Package of Practices for Cardamom cultivation

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Crops	Odia Name	Scientific Name	Family
Cardamom	ଗୁଜୁରାତି	*Elettaria cardamomum* Maton	Zingiberaceae

- Cardamom is one of the oldest known spices in the world
- Evergreen forests of Western Ghats of South India are considered as the centre of origin as well as natural habitat of cardamom.
- Cardamom is commercially cultivated for its dried fruits (capsules), which is also referred as cardamom of commerce

Types/cultivars

Based on adaptability, nature of panicle, shape and size of capsules, the cultivars are categorized into Malabar, Mysore and Vazhukka.

Malabar

These cardamom plants have medium size and attain two to threemeter height on maturity. The dorsal side of leaves may be pubescent or glabrous. The panicles are prostrate and the capsules are globose to oblong shaped. This variety is better suited to areas of 600 to 1200 meter elevation. Malabar type is relatively less susceptible to thrips infestation. It can thrive under low rainfall conditions.

Mysore

Plants are robust and attain 3 to 4 meter height. The leaves are lanceolate or oblong-lanceolate and glabrous on both sides. Panicles are erect and the capsules are ovoid, bold and dark green in colour. They are better adapted to altitudes ranging from 900 to 1200 meters from mean sea level (msl) and thrive well under assured, well-distributed rainfall conditions.

Vazhukka

This is considered to be a natural hybrid of cultivar Malabar and Mysore and consequently, the plants belonging to this group exhibit various characteristics intermediate to these two types. The plants are robust like cv. Mysore. Its leaves are deep green, oblong to lanceolate or ovate, panicles are semi-erect (pendent) and capsules are bold, globose or ovoid in shape. It is extensively cultivated in Kerala and Tamil Nadu at elevations ranging from 900 to 1200 meters above sea level.

Climate and soil

- The crop thrives well in regions which receive a well-distributed annual rainfall of 1500-2500 mm with a mean temperature of 15°C to 35°C, relative humidity of 75-90% and 600-1200 m above MSL.
- Cardamom grows luxuriantly in forest loam soils, which are generally acidic in nature with a pH range of 5.5-6.5.
- Growth of cardamom is enhanced, when planted in humus rich soils with low to medium available phosphorus and medium to high available potassium.

Varieties

Released varieties/selections of cardamom with high yield potential and superior capsule characters from different research organizations are.

Appangala-1, Appangala-2, IISR Avinash, IISR Vijetha, ICRI 1, ICRI 2, ICRI 3, ICRI 4, ICRI 5, ICRI 6, PV 1, PV 2, Mudigere 1, Mudigere 2, Mudigere 3

Apart from these, farmers varieties like Njallani green gold, Vander cardamom, Panikulangara No. 1, Palakuzhi selection and Valley green bold are also grown in cardamom growing tracts of the country.

Propagation

Propagation by vegetative means through suckers is considered to be the most preferred method. Production of planting materials from seeds and through tissue culture are alternative methods of propagation. Seedling propagated plants may not be true to its parent.

Clonal nursery

- Establishment of clonal nursery is essential for large-scale multiplication of high yielding varieties/selections. The planting unit consists of a grown-up tiller with a portion of the rhizome and a developing shoot.
- Sucker multiplication can be taken up from the first week of March to September.
- The site selected should be in open, well-drained areas adjacent to a perennial water source.
- Trenches with a width and depth of 45 cm and convenient length are prepared and filled with humus rich top soil, sand and well decomposed compost.
- The planting units are planted at a spacing of 1.8 m x 0.6 m in the trenches.
- To protect the planting units from direct sunlight and desiccation, overhead shade/pandal need to be provided.
- For better establishment of the suckers, irrigation may be given once in a fortnight.
- Apply fertilizers @ 48:48:96 g NPK per sucker in 2-3 splits starting from two months after planting.
- Neem cake @ 100-150 g/ plant may also be applied along with the fertilizers.
- On an average, 15- 20 good quality planting units could be produced from a mother clump within ten months of planting.

Seedling Nursery

Cardamom seedlings are raised in primary and secondary nurseries.

Primary Nursery

- Select nursery sites on gentle sloppy areas and preferably near a perennial water source.
- Clean the area from all existing vegetation, stumps, roots, stones, etc. In the cleared area, beds can be prepared having one-meter width, 20 cm height and at required length, generally six meters.
- Jungle topsoil can be spread to a thickness of two to three cm on the beds.
- Fully ripened bold capsules from high yielding and disease-free mother clumps of known source can be collected from second and third harvests for seed extraction.
- One kg fresh capsules comprising of about 500-800 fruits is sufficient to produce 3000-5000 seedlings.
- Seeds after extraction should be washed using water to remove the mucilage. It is then mixed with wood ash and dried in shade.
- About 175-200 g seeds are required to raise quality seedlings required for one hectare.
- Seeds are to be sown as early as possible, preferably within 15 days after extraction since seeds lose their viability on storage.

Primary Nursery

- Sowing in September gives maximum germination under field conditions; winter and peak southwest monsoon period should be avoided.
- Even under ideal conditions, the germination is often less than 50 per cent only.
- Breaking of hard seed coats through seed treatment with acid or similar chemicals improves germination.
- Acid scarification with 25 per cent Nitric acid for 10 minutes to break the seed coat will enhance germination.
- The seed is ready for sowing the next day. Sowing can be done in lines in rows at a distance of 10 cm. Seed rate is 30 to 50 grams per 6 X 1 meter size bed.
- After sowing, cover the bed with a thin layer of fine soil and then with mulch material, such as paddy straw.
- Avoid the contact of mulch material with the soil by spreading the mulch over tree twigs laid across the bed.
- Water the beds to sufficient moisture conditions. Once sprouting is observed, remove the mulch and cover the bed with thinly sliced mulch material in between rows.
- To protect the seedling from direct sunlight, provide an overhead pandal.
- Germination commences 20 to 25 days after sowing and continues for further 30 to 40 days.
- Seedlings when reach four to six leaf stage (five-six months after sowing) is transplanted to secondary nursery.

Secondary Nursery

Seedlings are raised in the secondary nursery by two methods.

1. *Bed nursery*
2. *Polybag nursery*

Bed nursery

- The beds are prepared as described in primary nursery.
- Spread a layer of compost on the bed and mix thoroughly with soil.
- Seedlings with 3-4 leaves are transplanted at a distance of 20 to 25 cm.
- Mulching and watering should be done immediately after transplanting.
- In Kerala and Tamil Nadu, transplanting is carried out during June-July, whereas in Karnataka it is undertaken during the months of November-January.

- Apply 90:60:120 g NPK per bed of 6 m × 1 m size, in three equal splits at an interval of 45 days. First dose of fertilizer may be applied at 30 days after transplanting.
- Earthing up need to be undertaken after each fertilizer application and hand weeding is done once in 20-25 days.
- One month before uprooting, the shade should be removed to encourage better tillering. The seedlings will be ready for transplanting after 8-10 months of planting.

Poly bag nursery

- Black HM/HDP bags of size 20 X 20 cm having minimum 100 GSM thickness with three to four holes at the bottom can be used for this purpose.
- Fill the bags with potting mixture in the ratio of 3:1:1 of jungle topsoil, cow dung and sand. The bags may be arranged in rows of convenient length and breadth for easy management.
- One healthy and disease free seedling at three to four-leaf stage can be transplanted into each bag.
- Cardamom plants from secondary nursery/polybags can be transplanted to the main field during the last week of May after receipt of southwest monsoon.

FIELD PLANTING AND AGRONOMIC MANAGEMENT

Land Preparation

For planting in a new area, ground should be cleared and if it is a replanting area, old plants should be removed. Shade regulation, terracing and preparation of pits should be done during summer months.

Shade Regulation

- Shade regulation is one of the important practices that should be attended during summer (March–April) in the new planting areas and during May–June after the receipt of summer showers in the existing plantation.
- If there is thick shade, branches should be chopped off to provide filtered light of 40 to 60 per cent of the open area.
- If area is open due to tree fall, planting of quick growing tree species like Karuna (Vernonia arborea), Corangati (Acrocarpus fraxinifolius), Chandana Viambu (Toona ciliata), Njaval (Syzygium cumini), Jack tree (Atrocarpus hetrophyllus) etc. should be taken up to protect the plants from direct sunlight.

Pit Opening

- Field operations are to be undertaken with the objective of preventing soil erosion and to conserve soil moisture
- In sloppy areas, soil should be protected from soil erosion for which planting should be taken up in terraces.
- Terraces should be made at required distances on contours depending on the spacing adopted.
- Pits of 90 X 90 X 45 cm can be prepared before commencement of monsoon, about 1/3 of the pit should be filled with top soil and 1/3 should be filled with 1:3 mixture of organic manure and topsoil.

Planting

- Planting materials of high yielding variety suitable for the areas may be selected for planting.
- They may be planted in the already prepared and filled pits and plants should be protected from wind by staking.
- For high yielding varieties plant to plant distance may be kept at 3 X 3 meters (1111 plants per hectare).
- Immediately after planting, the plant base should be mulched well with available dried leaves to prevent soil erosion and to conserve moisture.
- Planting should be done diagonally to the slope to reduce runoff.

Weed Management

- Two or three rounds of hand weeding at the plant base during May, September and December/January and slash weeding in the interspace are advisable.
- Use of spade for weeding is to be avoided as it will loosen the soil and cause soil erosion.
- The weeded materials may be used for mulching.
- Mechanical weeding using weed cutter is economical and ensures timely weeding in the initial years of plant establishment.

Irrigation

- Irrigation is required generally during summer months and also during periods of prolonged dry spells, if they coincide with the critical periods of plant growth when development of young tillers and panicles takes place.
- Water may be stored during the rainy season through various water harvesting measures without causing damage to the location and ecosystem.
- Irrigation can be done through different methods such as hose irrigation, sprinkler irrigation, drip irrigation or micro-sprinkler/mist/ fogger irrigation.
- Hose irrigation can be done at weekly intervals at the rate of 20-30 liters per plant depending upon the clump size.
- In the case of sprinklers, irrigation with an amount of water equivalent to 35 to 45 mm rain at fortnightly intervals is recommended under normal conditions.
- In case of drip or micro sprinkler irrigation, water at the rate of five to six liters per clump per day can be given.
- Fogger/mist irrigation system is used largely to create a suitable microclimate within the plantation eco-system thereby providing favorable environment for growth, flowering and seed setting.
- The frequency of operation of the irrigation systems depends on the macroclimate in the plantation area and hence has to be standardized for specific local weather situations.
- Irrigation is to be undertaken with utmost care to avoid excess wetness at the plant base for prolonged periods to prevent occurrence of rot diseases.

Soil and Water Conservation

- Opening of a rectangular silt pit (1.0 X 0.5 X 0.6 meter) in between four plants will help in soil and water conservation on gentle slopes.
- If the slope is steep, construction of stone pitching walls at 10-20 meter intervals across the slope and also making water collecting trenches along drainage channels at selected intervals will be helpful in nonlandslide prone areas.

Forking and Mulching

As far as possible, the entire plantation and particularly the plant base are to be kept under mulch for reducing evaporation loss, suppress weed growth and to maintain optimum soil temperature. It is very essential to keep the plant base mulched (5-10 cm thick), except during periods of heavy monsoon (June to September). However, in situations where soil has become compact and hard, forking the plant base to a distance up to 90cm and to a depth of 9-12 cm may be beneficial to enhance root proliferation, better infiltration of summer showers and for improving soil aeration. Forking could be done with the cessation of North East monsoon during November-December taking care to cause least damages to the root system.

Trashing and Pruning

- Trashing consists of removing old tillers, dead rhizome, dry leaves and leaf sheaths
- This operation may be carried out once in a year at any time after the receipt of the pre-monsoon showers in May.
- Pruning is the operation undertaken with sharp sickles for removing the dead and hanging leaves from the pseudo-stem.
- Care should be taken not to peel off the leaf sheath from the pseudostem.
- This operation may be done during January and during September, which coincides with the peak thrips population.
- The resultant plant materials obtained through pruning can be used for mulching

Earthing up

- Whenever the top soil covering the plant base is washed away and the rhizomes and roots are exposed, earthing-up of the plant base with top soil is recommended during November-December, before the withdrawal of North East monsoon.
- While carrying out this operation, care should be exercised to ensure that only top soil is used, and it is evenly and thinly spread at the base covering only half the bulb portion of the rhizome.
- This operation helps to keep the top 10 to 15 cm soil loose and friable enabling easy root penetration and water percolation.

NUTRIENT MANAGEMENT

Lime Application

Application of lime or dolomite is essential if pH of the soil is < 5.5. Though the quantity of lime is to be arrived at by assessing the lime requirement of the soil, for practical purposes, application of agricultural lime is recommended at one kg per plant per year for soils with pH below 5.0 (or 2 kg dolomite) and half a kg of lime (or 1 kg dolomite) when pH is between 5-5.5. Lime is to be applied in one or two splits during May and September. Fertilizer shall be applied only after 15-20
days of lime application.

Application of Organic Manures

Application of decomposed farmyard manure or compost at 5-10 kg per plant may be made during May-June. The manures should be thoroughly mixed with surface soil after application. Under irrigated condition, manuring can be done in two splits, one in May and the subsequent application during September. Organic manures such as neem cake (one kg per plant), bone meal (one kg per plant) or vermicompost (one kg per plant) have beneficial effects on root proliferation and plant growth and also helps to reduce nematode and root grub infestation.

Schedule for Application of NPK Fertilizers

Soil Application

Age of plants	Rain-fed areas (Kg/ha)	Irrigated areas (Kg/ha)
First year of planting	Nitrogen-25 Phosphorus -25 Potassium -50 (2 Split applications)	Nitrogen-25 Phosphorus -25 Potassium -50 (2 Split applications)
Second year of planting	Nitrogen-40 Phosphorus -40 Potassium -80 (2 Split applications)	Nitrogen-60 Phosphorus -60 Potassium -80 (3 Split applications)
Third year of planting (Stabilised yield)	Nitrogen-75 Phosphorus -75 Potassium -150 (2 Split applications)	Nitrogen-125 Phosphorus -125 Potassium -250 (3 Split applications)

Zinc (Zinc sulphate) shall be applied as foliar spray at 250 g /100 liters twice a year. Under high production technology, where crops are harvested from 18 months onwards, fertilizer recommendations for a full-grown plantation could be adopted from the second year onwards.

- Fertilizers could be applied in smaller doses in four or more splits after every harvest or combining both soil and foliar application of fertilizers. Whenever, the plant growth is affected due to root damage (root grub/ *Fusarium* disease/soil compactness), foliar application of DAP (one per cent) + MoP (one per cent) or 1 per cent 19:19:19 complex fertilizer could be adopted.

Time of Application

Soil application **:** May/June
September/October
December /January

Foliar application **:**
August/September
October/November
December /January

Application of Micronutrients

- Application of Zinc to the foliage is found to enhance not only cardamom growth and yield but also the quality of the produce. Hence, it is recommended that Zinc may be applied as a foliar spray as Zinc sulphate at 250 g/100 liters of water during April-May and September-October.
- Zinc should be applied alone and not to be mixed with any insecticide/fungicide/fertilizer since Zinc may precipitate and become unavailable to the plants.
- Soil application of Boron in the commercial grade borax at the rate of 7.5 kg/ha is recommended in boron deficient areas. It may be applied in two doses along with NPK fertilizers. Otherwise boron may be applied alone as foliar dose by using borax (at 0.25 %) during April-May and September-October.

DISEASES MANAGEMENT

Capsule Rot Disease & Clump Rot or Rhizome Rot

Integrated Management of Capsule and Rhizome Rot

- Regulate shade before onset of monsoon (May-June), avoid close planting,
- Minimum irrigation should be followed during summer months, trash the plants, cut, remove destroy diseased parts.
- Remove mulch from the base and ensure proper drainage.
- Spray Bordeaux mixture (1%) or Fosetyl-Aluminium (Aliette) 80WP (0.2 %) (200 g / 100 liters of water). The first spray should be done during May–June before the onset of monsoon and subsequent spray may be done during July–August. A third spray may be given in the month of September if the monsoon is prolonged and disease is still persistent.

Fusarium Disease

Management

After monsoon, cover the exposed root with soil, mulching and sufficient irrigation should be provided. Shade has to be provided in exposed area. Trash and clean the plant base during March–April before the onset of monsoon. Ensure shade in the plantation towards the end of monsoon showers. As a prophylactic measure, drench the plant basins with copper oxychloride (0.2%) during August–September. *Trichoderma harzianum* and *Pseudomonas fluorescence* mass multiplied on suitable carrier media may be applied to plant basins @ 1-5 kg depends on the size of the clump during May–June and September–October.

MANAGEMENT OF PESTS

Cardamom Thrips

Removal of dry leaves as well as leaf sheath (trashing/pruning) during January, May and September. Spray Quinalphos 25% EC at 120 ml / 100 liters of water or Diafenthiuron 50% WP at 80 g / 100 liters of water or Lambda-Cyhalothrin 04.90% CS at 40 ml / 100 liters of water.

Shoot/ Panicle/ Capsule borer

- Rouging and destruction of infested tillers during September– October.
- Spray Diafenthiuron 50% WP at 80 g / 100 liters of water or Lambda-Cyhalothrin 04.90% CS @ 40 ml / 100 liters of water within 20 days of adult moth emergence.

Root Grub

- ❖ Avoid planting of jackfruit, mango, fig etc. as shade trees as these trees are alternate hosts of the pest.

Nematodes

- ❖ Frequent change of nursery beds will help to reduce nematode infection in nurseries.
- ❖ Application of neem cake at 500g to 1 kg depends on the size of the clump in May–June/ September.

HARVESTING

Stage of Harvest

- ❖ The capsules should be harvested when they attain physiological maturity to fully ripened stage so as to allow the capsules for proper seed set and to obtain higher recovery.
- ❖ However, over ripening should be avoided as it results in loss of capsules due to rodents and squirrels in the field and also splitting at the time of drying which in turn leads to low premium price in the market.
- ❖ Recovery is highest (24 per cent) in the fully ripened capsules followed by the one harvested at physiological maturity (20 per cent) and at immature stage (14 per cent). The oil content varies with the maturity of capsules.

POST HARVEST OPERATIONS

- Cardamom capsules should be subjected to post harvest operations such as washing in water, curing, cleaning, grading, packing and storage.
- Capsules should not be stored after harvest for a longer duration as it adversely affects the quality of the end product.

Curing

- Cardamom curing may be defined as the process in which moisture of freshly harvested capsules is reduced from 80 per cent to 10–12 per cent through indirect heating.
- Drying is the most important unit operation that determines the colour and quality of the end products.
- In the improved cardamom curing devices, the alternate fuel source can be used either independently or in combination with the firewood. Improved systems are advantageous in retaining high quality of produce with respect to colour and helps in substantially reducing curing time (12–18 hours).

Cleaning, Grading, Packing and Storage

- Dried capsules have to be polished either manually or with the help of machines before marketing.
- Polishing is done by rubbing the dried capsule in a hot state against a hard surface.
- Polishing machines are also available which can be operated either manually, or with electric motors. Motorized machines having desired mesh can be used for polishing as well as grading of capsules.
- After grading, cardamom capsules can be stored over a long duration.
- For efficient retention of green colour during storage, cardamom should be dried down to a moisture level of 10-12 per cent.
- Use of 300-gauge black polythene lined gunny bags improves the storage efficiency.
- Store the commodity in wooden boxes at room temperature preferably in the curing house for better storage efficiency.

Thank You