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Large cardamom: Its constraints and strategies for better production in Sikkim and hilly districts of West Bengal: A review

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Abstract
Large cardamom gives recognition to Sikkim and hilly districts of West Bengal. It is a spice crop of significant economic importance in these areas. The major causes of low productivity of large cardamom in the past few decades are lack of proper shade management, viral and fungal diseases, lack of improved planting materials, moisture stress conditions and climate change. By using the good and healthy planting materials, application of farm yard manure, weed management, irrigation during dry period, diseases and pests management income of the farmers can be improved. Promising large cardamom varieties coupled with optimum inputs and technologies can increase yield.

Keywords: Large cardamom, disease, climate change, management

Introduction
Large cardamom (*Amomum subulatum* Roxburgh) belonging to family Zingiberaceae is the most important spice crop of Sikkim Himalayan region and hilly districts of West Bengal. It is also cultivated economically in some other north-eastern hill states like Arunachal Pradesh, Nagaland, Mizoram, Manipur, Meghalaya and Assam. Nepal, Bhutan and Myanmar are the other three countries where large cardamom is cultivated (Sinu and Shivanna 2007, Sharma *et al*. 2009, Gudade *et al*. 2013c) [10, 8, 5]. It is a perennial, shade loving plant (sciophyte), usually grows under tree canopy and requires well distributed rainfall round the year around 200 days with a total of about 3000-3500 mm water/year (Sharma *et al*. 2002, Gudade *et al*. 2013b) [7, 4]. It is essentially a cross-pollinated crop due to the heterostylic nature of its flowers. Effective cross pollination occurs with the help of bumble bees, (*Bombus haemorrhoidalis* and *Bombus breticeps*), (Deka *et al*. 2011) [2]. Large cardamom is used as a spice and also in several ayurvedic preparations. It contains 2-3 per cent essential oils having stomachic, diuretic and cardiac stimulant properties and is also a remedy for throat and respiratory trouble (Gudade *et al*. 2013a) [3]. It is also used in confectionaries, making perfumes and other medicines. The climate change has drastically reduced the production and productivity of large cardamom.

Production constraints
1. Moisture stress condition
One of the prime reasons for its low productivity is its cultivation in rainfed conditions. Owing to this constraint the crop faces severe moisture stress during winter period. Under such situation farmers have to depend largely on rain and *in situ* soil moisture conservation practices.

2. Lack of proper shade management
It is noticed that heavy shade or less shade hinders crop growth and production.

3. Viral and fungal diseases
Two main viral diseases namely *Chirke* and *Foorkey* affect the productivity of different large cardamom cultivars in hilly districts of West Bengal and Sikkim. *Chirke* is serious as far as rate of spread is concerned and *Foorkey* is serious as far as yield loss is concerned.

Chirke is characterized by mosaic with pale streak on the leaves. The streaks turn pale brown resulting in drying, withering of leaves and finally death of the plants. The flowering in diseased plants is extensively reduced. The *Chirke* disease is transmitted by mechanical sap inoculation and also by aphid, *Ropalosiphum maidis* Fitch. Excessive sprouting and formation of bushy dwarf clumps at the base of the mother plants that gradually die, characterize the *Foorkey* disease. Numerous small tillers also appear at the base of the affected plants that become stunted and fail to give any yield. The primary spread of the disease from one area to another is through infected rhizomes and further spread within the plantation by aphids, *Micromyzus kalimpongensis*. But during the last decade minor disease *viz*., *Colletotrichum* has become a major problem to almost all the large cardamom plantations due to congenial atmosphere of the fungal spore formation which spread rapidly in the growing areas.

4. Insects pests

Leaf caterpillar (*Artona chorista* Jordan) was the major pests of large cardamom a decade ago. However, presently minor pests namely stem borer (*Glyphopterix* spp), shoot fly (*Merochlorops dimorphus* Cherian), Lace wing bug, White grub (*Holotrichia* spp.) have become major pests. Changes of load of natural enemies in periodic climatic variation might lead to transformation of minor pest to major. In Sikkim, *Holotrichia* spp. was a major pest of ginger. This has now become major pest in large cardamom plantation in almost all the growing tracts.

5. Pollination

Pollination plays a major role in large cardamom capsule and seed setting. Major role is played by bumble bee (*Bombus breviceps* and *B. haemorrhoidalis* Smith.). These bees construct their nest in ground by making tunnels. There are very high chances to disturb the nests and habitat of the bee due to developmental work and agronomic practices.

6. Climate change and human activities in large cardamom growing tracts

The decrease in production and area of large cardamom during the last decade can be associated with several fold increase in construction of buildings, roads, deforestation, disease and pest occurrence, apathy of young generation towards agricultural activities, quick and lucrative alternate livelihood options, change of rainfall pattern, increased number of vehicles, change of water sources, and reduction of fertility status of the soil, *etc*. In the last decade due to gradual increase in temperature, plant behaviour shifting natural events of flowering and leafing has also been observed. Abnormal elongation of flowers with unknown etiology has also been recorded during the last decade. Economic life span of large cardamom was calculated to be 15 years. However, in practice the life span of the crop was reducing to seven to eight years irrespective of cultivars. In recent years, it is observed that the crop is performing well in some areas with less shade or even in open conditions which may be associated with climate change.

Strategies for better large cardamom production

1. Importance of organic mulches in large cardamom

Mulching helps in moisture retention up to 22-27 percent in the soil. Mulching helps to improve the infiltration rate and moisture holding capacity of the soil, reduces rainfall impact, provides a small pool of nutrient for plants, reduces evaporation from the soil, and reduces runoff and erosion. In large cardamom, organic mulches helps in reducing water erosion, increase night temperature and retain moisture content in soil for longer time. It is very beneficial to growth and development of this crop from October to March months of dry period.

2. Use of biocontrol agents

In large cardamom cultivation, the biocontrol agent *Pseudomonas fluorescens* is generally found to be effective as a protectant against major fungal pathogens and thus, offer disease control. These can grow, multiply and produce a number of hormones on organic matters, which promote plants growth and vigour. This also produces various types of substances which are antibiotic in nature and are helpful in protecting the plants from various diseases.

3. Establishment of large cardamom sucker nursery

Established certified nurseries, produces a large numbers of diseases free quality planting materials @ 1:5 ratio, which could be utilized in main field plantation and gap filling. There are mainly six popular cultivars of large cardamom *viz*., Ramsey, Ramla, Sawney, Varlangey, Seremna and Golsey. There are two high yielding varieties released by Indian Cardamom Research Institute for cultivation in Sikkim *viz*., ICRI Sikkim 1, ICRI Sikkim 2. These varieties are selected from Sawney variety and now are mostly used in tissue culture for planting material production.

4. Shade management

About 50% shade is found to be ideal. Cultivation of this crop has encouraged and supported highly diverse tree components as shade trees (Avasthe *et al*., 2011) [1]. About thirty six types of shade trees has been identified that can be used for large cardamom. Bamboo, pine and bananas are not recommended as these trees consume too much water. The lopping of branches of shade trees is very important and should be done before onset of monsoon. Planning and planting of shade tree saplings should be made well in advance by at least 2 years. Keep only appropriate shade by thinning out excess branches so that only 35% of the sunlight is infiltrated down to its canopy. Utis or Himalayan alder (*Alnus nepalensis*) is the most common and preferred shade tree for large cardamom. Sometimes black agronet can also be helpful to increase the heat in low temperature areas. The shade trees are plated within alternate rows or mixed intermittently in the same row with spacing of 7-10 m between plants for uniform shade on plantations.

5. Integrated Nutrient Management

Main planting is done in the first week of June and it is recommended that farm yard manure should be applied @10 kg + 2 kg Vermicompost/pit/year in two split doses: 1st during the month of April- May and 2nd in the month of Oct-Nov. Vermicompost having favourable impact on soil physical properties and good source of nutrients, particularly in the beds is gradually becoming popular organic manure and may be applied @ 1 kg/clump in two equal doses in combination with FYM.

6. Irrigation

Many scientists are generally not in the favour of large cardamom cultivation if there is no irrigation facility around the year. In the first year of planting watering is required at least once in 10 days during dry months in Jan to March for

better growth in coming months. Depending on availability of water sources hose, sprinkler or flood irrigation through small channels can be done. Water harvesting tanks or dugouts can also be made for supplementing when there is water requirement.

7. Harvesting and curing

The indication of time of harvest is when the seeds of top most capsules turn brown. As soon as the said colour appears and to enhance maturity bearing tillers are cut at a height of 30-40 cm from ground and left for another 10-15 days for full maturity. The spikes are harvested by using special knives known as "Elaichichhuri". The harvested spikes are heaped and capsules separated and dried. The cured capsules are rubbed on wire mesh for cleaning and removal of calyx (tail). Traditionally cardamom is cured in Bhatti, where capsules are dried by direct heating. Improved curing techniques are presently available in which cardamom is processed to give quality and appearance. One such method developed by Indian Cardamom Research Institute, Regional Station, Tadong is ICRI Improved Bhatti curing system where cardamom is dried through indirect heating at 45-50°C. Curing is done till moisture content of the produce is brought down to 10-12 % level and gives metallic sound while shuffling.

8. Post harvesting

The freshly harvested cardamom contains 72-85% moisture. Consumers prefer bold capsules with uniform size having its original dark pink colour. Following steps needs to be followed for better quality:

1. Remove extraneous matter and wash thoroughly the harvested produce before drying.
2. Adopt flue pipe system of curing to retain the original colour, aroma and flavour.
3. Dry the capsules immediately after harvest.
4. Remove tails after drying.
5. Grade according to size and colour and store in moist proof containers.
6. Use polythene lined gunny bags for storing.
7. Store in dry places and in wooden boxes.
8. Take necessary precaution against rat and insect damages
9. The dried cardamom may be preferably sold soon as long storage may lead to deterioration of quality.

9. Viral diseases of large cardamom and its management

Viral diseases of plants are cancerous in nature and difficult to cure. Production and use of virus-free planting materials, removal of infected host plants, creating awareness, preventing the movement of diseased planting materials to check introduction of viruses, regular phytosanitation, removal of virus sources, early detection through ELISA and use of chirke disease resistant varieties are the methods/approaches required to manage the disease in nurseries and plantations. Monitoring the plantation every month particularly during the rainy season and carefully identify the diseased plants and then uprooting and destroying it as and when they are seen. Nursery should be established about 500 m away from main plantation in order to avoid aphid colonization. The knife and other implements used for the purpose should not be used on healthy plants since disease could be transmitted through sap. Dip the implements in hot water for half an hour for killing the inoculum before going to the healthy plants for harvesting or cleaning.

Conclusion

Large cardamom contributes to the economy of this region but also plays an important role in the ecosystem and contributes to the human health. It is a spice crop of significant economic importance. This crop has helped to alleviate from poverty to many small household compared to traditional crops, the income from large cardamom is three to four times higher. For better production and as a precautionary measure it is suggested to always use healthy and disease free planting material; prepare own nursery and transplant from there itself; use dry and mature farmyard manure and use of water through construction of jalkunds or dugout ponds during dry spells.

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