-old wood with 30-40 cm length and 1.5 cm dia. Cuttings from the base of the shoot and lower part of crown have to be used as they root better. Cuttings are taken during January-February at the time of pruning in North India whereas, the cuttings are taken during rainy season in South India. Fig can also be propagated by air layering, shield or patch budding and side grafting. Focus glomeration rootstock offers resistance to root knot nematode. A spacing of 5-7 M is recommended depending upon the fertility status of the soil for maximum yield. Planting season varies from place to place viz., South India – August – September, Western India – June – July, North India – January – February.

After Cultivation

To keep the trees more productive and to facilitate inter cultivation operations, the fig trees are trained to a desired height and shape. The fig tree bears tow crops in a year, the first crop on the wood of previous season and the second crop on new wood of current season. Pruning is necessary to induce growth of flower bearing wood. The time and amount of pruning are adjusted according to the growth habit and bearing capacity of the tree. Notching stimulates production of laterals on vigorous upright branches.

Manuring and Irrigation

Fig responds well to manuring. A quantity of 20kg of FYM, 500-600g N and 350-400g P_2 O_5 per year per tree can be recommended. Since it is a drought tolerant crop is mostly grown as rainfed crop. However, irrigation helps to increase the yield. During summer, the crop can be irrigated once in 10-12 days. Frequent irrigation lending to excess soil moisture will cause splitting of fruits. It should be borne in mind that during fruit ripening, the plants should not be given any irrigation because it will result in insipid fruits viz., fruits with bland taste.

Fruit Set, Harvest and Storage

It has been observed even in common fig or Adriatic fig, the phenomenon of parthenocarpy is altered by climatic condition of a particular location. Hence there is a possibility of failure of fruit set by a particular variety in a particular location. The parthenocarpic fruit set can be enhanced by spraying 25 ppm of NAA or IBA on the flowers. For Smyrna figs, inter planting of Capri figs should be done for effective fruit set.

The fruits should be picked when they are soft and wilt at the neck. If the fruits are picked before proper maturity, milky latex exudes. Fresh figs are highly perishable. Slightly immature fruits are to be harvested for transporting to distant markets. Ripe fruits are picked either form the tree by twisting the neck at eh stem end or by cutting it or gathered after thy drop. The harvesting season is mid-February to June. Yield ranges from 180 to 360 fruits per tree.

Fully ripe fresh figs can be kept only for about a week at 0oC with a 90 per cent relative humidity. To preserve in a dried state, first the fig fruits are soaked in boiling saltwater for half a minute and subjected to sun drying for a few hours. Then they are dried under shade for 8 days and stored in polythene containers. Another form of preservation of fig is drying in an electric drier at 70 – 72oC with prior sulphur fumigation.

Indigenous Storage Practices

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Introduction

Indigenous information is eco-friendly and safe each to man and his atmosphere. It's calculable to 60-70% of food product created within the country is hold on reception level in autochthonic structures starting from bamboo baskets to mud structure, burlap luggage and fashionable bins. Women have accumulated information of family practices over generations by observation, experimentation and by handling age recent people's experiences and knowledge. Bound practices square measure distinctive to a given culture of a society and vary between countries, regions, villages and even communities.

Autochthonic practices emanate from the cultural contact of the folks involved and evolve in shut contact with specific atmospheric conditions and square measure supported ancient societies intimate information of their environment. Day by day the autochthonic technique is relapsing therefore there's a necessity to come up with awareness and dissemination of the autochthonic technical talent among the agricultural areas. Ancient technical talent teaches America a way to best utilization of natural sources for defend storage lifetime of seed.

Different Ancient Storage Practices

Proper storage of food grains is important to forestall spoilage, increase keeping quality and for financial reasons. The observe of exploitation natural sources for storage of varied home items dates back to the terribly earliest periods of famous history. There's proof of ash, sand and herbs utilized in ancient civilization, that are attributable with mystical power for increasing storage life. Several of those practices realize their credibleness even within the era. The logic behind the employment of this material is that they're user friendly and are related to scientific reasoning.

1. Stored wheat seed with wheat Straw: The wheat (*Triticum aestivum* L.) Seed hold on with wheat straw is best and customary practices used by farmers, one layer of wheat straw and a pair of layer of packed in correct sun dried wheat in burlap luggage and once more one layer of wheat straw regionally known as Bhusa broadcast and well air tight. The complete structure is roofed around with columbiform bird pea Straw regionally known as Khariya. The farmers believe that the wheat straw produce air tight structure for shielding the wheat seed from wetness.

2. Wheat seed hold on with onions: Wheat seed is hold on with onion is another wheat seed storage observe of remote villages of Chitrakoot farmers (MP). During this autochthonic technical talent, the two kilograms of correct preserved onions unfold the lower layers of cylindrical instrumentality so placed on the bread wheat seed. Two to three layers should be adopted. This can be additionally helpful for shielding storage lifetime of seeds. Farmers believe that the odor of onion is organic repellent for insect.

3. Red gram storage with common salt (Cajanus cajan): Grain storage they'd used common accessible ingredient flavored in their house for storage purpose. During this practice, regarding 200gm of salt was mixed for a kilogram of shrub manually. These treated grains were then hold on in jute burlap luggage and therefore the luggage was sewing. Thanks to this observe, insect was unbroken aloof from the hold on grains. As salt had abrasive action on insect skin forestall its movement within shrub grain, for brief term within the storage instrumentality. Farmer believes that this observe hold on shrub grains, for brief term period of 6-8 months.

4. Ash seed treatment in sorghum: Ash was mixed with the sorghum seed at quantitative relation of 1: four when the ash treatment, sorghum seed were tied air tight within the jute burlap luggage .during storage grains were subjected to losses by varied insect e.g., *Sitophylus oryzae*, gnawer (*Tartera indica*) and Mite (*Oligonychus indicus*) farmers powerfully believe that ash controlled these losses significantly hold on the sorghum grains for six month with none storage blighter downside.

5. Finger millet storage with arishth leave: arishth (*Azarachta indica*) leaves the storage of Ragi the strong odor of those leaves keep the storage blighter like lesser grain borers (*Rhyzoperth dominica*),saw toothed (*Oryzaephilus surinamensis*) and flat grain beetle (*Cryptoleste minutes*) away being all-time low and easy most of the farmer followed this technology to induce eliminate storage blighter than to relay on costlier chemical treatment arishth leave being organic repellant were additionally safe to use.

6. Camphor use in hold on grain: During this observe regarding 1gm of natural resin piece per five kilograms of grains was placed in and of itself in jute burlap luggage. This observe of putting natural resin within the grain storage bag repelled the storage thanks to sturdy odour emanated from natural resin. Short term storage of grains up to three months was potential.

7. Pungam leaves in paddy storage: During this methodology recent pungam (*pongomia glabra*) leaves were placed as layers in between the burlap luggage organized one higher than different future rooms. These leaves acts as a repellent against gelechiid moth (genus *Sitotroga cerealla*) and rice weevils (*Sitophilus oryzae*). The storage odour free from pumgam leaves avoided the blighter attacked.

8. Storage of vegetables seeds with cow dung: Vegetable cultivator hold on the seeds autochthonic which can be used for sowing next season. When correct drying the seed were hold on in rubbish .farmer s collected recent rubbish and created, plate like spherical formed structure by sound it with hand regionally known as varati vegetable seeds like ash gourd (*Benincasa hispida*), gourd (*Lagenaria siceraria*) were then embedded in rubbish so dried underneath sun for 2-3 days.

When drying the seed get stacked on the varati. Varaties were then hold on in open / within picket box hold on seed during this methodology up to 1 year. Farmers believed that cow dungs have immunostimulant properties increase the germination (90%) and viability of the seed significantly. Recent rubbish should be used for effective storage.

9. Paddy husk in managing storage pests: In paddy (Oryza sativa) Angoumois gelechiid moth (*Sitotroga cerealella*) and *Sitophylus oryzae* (*Sitophilus oryzae*) harm was severe. Farmers hold on the paddy grains in stuff pots and placed paddy husk in prime layer (5cm) higher than it. Farmer had found that storage pests unreferred these stuff pots hold on with paddy husk. J) Mud pots in grain storage: Farmers perceived that grains and seed materials once hold on in stuff pot forestall most of the storage pests. For this they'd created mud pot of various capability and size with the assistance of clay and soil.

During this follow, grains and seed materials were sun dried and clean before storing in pots. First, farmers placed a circular ring like structure regionally known as Kothila product of paddy (Oryza sativa) straw on the ground. Higher than that ring they placed the pots crammed with grains the pot was organized one higher than. The opposite and therefore the prime most pot was then closed with a lid. This arrangement was sometimes created within the house at the corner region. The grains or seed materials hold on throughout this mud pots were unbroken safe faraway from wide range of storage pests for nearly six months. When six month the grains were taken out and subjected to sun drying and once more hold on in mud pots.

10. Storage of seeds with lime: Farmers traditionally followed a observe of storing pulse grains in conjunction with lime powder. Throughout this observe, farmers dusted concerning 10 weight unit of lime per kg of grains. Once thorough change of integrity they keep them in jute gunny bags. The lime had a property of emitting irritating odour that repelled insects and prevented the grains from hurt. By this fashion, grains are kept for even one year.

11. Gingelly seeds storage: Post harvest losses area unit notoriously high in oil seed storage like gingelly (*Sesamum indicum*) seeds. At farm level storage, farmers through their expertise practiced several easy ways of tormentor management. In gingelly seeds storage, combining some of (nearly 100gm) paddy (*Oryza sativa*) in storage instrumentation considerably reduced the infestation of cornmeal lepidopteron (*Plodia interpunctella*) and prevented the injury of seeds for consecutive three-month storage amount.

This was potential as a result of the larvae of cornmeal lepidopteron had a habit of webbing the gingelly seeds with its secretion. Simply before pupation, larvae submit to a 'wandering' part spinning additional silk threads, that in significant infestations may kind webbing that fully cowl the grain surface. How-ever paddy being sharp edged prevented the larvae in webbing of gingelly seeds. Hence, these pests avoid the feeding of gingelly seeds keep beside paddy. Farmers once required gingelly seeds, used sieves to separate the seeds from paddy.

12. Neem oil in seed storage: Farmers practiced autochthonal post-harvest procedures that sometimes not needed a high degree of technical skills and far price. One such follow was the utilization of Melia Azadirachta (*Azadirachta indica*) oil within the seed storage treatment. For one kilogram of pulses seed twenty cc of Melia Azadirachta oil was used.

Manually farmers applied the Melia Azadirachta oil over the seeds to coat the seeds uniformly. Melia Azadirachta oil acted as repellent against many insects like weevils, red flour beetles (*Tribolium castaneum*), Long headed flour weevil (*Latheticus oryzae*) and Cadra cautella (*Ephestia cautella*), etc.

It destroyed a range of insects largely assaultive legumes at the egg stage itself. The farmers had perceived the particular properties of Melia Azadirachta oil like repellence, feeding and ovipositional deterrence, growth inhibition, etc. And used them against the storage pests. Some farmers used Melia Azadirachta oil mixed with coconut oil/castor oil (1:1) for treating the seed materials against the storage pests.

13. Pulse grains storage with ash: This was AN age recent follow being practiced for over fifty yrs. Farmers indigenously keep pulse grains in stuff mud pots. For safe storage of grains, seeds were crammed in stuff pot to its ¾th volume and so remaining prime 1/4th prime was then lined with ash (wood/ trash ash).

By this manner, wide ranges of storage pests like pulse beetles (*Callosobruchus maculatus*), and Cadra cautella (Ephestia cautella) were unbroken beneath the management for an amount of 6-8 months. Once vi months, the grains were exposed to sun and so the ash was unfolding higher than the grains surface and unbroken for storage.

14. Storage of tamarind with salt: This follow was being followed from over thirty-five yrs. Farmers keep tamarind (*Tamarindus indica*) by combining salt with it. Once harvest, tamarind was far away from its pods and so keep in stuff pots in layers.

Farmwomen indigenously practiced spreading of salt in between the tamarind layers. For this follow, regarding ten grams of salt was used for per kilogram of tamarind. By this manner of storage, storage pests like beetles and cornmeal lepidopteron (*Plodia cautella*) were prevented. Conjointly the salt facilitates in loosening of the tamarind flesh straightforward for handling throughout trying.

15. Storage of grains with sweet flag: This methodology was being practiced for over forty yrs. Farmers practiced AN autochthonal approach of storing grains with marsh plant (*Acorus calamus*.) During this follow, marsh plant was high-powered and mixed with grains and seeds of pulses, cereals and oil seeds.

For treating one kilogram of grains, regarding ten gram of marsh plant powder was used. The grains may well be kept effectively for six months with none tormentor attack. The sturdy odour emitted from marsh plant acted as a repellent against all the storage pests.

Conclusion

The protection of keep agricultural merchandise against insect attack is crucial for safe and steady offer of high-quality food. Insect injury in keep grains and pulses might quantity to 10-40%. within the past, insect infestation was usually a less major problem as a result of farmers cultivated ancient varieties, which, though low yielding, were usually additional immune to attack by insects.

However, the introduction of high yielding varieties has resulted in exaggerated storage losses, as these varieties area unit typically liable to insect injury. Hence, storage of grains and seeds while not tormentor infestation is crucial. autochthonal practices have blessings over outside information, it's very little and no price and is instantly accessible.

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Use of Ethylene Scavenging Systems to Extend Postharvest Life of Horticultural Produce

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Introduction

Ethylene (C_2H_4) is a pure unsaturated hydrocarbon found in nature. It is a volatile compound of enormous significance as a phytohormone. This plant hormone formed by higher plants activates and controls various physiological mechanisms, ripening and senescence aspects of crops. Ethylene induces various physiological responses such as geotropism, ripening, dormancy, senescence and flowering.

The low concentration edge needed for triggering physiological activities validates that reducing ethylene during a closed atmosphere can help the postharvest durability of fresh produce, apart from these postharvest losses and quality deterioration of fruits and vegetables mostly due to the ripening process induced by ethylene and contamination because of micro-organisms. Ethylene scavenger is needed to enhance the shelf life of fresh produce and it is a classic alternative to the use of chemical and disinfectants.

An effective way to regulate ethylene production within the package is to use of an ethylene scavenger. Ethylene scavenger absorbs ethylene produced by fresh produce (fruits and vegetable) to control postharvest losses and quality deterioration. Removal of ethylene from inside the package is important to fruits and vegetables to enhance their storage life.

Ethylene Scavenging Mechanisms

Ethylene scavengers are effective in eliminating ethylene concentrations inside the package. The covalent bond present in gaseous ethylene makes it is a very reactive compound which can be changed or degraded in different ways. Ethylene scavenging can be done via chemical or physical methods. These methods exploit the capacity of some materials or treatment to oxidize, decompose or/and adsorb ethylene gas, employing various mechanisms.

Effective systems use is potassium permanganate ($KMnO_4$) immobilized on an inert mineral substrate such as alumina or silica gel. The alumina functions mainly because the absorptive surface to hold the molecules of ethylene gas and is a carrier for the permanganate. $KMnO_4$ is a wide-spectrum oxidizing agent which reacts with ethylene along with other contaminant gases. Ethylene is firstly oxidized to acetaldehyde, which successively is oxidized to acetic acid, and acetic acid is further oxidized to carbon CO_2 and H_2O. Physical adsorption of ethylene is as result of van der Waals force among the molecules of the adsorbent and the adsorbate.

Solid adsorbents via mesopores can adsorb separate and consecutive layers of adsorbate, whereas those with micropores have the size of the pores of 0.6–0.3 mm filled with the adsorbate. Solid adsorbents develop the selectivity to the adsorbate after the former go via particular alkaline treatments such as reacting under a gas stream or with definite agents. The standard physical adsorbents are activated carbon, carbon fiber, zeolite and silica gel.

Ethylene Scavengers

Ethylene scavengers are kind of active packaging material which is used to scavenge ethylene from the packaging headspace. These ethylene capturing materials are generally used in the form of sachets which are placed inside the packaging, coating on packaging material or in form of ethylene scavenging active films which control the excessive ethylene from the fruits and vegetables that generates inside the package during storage.

The approaches for the ethylene regulation can be divided into three main types: first as reduction in ethylene (through modified atmospheric packaging via swapping the various gases in the headspace). Second, use of perforated packaging material (through use of microperforated packaging materials to permeate the gases to inside and outside of package). And third, ethylene removal (by the use of ethylene scavenger).

Effective ethylene scavenger can be categorized into two main categories such as ethylene absorbers and scavengers; absorbers are those materials who physically absorb and hold ethylene molecule from the surrounding environment, and on the other hand, ethylene scavenger, where water absorption is by means of a chemical reaction between two materials. The latter can be applied in the form of sachets and films and are typically placed in fresh produce package.

Based on their mechanism of action, ethylene scavengers can be classified as:
1. Catalysts: Often based on platinum or alumina, these operate at elevated temperature (> 200ºc) and catalytically oxidise ethylene to carbon dioxide (CO_2) and water.
2. Sorbents: These materials work by sorption of the ethylene and are often based on high surface area materials, including activated carbon, clays and zeolites.
3. Stoichiometric oxidising agents: Mostly based on potassium permanganate ($KMnO_4$), which again oxidizes ethylene and is itself reduced.

Some potential ethylene scavenging materials by their nature for fresh produce packaging applications are classified as fallow types.
1. Natural clays: Zeolite, Japanese Oya stone, cristobalite, coral, bentonite, halloysite nanotube, ceramics.
2. Regenerable sorbents: Propylene glycol, polyethylene, hexylene glycol, phenymethylsilicone, squalene, polystyrene.
3. Catalytic oxidizers: Potassium permanganate, palladium, potassium dichromate, silver nitrate, iodine pentoxide.
4. Electron-deficient dienes or trienes: Benzene, pyridines, diazines triazines, tetrazines (Having electron-withdrawing substitutes)
5. Other: Activated charcoal, crystalline aluminosilicates, kieselguhr, silica gel, aluminum oxide.

$KmNO_4$ Based Scavenging Systems

Potassium permanganate is a widely used ethylene absorber which oxidizes ethylene to ethanol and acetate via the breakdown of ethylene's double bond. Though some carbon dioxide and water are produced, some partially oxidized species like carboxylic acids may also be formed. As, $KmNO_4$ oxidizes ethylene its color changes from purple to brown, and thus, a color change indicates its residual ethylene absorbing capacity, but due to its toxicity $KmNO_4$ cannot be used in direct contact with food. Because of toxicity nature, $KmNO_4$ are generally embedded on different adsorbing materials like porous inert material with a high surface area such as clays, silica (SiO_2) gel, zeolites, alumina (Al_2O_3), vermiculite and activated carbon.

Generally, such scavengers contain about 4–6% $KMnO_4$ on an inert substrate. Various oxidizers have been combined with adsorbents to remove the adsorbed ethylene like potassium dichromate, potassium permanganate, iodine pentoxide, each respectively embedded on silica gel. There are some commercial $KMnO_4$ based scavengers, for example Chemisorbant, MM-1000 MULTI MIX ® MEDIA, Bi-On® SORB and SofnofilTM.

Clay Based Scavenging Systems

Clays are hydrous covered aluminosilicates composed of two layers, including tetrahedral and octahedral layers. It may adsorb ethylene gas; they can also create pores inside the plastic bag and alter the gas transmission properties of the bag. Because ethylene diffuses more rapidly via open pore spaces inside the plastic as compared to, through the plastic itself, ethylene would be expected to diffuse out of these pouches faster than through pristine polyethylene film bags. Ethylene is possibly removed by physical adsorption on materials with active surfaces such as activated carbon, zeolites and some clay (for example pumice, cristobalite and clinoptilolite).

These clays can be contained into an ethylene-permeable sachet or fine particles of such clays can be incorporated into the packaging film through extrusion process like plastic films. Zeolites have porous with three-dimensional structure with cation interchange, adsorption and molecular separating properties. Thus, zeolites have been used in numerous industrial and agricultural applications, as well as an ethylene scavenging material integrated into packaging material like film.

Activated Carbon Based Scavenging Systems

Activated carbons are non-crystalline porous with structure and it is a form of carbon acquired by pyrolysis of carbonaceous substance. The initiation step of carbon is supported out to produce more pores and alter their volume, arrangement and size, and it can be done via physical and chemical methods. The maximum number of commercial grades of activated carbons typically retains a pore volume in between 10 and 25 Å in diameter and its surface area in between 300 and 4000 m2 g^{-1}, but very few of them can extend the surface areas up to 5000 m2 g^{-1}.

Activated carbons can be in the form of granular, powdered or fiber. The best ethylene adsorption capacity of activated carbons is carried out by using granular form compared with powder form and fiber forms because of its more natural regeneration and adaptability. Activated carbon can be merged with other compounds, for example $KMnO_4$, to increase its adsorption capacity. Activated charcoal impregnated with a palladium catalyst and placed in paper sachets effectively removes ethylene by oxidation from packages of minimally processed kiwi, banana, broccoli, and spinach.

Titanium Dioxide Based Scavenging Systems

The photocatalytic oxidation of gaseous ethylene includes exposure to ultraviolet (UV) radiation and the use of a catalyst such as titanium dioxide (TiO_2). At the surface of the catalyst, illumination with UV radiation generates reactive oxygen species (ROS) that further oxidize ethylene into CO_2 and H_2O. In contrast, irradiation with significant shortwave vacuum UV radiation inspires photochemical oxidation processes, leading to the creation of ROS in the gaseous phase via decomposing oxygen and molecules of water and these reactive species oxidize the ethylene.

One of the favourable solutions for ethylene elimination is a nano titanium dioxide based photocatalytic system. The titanium dioxide based scavenging system does not need high temperature or pressure for scavenging, and it is less energy demanding as compared to thermal catalytic oxidation. Such scavenging system does not need frequent replacements and produces nominal waste that is green technology. TiO_2 nanorods and tin oxide nanoparticles are also utilized to detect the discharge of highly volatile organic compounds.

Electron Deficient Diene or Triene Based Systems

Some ethylene scavengers are based on electron deficient dienes or trienes such as benzenes, diazines, pyridines, tetrazines and triazines; these compounds have electron withdrawing substituents, like fluorinated alkyl groups, sulphones and esters (e.g. dicarboxydecyl, particularly dicarboxyoctyl and dicarboxymethyl ester groups), which react quickly and irreversibly with gaseous ethylene at room temperature (23 °C) and eliminate ethylene from the package.

Such compounds can be incorporated into permeable polyethylene bags or printing inks to remove ethylene from fresh produce packages. The scavenger may also be used in the form of sachets and labels packaging applications. About 0.01–1.0 M of the dicarboxyoctyl ester derivative of tetrazine combined in polymeric films was confirmed to be able to affect a tenfold drop in ethylene gas in sealed jars in 24 h and a 100-fold reduction within 48 h.

Conclusion

Ethylene can induce negative changes on postharvest quality of fruits and vegetables. In order to minimize the concentration of ethylene and enhancing the shelf life of horticultural products, ethylene scavengers can be used. Scrubbers using SiO_2 gel or zeolite as $KMnO_4$ supports seem to be a promising tool to slow down the ripening process and prolong shelf life of horticultural produce.

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Microplastic Menace in Soil Environment: Source, Impact and the Way Forward

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Introduction

Microplastic pollution has emerged as a serious concern, and has been listed as the second important scientific issue in the field of environment and ecology (Horton et al., 2017). Terrestrial systems have received far less scientific attention than their aquatic counterparts. Notwithstanding, microplastic contamination on land might be 4-23-fold larger than in the ocean (Horton et al., 2017). Indeed, agricultural soils alone might store more microplastics than oceanic basins (Nizzetto et al., 2016).

What Microplastics are?

The term of "microplastics" was first coined by Thompson in 2004 (Thompson et al., 2004). Recent reviews claim that plastics, including many reported as biodegradable, are actually more prone to disintegration than degradation. Thus, macroscopic plastic pollution generates particles smaller than 5 mm, which are commonly referred to as microplastics (MP). The Joint Group of Experts on the Scientific Aspects of Marine Environmental Protection (GESAMP), defines microplastics as plastic particles < 5 mm in diameter, which include particles in the nano-size range (1 nm) (GESAMP, 2016).

General Characteristics of Microplastics

The characteristics of microplastics have been reported by Leslie, 2014 as:

1. Synthetic materials with high polymer content.
2. Solid particles.
3. Smaller than 5 mm
4. Insoluble in water.
5. Not degradable.

Type of Microplastic According to Polymer

Microplastic and their diverse polymer constituents can be characterized following Driedger et al., 2015.

Polymer type	Abbreviation	Examples/ Source
Polyethylene terepthalate	PET	Bottles
Polyester	PES	Clothing
Polyethylene	PE	Common plastic
High density polyethylene	HDPE	Thick plastic containers
Polyvinyl chloride	PVC	Plumbing pipes
Polypropylene	PP	Drinking straws
Polyamide	PA	Nylon products
Polystyrene	PS	Beads used in beads

Types of Microplastics According to Source

Plastics find their way to terrestrial environments through different sources and as a result of certain trends and practices. A distinction of sources and pathways can be made based on the type of plastic particles found in the environment – whether as intentionally manufactured microplastics leaking to the environment (primary microplastics viz. Sewage sludge; Coated fertilizers), fragments of macro-plastics already present in the soil environment, or plastics disintegrating into microplastics prior to reaching the soil environment (secondary microplastics viz. plastics in compost, greenhouse, mulches etc). They may be of various shapes like films, flakes, beads, fibres, spherical beads, etc.

Effects of Microplastics in the Soil Environment

As with the concerns with plastics in other sector, there are issues with their application in agriculture also. Over time, film residue can decrease soil porosity and air circulation, change the microbial communities, and potentially lower farmland fertility. Fragments of plastic film have also been shown to release potentially carcinogenic phthalate acid esters into the soil, where they can be taken up in vegetables and pose a human health risk when the food is consumed. Film fragments left in fields can also accumulate pesticides and other toxins applied to crops. This is a special risk for sheep, goats and other livestock grazing on crop stalks because of their potential to ingest plastic material or the chemicals that leach from it. Further if this toxic plastic makes its way into rivers and oceans, which can be toxic for aquatic life.

1. Effect on water movement: The most important consequence is that the residue can prevent the penetration and flow of water within the plough layer and surface layer of soil, reducing infiltration and affecting the water absorption of the soil.

2. Effect on earthworms: A mixed response on the earthworms was reported. In one study, earthworms *Lumbricus terrestris* exposed to concentration of 28% microplastics (w/w in dry plant litter) and above, experienced growth inhibition (1.4 mg weight gain compared to 10.3 mg weight gain in control with no exposure to microplastic) and subsequently died (8–25% compared to 0% in control with no exposure to microplastic) even though their reproduction was unaffected (Huerta Lwanga et al., 2016). These are high exposure concentrations that could occur under contaminated land scenario. Another study using Eisenia fetida exposed to 0.25 and 0.5% of microplastic (w/w in dry soil) showed no growth inhibition, with growth inhibition only occurring at exposure concentrations 1% (Cao et al., 2017).

3. Effect on algae: Studies on algae in the aquatic environment showed that nanoplastics are adsorbed onto the cell wall of algae such as Scenedesmus, Chlorella and *Pseudokirchneriella subcapitata* (Bhattacharya et al., 2010). These experiments, indicated these nanopolystyrenes were not lethal to the algae at concentrations up to 100 mg/L. However, they did reveal that these nanoplastics can lead to the physical inhibition of algal photosynthesis due to increased water turbidity and light scattering, coverage of the algal cell surface with microplastics, or immobilisation of algae at concentration of around 1.5 mg/L and above (Bhattacharya et al., 2010).

4. Effect on microbial activity: de Souza Machado et. al., (2018) reported that application of microplastic particles in soil have led to the decrease in microbial activity. As a result, various fundamental processes in the soil will slow down. There will be decrease in organic matter decomposition, less nitrogen fixation, poor soil structures, less availability of nutrients and poor soil health.

5. Effect on soil aggregation: Studies have revealed that soils contaminated with microplastic particles decrease the number of water stable aggregates (de Souza Machado et al., 2018). This decrease in water stable aggregates affects various soil physical properties. Stable aggregates can provide good pore spaces that are useful for air, water, nutrient and biota movement within the soil. Large pores associated with water stable aggregates favour high infiltration rates and appropriate aeration for plant growth. Weak aggregates lead to disintegration of structure and clogging of pores. Weak aggregates at the surface may lead to the problem of surface crusting. Surface crusting prevents infiltration and enhances runoff. It also affects seed germination.

6. Groundwater pollution: Rillig (2012) commented that microplastics can migrate through the soil profile and reach the groundwater. Bläsing and Amelung (2018) also warned of the potential of nanoplastics or colloids to pass through macropores and coarse soil. Scheurer and Bigalke (2018) suggested the probability of microplastics to be transferred to groundwater in areas with high groundwater table and coarse soils. Heavy metals have been observed to be adsorbed on the surface of microplastics (Brennecke et al., 2016). Microplastics can move vertically within the soil and can leach or move through cracks along with other pollutants to groundwater, these adsorbed heavy metals can reach the ground water with these microplastic particles and lead to contamination of groundwater with these heavy metals. This contaminated groundwater when used for agricultural purposes will lead to accumulation of these heavy metals in the soil and cause phytotoxicity. Various organic pollutants and pesticides like phenanthrene and DDT have also been observed to be adsorbed to microplastic particles (Bakir et al., 2014). The contaminated groundwater may even be used for consumption purposes. Evidence of pathogenic bacteria Vibrio sp. present on microplastics have also been found

(Kirstein et al., 2016). The consumption of the contaminated ground water may lead to various physiological disorders in various organisms.

How to Combat the Microplastic Pollution?

1. Manufacturing of biodegradable plastics and their use in agriculture- Cellulose acetate (CA) is a synthetic product that is derived from cellulose that is found in each part of a plant. Research shows that CA degrades and is reduced by 70% of its weight after 18 months in nature. There are a few new fossil fuel plastics that are also biodegradable. The most common ones are Polybutylene succinate (PBS), Polycaprolactone (PCL), Polybutyrate adipate terephthalate (PBAT) and Polyvinyl alcohol (PVOH/PVA).

2. Safe collection and proper disposal of used plastics.

3. Use of natural mulches such as rice straws, hay, leaves etc. as these will reduce the cost of cultivation as well as provide natural materials to soil for degradation.

4. Banning or controlling the use of oxo-plastics- These contain additives that cause the material to become brittle and break apart into fragments when exposed to UV light, heat and/or oxygen. Several studies show oxo-degradable plastics fragment in field conditions (Steinmetz et al. 2016).

5. Controlling or banning the use of microplastic beads in cosmetics- Plastic microbeads can no longer be used in cosmetics and personal care products in the UK and US. Such initiatives must be further aggravated.

6. Screening of microplastic particles coming from sewage and sludge through filtration- Wastewater treatment plants (WWTPs) can act as a barrier but also as entrance routes for microplastics to aquatic environment. Conventional wastewater treatment with primary and secondary treatment processes can remove MPs from the wastewater up to 99%. Several filters and microplastic removal methods are in use such as discfilters, rapid sand filters, dissolved air floatation method and membrane bioreactors (Talvitie et.al., 2017).

7. Use of degradable coatings for coated fertilizers- Very common example for bio degradable coated fertilizers is the neem coated urea. Treinyte et. al. (2017) showed that these coatings did perform the task of slow release of fertilizers as well as the coatings of the granules of the fertilizers strongly influenced the development of the systems of roots of tomatoes.

8. Screening of plastics before composting.

9. Microbial degradation- Several bacteria species have been reported to degrade plastic polymers. For example, polyethylene was degraded by Staphylococcus sp., Pseudomonas sp., and Bacillus sp., isolated from soil (Singh et al., 2016), and polystyrene was degraded by *Rhodococcus ruber* (Mor and Sivan, 2008).

Conclusion

It is evident that the microplastics that enter the soil environment through various sources adversely affect the soil health. Its movement in the soil has been seen and it has been speculated by many scientists that it can also reach the ground water along with the organic and heavy metal pollutants. It has also been observed that it does get sequestered into soil aggregates and also been seen to decrease the number of water stable aggregates. Its effect on water movement, on earthworms, algae, microbial activity, groundwater etc has been seen. Although uptake of microplastics by plants has not yet been observed but studies still need to be done on its direct effects on plants. Since it is ingested by earthworms, these microplastics can find a way into the human body through food chain (Weithmann et al., 2018). We can say that these tiny particles of anthropogenic origin do affect the soil health adversely. The effect on soil health will also adversely affect the food production capacity. In this era of growing population where the number of mouths to be fed is increasing rapidly we cannot afford to be held back by our own activities. Although there are some microbes which have been discovered to degrade plastics the research on microplastic population is still scarce and we still do not know the amount of damage it has already done. We need to raise awareness about these tiny miscreants and start taking this type of pollution seriously.

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Urban Farming: The Food for Future

Article ID: 30703

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Introduction

In the past days, the vegetables and fruits plants were growing at backyard homes in villages and towns. Be that as it may, in ongoing patterns, due to the urbanization and populace blast to meet the food security of people in the future, unpredictable utilization of pesticides and synthetic fertilizers has begun to build the food production. Along these lines, it is making an irretrievable wellbeing threat to people. So, as to conquer this, the cultivation of fruits and vegetables on the lawn or terrace of the house has again risen.

Necessity of Urban Farming

Balanced diet is significant for people's physical and psychological wellness. A Balanced eating routine comprises supplements, nutrients, minerals, proteins, fiber, and furthermore an adequate amount of water. On the off chance that the eating regimen isn't adjusted, there is a danger of contracting resistance status. Along these lines, it is prudent to devour a reasonable eating regimen of 150 everyday fruits and vegetables of 300 every day as indicated by the Indian Council of Medical Research.

Advantages

1. Large consumption of nutritious vegetables.
2. Save the expense brought about on the acquisition of fruits and vegetables.
3. It expands the greenery around the house and can diminish atmospheric contamination and thus get fresh air.
4. Procurement of fresh fruits and vegetables for consumption by cultivating it in natural way.
5. Lessens Global warming.
6. Upsurges the aesthetic worth of the house.

Containers Utilised for Urban Farming

1. Clay pots: These pots are comprised of prepared clay and are accessible in different sizes for cultivating fruits, vegetables and ornamental plants.
2. Plastic jars: These are very easy to use again, without holes and can be kept in low space.
3. Fibre pots: These are little pots that are round or square around 5-10 cm in size.
4. Stone pots: The moisture in these pots is dries up speedily. Plants get healthy air.
5. Polythene bags: These are utilized to cultivate large fruit trees.
6. Hanging baskets: These are utilized for growing small ornamental plants.

Growing Plants in Containers

Growing vegetables in plastic basins, porcelain containers and pots accessible to us is called Horticulture cultivation with containers. The vegetables incorporate tomato, carrot, eggplant, Bhindi, Cabbage, Cauliflower, Brinjal, Onion, radish, peas, potato and green leafy vegetables and mostly strawberry fruits. Holders ought to be chosen dependent on the vegetables that are to be cultivated. The chosen holder ought to have a drainage system for perforation for easy flow of the abundance of water and supplements.

These containers can be mounted on the terrace in the courtyard of the house, on the back or on the stair wall. Wooden boxes, bamboo containers, and drums can likewise be utilized, given the base ought to be punctured to stay away from any sewage. The establishment of the containers ought to be done on the sunny spot on the terrace.

Filling of the Containers

Foremost polythene paper ought to be covered in a plastic plate. At the point when the water is high, make a little gap on the base of the holders to drain the water. Put one inch of soil on the base and afterward two inches of vermicompost off the ground and another inch of vermicompost on the top.

1. Maintenance of Farming.
2. Spray the water each day till the seed sprouts at the base.
3. Watering the plants ought to be done once in a day.
4. The use of fertilizers ought to be done to build the development and yield of the plants.
5. To shield the plants from pests and diseases, shower the plants with Neem oil and establishment of yellow sticky traps.

Conclusion

Urban farming assists with cultivating fruits, vegetables, flowers, ornamentals and medicinal plants which are required for house purpose. Farming expands the beautification of the house and keeps the mind fresh and calm from urban life.

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Precision Agriculture: Modern Agriculture Revolution and its Importance in Site-Specific IPM

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Introduction

Precision farming techniques can improve the economic and environmental sustainability of crop production. In today's agriculture, producers tend to farm each field as a single unit. Although they often recognize in-field variability, they have had few tools with which to manage that variability. As a result, producers have based management decisions on average conditions, hoping that the inputs would be adequate for most of the field. Precision farming uses information technologies to segment a field into smaller units and determine each unit's individual characteristics. In this way, the producer can apply production inputs in the precise location and quantity they are needed for maximum economic yield.

Precision Farming Process

Precision farming process involves collecting accurate spatial data on crops, and using this to manage a farming operation more efficiently, and hence more profitably. A simpler approach to input management is to divide the field into high-, medium-, and low-yield zones and take a sample from each. This is less time-consuming and costly than grid-sampling, but does not, of course, provide as much detail (Joubert, 2012). Precision farming is a process where a large field is divided into a finite number of sub-fields, allowing variation of inputs in accordance with the data gathered. Ideally, this will allow maximization of return on investment, whilst minimizing the associated risks and environmental damage (Subrata and Atanu Maity, 2013).

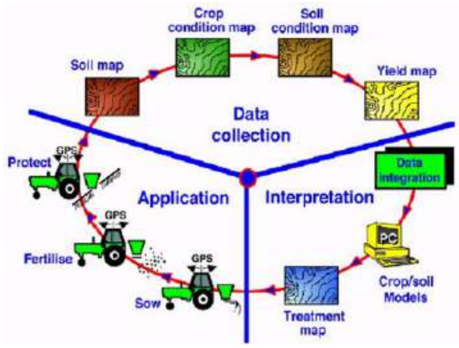

Fig.1 Elements of PA

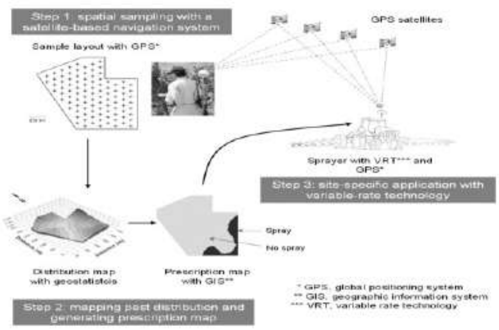

Fig.2 Three main steps of site specific IPM

Precision Pest Management

The art and science of utilizing advanced technologies for enhancing crop yield while minimizing potential environmental threat to the planet (Khosla, 2001). In conventional agriculture, without considering this variability pesticides were applied at a uniform rate throughout the field this led to many problems. In contrast to this Precision Pest Management (PPM) has developed, which emphasizes on judicious pest management at micro-level.

Components of PF

1. Geographical information system (GIS).
2. Global positioning system (GPS).
3. Remote Sensing (RS).
4. Variable Rate Technology.
5. Farmer (Sharma et al, 2005).

Geographical Information System (GIS)

As the precision pest management is information based and concerned with spatial and temporal variability of pest population, GIS is the part and parcel of it. GIS is the key to extracting value from information on pest population dynamics. It is the brain of precision farming system. It is the spatial analysis capabilities of GIS that enable precision farming (Clark and McGucken, 1996). But due to complex nature of available GIS software packages, non-specialists may find it difficult to practice in pest management. Therefore, some simple, easy to use formats need to be developed for suitability of this technology in production agriculture including pest management. The pest population dynamics could be better understood through computer simulation modelling and linking of GIS with these models are crucial for precision management (Goodchild et. al., 1993).

Global Positioning System (GPS)

GPS is a navigation system based on a network of satellites that helps users to record positional information (latitude, longitude and elevation) with an accuracy of between 100 and 0.01 m (Lang, 1992). GPS allows farmers to locate the exact position of field features, such as soil type, pest occurrence, weed invasion, water holes, boundaries and obstructions. There is an automatic controlling system, with light or sound guiding panel (DGPS), antenna and receiver. GPS satellites broadcast signals that allow GPS receivers to calculate their position. In many developed countries, GPS is commonly used as a navigator to guide drivers to a specific location. GPS provides the same precise guidance for field operations. The system allows farmers to reliably identify field locations so that inputs (seeds, fertilizers, pesticides, herbicides and irrigation water) can be applied to an individual field, based on performance criteria and previous input applications (Batte and VanBuren, 1999).

Remote Sensing (RS)

It is the art and science of getting information about an object or phenomenon without being in physical contact with that object or phenomenon. Remote sensing is already being used for soil mapping, terrain analysis, crop stress, yield mapping and estimation of soil organic matter, but on a scale larger than what is required for precision agriculture. Remote sensing at high resolution can be of great use in precision pest management because of its capacity to monitor the spatial variability (Moran et. al, 1997). The remote sensing satellites send a known signal towards the earth and a part of the signal is reflected back. The image data are actively collected by measuring the Sun's energy reflected by an object or electromagnetic energy emanated from an object. Remote sensing can be of various resolutions, spatial coverage and frequencies e.g. measurement of the intensity of disease infestation will require higher resolutions than what is required for monitoring weed infestation (Biswas et. al, 2008).

Variable Rate Technology

VRT systems set the rate of delivery of farm inputs depending on the soil type noted in a soil map. Information extrapolated from the GIS can control processes, such as seeding, fertilizer and pesticide application, and herbicide selection and application, at a variable rate in the right place at the right time. Variable rate application requires controllers, which change the application rate on the go, and actuators, which respond to the controller to regulate application (Batte and VanBuren, 1999). Variable Rate Technology (VRT) refers to the instrumentation used for regulating application rates of fertilizer, lime, pesticides, and seed as an applicator travels across a field, based on a decision support system and(or) management plan. VRT provides the opportunity to manage production based on soil type, soil texture, organic matter, nutrient levels, soil pH, weed and insect populations, disease, spatial pattern of nematode populations, desired yield, and other factors (Strickland et. al, 1998).

Farmer

Farmer is the essential component of precision agriculture and obviously, will be the same in precision pest management too. For assessing and managing the variability of pest populations, decision making is the key factor ad ultimately that is to be done by the farmer. In a wider perspective, it is true that farmers do practice precision pest management where the decision is based on variability what perceive rather than real variability that exists. Precision pest management in information and knowledgebase practice. Therefore, farmers have to be trained adequately so that they can monitor the dynamics of pests and diseases and take right decision at the right moment (Biswas et. al, 2008).

Opportunities

Despite the many obstacles listed earlier, business opportunities for precision farming technologies including GIS, GPS, RS and yield monitor systems are immense in many developing countries. In Japan, the market in the next 5 years is estimated at about US $ 100 billion for GIS and about US $ 50 billion for GPS and RS (Srinivasan, 2001). Punjab and Haryana states in India, where farm mechanization is more common than in others, may be the first to adopt precision farming on a large scale (Srinivasan, 2001).

Recently, the governments of certain Asian countries initiated special efforts to promote precision farming. In Japan, the Ministry of Agriculture has allocated special funds for research on remote sensing applications of precision farming. A quasi-governmental institute "Bio-oriented Technology Research Advancement Institute (BRAIN)" is also funding research on precision farming. In Malaysia, the Malaysian Agricultural Research and Development Institute (MARDI) is promoting research on precision farming of upland rice. In other countries, the private sector, which holds or leases a large acreage, is likely to adopt precision farming sooner than the small holders.

Conclusion

Precision farming in many developing countries including India is in its infancy but there are numerous opportunities for adoption. I believe that progressive Indian farmers, with guidance from the public and private sectors, and agricultural associations, will adopt it in a limited scale as the technology shows potential for raising yields and economic returns on fields with significant variability, and for minimizing environmental degradation.

Although, it is recognized that agriculture is a major polluter of the environment in many developing countries, farmers will not adopt precision farming unless it brings in more or at least similar profit as compared to traditional practice. The support from governments and the private sector during the initial stages of adoption is, therefore vital. It must be remembered that not all elements of precision farming are relevant for each and every farm. Precision farming cannot be convincing if only environmental benefits are emphasized. On the other hand, its adoption would be improved if it can be shown to reduce the risk.

We must be cautious, however, is not overselling the technologies without providing adequate product support. The adoption of precision farming also depends on product reliability, the support provided by manufacturers and the ability to show the benefits. Effective coordination among the public and private sectors and growers is, therefore, essential for implementing new strategies to achieve fruitful success.

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Little Millet: A Crop for Climate Resilient Agriculture

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Introduction

The earliest agricultural practices mostly consisted of altering the indigenous flora and fauna for benefits. The genetic base accessible for exploitation and manipulation was very broad at that time. As the agricultural practices became more sophisticated and population increased abruptly, demanding for more production, the focus shifted largely to the crops which provided food security coupled with high production.

Thus, the number of plants which were in popular cultivation gradually declined. The attention of the people hence shifted from local varieties to varieties which had high production, even though they were alien. The situation still more aggravated after Green Revolution, which focused the attention of farmers as well as scientific community to the small number of high-yielding plants and varieties. But the rapid climate change has forced the attention of researchers to search for the plants which can rapidly adapt to the drastic climate change and adapt in any type of environment.

As a result, recent years have seen an increasing amount of works concerning the use of minor crops, to identify plants suitable for a large range of environment. Millets are one such type of group. Minor millets are often an overlooked staple food crop for millions of people, living in the harshest and food insecure regions in the world. Due to their rich nutritional value and extreme resilience to drought and other abiotic stress, they make a valuable food security crop for millions of people in marginal environment. Among the minor millets, the little millet is one of the least exploited crops.

Little millet *(Panicum sumatrense)*, belongs to the Poaceae family. It is believed to have originated from wild taxa *Panicum psilopodium* through natural selection (Hiremath et al., 1990). It is an annual erect and self-pollinating tetraploid (2n=36) crop commonly known as 'Kutki'. It is one of the important small millets indigenous to Indian subcontinent. It is grown throughout India, in more than half a million hectares, on light red soils and hillsides as a rainfed crop (Nirmalakumari et al., 2010; Mall and Tripathi, 2016).

It is widely grown in marginal areas and is associated with tribal agriculture (Kumar et al., 2017). It is cultivated both in the tropics and sub-tropics and even at an altitude of 7000 ft (Nirmalakumari et al., 2010). The grains are enclosed in hard seed coat and thus require excessive milling for the recovery of grains. The grains resemble small rice grains and can be cooked in a similar way. Since the post-harvest processing is very tedious, the crop is not in popular agriculture.

Nutritional and Health Benefits of Little Millet

Millets are three to five times nutritionally superior to other cereals like rice and wheat. They are found to be rich source of proteins; fatty acids; minerals like calcium, iron, potassium, phosphorous, magnesium and zinc; vitamin B; dietary fiber and polyphenol contents. Millet protein contain large amount of essential amino acids particularly Sulphur containing amino acids like methionine and cysteine (Amadou et al., 2013). Little millet like any other millet is nutritionally superior to cereals.

They are rich in crude fiber, protein, vitamins and other essential amino acids. It is rich in vitamin B and has high nutritional value especially due to the presence of phosphorus and iron (Mall and Tripathi, 2016). The grains contain proteins (9.80-12.49 g/100 g), fat (2.87-5.09), ash (0.98-4.78), crude fiber (0.49-8.72) and carbohydrates (62.25-76.59 g/100 g) (Usha et al., 2011). The zinc content of the grains varies from 2.04-8.00 mg/g, iron content from 1.49-23.38 mg/g and calcium content ranges from 1.14-13.15 (Manimozhi Selvi et al., 2015). The grains contain 0.24 to 0.58 mg/100g copper and 0.08 to 0.16 mg/100g, 0.24 to 0.58 mg/100g, 0.08 to 0.16 g/100g (Kundgol et al., 2014).

Millets have low GI (Glycemic index) and no gluten content, which makes them more suitable for the people with allergies and intolerance of wheat. They are also good for type 2 diabetic patients and can reduce the risk of heart disease. They are rich in starch, protein and fiber and thus can be used as high energy food (Mall and Tripathi, 2016). As little millets contain no gluten, it has become a natural choice for those with celiac disease or other forms of allergies and intolerance of wheat (Saturni et al., 2010). The little millet grains are also found to have antioxidant activity. The antioxidant activity in processed millet grain is higher than whole millet grain.

The processed millet grains exhibit a higher iron reducing power, which is highly desirable for the use of base material in healthy food formulations (Kundgol et al., 2014). The processed millet grains also contain phenols, flavonoid and tannins (Pradeep and Guha, 2011). Millet foods are considered as potential prebiotic which can enhance the function of probiotics providing health benefits (Amadou et al., 2013). Considering the various health benefits, it can be used in preparation of variety of dishes such as idli, dosa, vada, bajji, murruku, pongal, mudda, kichidi, pulav/biryani, upma, bread and biscuits. Thus, little millet can serve as an ideal alternate food crop for rice and wheat for its high nutritional value and health benefits.

Biotic and Abiotic Stress Tolerance of Little Millet

Millets are known for their climate-resilient features such as adaptation to wide environmental conditions, less reliance on synthetic fertilizers, less irrigational requirements, minimum vulnerability to environmental stress. They can also obtain better growth and productivity in low nutrient input requirement (Bandyopadhyay et al., 2017). The millets are C4 photosynthetic plants and have a short life span of about 12-14 weeks, which are also added advantage in contributing towards climate resilience.

Little millet is usually cultivated on red soils and hillsides in marginal environments as a rainfed crop, which is usually never irrigated (Mall and Tripathi, 2016). They can tolerate drought condition and are suitable for cultivation in adverse environments like dry, semi-arid to sub-humid drought-prone agro ecosystems. The drought conditions induce gradual increase in length of root in all growth stages, increase in number of solutes like glycine betaine, proline, carbohydrates, leaf protein and other free amino acids. The activity of antioxidants like superoxide dismutase, catalase and peroxidase are also increased in stress condition. The amount of pigments like chlorophyll a, chlorophyll b and total chlorophyll decreases during water stress conditions. These physio-chemical adaptations prove that little millets are extremely drought tolerant (Ajithkumar and Pannerselvam, 2014; Patil et al., 2018)).

The little millet plant can thrive in wide range of environmental conditions and can tolerate a wide range of insects and pests. The studies reveal that, the plant is especially resistant to grain smut incidence. The late maturing cultivars are particularly resistant to the disease (Kumar et al., 2017). Early maturing cultivars are more susceptible to grain smut caused by Macalpinomyces sharmae. However, the disease incidence can be effectively reduced by seed treatment with carboxin @ 2g/kg of seed + 0.05% carbendazim foliar spray (Jain et al., 2012). The plant is affected by banded leaf and sheath blight caused by Rhizoctonia solani, but some cultivars show resistant to the disease (Chouhan, 2014).

Conclusion

Little millet is nutritionally superior to cereals, yet its utilization is limited and is restricted to only certain cultural occasions in certain parts of the country. It can tolerate extreme environment conditions and can be cultivated in diverse and adverse environments. It can prove to be a very important crop in the scenario of rapid climate change. Yet it is not in widespread cultivation and is one of least exploited crops. However, there is a need to restore the lost interest in this millet due to its potential nutritional qualities and health benefits.

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Locust Swarm Alert and its Control Through Natural farming

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Locust Swarm Attack Alert

In the middle of the coronavirus pandemic, India has to fight another battle against the swarms of locusts that have entered the western parts of India. Swarms have already made their way into Rajasthan, Gujarat, Madhya Pradesh, Uttar Pradesh, Punjab and Maharashtra. The current locust invasion is the worst in India since 1993. As per the locust forecasting by United Nation's food and agriculture organization, the current locust outbreak is the biggest in 25 years in Ethiopia and Somalia, 27 years in India, 70 years in Kenya.

The locust attack is likely caused due to additional cyclones in the African region. The outbreak originated from two cyclones (May and Oct 2018) that allowed three generations of breeding - from June 2018 to March 2019 - in the Arabian Peninsula, and caused an 8,000-fold increase in locust numbers. The locusts currently attacking crops in India bread and matured in Iran and Balochistan in Pakistan. Still the swarms of locusts breeding in Horn of Africa are likely to reach India and Pakistan next month and could be accompanied by other swarms

About 90,000 hectares in 20 districts of Rajasthan have been affected due to the locust attack. Swarms of locust have moved from Sri Ganganagar, Nagaur, Jaipur, Dausa, Karauli and Swai Madhopur towards other areas in Gujarat (Amreli, Surendranagar and Bhavnagar districts), Uttar Pradesh (Jhansi, Agra and Delhi's neighbouring Guatam Budhh Nagar), Punjab (Fazilka and Muktsar district), Madhya Pradesh (Neemuch, Ujjain, Dewas, Mandsaur, Sheopur, Morena, Tikamgarh, Panna, Chatarpur, Sehore, Raisen, Hoshangabad and Harda district) and Maharashtra (Amravati, Wardha and Nagpur district) after the authorities conducted operations to tackle them. It is also expected to move towards parts of Telangana, Karnataka and Andhra Pradesh.

The desert locust attack has wiped out crops spread over 50,000 hectares across states of Rajasthan, Gujarat, Uttar Pradesh, Punjab, Madhya Pradesh and Maharashtra. Locusts have destroyed lush green fields laden with crops like bajra, sorghum, maize, green gram, black gram, castor, wheat, cotton and vegetable crops (FAO, 2019).

Locust Management on Cultivated Crops

1. Spraying the crops with Neem based insecticides (Azadirachtin 1500 ppm) @ 5 ml/lit with any sticking agents like soap solution as a prophylactic measure
2. Spraying of insecticides like Malathion 50 EC @ 1.5 ml/lit or Chlorpyriphos 20 % EC @ 2.5 ml/lit during evening hours.
3. Dusting the crops with Malathion 5% DP or Fenvalerate 0.4% DP @ 25 kg/ha
4. Spraying of Entomopathogen *Metarhizium anisopliae* (strain IMI 330189) @ 2.5 x 1012 conidia/ha
5. Mechanical control Methods such as digging trenches dusted with Malathion 5% DP for hoppers to fall into or beating hoppers with branches
6. Baiting - Mixing insecticide dust of Malathion 5% DP or Fenvalerate 0.4% DP with a carrier such as maize meal or wheat bran, and scattering the mixture among or in the path of the locusts (5-15 kg/ha for marching bands and over 50 kg/ha for settled hoppers and adults). Farmers should make sure that the livestock should not eat the bait.

Locust Control Through Natural Farming

Multi layered crops designed for 365 days green cover with intercrops of cereals, pulses, oil seeds and vegetables, medicinal plants and flower plants will maintain the crop ecology. This natural ecosystem supports the growth of natural enemies. Many deterrent crops /trap crops present in the crop ecosystem that protect the attack or minimize the attack by Locusts. Further spraying of Botanical pesticides and antifeedants certainly keeps away the locust swarms from Natural farming fields. Bund plantations, boarder crops will further minimize the damage (John, 2002).

Integrated farming systems, growing of desi poultry and fisheries will minimize the damage, as Locust become food for chicken and fishes (Particularly young instars). Details are described below.

1. Deterrent plants: Marigold, chrysanthemum, Jasmine, mint, Onion, Garlic and coriander repel the locust. Planting these plants as trap crops in the major crops keep away locust swarm. Natural farming practices recommend flower crops in between major crop. Coriander and mint as green mulch crop between rows may be useful for pest reduction and for extra income. Other weed plants like Lantana also repels pests.

Fig. 1 Marigold

Fig. 2 Ginger

2. Trap crops: Although grasshoppers will feed on many different plants, they often prefer and cause the most damage to Pulses, Beans, Maize, Sweet corn Soybeans, Cotton, Rice, Grasses, Tobacco, Carrots, Onions, Tomatoes. We can distract grasshoppers and locusts from eating crops by growing different plants around fields and inside the fields. For example; Marigold. Marigolds also repel other insect pests, including nematodes and whiteflies. In Natural farming, growing of Marigold as trap crops is common practice.

3. Boarder plantations (Trees and shrubs): Planting trees and shrubs around fields and on buds create crop ecosystem. These will be used for anchoring birds which are natural predators. Trees and Shrubs deter locust laying eggs. These trees, shrubs and flowering plants shelter birds, parasitic wasps and other natural enemies of locusts and grasshoppers.

4. Green mulching: Grasshoppers and locusts like areas with some vegetation but not too much. Having a permanent cover on the soil discourages grasshoppers and locusts from laying eggs. It also makes it harder for the hatched locusts to emerge from the soil. Covering the soil with green mulch or dead mulch is common practice in natural farming. This practice will reduce the egg laying and hatching drastically in the breeding areas. Further, green mulching with certain leafy vegetables (Mint and Coriander) repel the locusts.

5. Ducks and Chicken predate on Locust: Growing desi poultry birds, and ducks around the fields or as integrated farming system may be useful for the control of locusts. Further locust is good source of feed for poultry and ducks. In China and other African countries this has been successfully demonstrated. This will compensate the crop loss, if damaged by locust. Desi poultry and ducks rearing are additional income source and extra livelihood for farmers.

Fig. 3 Desi poultry birds

Fig. 4 Ducks

6. Fisheries: Integration of Fisheries with paddy fields or any other multi-layered farming systems will be an extra income source for farmers. Farmers can catch locusts and feed the fishes, that will be good source of natural feed (ensure locusts are not treated with chemical pesticides).

Farmers Practices

1. Not approved method, but beating plates or generating heavy sound may repel locusts. This has been practiced in North west states of the country.
2. Lighting fires or making noise to prevent swarms from settling in crops.
3. Few farmers in India are using Sound systems to repel locust.
4. Use of flame throwers.
5. Burning of crackers.
6. Some farmers using motor bikes without silencer to generate huge sound.

Fig. 5 Farmer practices

Non-Chemical Control Methods

Extensive research is in progress on biological control and other means of non-chemical control of locusts. The current focus is primarily on pathogens, antifeedants and insect growth regulators. Thus far control by natural predators and parasites is limited since locusts can quickly migrate away from most natural enemies. Although giant nets, flamethrowers, lasers and huge vacuums have been proposed in the past, these are not in use for locust control. People and birds often eat locusts but usually not enough to significantly reduce population levels over large areas (Ritchie and Dobson, 1995). The details of non-chemical approaches are described in following three subheads.

Botanical Pesticides

1. Chilli-Garlic solution is most effective: Grasshoppers and locusts hate the smell and taste of garlic. If it is mixed with chilli become more powerful antifeedant. Locusts do not eat the crops due to allicin and capsicin and their smell and taste. Spraying of chilli garlic extract is best recommended in natural farming for all pests. Several case studies from international fields/gardens suggested that chilli-garlic extract is powerful botanical pesticide against locust.

2. Nerium Plant extract: In a laboratory study, it was proved that the leaves of *Nerium oleander* (Telugu: Ganneru) exhibited an inhibitory effect on the ovarian development of *S. gregaria*. Use of Nerium leaves as botanical pesticide is recommended in natural control. Grinding of 10 kg of leaves and extracting in the water 100 litres of water is sufficient for one-acre field. The efficacy has to be tested fully. It may be tried on experimental basis in selected fields (Bagari *et. al.*, 2015).

3. Linseed oil: Linseed oil, combined with some essential oils, is highly effective in killing two of the most problematic locust species: *Schistocerca gregaria* and *Locusta migratoria*. This botanical pesticide can be sprayed with conventional spraying devices and kills adult locusts within 24 hours. Botanical pesticides have already proved successful against several insect pest species, but this is one of the first to target locust swarms effectively. The toxicity of a linseed oil and bicarbonate emulsion against swarming locusts and looked for plant essential oils that would enhance its toxicity. The botanical pesticides known to be harmless to humans because of their historical use as cosmetics, spices or healing aids. It should be sprayed on crowded locust colonies at their evening resting places and should not sprayed over huge areas.

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Rice-Wheat Cropping System: Features, Challenges and Opportunities for Sustainable Cropping System

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Introduction

The Rice-wheat cropping system is India's most extensively adopted cropping system followed on an estimated area of around 13.2 million hectares. This cropping system is widespread in Indo-Gangetic plains (IGP) in North India and is predominant in the states of Uttar Pradesh, Punjab, Haryana, Bihar, Madhya Pradesh, etc.

It is not only followed in India, but it is also widely practiced as rice and wheat are the staple food in the South Asian countries like Bangladesh, Nepal, and Pakistan alongside India. The rice-wheat cropping system (RWCS) of India is vital for national food security contributing more than 70% of total cereal production in India, thus help in the self-sufficiency of the food grains.

Due to the continuous cereal-cereal cultivation, the mounting pressure on the natural resources has brought fatigue to this cropping system in recent years and has brought forth quite a lot of implications menacing its sustainability. The main motive of this review article is to highlight the Rice-Wheat Cropping System: Features, Challenges, and Opportunities by recapitulating the published papers in this area.

Features of the Rice-Wheat Cropping System

In rice-wheat cropping, Rice is grown as the Kharif season crop and wheat is grown as the Rabi season crop. This cropping system is well-known for high cropping intensity (Cropping Intensity is the ratio of Net Area Sown to the Total Cropped Area). Both rice and wheat have dissimilar soil requirements.

For instance, rice requires extensive puddling for stagnant water conditions; whereas wheat requires well-pulverized soil fair with moisture, air, and thermal regime. Due to the yearly alteration of soil from aerobic to anaerobic and then flipside to aerobic conditions. Both Rabi and Kharif season is taken by wheat and paddy crop rotation respectively. The Rabi crop of wheat demands more fertilizers than the Kharif crop of rice.

Green fodder is easily accessible round the year in rice-wheat cropping system and this in turn help to hold up large livestock population. Rice-wheat cropping system is identified for an ample amount of methane generation and its role in global warming.

Challenges of Rice-Wheat Cropping System

1. Agricultural Challenges:

a. Degrading soil structure and declining soil health: Due to Continuous shift to aerobic to anaerobic and vice-versa affects the soil structure and soil health.

b. Residue management: As the rice crop has a high C: N ratio it is not used for fodder and it also takes more time to decompose, hence the residue management is difficult and farmers are burning the residues causing environmental poll

c. Multiple nutrient deficiencies.

d. Weed flora shift and herbicide resistance leads to declining crop response: By the cropping system, the weeds are attaining the resistance to herbicides and response is below the expected.

2. Ecological Challenges:

a. Declining underground water table: As the Rice-wheat cropping system is the irrigated cropping system requires a huge amount of water and hike in no of irrigations causing the decline of the underground water table.

b. Groundwater pollution: Due to the indiscriminate application of the chemical fertilizers and increase of leaching of the nutrients to deeper layers causing the water pollution and depleting the water quality.

c. Outbreak of diseases and insect- pest: Because of lack of change in the cropping pattern the same crops will be grown in the same period every year in the rice-wheat cropping system, so the outbreak of diseases and insect- pest occurs at the same time can be controlled for some period but after the few years they attain the resistance to particular chemicals applied.

3. Livelihood Challenges:

a. High energy requirement: As both crop in this cropping system requires the different soil requirements so the puddling in rice and well-pulverized soil for wheat needs huge farm machineries, thus high energy demand.

b. Decreased land productivity, efficiency of water use and Poor incomes: The decline in land productivity and water use efficiency due to the cropping system will directly affect the yield of the crops which impact the return from the produce.

4. Climatic Challenges:

Climate change and environmental pollution: Due to the rice-wheat cropping system, because of the release of the methane from the fields under irrigated and flooded conditions unlike upland rice, which is one of the greenhouse gases, causes the climatic changes. By the large variations in the climate, the yield will be directly affected.

Opportunities of Rice-Wheat Cropping System

1. Conservation Agriculture:

a. Minimum soil disturbances by reduced tillage during wheat cultivation help for soil and water conservation and control soil erosion.

b. Retention of an adequate level of crop residues will increase the soil biological activity and also enhances the soil carbon sequestration.

c. Use of Viable crop rotation breaks weed, insect, pest, and disease lifecycle, thus reduce the use of the herbicide and pesticides which enhances the soil health.

2. Crop diversification: Crop diversification is of major importance in mitigating the biotic and abiotic problems raised due to RW monoculture choosing the alternative cropping system that helps in crop diversification. The alternative cropping systems as follows.

Table 1.

S. No	Kharif	Rabi
1	Rice	Maize
2	Rice	Chickpea
3	Rice	Mustard
4	Rice	Safflower
5	Groundnut	Potato
6	Rice	Marigold
7	Maize	Potato
8	Maize	Mustard

3. Resource conservation technologies (RCT):

Table 2.

RCT for Rice	RCT for Wheat
Leaf Colour Chart (LCC)	Zero Tillage
Alternate wet and drying method (AWD)	FIRBS
System of Rice Intensification (SRI)	System of Wheat Intensification (SWI)
Direct seeding method	Crop residue management
Aerobic rice	Surface seeding

Brown manuring	

4. Efficient nutrient and weed management:

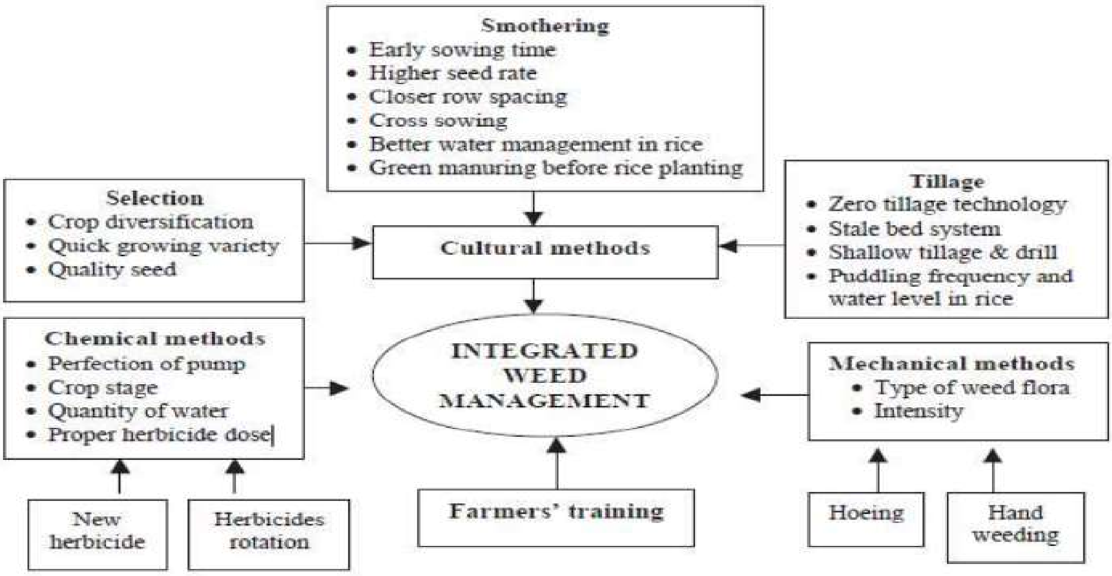

Figure 1.

5. Crop residue management: Burning of crop residue is a most important issue, so alternate options of residue management should be followed for proper residue management as follows.

a. Manuring.
b. Ethanol production.
c. Energy production.
d. Biogas and residue gasification.
e. Fast pyrolysis.
f. Biochar.
g. Incorporation and retention in soil.

Conclusion

RWCS has helped the country to pace en route for food self-sufficiency but due to continuous tradition of cultivation has thus arisen numerous sustainability issues. Employment of innovative and enhanced set of practices formulates this method sustainable. The practices like Conservation agriculture, resource conservation technologies, crop diversification, and Crop residue management as opportunities vital to improve profit, productivity, and sustainability of the system.

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An Overview of Oyster Mushroom Farming

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Introduction

Mushroom is a fungus shaped like an umbrella that grows in decomposing organic matter. Unlike most plants that produce seeds, mushrooms produce spores to continue the reproduction process. Mushroom farming is the process encompassing the growth, harvest, storage, and selling of mushrooms. It is scientifically known as floriculture. There are thousands of types of mushrooms and they require little to thrive. Because of their resiliency, mushroom farming is a low-risk business opportunity and has become a booming industry across the globe. According to the Food and Agriculture Organization of the United Nations statistics from 2016, China (Zhang et. al., 2014) is the world's leading mushroom producer, while the United States and Italy are second and third. While the total production was more than 10 million ton in 2016 (FAOSTAT, 2018).

Oyster Mushroom

The oyster mushroom got its name from its strikingly similar resemblance to a fresh shucked oyster. Though looking like one particular mollusc, there happen to be three different types of oyster mushrooms: *Pleurotus ostreatus*, *Pleurotus pulmonarius*, and *Pleurotus populinus*. The only true difference between them is the season in which they grow. When in the wild, all can be found growing in a layered formation; the mushrooms stacked on top of each other in clusters perturbing from decaying wood (Garcia *et. al.*, 1997).

Required Materials for Cultivation

Production materials vary depending upon the scale of the farm. For this document, we will focus on small scale mushroom farming. The necessary materials are Cellulose waste, Straw, Water, Machete Straw grinder, Boiling pot, Sterilizer, Temperature control device Sacks, Drums, Calcium carbonate(chalk).

Cultivation Process is Broken Down and Described in Several Procedures Below

1. Selection of Raw Materials: Straw is the base organic material for the production of oyster mushroom. It can be obtained from a variety of crops such as rice, wheat, barley, rye, sunflower, oats, buckwheat, peanuts hull etc. Straw should contain moisture levels of less than 12% (Kown et. al., 2004), ensuring a predominantly dry material free of mold. Additives including limestone, gypsum, suger, green hay, alfalafa, wheat, and rice can be mixed into the straw to boost mushroom production. Sawdust from hardwoods can also be used in place of straw.

Fig 1: Oyster Mushroom

Fig 5(a): Good Quality Straw

Fig 8: Preparation of Substrate

2. Storage and cutting of Raw Materials: Raw materials should be stored out of the elements and kept dry to avoid mold formation and loss of materials. If it is not possible to store the raw materials in such an environment and they must be kept outside, covering them with a tarp is necessary to maintain a quality organic material. After the storing, chopping the straw is first step of the core processing.

The collected straw (or raw materials) are cut into small pieces, usually the length of the cut is 5-10 cm and are soaked in fresh water for 8-16 hours. Straw are light and less distributed organic material. Even after boiling, their density does not increase much, thus cutting is needed to tightly pack the raw materials into the plastics bag. Better the density, better the growth of mushroom.

Also, different external materials such as sunflower husks, cottonseed hulls are also used to increase the density. In some parts of the world only husks or hulls are used to grow commercial mushroom but in general they are used with straw.

3. Preparation of the Substrate: Once the cutting process is completed and before the "heating treatment", straw is mixed with some minerals such as limestones, gypsum, suge are also added during the preparation of substrates. These minerals act as sterilization as well as fertilizers.

In addition, wheat straw, wood chips, sawdust, sugar beet pulp etc can also be added as substrate. But it all depends on availability and are not the strict requirements. These materials should be chosen carefully as they may contaminate the whole mixture.

Standard Practices Used to Prepare Substrate

Agriculture straw such as corncob 53% or sawdust 53% or straw 53%, biogas residues or fungi residues 30%, rice bran or wheat bran 10%, peanut bran 2%, gypsum powder 1%, lime powder 2%, compound fertilizer 2%, the proportion between material and water is 1 to 1.25.

After the preparation of substrate, they are compressed into the bags and send for the heating treatment. Some growers pasteurize and sterile the substrate in a bulk before filling them to the bag. Usually, the first method is recommended as it prevents the contamination risk. Small hole of diameter 2-3 cm is made at the centre the bag for inoculation.

Country	Dimensions(cm)	Material used
Vietnam	20x30 or 18x25	Polyethene
India	45x30x15	Wooden Frame
South Africa	200x50	Polyethene
United States	23x13x74	Polyethene
Bangladesh	25x20	Polyethene
Nepal	36x61 or 46x66	Polyethene

Table 1: Packing bags sizes in different countries (Kown et. al., 2004)

Heating Treatment

"It is process of killing the pests and microorganism by the method of pasteurization and sterilization"

Sterilization

Sterilization is process of killing microorganisms which are harmful to mycelium growth. Heating temperature depends on the quality of substrate. If the quality is good, serialization temperature is maintained in between 95-199 degree

Celsius and the substrate is heated for about 4-5 hours. But if the substrate contains sands or dirt, it should be heated in high temperature ranging from 200 - 600 degree Celsius depending upon the quantity of dirt or sands.

Fig 9: Vertical Partition Drum

Fig 10: Horizontal Partition

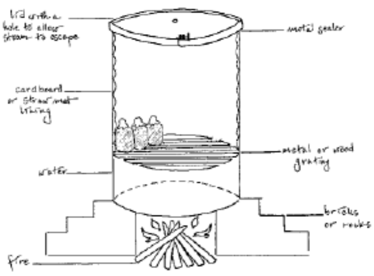

Fig 11: Pasteurization[8]

Pasteurization

For the small-scale production, oil drums are used for the pasteurization. It is a process of heating the bas using steams. The drums are coated or formed a good compartment inside to avoid burning of bags. The drums in layers into two halves vertically or 2-3 half horizontally, as shown into the figure below. The lower half of the drum is filled with water and upper half with bags. After placing the bags in the drums, lead is closed tight from the top to build sufficient pressure. The heating time depends upon the size of the bags, but usually they are heated for about 4-5 hours. After the seaming, bags are cool down to 25 degree Celsius.

Spawning

Spawning is a process to transfer mushroom mycelia to the bags. These can be found on farmers shops or from commercial spawn supplier.

Inoculation

This is carried out in a clean room to avoid contamination and the people who perform this task use sterile gloves. About a tea spoonful of spawn is placed in the substrate using the hole made earlier on centre of the bag. In some places the conditioned straw is kept on the bags layer wise and on the periphery of each layer, spawn is sprayed. Generally, 250g bottle can be sprayed to 3 packs.

Incubation

After the inoculation bags are moved to dark incubation rooms where the temperature is optimized to 20-25 degree Celsius for the best results. They are kept in the incubation rooms for about 15-25 days, depending upon size, material and condition of the bags. These bags can be arranged in various fashion. Generally, they are placed in rack and the touching between the bags are avoided. One of the methods is shown in the image below. As soon as the tiny mycelial fill up the bags, they are moved to the production room. In some case same room can be used as production. The room should have light for at least 10-12 hours for mycelial to grow into fruiting body.

Small holes throughout the bags are made for the mycelial to develop into a fruiting body. Maintaining the atmospheric humidity, CO_2, and water is very important. Mushroom contains about 90% of water thus maintaining humidity of the atmosphere is critically important during the early stage i.e. fruiting stage. Frequent watering about 2-3 buckets 5 to 6 times during the reproductive growing phase is required. Supplying water directly to the mushroom should be avoided.

Fig 12: Incubation Using Small Bags[9]

Fig 12: Harvest Ready Oyster Mushroom

Some references (Yang et. al., 2013) to environmental condition based on king oyster mushroom requirements is shown in the table below.

Parameters	Spawn phase	Pinhead	Fruiting body
Temperature (°C)	24–25	10–15	15–21
Relative humidity (%)	90–95	95–100	85–90
CO_2 (ppm)	5000–20,000	500-1000	≤2000
Air replacement	1	4–8	4–5
Light (lux day−1)	-	500-1000	500-1000

Table 2: Environmental setup for different stages

Harvesting and Storage

The mushrooms should be ready to harvest in approximately 3 to 5 days after you see the first mushrooms begin to form. When the cap of the largest mushroom in the cluster begins to go from convex (turning down at the edges) to concave (flattening out or turning up at the edges), pick the whole cluster. Blue oyster and elm oyster mushrooms grow in clusters of multiple mushrooms, and it is generally best to pick the entire cluster when you see that the largest mushrooms in the cluster are ready to harvest. A white powder on the side of the bag means the mushrooms are simply your mushrooms right away.

Hygiene and Some Market Statistics

Mushroom is widely considered as a power house of nutrition. It contains moderate amount of fibres and several minerals, vitamins (B, D), copper, iron, potassium, magnesium, and more interestingly it's low in calories and fat, 100% cholesterol free. It also contains some antioxidants which is believed to prevent cancer. The mushroom made up $1.22

billion [13] of revenue for the U.S. economy in 2016-17, with 929 million pounds being produced. By 2019, the world market is expected to produce $50,034.12 million (Rohan, 2018).

Conclusion

The above description of mushroom farming will yield a quality product. There are other techniques used to achieve similar results, but this technique will be the most efficient way to turn a profit with a small-scale operation as it uses locally available materials and with a minimal investment. This particular process also accounts for distributing a quality product that creates customer retention. Adhering to this guide will ensure you are well on your way to making a decent profit with minimal costs, while also establishing a growing clientele to turn your small-scale mushroom farm into mushroom farming empire.

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Smart Transportation: A Pillar for Smart City

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Introduction

The cities across the globe are facing complex challenges. Increasing population and urbanization have raised numerous infrastructure related problems. The problems related to waste management, traffic congestion, energy management and deteriorating infrastructure have alarmingly increased in recent years. Cities need to find innovative ways to address these issues.

To ensure economic and social growth by solving variety of challenges, cities are now focusing on becoming Smart Cities. Smart City is a concept of utilizing the innovative technologies to mitigate its various issues and streamlining its operations. Smart City concept aims at providing core infrastructure and give quality life to its citizens. It is an effort to make our cities intelligent by enhancing their productivity, efficiencies, effectiveness, transparency and sustainability. Smart cities rest on various pillars e.g. smart waste management, smart transportation, smart energy management, smart water management and E-Governance. Smart City is a holistic approach encompassing growth of various sectors and ensuring their connectivity. This article talks about the need to shift our transportation towards smart transportation and its various challenges.

Smart Transport & Challenges

The transportation sector is one of the major contributors to India's GDP. Rapid urbanization and population have put immense stress on our transportation. India has the second largest road network stretching over 58 lakh kilometers (MoRTH). Around 60% of the total freight and 87% of passenger traffic is carried by the roads, yet the quality of road infrastructure is a matter of concern (1).

The major inherent challenges posed upon our country's transport are:
1. Inadequate and inefficient public transport facilities
2. Poor traffic management, parking issues and road safety concerns
3. Lack of intermodal options
4. Vehicular emissions
5. Poor implementation of Intelligent Transport Systems (ITS)

We are now looking for solution to decongest our roads and make the transport more efficient and smoother. One of the major milestones of Smart Cities initiative is to create an efficient urban mobility and public transport facilities. Smart Transport is one of the major pillars of the Smart Cities initiative. Smart Transport provides a sustainable solution to decongest our roads, enhance their connectivity and make our smart cities livable.

It leverages the use of Information and Communication Tools (ICT) for predicting the demand and supply data required for better transport planning. The innovative technologies used in Smart Transport can help in improving the reliability of public transport and dissemination of its arrival/departure/route information. To move into an era of Smart Transport in India, thrust is on providing adequate infrastructure, enforcement of law and legislative provisions towards sustainable fuels and efficient implementation of urban mass mobility schemes.

Focus Areas of Smart Transport

There are four areas which Smart Transport targets for improvement i.e. Smart Automobiles, Sustainable Fuels, Intelligent Transport Systems and Smart Infrastructure.

Smart Automobiles

Smart Automobiles aims at advancement in technologies for data gathering, improving engines designs and assist the drivers to avoid the accidents. Some of the technological advancement in the field of Smart Transport are Anti-Lock

Braking System, Automated Manual Transmission, Vehicle to Vehicle (V2V) communication and collision avoidance technology. Anti-lock braking system (ABS) is a safety system that allows the wheels of the vehicle to maintain tractive contact with the road surface, preventing wheels from skidding. Automated Manual Transmission (AMT) is an automatic gearbox that assists in manual gear change without the need to depress the clutch pedal manually.

To enhance the road safety automakers have come up with Advanced Driver Assistance System (ADAS), which help the drivers to avoid the accidents both at high speeds and during the backward movement of vehicles. ADAS is supported with Adaptive Cruise Control, Automatic Emergency Brake, blind spot monitoring, lane change assistance and forward collision warnings, integrated with sensors, cameras, radars, LIDARs, ultra sound sensor etc. and send command to plural actuators, engine, brake, steering etc. Besides increasing passenger's safety, ADAS applications are also concerned with improving the comfort, convenience, and energy efficiency (Kala, 2016).

Electrical vehicles provide a great technological solution to combat transport emissions. Due to environmental concerns focus has been shifted towards improvement of fuel efficiency and reduction of Green House Gases (GHG). Fully battery driven electrical vehicles and Hybrid Electric vehicles are the promising technologies in Smart Transport era. It is estimated that the electrical vehicle's share in global market could reach about 20 million by 2020.

Connected Cars are also offering huge possibilities of integrating internet with electronic devices of cars. Connected car is using Internet of Things (IoT) technologies to connect the various electronic devices of cars such as safety features, navigation systems and control systems through internet. This vehicle is able to optimize its operation and also passenger's comfort using onboard sensors and internet connectivity. This technology also provides a window for the mobile to communicate with the electronic systems of the car.

Sustainable Fuels

Smart transport initiatives aim at streamlining and enhancing the transport efficiencies by reducing the carbon footprint. Green House Gas (GHG) emission has been a major concern for all cities. Use of clean and sustainable fuels are the best way to tackle GHG emission. Bio-fuels, ethanol and compressed natural gas (CNG) are examples of clean fuels. Vehicle running on hydrogen fuels and fuel cell technologies also provide cleaner options of transportation. Karanja and Jatropha are being used in India for producing Bio-diesel which are also alternatives to petroleum-based fuels. These alternatives and cleaner fuels are being targeted to be used in all modes of transport i.e. roadways, waterways and airways.

Intelligent Transport System

Intelligent Transport System (ITS) is an important focus area of Smart Transport. ITS aims at improving the traffic efficiency by minimizing the traffic problems and provides the real time information about the traffic. ITS uses various information and communication tools to effectively manage the transportation (Sumalee and Ho, 2018). Passenger information systems and Real-time Parking management are the major areas of ITS.

They provide information related to estimated arrival/departure of public transport and availability of parking slots respectively to the users and staffs. Multi-Level parking also provides a solution to minimize the land usage and low maintenance costs for parking. Tire Pressure Monitoring System (TPMS) provides a real time tire pressure to the drivers to avoid accidents and improve to fuel efficiency.

Smart Cards are offering great flexibility to the citizens while using transport facilities. Using single integrated smart card, user can pay for assessing any public transport and even parking fees and electronic toll collection can be linked with the card. Electronic Toll collection uses RFID technology that reads and automatically deducts the toll at each entry gates. This is a great way to reduce the queue time and also the fuel consumption at the toll gates. India is still catching up with other countries in adoption of RFID technologies in freight transportation. RFID in freight transportation offers a huge scope to automate the supply chain process (Dolgui and Proth, 2008). These technologies can save time and energy by improving the freight vehicle operations and helps in efficient data collection and recording.

Smart Transport Infrastructure

Smart transport infrastructure aims at providing adequate infrastructure for all modes of transport. In India major freight movement takes place through roads (around 65%). Government has launched a number of schemes such as Atal Mission for Rejuvenation and Urban Transformation (AMRUT) and Pradhan Mantri Gram Sadak Yojna (PMGSY) to boost the transport infrastructure of the country. Many developed countries have successfully created infrastructure for High Speed Rails. As per UNEP study, high speed rails have lower GHG emissions than road or air transport, which align with the objectives of smart cities initiative.

Integrated Transit hubs provide seamless connection for multiple modes such as metro system, bus system, ports and rail system. Adoption of this approach can boost the movement of cargo and passengers across the globe. Non-motorized transports e.g. cycle, rickshaw, walk also require proper infrastructure and must be accounted while planning for smart cities.

Apart from these, there are some other infrastructure also which are required in the near future as we move towards smart transport era. Adequate charging stations along the roads, in the parking areas and their compatibility with electric vehicles are required for efficient mobility of these vehicles.

To optimize the idle time during the traffic signal, smart traffic lights can be incorporated. These technologies can sense the condition of traffic and accordingly tune the traffic lights resulting in smooth traffic movement. Bicycle sharing system is also gaining popularity and can be easily found near metro stations, colleges and workplaces. These services can be easily availed using smartphone apps and can be used within the city.

The smartphone application provides real-time information regarding the availability and nearby bicycle sharing zones to the users. Many of the privately owned cab facilities are providing the option of dynamic carpooling. Passengers in the same route can use this facility and can save money and time. These modes of transport are being widely used in big cities of our country and a lot need to be done to spread their reach.

Role of Standards

Standards are crucial in interchangeability, adoptability and harmonization of latest emerging technologies. It helps in smoother implementation of services as it provides information on code of practices, covers the safety aspects and requirements.

As the smart transport involves numerous integrated technologies, standardization of their different aspects is of utmost importance. Standards formulating bodies should continuously strive for identifying various areas of smart transportation for standardization process. Some of the aspects of smart transportation such as electronic fee collection, communications access for land mobile (CALM) used in ITS, interoperable fare management system of public transport, requirements of road traffic safety management and RFID tags for tolling require efforts for standardization and harmonization.

Standardization of electronic ticketing machine (ETM), reverse parking assistance systems (RPAS) and advanced driver assistance system (ADAS) are also being carried out by integrating various technologies and concerned sectors.

Conclusion

As the needs and existing infrastructure vary among various countries, there is no common yardstick for defining and creating smart cities. The use of digital technologies in trade, governance and infrastructure is definitely a common factor while moving towards smart cities. Our country has unique set of constraints which make smart cities initiative a challenging one and at the same time provides huge possibilities for improvement also.

While Government is investing a lot to improve the public transportation, there is also a need to leverage the smart technologies to improve our public transportation. Smart Transportation is undoubtedly one of the key pillars of smart cities initiative in India. Proper planning and implementation towards smart transportation would surely thrust the smart cities initiative and provide quality life. But the road towards smart cities cannot be travelled only by focusing on each pillar individually.

There must be an integrated approach towards development of each sector of smart cities initiative. At the policy making and implementation level, government and private stakeholders have to play a crucial role. The schemes unveiled by the government must hit at the ground level and these require active participation at all levels. The milestones of every projects under smart cities initiatives must be clearly laid down and publicly available. Monitoring of every project is equally important and projects must be evaluated considering the three important determinants i.e. cost, time and quality. Ever increasing demands and population of the cities have definitely triggered the need for smart cities. Smart cities powered by artificial intelligence, IoT and big data will surely improve the quality of life of the citizens and make our cities more efficient.

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Therapeutic Potential of Mushrooms

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The major attribute of mushrooms is their medicinal properties and presence of bioactive compounds. The pharmacological properties of mushrooms include immunity enhancement, maintenance of homeostasis, regulation of biorhythm, and most importantly cure and prevention of various life-threatening diseases such as cancer, stroke, and heart diseases.

Medicinal properties of mushrooms including anti-inflammatory, antioxidant, immunomodulatory, anticarcinogenic, antiviral, antibacterial, antifungal, hepatoprotective, antidiabetic, anti-angiogenic, hypoglycaemic, etc. have been reported. Immunomodulatory and antitumor activities of polysaccharide– protein complex (PSPC) from mycelial cultures of mushrooms have been extensively studied (Xu and Beelman, 2015). The pharmacological potential of mushrooms includes the following.

Mushrooms as Antioxidants

Edible mushrooms possess potent antioxidants. A study of methanolic extracts from black, red, and snow ear mushrooms found that mushrooms possess an inhibitory effect on lipid peroxidation, 1,1-diphenyl-2-picrylhydrazyl (DPPH) radical scavenging and hydroxyl radical scavenging, and a strong reducing power and ability to chelate ferrous ions. Similar studies on other mushrooms, including *D. indusiata, G. frondosa, H. erinaceus, T. giganteum, F. velutipes, L. edodes, P. cystidiosus, and P. ostreatus, Agrocybe cylindracea* also reported antioxidant properties of these mushrooms (Kasuga *et. al.*, 1993).

Mushrooms as Hypocholesterolemic Agents

Regulation of the cholesterol level is important for the prevention and treatment of cardiovascular diseases. Edible mushrooms are an ideal food for the dietetic prevention of atherosclerosis due to their high fibre and low-fat content. Initial research on the cholesterol-lowering effects of mushrooms was conducted in Japan in the 1960s, and it was demonstrated that when rats were fed with a high fat and high cholesterol diet supplemented with 5% water of the fruiting bodies of *L. edodes* for 10 weeks, the plasma cholesterol levels of the animals decreased significantly (Sun *et. al.*, 1984).

Several other studies on Lentinula extracts have shown them to cause a significant decrease in serum cholesterol in young women and old people. In another study, dietary fibre extracted from *P. cornucopiae* had a marked in vitro anti-atherosclerotic effect and patients with coronary disease showed a decreased atherogenic activity (20–40%) in their sera after the consumption of this mushroom, which confirms its property of natural cholesterol-lowering agent. It has been suggested that the fruiting bodies of oyster mushrooms could be recommended for consumption as a natural cholesterol-lowering agent in the human diet. Dietary fibre isolated from *Auricularia auricula* and *Tremella fuciformis* significantly decreases the serum total cholesterol (TC) and LDL cholesterol levels. Various studies have shown that Lentinula mushrooms can lower both the blood pressure and the free cholesterol level in plasma and can accelerate the accumulation of lipids in the liver by removing them from circulation. Mushroom like *A. auricula-judae* displays anticoagulation, anti-aggregatory activity in the blood platelets of mice and rats, thus serving to lower their total cholesterol, total triacyl glyceride, and lipid levels. *Grifola frondosa* has been reported to reduce blood pressure in rats without changing the plasma high-density lipoprotein (HDL) level or serum cholesterol level (Mizuno, 1995).

Mushrooms as Hypoglycemic Agents

Edible mushrooms are an ideal food for the dietetic prevention of hyperglycaemia because of their high dietary fibre and protein and low-fat content. Lectins isolated from mushrooms (*Agaricus campestris* and *A. bisporus*) have been shown to enhance insulin release in isolated Langerhans rat islets. The presence of a nonlectin- type component in A. campestris that displays insulin-releasing and insulin like activity has also been reported (Gray and Flatt, 1998). Guanidine, which is a known hypoglycaemic substance related to the biguanide class of oral antidiabetic drugs, has been found in edible mushrooms.

Mushrooms as Antitumor Agents

Cordyceps militaris has been used for a long time in Eastern Asia as a nutraceutical and in traditional Chinese medicine as a treatment for cancer patients. Searching for new antitumor agents including mushrooms has become a topic of research. It was reported that *Ganoderma lucidum*, *Phellinus rimosus*, *Pleurotus florida*, and *Pleurotus pulmonarius* possess profound antioxidant and antitumor activities. The antitumor activities of the higher basidiomycetes extract of fruiting bodies of Boletus edulis and other Homobasidiomycetes were tested against the Sarcoma 180 line in mice and were found to have significant activity. Calvacin was isolated from the giant puffball (Calvatia gigantea), and it was found effective against many experimental tumors, including Sarcoma 180, mammary adeno carcinoma 755, leukemia L-1210, and HeLa cell lines. There are approximately 650 species of higher basidiomycetes that have been found to possess significant antitumor activity (Thekkuttuparambil *et. al. 2007*).

Mushrooms as Immunomodulators

Immunomodulators are the most important medicinal mushroom drugs used especially in Japan, China, Korea, and other East Asian countries today. Some polysaccharides or polysaccharide–protein complexes from mushrooms are able to stimulate the non-specific immune system and to exert antitumor activity through the stimulation of the host's defence mechanism. These drugs activate effector cells like macrophages, T lymphocytes, and NK cells to secrete cytokines like TNF-a, IFN-g, IL-1b, etc. which are antiproliferative and induce apoptosis and differentiation in tumour cells (Reshetnikov et. al., 2001).

Mushrooms as Antimicrobial Agents

Mushrooms need antibacterial and antifungal compounds for survival in natural environment. Hence, they are rich sources of natural antibiotics. Many of the extracellular secretions by the mushroom mycelium are known to combat bacteria and viruses. Considerable antifungal and antibacterial activity against *Staphylococcus aureus, Bacillus subtilis, and Escherichia coli* has been reported in several compounds extracted from various mushrooms. It was observed that whole extracts of *Ganoderma pfeifferi* inhibit the growth of microorganisms responsible for skin problems. Oxalic acid has been found to be the compound responsible for the antimicrobial effect of *Lentinula edodes* (Berk.) against *S. aureus* and other bacteria. Ethanolic mycelial extracts from *L. edodes* possess antiprotozoal activity against *Paramecium caudatum* (Badalyan, 2004).

Mushrooms as Antiviral Agents

Specific drugs are urgently needed for cure of viral diseases as they cannot be treated by common antibiotics. Antiviral effects are described not only for whole extracts of mushrooms but also for isolated compounds. They may act directly by inhibition of viral enzymes, synthesis of viral nucleic acids, or adsorption and uptake of viruses into mammalian cells. These direct antiviral effects are exhibited especially by smaller molecules. Indirect antiviral effects are the result of the immune-stimulating activity of polysaccharides or other complex molecules. Small molecular compounds with antiviral activities, several triterpenes from Ganoderma lucidum (i.e., ganoderiol F, ganodermanon triol, ganoderic acid B), are active as antiviral agents against human immunodeficiency virus type 1 (HIV-1) (Brandt and Piraino, 2000).

Mushrooms as Antiallergic Agents

Although extracts of many mushrooms can stimulate the immune system, some have been reported to suppress immune responses also. This property could be of benefit for the treatment of allergic diseases that are nowadays increasing worldwide. Ethanolic extracts of the edible Japanese basidiomycetes *H. marmoreus, F. velutipes, Pholiota nameko,* and *Pleurotus eryngii* show significant antiallergic effects in mice. Some compounds from *G. lucidum* (ganoderic acids C and D) have been shown to inhibit the histamine release from rat mast cells.

Eating of *Tricholoma populinum* led to the regression of severe allergic symptoms in a patient with thromboangiitis obliterans and in another patient with urticaria. Hispolon and hispidin, isolated from fruit bodies of *Inonotus hispidus*, have been reported to inhibit the chemiluminescence response of human mononuclear blood cells and the mitogen-induced proliferation of spleen lymphocytes of mice (Kreisel *et. al.*, 1990).

Mushrooms as Anti-Inflammatory Agents

Whole mushrooms and extracts may show anti-inflammatory activity due to the presence of bioactive compounds. Ethanolic extracts from *P. linteus* and a proteoglycan have been shown to induce anti-inflammatory effect in the collagen-induced arthritis and in the croton oil-induced ear edema test in mice and antinociceptive effect in the writhing test. The edible mushroom *G. frondosa* contains ergosterol; ergosta-4-6-8(14), 22-tetraen-3-one; and 1-oleoyl-2-linoleoyl-3-palmitoyl glycerol which inhibits cyclooxygenases I and II activity (Kim, 2004).

Mushrooms as Hepatoprotective Agents

Ganoderic acids R and S and ganosporeric acid A from *G. lucidum* showed in vitro antihepatotoxic activity in the galactosamine-induced cytotoxic test with primary cultured rat hepatocytes. In vivo study of two fractions of total triterpenoids extract of *G. lucidum* protected mice against hepatic necrosis induced by chloroform and D-galactosamine, and these hepatoprotective effects were perhaps related to the ability to promote the activity of scavenging enzymes for hepatic-free radicals in mice and thus to raise the ability of anti-oxidation in mice (Whang *et. al., 2002*).

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Impact of COVID-19 on Agriculture and Allied Sectors of Odisha

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Introduction

At the cusp of the cyclonic storm and COVID-19, Odisha is forced to handle the dual challenges of disaster preparedness and the pandemic impacts and responses simultaneously. The nationwide lockdown to enable social distancing to curb the spread of the disease has impacted livelihood of people severely. The pandemic has also thrown up a fresh set of challenges for the disaster management and health authorities, particularly as migrant workers desperately seek avenues to return home.

The first case of the COVID-19 pandemic of Odisha was confirmed on 16th March 2020 in an Indian who returned from Italy. Since then the cases have been increasing on a daily basis. Currently, out of 30 districts of Odisha 5 districts (Anugul, Balasore, Bhadrak, Ganjam and Jajpur) districts are under red zone, 13 districts are under orange zone and 12 districts are under green zone. Ganjam districts becomes identified as major hotspot of COVID-19 in Odisha.

Though impact of the lockdown on State economy is yet to be assessed, sources maintain that agricultural sector will be the worst hit. Rabi crops have been completely ruined and farmers would require financial assistance to start afresh for Kharif. The State Government has begun measures to assist the agriculture sector by taking it out from the lockdown. Pisciculture too stands exempted but it is doubtful whether Odisha's agricultural GDP, which clocks an annual growth rate of about 4.5 per cent, can maintain the tempo. So, we briefly discussed the impact of COVID on Odisha agriculture.

Impact on Field Crops, Vegetable and Fruit Sector

The COVID-19 lockdown and excessive restrictions on movements of farmers and farm goods have taken a heavy toll on the rural economy. As the agricultural markets shut, state governments have told farmers not to come to the towns with their produce but wait in their respective villages for procurement by authorities. The farmers are keeping their fingers crossed despite assurance by the governments that all their produce would be procured due to less hopes of an early return to normalcy.

With a bumper yield of vegetables and cash crops like pulses and oilseeds, farmers are desperately looking for government help to sell their produce at least in the local markets at whatever prices. Brinjal prices has been decreased by 50 per cent and pumpkin farmers are also facing great loss because rotting of pumpkin in the field.

Scarcity of Labour

Non-availability of agriculture labourers has hit the farmers hard. Many labourers have gone back to their native places due to the lockdown and those available are demanding higher wages. There is a great demand for agriculture labour but no one is available due to lockdown. Amidst lockdown there is no transportation facility to lift labourers from nearby villages. So, it is creating a problem for harvesting farm produce.

Impact on Seed Production

The lockdown continues to hit agriculture sector by cutting off farmers from buyers of their produce. Registered growers of seeds stare at a huge loss after the State Government agencies stopped procurement from them. Though seeds of food crops come under essential commodities and the State Governments have been allowed to expand list depending on their assessment of situation, farmers involved in seed production have been running from pillar to post to sell their stock to the Government.

Farmers registered with Odisha State Seeds Corporation (OSSC) are unable to process seeds in the processing units of their districts despite instruction from Agriculture department to the Collectors to allow them to operate. Even as some

Collectors have lifted restriction on the operation of seed processing units, the farmers are not allowed to move out of their house.

Impact on Dairy Sector

The ongoing lockdown measures have cascading effect on all sectors including the dairy farmers of the State. The availability of feed and fodder to dairy farmers is become a main challenge to ensure nutritional security of dairy animals. Ever since the lockdown, the OMFED has substantially reduced its milk procurement from the local dairy farmers due to severe demand squeeze.

Impact on Fishery Sector

The Odisha government's decision to put districts under lockdown has dealt a blow to the fishing sector in the state. The heat is being felt in coastal districts like Ganjam borders with other states have been sealed, affecting fishermen who sold fish from the regions. The destiny of these fishermen now hangs in balance. Before the lockdown, fish suppliers would travel to West Bengal in trucks and buses to sell off the fish. That has been stalled now.

The prices of fish are falling. Fishermen are losing money. The rate of fishes like pomphret, rohu, mirakali, among others has seen a drastic fall. While some fish merchants preserved fish in cold storages, most lack facilities to do the same. As a result, they have no choice but to sell off the fish at a lower price.

Impact on Poultry Sector

All Odisha Poultry Forum (AOPF) claimed that sales of chicken and eggs have decreased over the last few weeks, due to rumours linking them to the coronavirus infection. Around 70 lakh kg chicken was being sold every week in the state while the sale has affected by 30-40 per cent.

Government Initiatives

1. The government has stressed on extensive use of technology and for this WhatsApp groups have been created to keep an eye on the market situation across the country and to follow appropriate steps for the marketing of agricultural produce of the state.

2. The farmers are advised to make ample use of platform like Ama Krushi helpline within the existing situation for any query related to agriculture and marketing of their produce.

3. The warehousing facilities for agri-inputs have also been exempted from the purview of restrictions.

4. To facilitate the use of farm machinery the custom hiring centres have been reportedly permitted to remain open

5. The state has taken steps for procurement of rabi produce such as green gram, black gram, groundnut, sunflower for which procurement centres have been opened. The farmers have been advised to enrol their name in e-Samrudhi portal of the NAFED.

6. To overcome the problem of human labour, the farmers are told to engage combine harvester for the timely harvesting of paddy, except the farmers enrolled under the seed production programme.

7. Government is making sure that there should not be any problem for credit availability to the farmer.

8. Odisha government is encouraging contract farming so that farmers should get a market security to dispose there produce.

Conclusions

Going ahead, one can foresee many difficulties as farmers and farm labourers set out to rebuild their lives and livelihoods. There is a need for relief, as well as rehabilitation measures, to help the affected and pick the threads again, overcome the loss sustained and rebuild their lives. The COVID-19 lockdown and excessive limitations on movements of farmers and farm goods have negative impact on the rural economy. With a bumper yield of vegetables and cash crops like pulses and oilseeds, farmers are desperately looking for government help to sell their produce at least in reasonable prices in the local markets. Because of misinformation on social media, the public is not going for non-vegetarian food which require to create awareness among the people about fake news. In this context, Government should seek the help of cooperatives to procure the milk and help the farmer by giving them actual price of the milk. Government initiatives like promoting contract farming is really appreciable. Precautionary measures like maintaining social distancing and hand washing will need to continue as COVID-19 continues.

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Crop Residue Management Under Conservation Agriculture

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Introduction

The cropping system of rice -wheat is grown on largest area of the world. These crops grown on 13.5 mha and are recognized as the important crops for food security in South Asia. Rice-wheat is followed in Indo-Gangetic Plains (IGP) of Bangladesh, India, Nepal and Pakistan of South Asia and this plain has the fertile alluvial soils. In India similar system is practiced as most profitable system in IGP states of Punjab, Uttar Pradesh, Haryana, Bihar and West Bengal which occupies about 15% of the total geographical area of India. However, rice -wheat rotation of the IGP, occupies 53 % of the total area and about 42% of the total farming area of the India. India ranks second in the production of rice and wheat in the world. Harvesting of these crops generates large volume of residues. In India, on an average 500 million tons of crop residue generated per year. Among different crop residue, 34% comes from rice and 22% from wheat crops, most of which is burnt on-farm. The major reasons for the burning of residue are high cost of removing the crop residues by conventional methods and use of combines for harvesting of crops, lack of buyers for power generation or other purposes, little time for planting succeeding crop, lack of labor and financial assistance from government. Burning of residue results in loss of soil nutrients, elevates soil temperature which leads to death of beneficial soil organisms and responsible for greenhouse gases emissions. So, conventional farming practices have to be replaced with a sustainable system which agrees on the three basics components: ecological, economic, and social sustainability (Kaur 2013; Pilgeram 2013). Meanwhile, Conservation Agriculture (CA) farming systems is one most suitable to achieve the sustainability in agriculture production. It consists of basically three principles viz., minimum soil disturbance, permanent soil cover and diversified crop rotations. As, crop residue cover is major component of CA, it can be retained or incorporated into soils to prevent soil erosion from wind & water and to augment the soil moisture.

Management Practices

Permanent crop cover with recycling of crop residue generated in large amount is a pre-requisite and integral part of conservation agriculture. Surface management of residue and mulching are the options to avoid crop residue burning, reduce labour cost and to increase sustainability. The residue is left on the soil surface to protect the topsoil enriched with organic matter from erosion. At the same time, fresh residues must be added to the soil when existing residues decompose. (Magdoff and Harold 2000) Burning not only increases mineralization rates which rapidly depletes nutrients and organic matter from the soil but also causes air pollution. In CA, plants are either left in the field or killed, with their residues left in the field to decompose in situ. This practice is primarily aimed at protecting the enriched topsoil against chemical and physical weathering. Plant residues slow down the speed of falling raindrops (Thierfelder and Wall 2009), provide a barrier against strong winds and temperature, decrease surface evaporation, and improve water infiltration.

Surface retention of residue in soil can be managed by the technology of happy seeder and zero tillage. Happy seeder is used in the combine harvested paddy fields for planting of wheat. Zero tillage is also used in standing stubbles of combine harvested rice after removing loose straw. It was also observed that with the practice of surface retention of residues enhances the soil NO_3 by 46%, N uptake by 29%, and yield by 37% than burning. The soil physical properties viz. soil moisture, temperature, aggregate formation is affected by residue management practices. Surface retention is also act as mulch and mulching play important role in suppression of weeds.

To maintain or increase soil fertility and productivity with green manure or cover crops to be grown in spite of other crops. They increase SOM content either by adding fresh plant residues to the soil or by reducing soil erosion. Most of Legume cover crops can have the ability to fix nitrogen from the atmosphere into the soil increasing N availability to crop plants. Cover crops are mowed or killed before or during soil preparation for the next economic crop. (Miguel et al. 2011; Farooq and Nawaz 2014) A gap of 1 or 2 weeks before planting the next crop is needed to allow some decomposition and reduction in allelopathic effects of the residues, and to minimize nitrogen immobilization.

CA improves soil biodiversity, soil biological activity, water quality and soil aggregation, and increases soil carbon sequestration through maintenance of crop residues. By keeping residues on the surface and using cover crops, permanent soil cover is maintained during fallow periods as well as during crop growth phases. Opined that the benefits of each principle need to be properly evaluated as trade-offs exist and some farmers have not adopted all of CA components Giller et al. (2009). Retaining crop residues has positive and negative effects; researchers should develop strategies to enhance the positive effects (Kumar and Goh 2000).

Conclusions

In most of the studies revealed that management of residue play significant role in protection of soil surface but also reduce the evaporation losses and water saving by the use of cover crops. The residue on the soil surface reduces the touching of sunlight and reducing the air exchange which resulted in less use of energy for the loss of water from the surface of soil (evaporation). It will also impact the soil physical and chemical properties and productivity of crops. This practice of CA has effect on microclimate which shows positive affect on biological systems. The management of residue under field condition with CA could show path towards sustainable agriculture by reducing residue burning and environmental pollution.

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Doubling Small Holding Farmer's Income Through Integrated Farming Systems

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Abstract

In India, majority of farmers are small and marginal farmers, due to changing climate and its impact on present day agriculture, the farmers are facing many risks in agriculture. Due to this most of the small and marginal farmers are becoming agricultural labourers or non-farm labourers. Integrated Farming System assures farmers with additional income from cropping and allied enterprises through resource recycling in an eco-friendly approach. It reduces the use of external inputs, thus reducing the cost of production. The allied enterprises like Dairy, Goat, Poultry, Mushroom, Kitchen garden, Apiary etc., not only reduces the risk in agriculture but also supplies nutritional food for the farm family. Additional employment is generated all-round the year with inclusion of diversified cropping systems and allied enterprises. It also helps in improving the water productivity and energy saving. It helps in mitigating climate change as it is eco-friendly. With allied enterprises and crop diversification along with resource recycling, Integrated Farming System will for sure, double the farmers income.

Introduction

In India, farmers mostly are small and marginal with land area one hectare or one and two hectares. Rural households engaged in agriculture are 57.8 percent out of which 69 percent are marginal and 17.1 percent are small landholdings. The percentage of cultivators employed in agriculture, has declined from 71.9 percent in 1951 to 45.1 percent in 2011, owing to low productivity, due to various factors including adverse weather conditions. The lack of agricultural growth moved the rural populations towards the non-farm sector, increasing non-farm rural employment by about 12 percent between 1999-2000 and 2011-2012. (Preethy Bhogal, 2016).

During the past, agriculture sector focused on raising agricultural output and improving food security. Since the adoption of green revolution, food production multiplied 3.7 times, while population multiplied by 2.55 times resulting in 45 per cent increase in per person food production. The NSSO data on Consumption Expenditure Survey (2011-12) reveals that the income of more than one fifth of rural households with self-employment in agriculture as their principle occupation were below poverty line. Less income and large difference in income between agricultural and non-agricultural workers were an important reason for the emergence of agrarian distress during 1990's. Low farm income and farming shocks due to losses were the reason for sharp increase in farmer's suicide during 1995 to 2007 (Chand and Parappurathu, 2012). It is apparent that income earned by a farmer from agriculture is crucial to address agrarian distress and promote farmers welfare.

With this background, Integrated Farming Systems (IFS) therefore assumes greater importance for sound management of farm resources to enhance the farm productivity and reduce the environmental degradation, improve the quality of life of resource poor farmers and maintain sustainability. In order to sustain a positive growth rate in agriculture, a holistic approach is the need of the hour. Farming system is a mix of farm enterprises in which farm families allocate resources for efficient utilization of the existing enterprises for enhancing productivity and profitability of the farm. As early as 1977, FAO has stated that "in Integrated Farming System there is no waste" and "waste is only a misplaced resource which can become a valuable material for another product".

Major farming systems in India are classified into eight broad categories viz., irrigated, wetland, rainfed farming in humid, dry and cold areas, coastal, mixed and urban based farming systems. India, being the country of rich agricultural diversity, almost all the farming systems are under practice across various agro-ecosystems.

Successful IFS in Tamil Nadu: Modules for Lowland, Irrigated Dryland & Rainfed Ecosystems

Studies on integrated farming system involving various components were carried out at different agro-climatic zones of India since 1985. The approaches were to find out viable components for wetland, irrigated dryland and rainfed situations. The identified technologies emanated from the research programmes on integrated farming systems for the last three decades are enormous. The best combinations of crop based integrated farming system which plays a crucial role in livelihood security are discussed below.

1. Lowland ecosystem: To enhance and sustain the productivity, economic returns, employment generation for family labour, efficient resource recycling and improving the soil fertility with environmental protection, integration of cropping with 0.25 ha each of sugarcane (planted)-sugarcane (ratoon) -banana (3 years), banana-turmeric-rice-banana (3 years) and annual cropping of maize-rice-sesame-sunnhemp rotation applied with recycled goat manure as fish pond silt @ 6.25 t/ha and 100 per cent recommended NPK fertilizer for each crop combined with BN hybrid grass + *Desmanthus* in 0.10 ha for 20 female + one male Tellicherry goat and 400 numbers of polyculture fish in 0.04 ha pond water comprising catla (20 per cent), silver carp (20 per cent), rohu (20 per cent), mirgal (15 per cent), common carp (15 per cent) and grass carp (10 per cent) fed with goat dropping could be resorted. The system as a whole recorded 37679 kg/ha of Rice Grain Equivalent Yield, Rs.1,31,118 of net return per hectare with benefit cost ratio of 3.36, employment generation of 576 mandays and nutrient gained by recycling of goat manure was 20.2, 21.0 and 15.9 kg N, P_2O_5 and K_2O through fish pond silt (Jayanthi, *et.al.*, 2009).

The model comprising of cropping systems (Rice – Rice – Blackgram, Maize – Rice – Sesame, Bhendi-Rice – Sunflower, CO 4 Fodder grass, Azolla in 0.6 ha + Horticulture (Banana) in 0.1 ha + Dairy (2 cow + 1 heifer) + Fisheries (0.08 ha) + Poultry (0.01) + Vermicompost developed for the marginal farmers of cauvery delta zone, gave the production throughout the year (25.37 t REY/year), Gross income (Rs.3.94 lakhs/year), net income (Rs.1.76 lakhs/year) and generate employment (414 man days/year). The highest net return of Rs.79719 was realized from cropping component followed by the dairy (Rs.28813), fisheries (Rs.27624), poultry (Rs.16354) and horticulture (Rs.13177). The IFS model provides employment and profit throughout the year. The model also meets 27.6% of inputs required for different enterprises within the components besides providing all the commodities (Cereal, pulses, oilseeds, vegetables, fruit, chicken, milk and fish) required for the farm family. (AICRP – IFS Annual report – TNAU - 2016)

2. Irrigated dryland ecosystem: Farmer participatory research for irrigated dryland revealed that to enhance and sustain the productivity, economic returns, employment generation for family labour and soil fertility with environmental protection for one acre land, integration of sunflower - maize + cowpea - green gram in 0.60 ac with 2.6 t composted organic manure (50% of production) to sunflower + 100% recommended NPK fertilizer to each crop in the system and 0.9 t composted organic manure (50% of the production) along with 100% recommended NPK fertilizer to CO 3 Cumbu Napier hybrid grass + Desmanthus 3:1 ratio in 0.20 ac and for vegetable crop raised in 0.10 ac, 0.5 t vermicompost application along with 150% recommended NPK fertilizer + milch cow (2+1) + Tellicherry goat (10 female + one male) + guinea fowl (20 Nos.) could be resorted (Jayanthi, *et. al.*, 2009).

IFS model developed for 1.20 ha by AICRP – IFS, TNAU, Coimbatore with components crop – horticulture – dairy - goat rearing – biogas – vermicompost – border plants and kitchen garden, a net return of ₹ 2,92,702 / year could be realized. Cropping component recorded a maximum net return of ₹ 94,586 followed by dairy and goat unit with net returns of ₹ 91,588 and ₹ 66,389 respectively. The net returns from other enterprises like vermicompost unit, biogas unit, compost yard, border plants and kitchen garden were ₹ 39,955. Saving of production cost, with recycled farm products was 27.6 % (Rs. 1,12,573) and farm labour engaged was 35.9 % (Rs. 1,46,531). The average total farm production per year in terms of Maize equivalent yield from main product was 38.2 t/ha and from by product was 7.7 t/ha summing to a total of 46 t. The Model generated a mean employment of 778 man days round the year with a benefit cost ratio of 1.96. The nutrient addition through vermicompost and FYM was 191 kg nitrogen, 86 kg phosphorus and 112 kg potassium per year (AICRP – IFS Annual report – TNAU - 2016).

This integrated farming system of irrigated dryland ecosystem assures the climate resilient agriculture in areas with ground water potential.

3. Rainfed ecosystem: On-farm experiments were conducted to optimize and stabilize the crop - livestock - silvipastoral farming system in dry land areas of Western zone of Tamil Nadu.

Research revealed that, rotational grazing of 39 numbers of sheep per ha is optimum stocking density to graze in the silvipasture land with *C. setigeru*, *S. hamata*, fodder sorghum and *Pillipesara* fodder system. *Cenchrus setigerus* , *S. hamata*, fodder sorghum and *Pillipesara* system with sheep (5+1) and buffalo (2 nos.) was the best promising IFS, which generated the highest system productivity, employment generation, net return and benefit cost (Jayanthi, 2013).

Promising IFS Technologies Developed and Adopted by Farmers in Tamil Nadu

Ecosystem		Farming system technology
Lowland (1ha)	:	i. Cropping (0.75 ha) + fodder Crop (0.12 ha) + fishery (1000 nos.) + mushroom (5 kg/day) + goat (20 female + 1 male) + vermicompost (4t production Capacity) ii. Crops (80 % area) + fishery - 500 No's (10 Cents) + poultry-50 birds (layer/ broiler) + mushroom (5 kg/day) + vermicompost with 5 t production capacity
Irrigated dryland (1ha)	:	i. Cropping (0.70 ha) + milch cows (3 + 2) + goat (10 female + 1 male) + vegetables (0.06 ha) + fodder Crop (0.20 ha) + vermicompost (6 t production capacity) ii. Cropping (90% area) + milch cows (2 Nos.) + biogas unit (2 m3) + Desi poultry - 30 birds + goat (10 + 1 No's)
Rainfed (1ha)	:	i. Cropping (0.75 ha) + silvipasture (0.20 ha) + farm pond (0.04 ha) + buffalo (2 Nos.) + goat (10+1) + bio-compost (8 t production capacity) ii. Cropping and horti-pasture (90 % area) + sheep (10 + 1) + desi poultry - 30 birds + vermicompost + mobile sprinkler (1 unit) + farm pond (10 cents)

The above results clearly indicate that farming system for different situations, enhances the productivity, profitability of the system along with nutrition security of the farm family. It also sustains the productivity of the soil through rich nutrient supply by recycling of organic wastes generated from varied allied enterprises. The best advantage of utilizing low cost /no cost waste material at farm level for recycling, reduces the production cost and improves the farm income along with additional yield.

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Conservation Agriculture and Its Role in Soil and Water Conservation

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Introduction

Our natural resources like air, water, soil degrading day by day. There are many examples of degradation of natural resources worldwide. Amazon rainforest wildfires are the more recent example of resources degradation. The Amazon rainforest contributes 60% of all rainforests. It is the earth's lungs and with it getting destroyed is constitute a huge risk to the environment and the whole world. Not only our forest resources are degrading but our water resources are also facing consequences of it. Because reduction of forest cover impacted the microclimatic conditions and hydrological cycle. It is observed that one in three people in the world are already facing water shortages and almost one-fifth of the world population live in areas of physical water scarcity. Approximately 85% fresh water is used for irrigation of farmland. Apart from our water resources land resources are also degrading. The main reason for degradation of land resources is deforestation, shifting cultivation, over grazing, faulty agricultural practices, and water erosion. It is found that about 40% of the world's agricultural land is seriously degraded. This degradation of the land resource has caused crop yields and productivities to decline and has promoted the agricultural practice of an alternative production model that is ecologically sustainable as well as profitable. Another challenge for agriculture is its environmental footprint and climate change. Agriculture is not only victim but also the contributor of greenhouse gas emissions which contribute to global warming and climate change. It is responsible for about 30% of the total greenhouse gas emissions of $CO2$, $N2O$ and $CH4$ that make it world's second largest GHG emitter after the energy sector and crop productivity directly affected by the consequences of a changing climate. The main contributors of GHG emission in agriculture are crop residue, manure management, emission from soil, rice cultivation, and enteric fermentation. The effects of climate change are felt more and more in agriculture sector because extreme climatic events occur with higher frequency. A system approach should be implemented to conserve the natural resources like soil and water. Conservation agriculture is a system approach that can prevent losses of arable land while regenerating degraded lands and conserve more water. Modern agriculture faces problems of finite resources (water, land) and low efficiency, increasing environmental pollution and global warming, reducing productivity, increasing cost and decreasing income. Conservation agriculture is an important solution of these problems. There are three pillars of conservation agriculture- (1) Minimum soil disturbance (zero tillage) (2) Mulching (at least 30%) (3) Crop rotation (at least three different crops). In Indo-Gangetic plains, the adoption of zero-tillage in wheat production reduced farmer's costs per hectare by 20 percent and increased net income by 28 percent (FAO, 2016). Conservation Agriculture is 20 to 50 percent less labor intensive and generates big savings on tractor operations, fuel and time thus contributes to reducing greenhouse gas emissions through lower energy inputs and improved nutrient use efficiency. At the same time, it protects and stabilizes soil from breaking down and releasing carbon to the atmosphere.

History of CA

Tillage, the mechanical manipulation of soil was asked for the first time in the 1930s. When in central USA, due to extreme drought a very severe wind erosion event occur which is known as dustbowl. In this event of dustbowl millions of tons of soil were lost. With time, the idea of reduced tillage was introduced to protect the soil by keeping it covered with crop biomass. Then, in 1940s, seeding machinery development was allowed to seed directly without any tillage. In the 1960s, no-till is adopted commercially in the USA. After that in 1964s, first time Australia did experiment on no-till. During early 1970s, no-till is introduced in Brazil and West Africa. The Conservation agriculture experience in the USA helped to motivate the CA in South America and South Africa. CA took more than 20 years to approach the significant adoption levels. During this period, farm machineries and agricultural practices in no-tillage systems were upgraded and advanced to optimize production & machinery and field operations. From the early 1990s, the adoption of conservation agriculture started increasing exponentially. Which uprising the agriculture of Argentina, Uruguay, Paraguay and Brazil. During the period of 1990s, various international research organizations (FAO, World Bank etc.) became interested in the promotion of CA. This promotion increased levels of awareness and adoption in other African countries as well as Asia particularly in Pakistan, China, India and Kazakhstan. In Pakistan and India, wheat–rice cropping systems in the Indo-Gangetic Plains are being transformed into CA systems, referred to as 'double no-till' rice–wheat systems, and in some places, there is an added short season legume crop referred as crop rotation. It is expected that major increase in the adoption of CA cropping systems across Asia in the coming decades. Since 2009, CA adoption is increases at the rate of 10 million ha annually.

Global Spread of Conservation Agriculture

Country wise adaption of conservation Agriculture (M ha)

Country	2008-09 (M ha)	2015-16 (M ha)	% increase
USA	26.5	43.2	63.0
Brazil	25.5	32.0	25.5
Argentina	19.7	31.0	57.4
Canada	13.4	19.9	48.5
Australia	12.0	22.3	85.8
Paraguay	2.4	3.0	25.0
Kazakhastan	1.3	2.5	92.3
China	1.3	9.0	592.3
India	-	1.5	-
Total	106.5	180.5	69.5

Cropped area under CA by region (2015-2016)

Region	CA cropped area (M ha)	% of global CA cropped area	% of cropped area in the region
Africa	1.5	0.8	1.1
Europe	3.6	2.0	5.0
Russia & Ukraine	5.7	3.2	3.6
Asia	13.9	7.7	4.1
Australia & NZ	22.7	12.6	45.5
North America	63.2	35.0	28.1
South America	69.2	38.7	63.2
Global total	180.4	100	12.5

Benefits of CA

1. Higher crop productivity
2. Enhance soil quality
3. Enhance C sequestration and build up in soil organic matter
4. Mitigate GHG emissions and impart greater resilience to climate change
5. Increasing water and nutrient use efficiency
6. Avoid crop residue burning
7. Enhance crop intensification
8. Control weeds
9. Reduce evaporation
10. Improve biological activity in soils
11. Improve recycling and availability of plant nutrients
12. 5-10% increase in system yield
13. 46-62% energy saving
14. 8-17% irrigation water saved
15. 16-56% profitability
16. 26-44% labour saving.

Constraints in Adoption of CA

1. Machines dependence and Unavailability at Farmers level
2. Lower purchasing power of majority farmers and fragmented and smaller land holding
3. Farmers education and technical knowledge

4. Residue availability and competitive role
5. Weed problems & herbicidal dependence
6. Birds, rodents, and snakes (sugarcane) problems, particularly under crop residue.

Role of Conservation Agriculture in Soil and Water Conservation

1. Conserving soil water: Retaining crop residues on the land surface can provide cover to soil surface which reduce evaporation, reduce runoff velocity thus give more time to infiltrate and increased soil moisture content.

2. Improving soil quality: Soil quality usually has three main aspects: chemical, biological, and physical. Physical quality (soil structure) has big effects on chemical and biological process in the soil. No-till reduces soil compaction and prevent soil structure decline which improve soil physical quality ultimately improve biological and chemical quality of the soil.

3. Increase soil organic carbon and organic matter: Crop residues which contain carbon improved organic carbon contents in soil by conservation agriculture and nutrients at the soil surface layer. Crop residue causes lower oxidative losses of organic C due to decrease in oxygen below the soil surface in zero-till system.

4. Improving hydraulic conductivity and infiltration: Zero-tillage improves infiltration than other tilled soils due to larger number of macro pores. No-till leaving old root holes to facilitate internal drainage. There is increased in fauna activity and accumulated organic matter forming a litter of residues. Crop residues protect the soil from raindrop impact which reduce loosening of surface aggregates and prevent pore sealing and crust formation. Residues left over the soil also slow the flow of surface runoff thus increase the opportunity for water to infiltrate.

5. Soil stability and aggregation improvement: Soil stability refers to the susceptibility of soil to change under natural or anthropogenic disturbance which improved by adopting CA due to decrease in erodibility of soil and avoiding the pulverization of soil aggregates. Soil is more stable and aggregated under CA systems.

6. Reducing soil erosion: Mulching on the soil surface reduce rainfall impact which decreases soil detachment. Mulching also reduce runoff velocity this will help to increase moisture infiltration and decrease detachment & transportation of soil from place to other. Residue retention on the surface eliminates wind erosion also.

Conclusions

Conservation Agriculture (CA) is not only provides a window of moisture conservation, but also the ways to check the water losses and enhanced the system water productivity. Indian agriculture is likely to suffer losses in long run due to heat, erratic weather, and decreased irrigation availability. Indian agriculture faces many emerging challenges like food security, low income in rural areas, nutrition security, water scarcity, land degradation and climate change. Adaption of CA can help minimize negative impacts to some extent. Improve in land and water productivity is an important interdisciplinary approach and only possible by the choosing of the appropriate resource conservation technology depending upon the region.

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Zero Budget Natural Farming: In India

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Abstract
In our country a major problem of different losses faces by the farmers. To the solve this problem invented a new technique is called as ZBNF. In this method chemical is not use in farming.

As well, India needs advanced technologies to lessen physical degradation of soils due to flooding, waterlogging, and crusting. But such a comprehensive approach needs a solid embrace of scientific temper and a firm rejection of anti-science postures.

Introduction
The 'budget' word refers to credit and operating cost, hence the phrase 'Zero Budget' means with no using any credit, and without spending any money on purchased inputs. The means of 'Natural farming' is farming with Nature and without chemicals.

Zero budget natural farming is a practice of chemical-free agriculture representation from traditional Indian practices .It was originally encouraged by agriculturist Subhash Palekar, who developed it in the mid-1990s as an alternate to the Green Revolution's approaches that are determined by chemical fertilizers and pesticides and intensive irrigation. It is a fixed of farming methods, and also a grassroots laborer movement, has widen to various states in India.

The ZBNF has achieved wide success in southern India, mainly the southern Indian state of Karnataka where it first evolved. ZBNF inspires a force of volunteerism along with its peasant farmer members, who are the main protagonists of the movement. It has achieved wide attainment in southern India, especially Karnataka where it was firstly evolved (Kumar. N, 2012)

Definition
Holistic agriculture or Zero Budget Natural Farming (ZBNF) is a method of agriculture that counters the commercial outflow and things required for the growth of plant are present around the root zone.

Some Unique Quality of ZBNF
1. In the Zero Budget Natural Farming nothing has to be purchased from the outside. Every one thing required for the growth of the plant are presented around the root zone of the plants.
2. 98 to 98.5% nutrients are taken from air, water & solar energy.
3. Remaining 1.5% nutrients taken from the soil are also available free of cost as it is taken from the prosperous soil which is enriched with these nutrients.

Big Concepts
1. An approach towards sustainability.
2. Expense-free farming.
3. One native cow with farming up to 30 acres.
4. Farming with least electricity and water consumption.
5. Producing quality, poison-free food.
6. Agriculture without external input.
7. Techniques of multi-crop cultivation for higher net income.
8. Reducing external labour requirement.
9. Farming in tune with nature.
10. Saving the farmers from suiciding themselves and leaving behind their families as beggars.

Principles of ZBNF

1. Low input farming: The production outlay for the farmer is zero as no input wants to be purchased. As 1.5 to 2.0 % of the nutrients are taken from the soil by the plant, there is no need to add fertilizers. These nutrients obtained by nature (as in the forest) are totally free of cost.

2. Natural inputs: In this type of farming does not require chemicals inputs or organic compost like vermi-culture.

3. Soil mulching:

a. It is essential to create the microclimate under which micro-organisms can well grow, that is 25 to 32 °C temperature, 65 to 72 % moisture.
b. Its makeup darkness and warmth in the soil.
c. It conserves soil humidity cools it and protects its micro-organisms.
d. It promotes humus development, suppresses weeds and maintain the water requirement of crops.

4. Multiple cropping: Multi-cropping is a good way to minimize the risks for the farmer who is able to enjoy stability of yield throughout the year. In casing of a crop's failure, he can also rely on the other crops. It has prolonged farmers' income sources.

4 Pillars of ZBNF

1. Jivamrita: It is a microbial culture done by a fermented. The Palekar advises it is only desirable for the first 3 years of the transition, later than which the system becomes self-sustaining.

a. How to practice Jivamrita: Take 200 liters of water in a drum; then add 10 Kg fresh local cow dung and 5 to 10 liters aged cow urine; after that add suitable amount of 2 Kg of Jaggery +2 Kg of pulse flour and a handful of soil from the bund of the farm. The solution well Strike and let it ferment for 48 hours in the shade. Now it is ready for application. The 200 liters of jeevamruta is adequate for one acre of land.

b. Application of Jivamrita: It is applied to the crops twice a month in the irrigation water or as a 10% foliar spray.

2. Bijamrita/beejamrutha: It is used for seeds, seedlings or any planting material for treatment. Bijamrita is useful in protective young roots from fungus as well as from seed-borne and soil-borne diseases that generally affect plants after the monsoon period. It is collected of alike ingredients as jeevamrutha - local cow dung, a dominant natural fungicide, and cow urine, a strong anti-bacterial liquid, lime, soil.

Bijamrita Application as a seed treatment: It is used to the seeds of any crop: coat them, combination by hand; dry them well and use them for sowing. The leguminous seeds, immediately dip them quickly and let them dry.

3. Acchadana – Mulching: Palekar, suggest the there are three types of mulching:

a. Soil Mulch: This protects topsoil throughout cultivation and does not destroy it by tilling. It promotes water retention and aeration in the soil.

b. Straw Mulch: It refers to the dry biomass waste of previous crops, but as According to Palekar suggests, it can be composed of the dead material of any living being (plants, animals, etc). The approach to soil fertility is very easy – give dry organic material which will decompose and form humus through the activity of the soil biota which is activated by microbial cultures by Palekar's.

c. Live Mulch: It is essential to develop multiple cropping patterns of monocotyledons and dicotyledons grown in the same field, to supply all essential elements to the soil and crops by According to Palekar. For instance, legumes are nitrogen-fixing plants & of the dicot group. The rice and wheat are monocots supply other elements like potash, phosphate and sulphur.

4. Whapasa - moisture: Palekar suggest challenges the idea that plant roots require a lot of water, thus countering the over reliance on irrigation in green revolution farming. According to him, what roots need is water vapor. It is the condition where there are both molecules are present in the soil such as air and water and he encourage reducing irrigation, irrigating only at noon, in alternate furrows ZBNF farmers report a significant decline in need for irrigation in ZBNF.

Conclusions

The Zero Budget Natural Farming is a major challenge of saving the soil health without any use of chemical. In India it is a very suitable technique for the improvement of soil health and maintain environment balance. The ZBNF is a best approach for the Indian farmer & its application to save our health and ecological system. In this topic include the technique of ZBNF how to farmer done.

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