LARGE CARDAMOM GUIDE



स्पाइसेस बोर्ड
भारत

SPICES BOARD
Ministry of Commerce & Industry
Government of India
Sugandha Bhavan, P. B. No. 2277
Palarivattom P.O., Kochi 682 025, Kerala
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(*Amomum subulatum* Roxb.)

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Message

Dated: 9/05/2023

It's a matter of pride that Indian Cardamom Research Institute(Spices Board), Regional Research Station, Sikkim is bringing out the 7th edition of Large Cardamom Guide. The Regional Research Station (RRS) of Indian Cardamom Research Institute (ICRI) has its legacy in Large Cardamom Research as it is the only research institute having a mandate exclusively on Large Cardamom.

It's noteworthy to mention that ICRI RRS has released two varieties of Large Cardamom, viz, ICRI Sikkim 1 & 2 and also standardised various aspects on Large cardamo

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etary

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MESSAGE

n which originated in the Sikkim Himalayas is the main spice crop th eastern states. The crop is grown organically and hence its very year. Now-a-days, there are various challenges in Large e to various environmental and biological factors. All these hinder reach its fullest potential. I am happy that Indian Cardamom ing the 7th edition of Large Cardamom Guide for the benefit of booklet has extensively covered all the important aspects of n. Detailed illustrations are given in the guide to properly the corrective measures to be adopted.

Spices Board and the

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FOREWORD

Large Cardamom (*Amomum subulatum* Roxb.) is a important spice crop grown in the Sub-Himalayan states of Sikkim, Arunachal Pradesh, Nagaland, Manipur, certain pockets of Meghalaya, Uttarakhand and in Darjeeling & Kalimpong districts of West Bengal. The crop has its origin in Sikkim and later its cultivation expanded to the other North Eastern states. Spices Board has its been extending all necessary support in promoting cultivation of the crop. The Regional Research Station (RRS) of Indian Cardamom Research Institute (ICRI), Spices Board in Sikkim has always taken a pivotal role in research and development of Large Cardamom. The 7th edition of the Large cardamom Guide (organic) is a testimony to the continuous striving of excellence by ICRI. I congratulate the Director and all the scientists of ICRI RRS Sikkim for publishing the Large Cardamom Guide. I believe that the Guide will immensely benefit farmers in adopting Good Agricultural Practices for sustainable livelihood and socio-economic development.

Kochi
August, 08, 2023

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The Research Station for Large Cardamom in Sikkim was established in 1987 as the third Regional Station of the Indian Cardamom Research Institute (ICRI), Spices Board. This station was established exclusively for Large Cardamom research. The research findings are extended to the farming community through various extension programmes of Spices Board li

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INTRODUCTION

Large cardamom, a member of the family *Zingiberaceae* under... crop cultivated in sub-Himalayan ... Nagaland, Kalimpong and Darjeeling ... growing wild in forest ecosystem ... sub- Himalayan region at altitudes ranging ... It is a shade loving plant (sciophyte) ... from 2000-3500 msl. It is locally known ... Nepali. Large cardamom is known to be one of the oldest spices used by the mankind. In India, it has references of use in Ayurvedic preparations as early as 6th Century ... mentioned by Sushruta. It is also used in Unani medicines like Arq Elaichi and Anusoon-E-Sada. The ... of large cardamom contain ... per cent essential oil, powerful flavouring agent and are used mainly as spice. Large cardamom has tremendous potential as natural products with flavour and fragrance has a high demand in food industry, perfumeries, medicines etc. ... pungent, ... stimulative, diuretic and ... cattle and also a remedy for so

The total area in India under the crop is 44701 ha with a production of 8803 MT with an average productivity of 196.93 kg/ha during 2021-22.

Botany

This semi perennial rhizomatous herb has subterranean rhizomes bearing about 11-15 circular scales along the cross section which are formed after shedding of the leaves. At maturity, rhizomes bears leafy stem with about 13-15 leaves, whereas the lower or basal scales form the roots. The leafy stem is formed by long sheath like structure encircling one another. Many such rhizomatous leafy sheaths of about 30 to 70 numbers form a clump which is considered a "single plant". The rhizomes mature in about 10-12 months of their emergence where vegetative buds are formed on the middle scales. The flower buds originate on the middle and upper scales. Usually, each rhizome bears one pseudostem with about1-3 flower buds or spikes. The rhizomes usually become dry after bearing the fruits or capsules. The height of the robust leafy stem (pseudostem) ranges between 1.0 and 2.5 m. The leaves are arranged distichously (slightly alternate) and are simple, linear, lanceolate with dark green leaf blade, glabrous on both sides with a prominent midrib. The inflorescence is a dense spike on a short peduncle (3-5 cm) with an axis (3-6 cm) bearing about 45-50 flower buds arranged in an acro-petal sequence. The flowers are medianly zygomorphic, bisexual, epigynous and bracteate. The yellowish perianth (3+3) is differentiated into calyx, corolla and anther crest. All the cultivars and varieties of large cardamom belong to *Amomum subulatum* Roxburgh. Out of the total 150 species of *Amomum* that occur in the tropics, only 8 species are considered native of Eastern sub-Himalayan region *viz*., *A. subulatum* Roxb., *A. costatum* Benth., *A.linguiformae* Benth., *A. paucifloram* Baker., *A. corynostachyum* Baker., *A dealbatum* Roxb. (*A. sericeum* Roxb.), *A kingie* Roxb. and *A. aromaticum* Roxb. Cultivated large cardamom (*Amomum subulatum* Roxb.) along with the occurrence of seven wild species makes this plant native to Sikkim.

The flowering season begins early in the lower altitudes with a peak during March-April, while it is late in the hi

July. The fruit is a trilocular, many seeded capsule. The capsule wall is echinated having reddish-brown to dark-pinkish to maroon colour. The seeds are di-angular, whitish when immature and become dark-greyish towards maturity. Usually, the capsules formed at the basal portion of the spike are bigger and bolder than middle and top portion.

Climate

Large cardamom, a shade loving plant (sciophyte), has its natural habitat in the humid subtropical semi-evergreen forests of mountainous sub-Himalayan region. It grows well in the altitudes of 600-2200 m AMSL receiving annual rainfall of 2000-3500 mm apportioned over 200 days. Cloudy conditions prevail for most of the monsoon period. The lower altitudes of cooler zones (proximal to the snow-line) and higher reaches of the warmer zones are best suited for its growth. Large cardamom belts experience mean annual ambient temperature ranging from 6^0C (December-January) to 30^0C (June-July) accompanied by constant high relative humidity. Continuous rain during flowering is detrimental as it hampers the foraging activities of pollinating bees and leads to poor capsule setting and development of barren spikes. Plants remain dormant during severe winter and it can withstand up to 2^0C, but frost and hailstorm are injurious to the crop.

Soil

Large cardamom is generally grown in forest loamy soils having a depth of few centimeters to several inches. Colour of large cardamom soil ranges from brownish yellow to very dark greyish brown. Texture varies from sandy, sandy loam, silty loam to clay. In general, large cardamom soils are acidic in nature and majority of soils have pH ranging from5.0 to 5.5 with more than one per cent organic carbon content. On an average, these soils have high available Nitrogen and medium levels of Phosphorus and Potassium. Plants cannot withstand water-logged conditions; hence, adequate drainage is very important for better stand of the crop especially when planted in non-sloppy or terraced lands.



Large cardamom plantation under forest ecosystem



A mature large cardamom plant (clump







Large cardamom – Inflorescence (spikes), bloom and bearing tillers with capsules on spikes



Fresh capsules



Dried capsules (Large cardamom of commerce)

CULTIVARS AND VARIETIES

There are mainly six popular cultivars of large cardamom *viz*., *Ramsey*, *Ramla*, *Sawney*, *Varlangey*, *Seremna* and *Dzongu Golsey*. Several others types which are not so popular include *Chivey*, *Ramnag*, *Madhusey*, *Seto Golsey*, *Kopringe*, *Rato Sawney*, *Hario Sawney* and *Mongney*.

1. *Ramsey*: It is well suited to high altitudes (>1515 m AMSL) and can be cultivated even in steep slopes. The cultivar is identified by the maroonish colour of the tiller and narrow leaves. Plants are 1.5 to 2.0 m tall, robust with large number of tillers. Flowering starts in May and crop becomes ready for harvest by October- November. Capsules are small with around 25 - 40 seeds.





a **b** **c**

***Ramsey*: a. clump, b. flower and c. capsules**

2. *Ramla*: Plants are 1.5 to 2.0 m tall and vigorous like *Ramsey*. Colour of tillers resembles that of *Ramsey* and the leaves are broad and long. Capsules are dark pinkish in colour with 30 - 40 seeds. Cultivation is restricted to a few high altitude areas (>1515 m AMSL) in North Sikkim. Flowering commences in May and the crop is generally ready for harvest in October.





a **b** **c**

***Ramla*: a. clump, b. flower and c. capsules**

3. *Sawney*: It is a widely adapted cultivar, which is most suited to medium (975 – 1515 m AMSL) and high (> 1515 m AMSL) altitude areas. Plants are 1.5 to 2.0 m tall, robust in nature, leaves are ovate and broad and the colour of tiller is maroonish. Capsules are big and bold with 35 - 50 seeds. Flowering starts from March to May and harvest begins in September - October, sometimes extends up to November in high altitude areas.





a **b** **c**

***Sawney*: a. clump, b.flower and c. capsules**

4.*Varlangey*: It is suited to grow in mid and high altitude (>975 m AMSL) areas. Its yield performance is exceptionally high at higher altitudes (>1515 m AMSL). Plant height is 1.5 - 2.5 m, robust and resembles *Ramsey* having narrow leaves with wavy margins. The ratio of productive tiller to spike is relatively high in this cultivar. On an average, 2 - 3 spikes per productive tiller are recorded and the capsules are bold with 50 - 70 seeds. Flowering starts in May at medium altitudes and during June - July at high altitudes. Consequently, in high altitudes, harvesting is delayed up to the end of November.





a **b** **c**

***Varlangey*: a. clump, b. flower and c. capsules**

5. *Seremna*: The cultivar is known for it's location specificity. It is grown in Hee-Gaon area of West Sikkim at low altitudes (<975 m AMSL) and has high yield potential. Pla

High yielding Varieties: Indian Cardamom Research Institute, Regional Research Station, Spices Board, Tadong released two high yielding varieties during 2004. These two varieties *viz.,* ICRI Sikkim 1 and ICRI Sikkim 2 are selections from the cultivar *Sawney*.

1. ICRI Sikkim 1: This variety is well suited for 1500 to 1650 m AMSL altitudes. Plants are robust with maroon tillers and leaves are ovate and broad. In a 5 year old plant, sixty per cent of spikes were found to bear 14 capsules per spike. The capsules are bold and maroon. Eighty per cent of capsules have a size of 2.2 cm (length) x 2.0 cm (dia.) with 35-50 nos. of seeds. Average yield recorded is around 840 kg/ha.



a **b** **c**

ICRI Sikkim 1:a. clump, b. flower and c. capsules

2. ICRI Sikkim 2: This variety is suited to 975 -1500 m AMSL altitudes. Plants are robust in nature and leaves are ovate and broad. Tillers are deep maroon in colour. In a 5 year old plant, sixty per cent of spikes were found to bear 15 capsules per spike. Capsules are also maroon in colour, bold and seventy per cent capsules are more than 2.7 cm in length and 2.2 cm in diameter with an average of45 seeds. Average yield is around 898 kg/ha.



a b c

ICRI Sikkim 2: a. clump, b. flower and c. capsules

PROPAGATION

The propagation of large cardamom is mainly done through seeds or suckers. Tissue culture techniques are also available but are not popular.

Propagation through seeds enables production of large number of seedlings. Viral diseases are not transmitted through seeds and therefore, the seedlings are free from viral diseases. Due to cross-pollination, plants raised through seeds exhibit variation in their characteristics from their parents.

On the other hand, producing planting material through suckers ensures true to the type/parents. Plants with high productivity can be raised by collecting planting materials from high yielding, disease free mother plants. These techniques produce suckers ready for field planting in the next season itself. But there are

chances of transmission of viral diseases if suckers are taken from diseased plantation.

Tissue culture technique though produces true to type and large number of plants; it requires expertise and high investment and hence it is not so popular till date.

I. Propagation through seeds

Seeds are collected from high yielding and well-maintained plantation free from diseases. Well matured capsules from bottom and middle portion of the spikes are selected for extraction of seeds. After de-husking, seeds are mixed and rubbed with fine sand and then washed with water to remove the mucilage completely. Once the water is completely drained, the seeds are mixed with wood ash, dried in shade and sown in the primary nursery.



Spikes, capsules, de-husked capsules and seeds

I a. Primary Nursery

Seeds are generally sown in September - October. Seed beds are prepared in well-drained soil dug to a depth of 30 cm and left for weathering. Raised beds with around 30 cm height, 1 m width and convenient length, preferably 6 m, are prepared. Well decomposed cattle manure is mixed with the soil and the surface of the bed is made to fine tilth. About 80 -100 g of seeds per bed is sown in lines across the bed at a distance of 10 cm. Seeds are covered with fine soil and mulch with rice straw / dry grass (10 -15 cm thick). Watering is done at regular intervals to keep the surface of the bed moist. In Sikkim condition, germination of seeds commences after 5-6 months of sowing. Acid treatment (seeds soaked in 25% Nitric acid for 10 minutes) or soaking of seeds in 25% cow dung slurry for 5 days increases the percentage of germination. When germination is noticed the mulch materials are removed. The inter space between rows is then re-mulched with chopped rice straw. Shades are immediately erected by using bamboo mats / reed mats or agro-shade nets. The beds are watered regularly and weeding is done as and when required. When the seedlings attain 3 to 4 leaf stage, they are transplanted to secondary beds / nursery.



Raised seed beds and germinated seedlings ready to transplant



Secondary nursery

II. Propagation through suckers

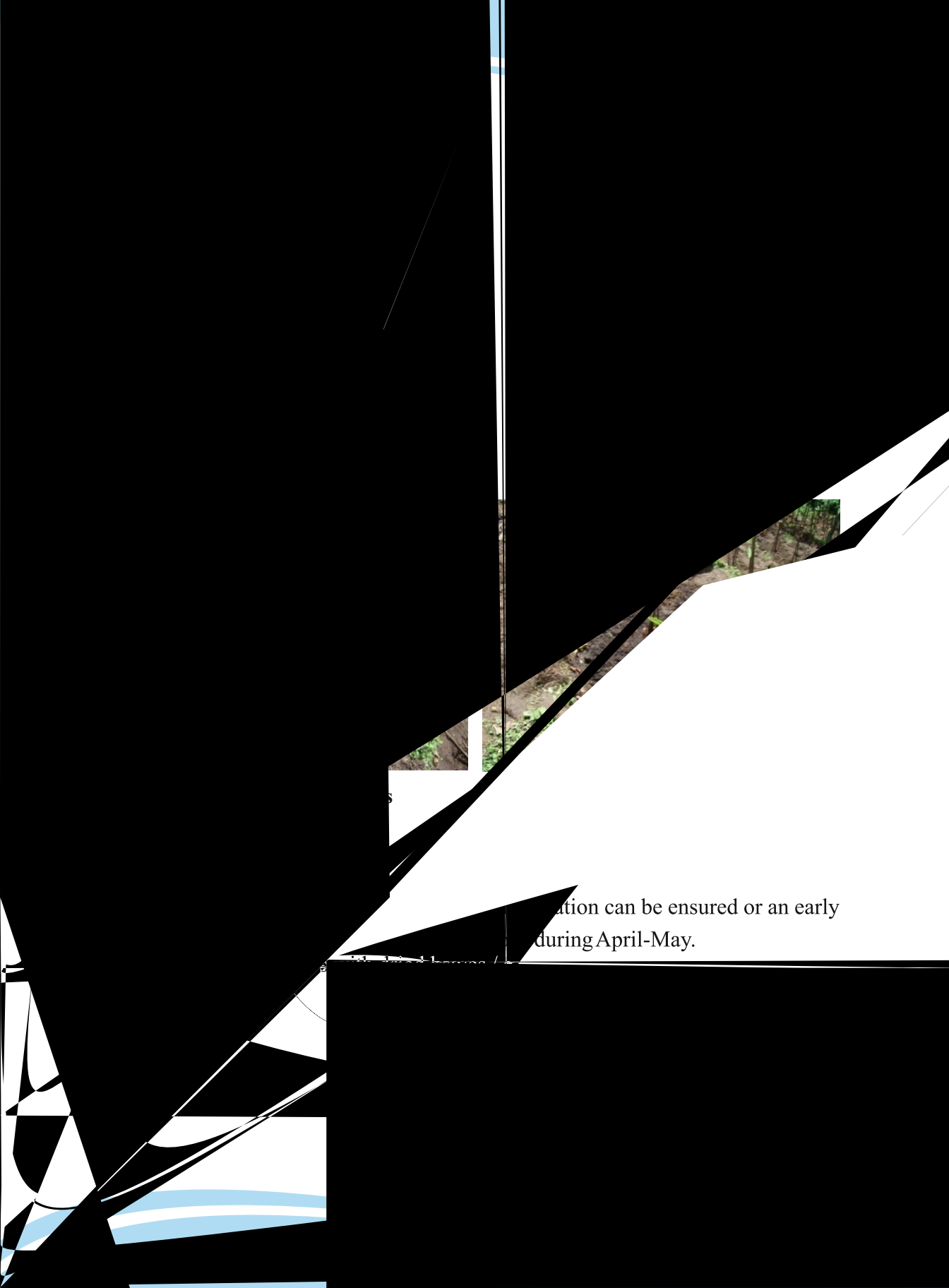
The suckers collected from high yielding disease-free, elite plantations having one mature tiller with one or two immature tillers or vegetative buds is used as planting units.

Selection of planting material

- High yielding disease free plantations to be selected.
- The plantation should have high yield record *i.e.* more than 800 kg / ha for at least 3 consecutive years.
- One mature tiller with one or two immature tillers or vegetative buds is used as planting unit.

Site of nursery

- The nursery should be around 500 meters away from the main plantation to avoid occurrence of pests and diseases.
- The irrigation facility should be available.
- It should be easily accessible by road.



ation can be ensured or an early

during April-May.

- Well decomposed cattle manure may be applied.
- The plot may be maintained with 50 per cent shade under shade trees or using agro shade net.
- The disease and pest incidence to be monitored from time to time and necessary management practices to be adopted.
- On an average, five planting units could be obtained from a single plant.



Large cardamom sucker nursery

PLANTATION ESTABLISHMENT AND MANAGEMENT

Selection of site

Large cardamom grows well in forest loamy soils on terrains with gentle to medium slopes. Luxuriant growth is observed when perennial water sources are located nearby plantation. However, water logged condition is detrimental to the plants and hence adequate drainage is required. It performs well under partial shade (50 per cent) and the shade tree, *Alnus nepalensis* (Himalayan alder or *Utis* in Nepali) - large cardamom agro-forestry system is an ideal system for sustainable cultivation in Sikkim Himalayan region.

Soil type: Deep, well drained, loamy textured soil rich in Organic matter and Nitrogen, medium level of potassium and phosphorous, with a pH of 5.0 to 5.5 are ideal for large cardamom.

Land preparation

The land selected for planting should be cleared of all the under growth, weeds etc. before the onset of monsoon. Old large cardamom plants, if any may also be removed. Pits of size 30 cm x 30 cm x 30 cm are prepared on contours at a spacing of 1.5 m x 1.5 m from the center of the pits. Wider spacing of 1.8 m x 1.8 m is recommended for robust cultivars like *Ramla*, *Ramsey*, Sawney, and *Varlangey*



Land preparation for planting

etc., while closer spacing of 1.2 m x 1.2 m is advised for non-robust cultivars like *Dzongu Golsey*, *Seremna* etc. Pits are left open for weathering for a fortnight and

then filled with top soil mixed with cow dung compost/FYM @ 2-3 kg per pit. Mix *Trichoderma* @50-60g with cow dung compost/FYM @ 2-3 kg per pit. Pit making and filling operation should be completed in the third week of May before the onset of pre-monsoon showers.

Planting

Planting is done during June-July in Sikkim and Darjeeling. In Arunachal Pradesh, planting is done in the month of May when there is enough moisture in the



Planting Unit



Planting and staking of suckers



Planting upto collar region



Deep planting: delayed tiller emergence

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Soils with ... ...ng... from 5-5.5 are ideal for the growth

Large cardamom soils are deficient in the micro nutrient Boron. The Boron plays a significant role in pollen development and influences the productivity. Application of Borax as foliar application @ 0.5% (5g/litre) + soil application @ 2.5 kg/ha is recommended for correcting Boron deficiency and increasing productivity.



Plant base cleaned before application and application of manure at plant base

Soil base making and mulching

If the land is not terraced, soil base may be made by cutting top soil from the upper half and to be placed on the lower half followed by mulching. Mulching at the plant base with easily degradable organic materials is good for conserving both moisture and soil. The mulching can be done after harvest and cessation of rains during October-December. Dried organic matter, leaves, weeds etc, can be used as mulching materials. Among different moisture conservation practices surface mulching is effective for retaining higher soil moisture content. Soil moisture can also be conserved by filling biomass in trenchesmade across the slope in plantations.



Mulching at plant base

Weed management

Weeds compete with crop for nutrients, water and sometimes act as alternate host for diseases and insect pests causing damage to the crop. Hence, weeding is an important cultural operation to be carried out for atleast three rounds / year during the initial two to three years. Later when plant is fully grown and occupies more space, then two rounds of weeding is sufficient. First round of weeding to be done during April- May to facilitate the movement of pollinators and the next round, just before harvest during September - October. Clean weeding is not advisable in hilly terrain as it may lead to soil erosion. Around the plant base weeds are pulled out by hand and the inter-space needs only slash weeding with sickle. The thrashed materials can be used for making compost or disease-free weed material can be used as mulch.



Manual weeding around plant base



Slash weeding (sickle) in interspaces



Adequate shade (50%) also protects the crop to some extent from damage due to hail as well as frost. Under dense shade, blight disease incidence will be high. Under less shade or planting large cardamom in open field without any shade resulted in with varying response as over-exposure to direct sunlight causes yellowing of leaves to reduced life span of crop. Therefore, it is very much important to maintain optimum shade through shade regulation. The lopping of branches of the shade trees to remove excess shade is very important and should be done before the onset of the monsoon during May - June. Judicious shade management is very important for optimum plant growth, timely flowering and for obtaining better yield. In areas with insufficient shade, planting of saplings of shade trees belonging to different species should be done during June–July. The most common shade trees are *Utis* (600– 2000 m AMSL); *Chilaun*e (550–1515 m AMSL); *Panisaj* (400–1000 m AMSL); *Pipli* (900–2000 m AMSL); *Malato* (670–1515 m AMSL); *Asarey* (850–2000 m AMSL); *Karane* (1500–2400 m AMSL); *Bilaune* (670–1515 m AMSL) etc. *Artemisia* sp. can be used as a temporary shade for new plantations. Depending on the altitude, planting of shade tree saplings in a row with a distance of 9 -

INSECT PESTS AND MANAGEMENT

There are as many as 23 insect pests found associated with large cardamom and the entire pests do not cause economic damage to the plant. Among the insect pests, leaf eating caterpillar (*Artona chorista* Jordon), Shoot fly, (*Merochlorops dimorphus* Cherian) and White grub (*Holotrichia*s pp.) are considered as important pests. Capsule borer and nematodes are emerging as important pests, while incidence of stem borer (*Glyphipterix* spp.) has been coming down. Aphids are responsible for transmitting viral diseases *viz*., *Chirke* and *Foorkey*.

LEAF EATING CATERPILLAR: Leaf caterpillar *Artona chorista* Jordon (Lepidoptera: Zygaenidae) is a major defoliator of large cardamom plants causing noticeable damage to the crop. The adult is a moth, black and its size ranges from 10–15 mm. The male moth can easily be distinguished from female with its bushy antennae, white bands on the abdomen and smaller size.



Leaf caterpillar and its damage

Period of occurrence

Although the leaf caterpillars remain in the field throughout the year, their infestation is mostly observed from June to July and October–March.

Management

a) **Cultural:** The caterpillars are gregarious in nature, sluggish and they feed underneath the cardamom leaves. During June-July and October - December, the infested leaf can easily be collected along with the larvae and destroyed. When an outbreak is observed in a locality, the cardamom farmers as a group may engage in manual collection and destruction of caterpillars so that the incidence can be totally managed within few years.

b) **Biological:** Some natural enemies are reported to kill the caterpillars and pupae, however, so far no commercial exploitation of these nat

Chloropidae) and *Bradysia* sp. (Diptera: Sciaridae). However, *M. dimorphus* is most prevalent in large cardamom growing tract of Sikkim and Darjeeling. The adult fly *M. dimorphs* is 5–6 mm in size and brownish yellow in colour. In the main field, more damage is recorded at higher altitudes than in the lower altitude.

Period of occurrence

Although the shoot fly is found throughout the year but severe incidence of the pest noticed during February to August. Higher incidence is recorded in new plantations within 3 years of planting.

Nature of damage

The tip of the shoot becomes brown and later whole shoot dries up. Low to moderate damage by shoot fly is recorded in large cardamom plantation in Sikkim and West Bengal. Single, pale glossy white maggot bores the young shoot and feeds on the central core of pseudostem from the top to the bottom resulting in its death. In general, young shoots up to one foot length are infested by shoot fly and incidence was as high as 56 per cent of new shoots.



Shoot fly infestation symptoms

Management:

a) Cultural: For managing this pest, infested young shoots should be removed at ground level and destroyed. Adult shoot fly can be trapped using fish meal bait and then destroyed.

b) **Biorational / biopesticides:** Application of neem seed kernel extract 5 ml per litre during new shoot emergence at monthly interval reduces the pest problem.

3. Stem borer

Stem borer *Glyphepterix* sp. (Glyphiperidae: Lepidoptera) is also an important pest reported from all the cardamom growing tracts.

Period of occurrence

Stem borer incidence is noticed throughout the year. But during four periods, December-January, March-April, May-June and September-October their abundance is more. The incidence of stem borer is more in low elevations than in higher elevations.

Nature of damage

The larvae feed on the central portion of the shoot which results in drying of the central leaf of the plant and this symptom is known as dead heart. Infestation of this pest is also indicated by the presence of entry holes plugged with excreta. Damage up to 19.50 per cent is reported due to its infestation.



Stem borer larvae and frass material after infestation

Management

a) Cultural: For managing this pest, infested shoots to be removed at ground level and destroyed.

b) Biorational / biopesticides: Application of neem seed kernel extract 5 ml per litre during new shoot emergence at monthly interval reduces the pest problem.

4. White-grubs

In Sikkim, four species of white grubs (*Holotrichia* spp., Coleoptera: Melolothidae) are reported. Among these *H. seticolis*is identified as major one, while another species named as *H. sikkimensis* is also found to cause damage. The young grubs are white translucent whereas mature grubs are pale coloured and 'C' or semi-circular shaped. Adults are dark brown dorsally, yellowish ventrally, forewing thick (elytra), hind wings membranous, crepuscular to nocturnal in habit. As large cardamom being cultivated under natural forest e





Yellowing of leaves in white grub infested plant, grub larvae and adult beetle

Period of occurrence

The adults emerge in large numbers on receipt of summer showers during April-May. Larval stage of this pest is causing damage to the crop. The grubs are active in their second and third instar larval stages and remains very active during rainy seasons (July-October) and feed on organic matter until they come in contact with living roots of plants.

Nature of damage

White grub is a polyphagous and it feeds on the feeder roots and newly formed rhizomes. The infested plant shows yellowing of leaves and withering symptoms. In severe infestation, pseudostem may be cut at the basal region by third and fourth instar grubs.

Management

a) Cultural: For managing this pest, community wise collection and killing of adult beetle during dusk to night period (6.00 - 7.30 pm) in the month of May to early July from their preferred host tree. Place light traps @ 1 trap/ha during May to early July also reduces the adult beetle too some extent.

b) **Biorational / biopesticides:** Drenching of root zone with neem seed kernel extract 5 ml per litre water at monthly interval reduces the pest problem. Soil drench with *Metarrhizium anisopliae*($1 \times 10^{8} CFUg^{-1}$) @10.0 g per litre or NKAE 5% + 1.0 % surfactant or *Beauveria bassiana* ($1x\ 10^{9} CFUg^{-1}$)@ 10.0 g per litre of water at monthly intervals can also effectively manage the pest.

5. Aphids

In large cardamom, aphids cause more damage as a vector of viral diseases rather than as a pest. The aphids are associated with the transmission of viral diseases (*Foorkey* and *Chirke*) of large cardamom. The major species associated with large cardamom are:

1. *Pentalonia nigronervosa* f. caladii (Goot) (Hemiptera: Aphididae)
2. *Micromyzus kalimpongensis* (Hemiptera: Aphididae)
3. *Rophalosiphum maidis* (Fitch) (Hemiptera: Aphididae)
4. *Rophalosiphum padi*(Lin.) (Hemiptera: Aphididae).

Period of occurrence

The aphid population is recorded high during summer months a

Nature of damage

P. nigronervosa f. *caladii* and *M. Kalimpongensis* are known to be as vectors of *'foorkey'* or virus yellow disease. The aphids colonize at the base (rhizome) of the clump and if population is more, they move to aerial portion of the clump. They remain mostly to exposed rhizomes and dried leaf sheaths and they suck the sap from the pseudostem.

Maize aphids, *Rophalosiphum maidis* and *R. Padi* are found to be on the lower surface of the leaves of large cardamom, congregating near the mid-rib and veins. These aphids are known to be the vector of another viral disease, mosaic streak or '*chirke*'.

a) Cultural: The removal and destruction of diseased plants is helpful in control of further spread of disease and in reduction of aphid population. It is necessary to keep vigil on infestation of these aphids on their most important alternate hosts like Banana and Canna for *P. Nigronervosa* and maize for *R. maidis* and *R. padi*. If infestation is noticed, alternate hosts also to be removed and destroy to minimize the chances of spread of these pests.

b) **Biorational / biopesticides:** Spraying of Neem oil (Azadirachtin 0.15%EC) 1500 ppm @ 3 ml per litre formulations at 15 -20 days interval provides effective control.

6. Capsule borer: (*Jamides alecto* Lycaenidae : Lepidoptera)

The infestation of capsule borer is in increasing trend in large cardamom growing tracts and gaining importance as it causes damage to the economical part of the plant *i.e.,* the capsule. With increase in infestation, it may attain the status of a major pest within few years. Capsule borer, is identified as *Jamides* sp. belonging to Lepidoptera

Period of occurrence

The adult butterfly appears in the cardamom fields from March - April

onwards in lower elevations whereas seen upto mid-September in higher elevation. Its incidence coincides with the onset of flowering to developmental phase of the capsule.

Nature & extent of damage:

Out of the various stages in life cycle, larvae alone cause damage to the crop by eating away developing seeds of the capsules by boring a hole on it. In laboratory studies, it was observed that a single larvae feedaround 7-9 capsules during its larval phase. In surveys, the extent of damage recorded was upto 33.9%.



Adult capsule borer (*Jamides* sp.)



Larvae feeding inside capsule



Capsule with hole

Management

As it is an emerging pest, so far, no management practice is adopted. Moreover, applications of any biorational / biopesticides also deter the movement of bumble bees, the major pollinator of large cardamom. However, it was observed that infestation used to be more in unattended and neglected plantation, so phytosanitation is one of the important aspects to be taken care to reduce the infestation.

7. Nematodes

Nematodes are important pest causing damage to the crop. In large cardamom root knot nematode, *Meloidogyne incognita*, was only reported earlier infecting seedlings/plants in nurseries and plantations causing considerable damage. The affected seedlings/plants show stunted growth, the leaves become narrow and are arranged in a rosette fashion due to reduction in internodal length. Root system shows excessive branching with galls. However, recent studies revealed that apart from *Meloidogyne incognita,* the association of other nematodes like *Helicotylenchus* spp., *Hoplolaimus sp., Tylenchorhynchus annulatus, Pratylenchus* sp. and *Criconema* spp. are found in large cardamom soils. The nematodes, *Meloidogyne incognita* and *Pratylenchus* sp. are seen associated with cardamom roots. Further studies are under progress to prove its pathogenicity.



Foliar symptoms of nematode infestation

General Management Practices

Deep digging and exposing the soil to sun (solarization) before preparation for nursery reduces the nematode population. Use of the same site continuously for raising nursery to be avoided. Farmers are encouraged to change nursery sites every year and to raise seedlings in polybags containing healthy potting mixture. This practice not only reduces nematode incidence but also prevents movement of nematode through soil from one location to another.

Use of yellow sticky trap for monitoring soft bodied flyin



Yellow sticky trap

Pollinators of large cardamom

The bumble bees, *Bombus breviceps* and *B. haemorrhoidalis* have been recorded as important pollinators of large cardamom in all the altitudes. These bumble bees are called locally as *Bhomora* (Nepali*), Boom boom Taka* (Bhutia), *Tungboom* (Lepcha) in Sikkim and Tai- Taga(Galo), Ngonia, Tong,Taga (Nyishi) in Arunachal Pradesh. In Nagaland it is known as *Timipfi* (Tenyidie), *Teshukhwi* (Chokri), *Tshumikhuzho* (Khezha), *Mehdi* (Sangtam) and *Lemthunaoo* (Chang).



Bombus haemorrhoidalis



Bombus breviceps



Nest of Bumble bee in soil

Foraging activity of bumble bees is maximum during morning hours (4.00 am to 9.00 am) on clear days and their activity becomes less or even nil during heavy rains. It is also known that rock bee (*Apis dorsata*) plays a positive role in capsule setting. It is observed that for optimum capsule and seed set a minimum 50 visits by the pollinators are required. A well-set spike appears like a small pineapple. When the capsules get mature, the seeds are turned into blackish colour.

Decline of bumble bee population throughout the world is a cause of concern now. Bumble bees construct nest in the soil. During farm operations, care should be taken not to disturb the nests in the soil and also their natural habitat. Maintenance of natural vegetation as well as micro-climate of the bumble bee nests in the plantation bears significant importance. Flowering plants need to be grown in the plantation throughout the year to maintain continuous supply of their food.

DISEASES AND THEIR MANAGEMENT

Major threat to large cardamom is the widespread occurrence of fungal and viral diseases causing considerable damage and consequent crop loss in devastating proportions. Diseases affecting large cardamom and their management are dealt herewith in detail.

1. Blight (*Colletotrichum gloeosporioides*)

Colletotrichum blight has devastated the large cardamom plantation and is the cause of concern for severe crop loss and decline in plant population in the recent past.

Causal organism:

Blight is caused by *Colletotrichum gloeosporioides* and its perfect state is *Glomerella cingulata*. Lesions on leaf and sheath carry black dots and a



a



b



c



d

Blight Symptoms: a. Water-soaked lesions on leaves, b. lesions on pseudostem, c. breaking of pseudostem at the point of infection and d. severely affected plantation

Leaf sheath covering the pseudostem show blackish brown discoloration which extends up to rhizomes and subsequently turn into greyish or blackish patches with brown margins. Gradually, the pseudostem becomes brittle and breaks in the middle or at the collar regions. In most cases, the lesions on the pseudostem become necrotic as a result the entire leaves dry out giving a burnt appearance. Later, the pseudostem lodges at the point of necrotic lesion. As a whole, the entire plantation looks dried up.

The disease mostly affects the bearing tillers of the clump while the new tillers remain apparently healthy. However, later in the season, in some cases, the young emerging leaves of the new tillers in the diseased clump show pale yellow discoloration in the inter-veinal areas. Sometimes the emerging leaves are whitish in colour and droop without opening properly. Slight yellowing and narrowing of emerging leaves are also noticed and, in some cases, the pseudostem break open longitudinally in the middle and the young leaves emerge through the opening. Examination of the rhizomes of such tillers showed brown lesion with air space in the middle.

The spike from the diseased clump exhibits elongated appearance in comparison to the spike from the healthy clump and this is mainly due to lack of fruit setting. However, in other cases, flowering and seed-setting takes place but the seeds do not mature and remain whitish or light brown instead of natural black. Generally, the roots are not infected. In the cultivar *Varlangey* the newly formed tillers in the diseased clump show pale yellowing and rosetting of leaves giving a stunted appearance as compared to the healthy plants.

Collateral hosts:

Fourteen species of plants belonging to various families showed symptoms similar to *Colletotrichum* blight. Some of them are marigold, *Amomum dealbatum*(*Churumpa*), canna, wild colocasia, ornamental basil, *Alnus nepalensis* etc.

Management:

- No cultivar is found to be resistant to the disease. A holistic approach is required for disease management as the problem is related to environmental, soil and plant health.
- Diseased leaves, tillers and other plant parts which are cut during harvesting season should never be spread in t

- Application of bioagents like *Pseudomonas fluorescens* or *Bacillus subtilis* as foliar spray and as soil drench after harvest, before onset of monsoon and during monsoon months. Mix 3-5 litres of bioagents in 100 litres of water and apply @ 3-4 litres/clump.
- Apply *Trichoderma* mixed with FYM (1-2 kg/100kg) and neem cake (1kg/100kg) in soil @ 2kg/clump. This will reduce soil inoculum of pathogen.

General

Copper fungicides may be applied only when the disease pressure is high. Once disease pressure comes down, bioagents can be applied. It should be noted that after using Bordeaux mixture/COC, bioagents should be applied only after 15 days interval and never mix bioagents with copper fungicides.

Care must be given to provide adequate plant health. In highly acidic soils, liming has to be done to attain optimum soil pH. Apply recommended dosage of manure every year. Insufficient/lack of irrigation during winter leads to weakening and collapse of the plants. Plants grown in moisture deficient stress are more susceptible to blight disease and hence, providing irrigation during winter months is essential. Severely infected gardens and traditional plots may be temporarily (3-4 years) converted to other crops (crop rotation). Wherever possible, planting in new ideal locations is to be adopted.

2. *Phoma* leaf spot disease

Leaf spot caused by *Phoma*s p. was found to be of serious concern in the seedling nurseries in Arunachal Pradesh and field plants in Sikkim.



***Phoma* : Initial and advanced symptoms on leaves**

Epidemiology

Rapid spre

Symptoms

The disease symptom is seen as numerous translucent streaks on young leaves along the veins. The infection starts in emerging folded leaves which results in spread of the disease to the adjacent folds. When these leaves open, many translucent streaks are noticed on the leaf blade.



Leaf streak disease

Management

- Removal and destruction of severely affected plant parts
- Three rounds of 0.2 per cent Copper oxychloride (i.e, 200 g in100 lit water) or 1% Bordeaux mixture at 15 days interval can control disease.

3. Leaf Rust (*Phakospora elettariae*)

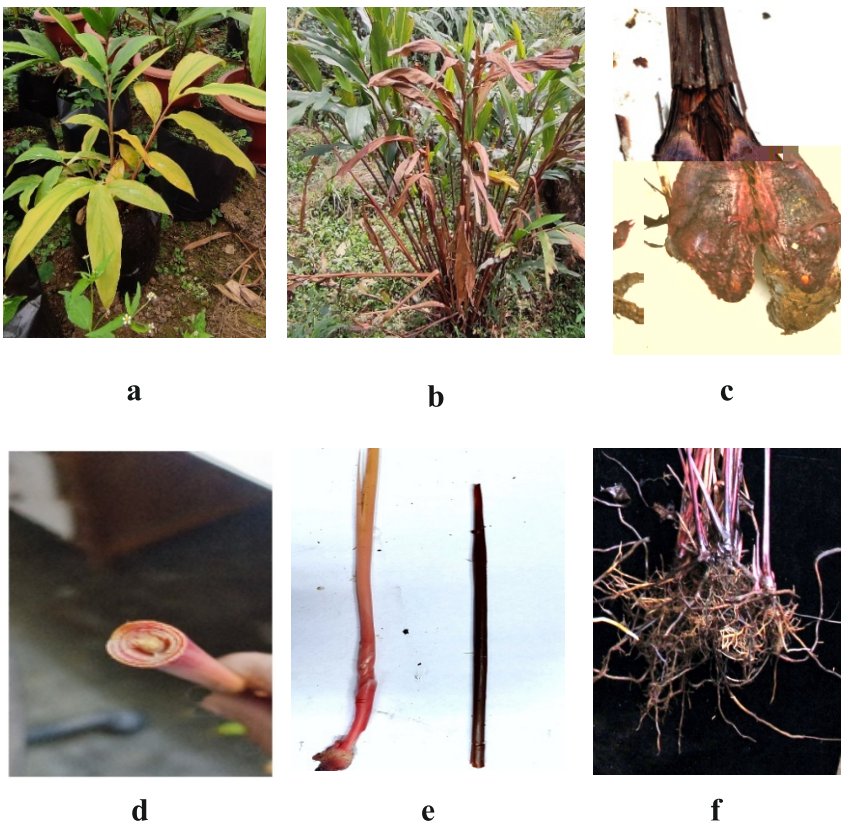
The disease mainly affects older leaves. It is prevalent throughout the year, but higher incidence is noticed during rainy months.

Symptoms

Leaf rust is often seen on lower leaves as numerous whitish to brown powdery pustules (uredosori) on the under surface of the leaves. The uredosori are seen surrounded by chlorotic haloes and on the upper side of the leaves the symptom appear as yellow necrotic patches. In severe cases the uredosori are found covering the entire leaf blade and cause premature drying of leaves

Dry rot symptoms can be seen by longitudinally opening the rhizome which reveals the discoloured / rotten area. Almost the whole rhizome may be invaded by the pathogen. The inner whorls of the pseudostem just above affected rhizome look brown and shrivelled. The central core of pseudostem turns brown and decay. Later, the pseudostem lodges from the base. The roots show blackening and the bark peel off easily. Finally, the whole clump dries up (Plate 5c to f).

In nurseries, the wilt incidence was observed during February-June while in plantations, it was noticed during October to June.



(a) Yellowing of leaves, (b) wilting and drying of leaves, (c) rotten rhizome (d) lodging of infected pseudostem (e) healthy& rotten central core of pseudostem and (f) rotten roots

Management

As it is an emerging problem, exclusive studies on management of *Fusarium* wilt/dry rot in large cardamom is under progress. Factors like acidic nature of soil, poor fertility status and poor plantation management predisposes large cardamom plants to soil borne diseases like wilt/dry rot.

- Correction of acidic soil by applying lime.
- Diseased plant materials to be properly disposed
- Provide adequate shade in the plantation.
- Provide irrigation during winter
- Apply recommended organic manures
- Pre-treatment of suckers with bioagents like *Pseudomonas fluorescens* or *Bacillus subtilis* @ 5 litres in 100 litres water for 30 minutes before planting.
- Apply *Trichoderma* mixed with FYM (1-2 kg/100kg) and neem cake (1kg/100kg) in soil @ 2kg/clump. This will reduce soil inoculum of pathogen.

6. *Chirke* disease

The disease is caused by virus (Large Cardamom Chirke Virus), transmitted through aphid vector and also mechanically through plant sap. The corn aphid *Rophalosiphum maidis* is one of the prevalent insect-vectors of the disease. Primary spread of the disease from one area to another is through infected rhizome and further spread within the field takes place by contaminated farm implements and aphids.

Symptoms

- The disease is characterized by mosaic appearance on leaves.
- The symptom is more prominent on young emerged leaves where discrete pale green to yellow longitudinal stripes running parallel to each other can be seen.
- The typical symptoms are masked on mature leaves.
- The flowering is greatly reduced which results in gradual reduction of yield over the years.





Mosaic symptoms of C*hirke* on young leaves



Aphid, *Rophalosiphum maidis*

7. *Foorkey* disease

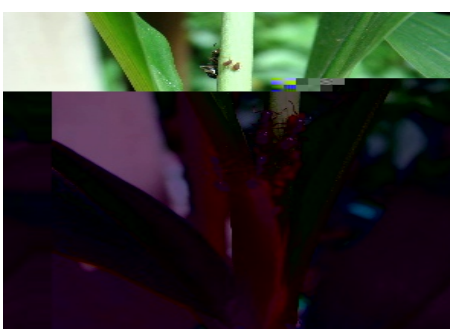
The causal agent of the disease is a virus (Cardamom Bushy Dwarf Virus)which is not transmitted mechanically through plant sap but through insect vector, *viz*., banana black aphid (*Pentalonia nigronervosa*) and *Micromyzus kalimpongensis*. It is transmitted in a persistent manner, means the virus can survive inside the aphid for a long time after feeding on infected plants. The virus also spread primarily through infected rhizomes.

Symptoms

- The affected plants produce many stunted shoots which fail to produce flowers.
- The leaves become small, lightly curled and pale green in colour. Sometimes, slightly broadened leaves resembling betel leaf is also seen.
- The inflorescence becomes stunted and sterile.



***Foorkey* affected large cardamom**



Aphid, *Pentalonia nigronervosa*

Management of viral diseases

Plants affected with viral diseases cannot be cured. Early identification of the diseased plants and its destruction can reduce the further spread. Hence, from an environmentally safe and economically viable perspective, the following measures would be adopted for effective management of viral diseases.

- Monitor the plantation every month particularly during rainy season and carefully identify the diseased plants.
- The diseased plants may be uprooted and destroyed as and when they are seen. They should be taken to an isolated place, chopped into small pieces and buried in pits for quick decomposition. As an alternative, mass uprooting and burning of infected plants at the village / area level could be taken up for eradication of the disease.
- Never collect planting materials from an infected garden or apparently healthy plants from severely infected gardens.
- Establish nursery about 500 m away from main plantation in order to avoid aphid colonization
- Spraying of Neem oil (Azadirachtin 0.15%EC) 1500 ppm @ 3 ml per litre at 15 -20 days interval provides effective control of aphids.
- Maintain clean clumps by removing old tillers with loosened leaf sheath so that aphids will not colonize.

During plantation monitoring, especially prior to harvesting, the plantation must be inspected carefully for identification of diseased plants. These plants may be uprooted and destroyed on priority. The knife and other implements used for

INTEGRATED PEST AND DISEASE MANAGEMENT (IPM) SCHEDULE FOR ORGANIC LARGE CARDAMOM PRODUCTION

Month	Operation	Target pests / pollinators
January-December (Throughout the year)	• Monitoring of plantations at 15 days interval to identify *Chirke* and *foorkey* infected plants for removal and destruction by deep burying outside the plantation. • Thrashing and phyto-sanitation. (Depending on pest incidence)	• Aphids and viral diseases (*chirke* and *foorkey*) (To make large cardamom plantation virus and pest free)
March – May	• Weeding in large cardamom plantations during flowering period will facilitate foraging of pollinators. • Phyto-sanitation by collecting blight infected leaves, caterpillar infested leaves and destroy them by deep burying outside the plantation. • Foliar application of Bordeaux mixture (1.0%) and application of copper oxychloride (0.3%) as drenching in plantations after phyto-sanitation. • Or Application of bio-control agents and botanicals as basal drenching and foliar spray (Two to three applications at monthly intervals)	• Pollination by bumble bees/ honey bees and conservation of bumble bee nests in the soil. • *Colletotrichum* blight • Leaf caterpillar (*A. chorista*),
June – July	• Phyto-sanitation by collecting blight infected leaves, caterpillar infested leaves, uprooting of viral infected plants and destroy them by deep burying outside the plantation. • Application of bio-control agents and botanicals as basal drenching and foliar spray (Two to three applications at monthly intervals)	• *Colletotrichum* blight • Leaf caterpillar (*A. chorista*), • Viral diseases (*chirke* and *foorkey)*

August December	• Weeding, covering of spike with dried leaves and small branches of trees • Trashing and phyto-sanitation. Application of bio-control agents and botanicals as basal drenching and foliar spray. • Foliar application of Bordeaux mixture (1.0%) and application of copper oxychloride (0.3%) as drenching in plantations after phyto- sanitation (Post monsoon).	• Mammalian pests • *Colletotrichum* blight, • Leaf caterpillar(*A. chorista*), • Viral diseases (*chirke* and *foorkey*)

Preparation of Bordeaux mixture

Dissolve 1 kg of Copper sulphate in 50 liters of water. In another vessel, slake one kg of quicklime by adding small quantities of water preferably warm water (1–1.25 kg of lime can be taken). When slaking is over, make up to fifty liters by adding water and stir well to get a uniform suspension of lime. Transfer the lime suspension thus prepared through a sieve and keep separately. Add 50 liters of the Copper sulphate solution to the 50 liters of lime solution with constant

Preparation of low cost fish meal traps (bait):

Fish meal trap/ bait to trap shoot flies can be prepared at farm itself.

Materials required

» Dried fish or fish waste (not used for consumption)

» Plastic bottle or a container with perforations on the upper side (for entry of insects)

» Soap/ kerosene /insecticides (wherever permitted)

Method of preparation

Mix dried fish/fish waste in water; allow it to ferment for few days until it emits putrid smell. Fill the perforated bottle/container to half level either with concentrated soap water or kerosene or insecticide mixed water. Place the fermented fish meal in small polythene bags and hang it inside the plastic bottle/container without touching the liquid inside. The bottles may be hanged just above the canopy level of the plants. The scent emitted by fish meal/bait will attract the flies which enter through the perforations in the bottle. The trapped flies later fall into the solution which kills them. The solution with died insects to be discarded and fermented fish meal/bait to be replaced at an interval of 14-15 days.

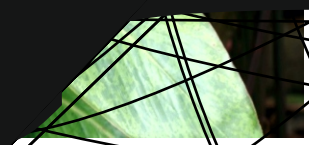
Preparation of Neem Seed Kernel Extract (NSKE)

Neem Seed Kernel extract can be prepared at farms itself.

Materials required

For preparation of 100 liters of 5% NSKE solution, following materials are required

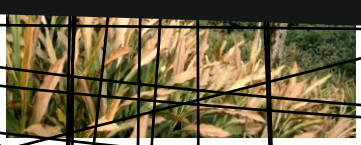
Neem seed kernels (well dried) – 5 kg
Water (reasonably good quality) – 100 litres
Detergent/ soap - 200g



Frost -Water-soaked pots



Frost-Brown dead tissues



Severe frost damage on plants in open areas

2. Hail Stones

Hail is a form of precipitation consisting of solid ice that forms inside thunderstorm updrafts. Hail stones happen during summer showers in March-April. In large cardamom, hail stones cause tearing off of leaf lamina parallel to the veins. The photosynthetic activity of the plants is greatly reduced, the affected tissue dries off and through the wounds saprophytic/parasitic fungal colonization happens. During the ensuing rainy season, severe physical damage is noticed on hailstone affected leaves.



Tearing off of leaves due to hailstones



Drying of torn leaves and colonization by fungi

3. Sun Scorch

Scorching of leaves is noticed in large cardamom grown especially in open areas and during summer. The symptoms include yellowing, browning and drying of lamina especially on the newly unfurled leaf. The under surface of affected area appears as if it is varnished. Chlorosis and bleaching also appears and the leaf gets parched later.



Sun scorched plants in open area



Yellowing and browning of leaf due to sun scorch

Management of abiotic stress

Large cardamom is a shade loving crop, traditionally grown under forest trees. Of late, the crop has been cultivated in open and terraced lands. The exposed pl

HARVESTING

Plants raised from seedlings takes 3 years from pl



Cutting of bearing tillers



Elaichi chhuri



Mature Spikes



Mature Capsules separated from spikes

rves g begins early in the lower
te vember-December at highe
ha.

var	Harvesting ti
nsey	October– No
mla	October– No
awney	August – Oc
Varlange	October –D
Seremna	August–Oc
Dzongu	September

RVEST

CURING

The shy v most 85 per cent moisture content. Hence their is highly perishable. They are cured or dried to bring dow re to10-12 per cent so as to prolong the shelf life.

Cardamom is cured (i.e., del ion of the capsules over low sustained heat) i uring furnace, the heat i oming from burning of wood fuel. T y, locally made furnac *i* used to cure cardamom. Here, the capsules



Fresh Capsules



Local bhatti



Local bhatti cured cardamom

ICRI modified Bhatti:

Improved curing devices are presently available for processing cardamom with superior quality. Indian Cardamom Research Institute, Regional Research Station, Gangtok developed improved curing technology known as ICRI Improved Bhatti where cardamom is cured through indirect heating. In improved Bhatti, a drum is kept as furnace in the lower firing chamber where the wood is fed as fuel. From the furnace, a set of flue pipes is fitted which carries smoke laden heat beneath the wire mesh (curing chamber) which later escapes through an outlet. Here

cardamom is dried by indirect heating at 50-55°C. Curing is done till moisture content of the produce is brought down to 10 -12 per cent and it gives metallic sound while shuffling. The cardamom cured in modified *Bhattis* retains its natural aroma and colour and is highly preferred in the market.

The system is available in two capacities that can process 200kg and 400 kg of fresh capsules. The cost is estimated to be Rs. 62,500/- (200 kg) and 92,500/- (400 kg). Spices Board, Ministry of Commerce, Government of India is promoting the ICRI improved Bhatti among farmers through subsidized promotional scheme as "ICRI Modified Bhatti".



ICRI modified bhatti



Flue pipe with furnace



Curing of cardamom in ICRI modified bhatti

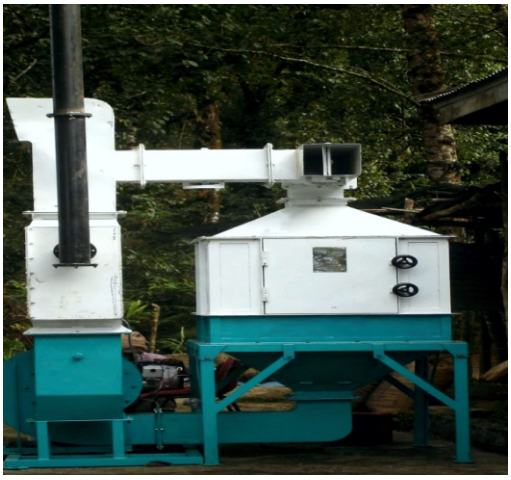


ICRI bhatti cured cardamom

In large cardamom drying, new improved driers are being used now a days which run either on electricity / diesel or both (hybrid). Cardamom cured in improved driers are found to retain good colour and aroma.



Dellmarc Electric Drier



Dryer run on Electricity/diesel or both

POLISHING

Polishing is done immediately after curing the capsules to provide a smooth texture and also to remove the calyx to some extent. The polishing can be carried out using cardamom polishing machine.



Cardamom polishing machine

TAIL CUTTING (Kanchi Cut)

The complete removal of calyx (tail) from large cardamom capsules manually using scissors (“*kanchi”* in Nepali) is known as tail cutting or kanchi cutting. The tail cut (kanchi cut) grade used to fetch higher price in the market.

At farmers' level tail cutting or polishing are not practiced. These processes are mainly done at Traders level to improve the marketability of the produce.



a



c

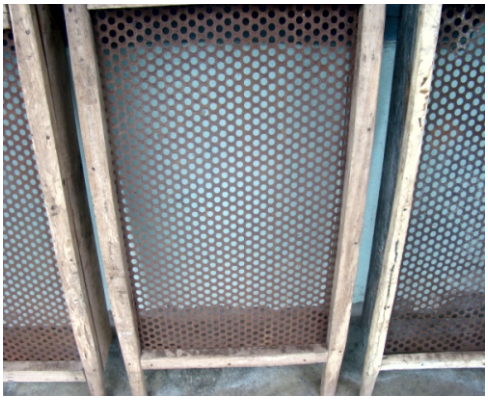


b

a. Cardamom capusles with tails (calyx) b. Tail cutting (kanchi cut)
c. Cardamom after tail removal (kanchi cut grade)

GRADING, PACKAGING AND STORAGE

Traditionally, the traders used to grade the capsules as *chhota dana* and *bada dana*. Traders use different sieves to grade their produce for better marketability. Indian Cardamom Research Institute, Regional Station, has standardized five grades for large cardamom capsules based on capsule size (dia).



Grading sieves developed by ICRI RRS, Tadong



Grading at a trader's godown

PACKAGING AND STORAGE

The properly dried large cardamom capsules should be allowed to cool and then packed in polythene lined jute bags. The bags may be stored on wooden platform away from sidewall of the store room to avoid absorption of moisture and thereby to avoid fungal growth on the stored produce.

The godowns where large cardamom capsules are stored should be free from storing any chemicals/paints/kerosene as exposure of the same leads to deterioration in quality of stored cardamom . The godowns should maintain proper ventilation and hygiene to keep the produce intact for a long time.



Packaging in polythene lined gunny bag



Storage in godown

MARKETING

In the Large Cardamom producing states, no regulated markets are available. Farmers sell dried cardamom to the local traders / dealers in primary (assembling) markets and from there it goes mostly to the secondary markets followed by various terminal (consumption) markets.

The terminal (consumption) markets for large cardamom are Delhi, Kanpur, Lucknow, Varanasi, Mumbai, Hyderabad, Amritsar, Jaipur, Nagpur, etc.

QUALITY AND USES OF LARGE CARDAMOM

QUALITY

In market, the quality of large cardamom is governed by its external appearance. The colour, size, shape, texture and flavour of the capsules determine its quality**.** In general, pinkish/maroonish bolder capsules with many seeds fetches higher market price.

The taste and aroma of capsules are determined by the presence of various aromatic compounds. The large cardamom constitutes around 2-3% of essential oil. The essential oil contains the volatile principles such as 1,8 cineole (75-85%), α -bisabolene (3-6%), α -terpinene (4-8%), α -terpineol + α – terpenyl acetate (3-6%) and also the β-myrcene, nerolidol, pinene, thujene etc., are known in traces. Cineole contributes to the pungency while α - terpenyl acetate towards pleasant aroma

USES

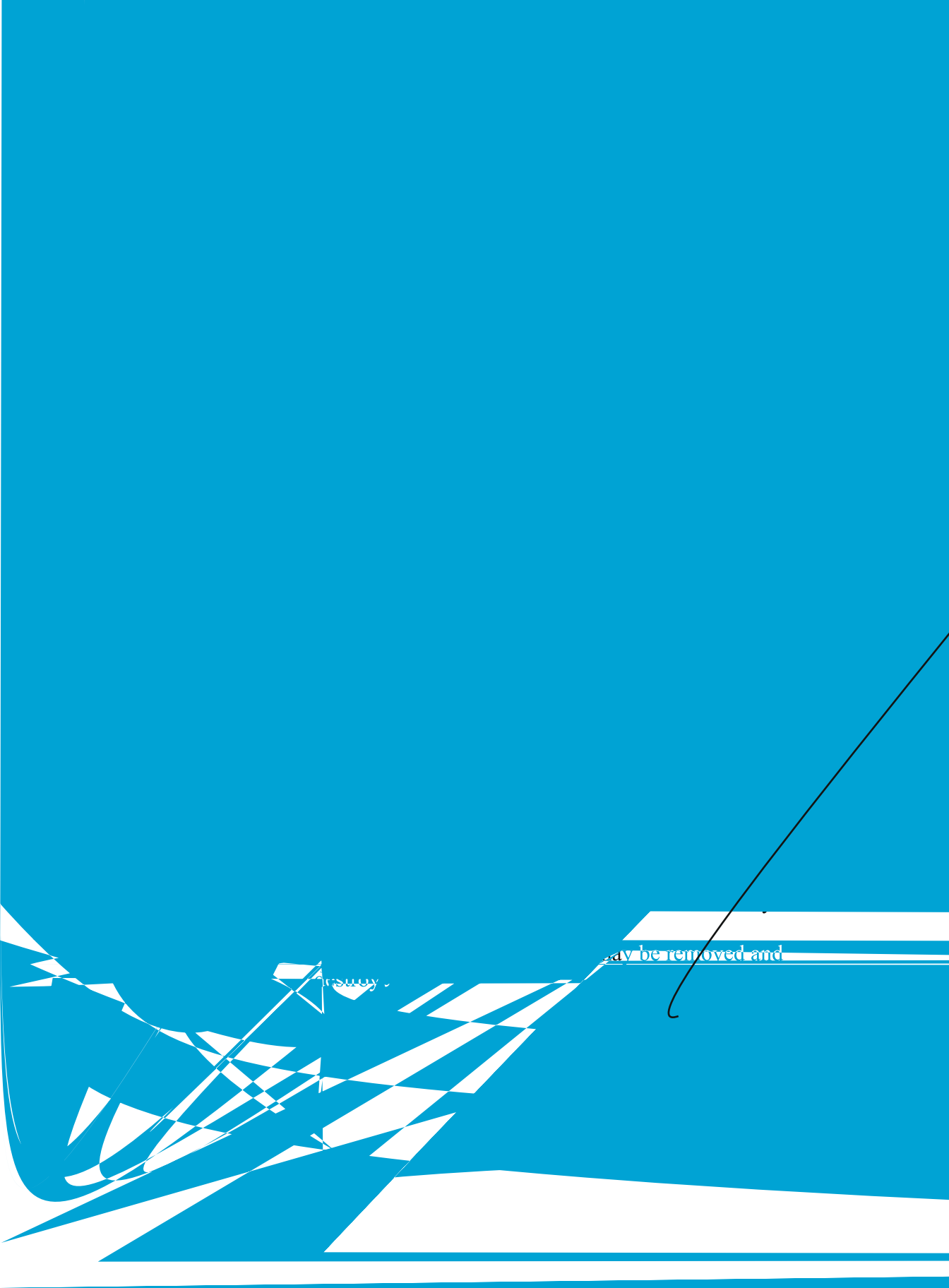
Large cardamom is mainly used as spice and also for medicinal purpose. As a spice, it is used as whole or in ground form. It is mainly used as a flavouring agent in pulav, briyani, rice preparations and also used in sweets like laddu, burfi, etc. Large cardamom is one of the important ingredients in garam masala, meat masala, curry masala and other food preparations.

It is also used in flavouring beverages viz. tea, coffee, buttermilk, etc. Seeds of large cardamom with silver coatings are also used as mouth fresheners.

Large cardamom is used in preparation of certain ayurvedic medicines for cold, cough, digestion and other stomach ailments. It is used as a fragrant adjunct to

other stimulants, which are bitter and pungent. The 1,8 cineole in large cardamom is reported to have antioxidant, anti-inflammatory and antimicrobial properties.

Large cardamom hu



March – April	**Plantation** • Irrigation may be done based on available soil moisture in plantation. • *Colletotrichum* blight and viral disease (*Chirke* and *foorkey*) infected plants may be destroyed by uprooting and burial at regular intervals. • Prophylactic spray and drench of *Pseudomonas fluorescens* (3-5 lt. in100 lt water) during April last week after removing blight infected plants (Phytosanitation). • Regular inspections may be carried out to observe shoot fly/stem borer incidence if any, may be hand-picked and destroyed mechanically. • One round of weeding may be done for easy movement of bumble bee and honey bee for pollination.
May– June	**Nursery** • Disease & pest affected plant parts may be removed and destroyed. • New site for secondary / sucker nursery has to prepare and planting may be completed. • One year old sucker nursery seedlings ready for planting in main field. **Plantation** • Decomposed cattle manure/organic manure may be applied in the plantation if not applied earlier for sustained production. • *Colletotrichum* blight and viral disease (*Chirke* and *foorkey*) infected plants may be destroyed by uprooting/burial at regular intervals. • Prophylactic spray and drench of *Pseudomonas fluorescens* 3-5 lt. in100 lt water – 1st week of May after removing blight infected plants if not applied earlier. • Spray and drench the plants with copper oxychloride 50% WP @ 1 Kg in 300-400 l of water/acre. • Regular inspections may be carried out to observe caterpillar / stem borer/shoot fly incidence if any, may be hand-picked and destroyed mechanically.

troyed mechanically

September - October	**Nursery:** • Over head pandal may be raised for the nursery opened during May- June. • Nursery bed may be mulched properly with dried forest leaves. • Disease/pest infested suckers may be removed and destroyed. • Necessary weeding may be carried out. • Seed bed/primary nursery bed may be prepared for raising nursery and seed may be sown. **Plantation** • *Colletotrichum* blight and viral disease (*Chirke* and *foorkey*) infected plants may be destroyed by uprooting and burial at regular intervals. • Spray/ drench of *Pseudomonas fluorescens* 3-5 lit. in100 lit water in September if not applied in August after removing the blight affected plants/plant parts. • Regular inspections may be carried out to observe caterpillar/stem borer/shoot fly incidence if any, may be hand picked and destroyed mechanically. • Capsule start maturing in higher elevation and one round of weeding and threshing may be done if not carried out earlier. • Farmers may repair their bhatti for curing cardamom. • Harvesting may be done when capsules are fully matured and curing can be carried out immediately. • Second round of application of dried or powdered cattle manure/organic manure may be carried out in the plantation to boost up the production.

November-December	**Nursery** • Nursery bed may be mulched properly with dried forest leaves. • Irrigate the nursery based on available soil moisture. • Disease/pest infested suckers/plant parts may be removed and destroyed. • Seed sowing and mulching has to complete immediately within 1st week of November in the seed bed/primary nursery bed and regular watering may be done based on soil moisture. **Plantation** • Harvesting has to be completed in higher elevation based on maturity and curing may be carried out immediately. • After harvest of the crop, the dried leaves and shoot may be dumped in pit for composting instead of using as mulching material. • The base of the plants may be mulched with forest leaves. • Viral disease (*chirke* and *foorkey*) infected plants may be destroyed by uprooting and burial at regular intervals. • Leaf caterpillar/stem borer infestation may be collected and destroyed mechanically. • Regular watering may be done based on available soil moisture in plantation.



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