

Vegetable crops	Varieties	Vegetable crops	Varieties
Curry leaf	Sen Kaampa, DWD1 (Suwasini), DWD2	Pointed gourd	CHES Hybrid 1, CHES Hybrid 2, Faizabad Parwal 1, Faizabad Parwal 3, Faizabad Parwal 4, Rajendra Parwal 1, Rajendra Parwal 2, Swarna Rekha, Swarna Alaukik, Kashi Alankar
Asparagus	Martha Washington, Mary Washington, Reading Giant, Palmetto, Mammoth, Mammoth White, Jersey Queen, Jersey Giant, New Jersey, Improved Perfection	Ivy gourd	Sulabha, Arka Neelachal Kunkhi, Arka Neelachal Sabuja
Globe artichoke	Green Globe, Purple Globe, Violet de Provence, Catanese, Spinosa Sarda, Bianco Tarantino, Precoce di Jesi, Bull, Tudella, E15, Brindisio, Romonesco	Winged bean	UPS-122, UPS31, Ravathy, WBC2, IIHR Selections 21, JCV44
Rhubarb	Victoria, Linnaeus, Mc Donald, Ruby Valentine, Sunrise, Strawberry, Cherry Red	Chekurmanis	Local types
Chow-chow	Round White, Long White, Broad Green, Creamy Green	Cassava	H97, H165, H226, Sree Vishakam, Sree Sahya, Sree Prakash, Sree Jaya, Sree Vijaya, Nidhi, KMC1, CO1, CO2, CO3, Sree Apporva, Sree Athulya
Jerusalem artichoke	Columbia, Mammoth, Oregon, Mammoth	Yam	Sree Keerthi, Sree Roopa, Sree Silpa, Sree Latha, Sree Kala, Sree Subha, Sree Priya, Sree Dhanya
Chive	Wilau, Aliai, Zornaja Rostan, Sempra		

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35. Shade Management in Cardamom: Towards Higher Productivity

JANANI, P

Scientist, ICAR- Central Potato Research Station, Shillong, Meghalaya-793009

INTRODUCTION: Small cardamom (*Elettaria cardamomum* (L.) Maton) belongs to the family Zingiberaceae has widely grown for its fruit and which is used as a spice. Cardamom is known as “Queen of Spices” is indigenous to evergreen forests of the Western Ghats in South India. It is the world’s third-most-expensive spice after vanilla and saffron, mainly used in culinary preparations and confectionery, beverages and liquors. Cardamom is a herbaceous perennial and shade loving plant (pseophyte), growing under shade in evergreen forests. Cardamom does not tolerate direct sunlight, and heavy shade or less shade hinder the growth and development of cardamom. The shade trees maintain adequate humidity and soil moisture, which is essential for cardamom cultivation. Shade requirements vary from place to place depending on land, soil, rainfall patterns, crop combination etc. Cardamom requires 40 to 60 per cent filtered light for initial growth and tillering. It is a cross-pollinated crop and mainly depending on honey bees for pollination. Therefore, judicious shade management is very important for growth, timely flowering for better productivity and capsule quality

Beneficial Effects of Shade Trees

Shade trees help to maintain temperature, humidity, soil moisture and creating a microclimate which promotes vegetative growth, flowering and fruit set

1. Protect the plant from sun scorching and mechanical injury caused by high wind velocity and rain

2. Shade trees serve as windbreaks and also help to minimize soil erosion and weed growth
3. The shade trees fallen leaves and branches can be used as a mulching material and also improves the soil fertility by enhancing microbial and earthworm activities.
4. Promoting the foraging activity of bees which are the major pollinators in cardamom
5. Decrease the pest (thrips, capsule borers and root grub) and diseases (azhukal rot and leaf blight) incidence (Korikanthimath, 2002)

Characteristics of Ideal Shade Trees

The desirable features of shade trees are

1. The tree must be fast growing to provide the necessary shade
2. It must have a wider canopy and hard heartwood to resist the wind
3. It must have small, thin leaves and well- spread branching system
4. Medium size and evergreen nature retaining their foliage throughout the year
5. The root system should be deep to avoid the competition for surface feeding of nutrients and moisture
6. Shedding of leaves during monsoon and production of new flesh before the dry season
7. It should not shed the leaves during the flowering phase of cardamom
8. Shade trees should have high nectar content with a long flowering phase which augments bee forage activity

9. Shade trees should not harbor insect pests and disease vectors
10. Two tier canopy is desirable with a height of not more than 3 m between the lower and higher canopy (George *et al.*, 1984 and Pradip Kumar *et al.*, 2012)

Tree species such as *Vernonia arborea* (Karuna), *Cedrella toona* (Red cedar), *Syzygium cumini* (Njaval) *Artocarpus fraziniifolius* (Palangi), *Diospyros ebenum* (Karimaram) and *Mimusops elangi* (Elangi), *Artocarpus heterophyllus* (Jack) tree etc., are some of the commonly grown shade trees in cardamom plantations.

Trees to Avoid in Cardamom Plantation

The tree species with the following traits need to be avoided for getting higher yield in cardamom

1. Trees with deciduous nature, large, broad leaves with a dense canopy
2. Trees with slow-growing nature and poor canopy spread
3. Softwood trees, which is susceptible to speedy wind
4. Trees characterized by the shallow root system and surface feeding nature which competes for plant nutrients
5. Trees serve as an alternate host for insect pest and diseases of cardamom

Eg. Temporary shade trees of cardamom like *Erythrina lithosperma* and *E. indica* complete for nutrients and soil moisture (shallow rooted) and act as an alternate host for the nematode.

Shade Regulation

Shade regulation is the most important practice of shade trees in order to provide the required light intensity to cardamom plantation. Therefore, it is essential to regulate the shade trees regularly during summer (March-April) and after summer showers (May-June). At the commencement of monsoon, lopping of shade trees has to be taken up before the onset of monsoon to provide adequate shade and minimize pest and diseases incidence. Dense branches should be chopped to provide 40 to 60 per cent light, which is essential for the production of tillers and optimal growth of cardamom plants. Alternate side branches of a tree in the lower one-third portion of the total canopy height should be cut and ensures a balanced canopy. Southwestern side should be provided with more shade than Northeastern side because of their vulnerability of sunlight.

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36. Microclimatic Requirements for Successful Production of Quality Vegetables

D. TRIVENI¹, G. KRANTHI REKHA², AND D. SRIKANTH³

¹PhD Scholar, ²Assistant Professor, ³M.Sc. Scholar, Department of Vegetable Science, College of Horticulture, Dr. Y.S.R.H.U., West Godavari, Andhra Pradesh.

Vegetables are important sources of vitamins, minerals, dietary fibers and antioxidants. Sufficient consumption of quality vegetables can reduce the risk of several non-communicable diseases such as cardiovascular disease, cancers, diabetes, obesity and metabolic syndromes. Inclusion of quality vegetables in the regular diet gives a healthy life. India is the second largest producer of vegetable crops in the world. However, its production is much less than the requirement if a balanced diet is provided to every individual. One potential approach to achieve this target is the promotion of protected cultivation. Other approaches like bringing the additional area under vegetable crops, using hybrid seeds and use of improved agro techniques will also increase the productivity of

vegetables but with protected cultivation, we will get high quality vegetables and maximum yields. Quality vegetable production is not only influenced by its heredity but also by the micro climate around it.

The important environmental factors to be manipulated to grow quality vegetables in the green houses are temperature, light intensity, relative humidity and CO₂ concentration. The need to protect the crops against unfavorable climatic conditions led to the development of protected cultivation. Protected cultivation is a technique wherein the micro climate surrounding the plant is controlled partially or fully to protect the crop from an adverse environment. Green houses, rain shelters, plastic tunnels, insect proof net houses and shade nets