AGRICULTURE & FOOD: E-NEWSLETTER
WWW.AGRIFOODMAGAZINE.CO.IN
E-ISSN: 2581 - 8317

System of Wheat Intensification (SWI)

Article ID: 10858

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Introduction

Wheat is the second most important cereal crop in India after rice. It is mostly grown in Uttar Pradesh, Punjab, Rajasthan, Haryana, Bihar, West Bengal, Uttarakhand, Madhya Pradesh, Gujarat etc. Since ancient days, wheat has been serving the hungry world and therefore, it is most important staple food in the world (Biswas, 2020). It is nutritionally rich in carbohydrates (60-80%), protein (10-15%), fat (2%), minerals (1.8%), crude fibre (2.2%), vitamins (Vitamin B complex, E) etc (Shewry and Hey, 2015). It has various uses as food, feed, starch and fuel etc. In the present context of low productivity of wheat and high demand from the ever-increasing population, wheat cultivation needs urgent modification of conventional practices which not only fail to elevate wheat yield but also create environmental hazards. Among various new interventions, one eco-safe option namely 'system of wheat intensification' holds good prospects in uplifting wheat productivity.

System of Wheat Intensification (SWI)

System of wheat intensification (SWI) is an innovative wheat cultivation technique which modifies traditional practices of inputs and other agronomic practices for favourable growth of both root and shoot, resulting in improved production of wheat. System of wheat intensification goes with SRI (system of rice intensification) principles as these principles are part of system of crop intensification.

Why is SWI Needed?

SWI is primarily needed to produce high wheat yield per unit of resources/inputs. SWI is pertinent considering the revamp required in food grain production specially, in wheat to meet demand of ever-increasing population. Continuous, excessive and unscientific applications of synthetic agro-chemicals create harmful soil and environmental issues. Besides, there is a gradual decline in response of crop to inputs particularly in the context of climate change. Intensive tillage, crop residue burning, depletion of soil organic matter, reduction of soil fertility, loss of soil health, lack of good quality and sufficient irrigation water, salinity problems, arsenic problems etc are also some major issues associated with chemical farming. All these lead to stagnation in production level of wheat. Under such scenario, SWI holds good prospects as it aims to improve wheat productivity at the minimum expense of inputs without sacrificing soil and environment quality. Further, it can be a promising option in uplifting the wheat production in low productive areas of Eastern India. As SWI follows alternate wetting and drying approach, it has good prospect in dry land areas too.

Principles of SWI

There are two basic principles of SWI:

1. Principle of root development (proper nourishment and sufficient space around the plant for better root growth and uptakes of nutrients and moisture)
2. Principle of intensive care (careful management of soil, agronomic practices in each stage of plant growth)

Package of Practices of SWI

Land preparation: Well drained, loamy, fertile, moist (but not water logged) soil having pH ranging from 6.0 to 8.5 is ideal for undergoing SWI. 3 ploughings are required for proper land preparation before sowing. First ploughing is done to remove roots or stubbles of previous crop. After 1-1.5 month, second ploughing is done.

Last ploughing is done before sowing of seeds. 15-20 days before last ploughing, 5.0 t FYM/ha or 1.0 t vermicompost/ha are applied. In absence of FYM and vermicompost, NADEP compost, liquid manures like *Panchagavya*, *Amritghol* and *Matkakhad* etc can also be applied. 27 kg DAP/acre and 13.5 kg potash/acre are broadcasted just before last ploughing (dose is variable based on the variety and agro-climatic condition).

Seed selection and treatment: Healthy, viable, free from seeds of weed or other crop/variety, certified, biotic and abiotic stress resistant/tolerant wheat seeds are considered for sowing. However, before sowing, seeds are treated properly using vermicompost, jaggery (*gur*), cow urine, warm water (60 °C) and Bavistin (PRADAN, 2012). 10 kg seeds are poured in 20 litres of warm water. Floating seeds are removed. 5 kg vermicompost, 4 kg *gur* and 4 litres of cow urine are added to viable seeds and left for 6-8 hours. After that, treated seeds are filtered and 20 g Bavistin is added to them. Seeds are then left for 10-12 hours in wet jute bag for sprouting.

Sowing of seeds: Time of sowing depends on soil temperature, irrigation, local agro-climatic condition, availability and type of variety. Seeds are sown in line through seed drill @ 2 seeds/hill at a squared spacing of 20 cm × 20 cm (squared spacing may vary based on the variety, soil moisture etc). Depth of sowing is generally maintained at 2.5-3 cm. Gap filling, if required, is done within 7-10 days. Overall seed requirement in SWI is 20-25 kg/ha only.

Irrigation: SWI requires a greater number of irrigations (3-6 irrigations) as compared to conventional method as it allows the crop field to wet and dry alternatively. A detailed comparison on different aspects of agronomic practices between conventional and SWI method of wheat cultivation is presented in Table 1. In SWI, first irrigation is applied at 15 DAS for root initiation. Second and third irrigations are applied at 25 DAS and 35-40 DAS, respectively, for good vegetative growth. Rest of the irrigations are done at around 60, 80 and 100 DAS depending on soil and climate.

Manure and fertilizer application: Integrated approach of nutrient management is a key factor in SWI. Apart from the basal dose, manure and fertilizer are top dressed after first and third irrigations. 4 q vermicompost /acre and 40 kg urea /acre are applied after first irrigation while, 15 kg urea/acre and 13 kg potash/ acre are applied after third irrigation.

Weeding: Weeding is done for 2-3 times through mechanical cono-weeder. First weeding is done at 20-25 DAS. Subsequent weeding is done at 10 days interval. Apart from making the land weed free, weeding also helps in loosen the soil and thereby, improving aeration, root growth of the crop.

Harvesting: Harvesting is done when moisture content of wheat grain is reduced to 20-25%.

Table 1: Comparison between conventional and SWI methods of wheat cultivation:

Particulars	Conventional method	SWI	Particulars	Conventional method	SWI
Seed rate	100-125 kg/ha	20-25 kg/ha	Panicle length	10-11 cm	15 cm
Seed treatment	Not necessary	Mandatory	No. of Grains/panicle	18-50	60-120
Method of sowing	Broadcasting or continuous	Dibbling in line	No. of panicles/hill	1-2 (for good stand: 2-4)	20-45
Spacing	No proper spacing regulation	20 cm × 20 cm	Stem	Thin	Thick
Weeding	Not done	2-3 times	Root	Shallow	Deep
Seed germination	After a week of sowing	Within 2-3 days of sowing	leaf	Narrow (Less LAI)	Broad (More LAI)
Irrigation	2-4 times	3-6 times	Yield	1-2 t/ha	3-4 t/ha

Source: ATMA (2008); PRADAN (2012)

Benefits of SWI

1. System of wheat intensification produces high number of tillers as well as effective tillers resulting in improvement in wheat productivity by more than 2 times over conventional practice (Dhar et al., 2014).
2. It increases panicle length and produces bold grains.
3. It causes early flowering and maturity by at least 4-5 days, skipping terminal heat stress.
4. It produces vigorous vegetative growth of the plant resulting in supply of bulk quantity of fodder/straw to livestock.
5. Wider spacing (square pattern) creates less crowding (or competition) above and below ground and thereby, allows roots to grow better (seminal roots moving downwards while, crown root moving horizontally for easy uptakes of moisture and nutrients) along with the growth of above ground biomass.
6. Better root system in SWI builds up drought and other abiotic stress resistances inside the wheat plant.
7. It ensures sturdy stem and thereby, checks lodging problem to a great extent.
8. SWI checks disease and insect attacks to a high extent.
9. It saves 75-80% seeds as it requires seeds in a very small quantity.
10. Weeding causes good aeration in root zone of soil and helps roots to penetrate easily to deeper soil layers for nutrients and moisture.
11. It requires very less water for wheat cultivation (20-30%) as compared to conventional practice.
12. SWI ensures high seed germination, low seedling mortality and better plant stand as compared to conventional practice.
13. It is a time and labour-saving approach as it uses seed drill and cono-weeder for sowing and weeding, respectively in place of manual approach.
14. SWI is a method of wheat cultivation with high economic benefit.
15. It promotes application of organic manures and improves soil health, microbial activity and fertility status.
16. As SWI reduces carbon footprints through less use of agro-chemicals, it is a suitable option considering the environment safety.
17. SWI is especially favourable for small scale farmers.

SWI in India

In 2006, inspired from positive results of SRI, People's Science Institute (PSI) introduced SWI in Himachal Pradesh and Uttarakhand with 40 farmers in 25 villages and obtained promising outcomes (66% yield increase over conventional practice). This technology was thereafter, transfused to grass root level of farmers of those two states within next 2-3 years through demonstrations by master farmers. Within 3 years, around 12000 farmers of Himachal Pradesh and Uttarakhand adopted SWI. It was then spread in Madhya Pradesh. In 2008-09, 415 farmers of Bihar adopted SWI. Bihar was the leading state in adoption of SWI where around 30000 farmers successfully shifted towards SWI from conventional wheat cultivation (PRADAN, 2012). Other important SWI practicing states are Punjab, Odisha, Uttar Pradesh, Chhattisgarh etc.

Constraints in Adoption of SWI

1. There is lack of research trials to confirm the merits of SWI in different agro-climatic zones.
2. There is a problem of managing irrigation under SWI in low lying areas/ undulating lands.
3. Cono-weeding is difficult in hard soil and is restricted to only male farmers.
4. Sometimes, there is a lack of availability of organic manures in many places.
5. There is need to develop suitable sowing and weeding implements at affordable prices for the small-scale farmers.
6. There is a lack of extension service to promote SWI to the farmers. Therefore, it remains as a mere technological intervention rather than a practical approach.
7. Adoption of SWI is still very low due to stereotypic mentality of farmers to cultivate wheat in conventional way as well as their disbelief on obtaining high yield at the expense of less inputs.
8. There is a lack of skilled farmers to undergo SWI.
9. There is a lack of policies and subsidies to popularise SWI among the farmers of various states.

Conclusion

System of wheat intensification has already proved its efficacy over conventional practice of wheat cultivation at various places under different agro-climatic situations. However, it still needs more confirmation of results through conducting various crop cutting experiments at different locations and situations. Besides, it requires good policy, subsidy back up and extension service from government and/or private organisations for its dissemination to every corners of farming community.

References

1. ATMA (2008). Assessment, refinement and validation of technology through System of wheat intensification (SWI) in Nalanda with assistance of PRADAN, Nalanda, Bihar, India. Retrieved from http:// www. Krishi.bih.nic.in
2. Biswas, S. (2020). Prospects and constraints of transplanted maize, wheat, sorghum and pearl millet: A review. International Journal of Environment and Climate Change. 10(5): 24-43.
3. Dhar, S., Barah, B.C. and Vyas, A.K. (2014). Comparative performance of System of Wheat Intensification (SWI) and other methods of wheat cultivation in north western plain zone of India. In: International SRI Research seminar on recent Changes in Rice Production and Rural Livelihoods: New Insights on the System of Rice Intensification (SRI) as a Socio-Technical Movement in India. Indian Agricultural Research Institute, New Delhi. Retrieved from http://www.sri-india.net/ event2014/research.htm#Abstract_7
4. PRADAN (2012). Cultivating wheat with SRI principles: A manual. System of Rice Intensification website.
5. Shewry, P.R. and Hey, S.J. (2015).The contribution of wheat to human diet and health. Food and Energy Security. 4(3):178-202.