



Good Agricultural Practices (GAP) for **CARDAMOM**

(Elettaria cardamomum Maton)

A Practical Guide for Sustainable and Quality
Cardamom Production



ICAR – Indian Institute of Spices Research
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R Dinesh

Director

ICAR–Indian Institute of Spices Research

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Foreword

Cardamom (*Elettaria cardamomum* Maton), popularly known as the “Queen of Spices”, is one of the most important plantation spices cultivated in the Western Ghats of India. The crop plays a vital role in the livelihood security of thousands of farmers in Kerala, Karnataka and Tamil Nadu and contributes significantly to the spice economy and export earnings of the country.

The adoption of Good Agricultural Practices (GAP) is essential for ensuring sustainable production of high-quality cardamom while minimizing adverse impacts on the environment. GAP emphasizes efficient crop management, balanced nutrient use, integrated pest and disease management, conservation of soil and water resources, and protection of worker health and biodiversity.

This publication has been prepared to provide farmers, extension personnel and other stakeholders with scientifically validated recommendations covering various aspects of cardamom cultivation, including nursery management, field establishment, nutrient management, plant protection, harvesting and post-harvest handling.

I am grateful to Dr. S. K. Singh, Deputy Director General (Horticultural Science) Indian Council of Agricultural Research (ICAR) and Dr. Sudhakar Pandey, Assistant Director General, Horticultural Science, ICAR for their constant support, guidance and encouragement.

The contributions from Spices Board, Directorate of Arecanut and Spices Development, Keralam Agricultural University and World Spice Organization have helped immensely in fine tuning and curating the content of this publication.

I am confident that this manual will serve as a useful guide for promoting sustainable cardamom cultivation, improving productivity and quality, and enhancing the profitability of cardamom farming.

R. Dinesh

Director

ICAR–Indian Institute of Spices Research

Kozhikode, Keralam



Preface

Cardamom cultivation in India has undergone significant changes in recent decades owing to changing climatic conditions, evolving pest and disease challenges, and increasing demand for high-quality produce in domestic and international markets. These developments necessitate the adoption of scientifically sound and environmentally sustainable production practices.

This manual presents Good Agricultural Practices (GAP) for small cardamom cultivation and incorporates recommendations generated through research, field validation and practical experiences from farmers and extension agencies. The publication covers major aspects of cardamom production, including nursery management, clonal propagation, field establishment, shade and irrigation management, nutrient management, pest and disease management, harvesting, post-harvest handling and safe use of pesticides.

The objective of this manual is to provide a practical reference for farmers, extension personnel and other stakeholders involved in the cardamom value chain. Adoption of the recommended practices will help improve productivity, enhance produce quality, ensure food safety and promote sustainable cardamom cultivation.

The authors gratefully acknowledge the contributions of scientists, technical staff, farmers and institutions whose efforts have supported the development of these recommendations.

Disclaimer

The crop production, plant protection and post-harvest management recommendations presented in this publication are based on research findings, field evaluations and technical expertise available at the time of publication. Certain products, molecules or management practices mentioned in this document may have been included based on their demonstrated efficacy under experimental or field conditions.

Farmers, extension personnel and other stakeholders are advised to use only those pesticides, fungicides, insecticides and other plant protection products that are approved and registered by the Central Insecticides Board and Registration Committee (CIB&RC), Government of India, for use in cardamom. Users should always follow the label claim, recommended dosage, waiting period, safety precautions and statutory regulations applicable at the time of use.

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Readers are encouraged to consult the latest recommendations issued by ICAR, State Agricultural Universities, the Directorate of Plant Protection, Quarantine & Storage, and CIB&RC before adopting plant protection measures.

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1. Introduction

Cardamom (*Elettaria cardamomum* (L.) Maton) is one of the oldest and most valued spices in the world. The evergreen forests of the Western Ghats of South India are considered the centre of origin and natural habitat of the crop. Cardamom is cultivated primarily for its dried fruits, known as capsules, which are highly valued for their characteristic aroma and flavour.

Cardamom is widely used in culinary preparations, beverages, bakery products, pharmaceuticals and perfumery industries. Owing to its diverse uses and high market value, it is regarded as one of the most important plantation spices cultivated in India. In India, cardamom is predominantly cultivated in the Western Ghats region covering the states of Kerala, Karnataka and Tamil Nadu. The crop plays a significant role in the plantation economy of these regions by generating employment and income for farming communities. India is also one of the leading producers and exporters of cardamom and cardamom-based products, catering to both domestic and international markets.

Adoption of Good Agricultural Practices (GAP) is essential for sustainable cardamom cultivation. GAP promotes efficient use of resources, improves productivity and capsule quality, reduces pesticide residues, and minimizes adverse environmental impacts. The implementation of GAP also helps farmers produce safe, high-quality cardamom that meets the requirements of domestic and export markets.

2. Types of Cardamom Cultivars

Based on adaptability, growth habit, nature of panicles and capsule characteristics, cultivated cardamom is broadly classified into three cultivar types: *Malabar*, *Mysore* and *Vazhukka*.

Malabar Type

The Malabar type is characterized by prostrate panicles that spread along the ground. The capsules are generally medium-sized and possess good aroma. This type is widely cultivated in Karnataka and parts of Kerala.

Mysore Type

The Mysore type produces erect panicles and is known for its bold, uniform capsules. It is predominantly cultivated in Kerala and Tamil Nadu and is generally considered more productive under favourable growing conditions.

Vazhukka Type

The *Vazhukka* type is a natural hybrid between the Malabar and Mysore types.



It is characterized by semi-erect or pendent panicles and combines desirable traits of both parent types. Owing to its adaptability and yield potential, it is the most widely cultivated cultivar type in Kerala.



Malabar



Mysore



Vazhukka

3. Climate and Soil Requirements

Climate

Cardamom thrives under humid tropical conditions with well-distributed rainfall and moderate temperatures. The crop performs best in areas receiving 1500–2500 mm of annual rainfall and at elevations ranging from 600 to 1200 m above mean sea level. An optimum temperature range of 15–35°C, coupled with high relative humidity and filtered shade, promotes vigorous growth, flowering and capsule development.

Soil

Cardamom grows best in well-drained forest loam soils rich in organic matter. Soils with good moisture-holding capacity and adequate aeration are ideal for healthy root growth and nutrient uptake. The optimum soil pH for cardamom cultivation ranges from 5.5 to 6.5.

Crop growth and productivity are generally enhanced in soils containing low to medium levels of available phosphorus and medium to high levels of available potassium. Regular soil testing is recommended to assess soil fertility and to facilitate balanced nutrient management.

4. Improved varieties of Cardamom

Several improved varieties and selections with high yield potential have been developed by research institutions and farmers. They are listed in Tables 1-2.

Table 1. Important released varieties of small cardamom

Variety	Type	Salient Features	Yield Potential (dry) (kg/ha)	Recommended Area
ICRI-1	<i>Malabar</i>	Early; bold dark green capsules; high oil	660	South Idukki (Kerala)
ICRI-2	<i>Mysore</i>	Suitable for irrigated & high altitude	750	Kerala & Tamil Nadu
ICRI-3	<i>Malabar</i>	Bold parrot green capsules	1000	Karnataka
ICRI-4	<i>Malabar</i>	Early; suited for low rainfall	650	Tamil Nadu (Palani hills)
ICRI-5	<i>Malabar</i>	Hybrid; high yield; rot tolerant	1650	Kerala & Tamil Nadu
ICRI-6	<i>Malabar</i>	High % bold capsules; pest tolerant	1200	Kerala & Tamil Nadu
ICRI-7	<i>Vazhukka</i>	Angular pale green capsules	700	Kerala
ICRI-8	<i>Malabar</i>	High recovery of bold capsules	1200	Karnataka
ICRI-10 (Sugandha Bharathi)	<i>Malabar</i>	High yielding, climate resilient variety	2270 (Potential – 4299)	Kerala
PV-1	<i>Malabar</i>	Early maturing variety	260	Kerala & Tamil Nadu
PV-2	<i>Vazhukka</i>	Bold green capsules	982	Kerala

PV-3	<i>Malabar</i>	Attractive green capsules	611	Kerala
PV-5	<i>Vazhukka</i>	High capsule setting; thrips tolerant	1116	Kerala
Mudigere-1	<i>Malabar</i>	Tolerant to pests; bold capsules	275	Karnataka
Mudigere-2	<i>Malabar</i>	Suitable for valley conditions	475	Karnataka
Mudigere-3	<i>Malabar</i>	Tolerant to thrips & borers	400	Karnataka
Appangala-1	<i>Malabar</i>	Early; highly adaptive	745	Karnataka & Wayanad
Appangala-2	<i>Malabar</i>	High yielding; Katte resistant	927	Karnataka & Wayanad
IISR Avinash	<i>Malabar</i>	Resistant to rhizome rot & blight	847	Karnataka & Wayanad
IISR Vijetha	<i>Malabar</i>	Katte tolerant	643	Karnataka & Wayanad
IISR Manushree	<i>Malabar</i>	Moisture stress tolerant, 50 % of the capsules are > 8 mm	550	Karnataka and Kerala
IISR Kaveri	<i>Malabar</i>	Compact flowering. 70 % of the capsules are > 8 mm. Tolerant to moisture stress.	482	Karnataka
IISR Sujyothi	<i>Malabar</i>	High yielding hybrid, 70 % of the capsules are >7 mm	705	Karnataka

Table 2. Farmers varieties of cardamom registered with Plant Varieties and Farmers' Rights Authority and National Innovation Foundation

Variety	Type	Salient Features
Njallani Green Gold	<i>Vazhukka</i>	High yielding; bold and green capsules
Pappalu	<i>Vazhukka</i>	Long panicles, ovoid capsules
Arjun	<i>Vazhukka</i>	50 % of the capsules are comparatively bigger size (10 mm length and 8 mm width). High recovery rate (Dry 20-25 %).
Elarajan	<i>Vazhukka</i>	Produces uniform bold capsules of 8 to 9 mm and also more number of capsules per panicle
Thiruthali	<i>Malabar</i>	Produces medium bold, parrot green capsules. Suitable for rainfed conditions and areas with less shade
Wonder Cardamom	<i>Mysore</i>	Capsules are bold and deep green in colour. Variety can be intercropped in rubber plantations
Panikulangara Green Bold-1	<i>Vazhukka</i>	Long, semi erect panicles, capsules retain attractive green colour even after drying
Panikulangara Green Bold-2	<i>Vazhukka</i>	Ovoid capsules, mature capsules are parrot green in colour
Ela (White Flower Cardamom)	<i>Vazhukka</i>	Flowers are pure white in colour. Capsules are globose in shape and pale green when mature.
Pachaikkai	<i>Malabar</i>	Drought tolerant, produces bright green coloured bold capsules
PNS Vaigai	<i>Mysore</i>	High and consistent yielder. Produces 60-70 percent capsules > 7 mm.
Thadathil Gold	<i>Vazhukka</i>	High yielding variety. Ovoid, pale green colour capsules.



Appangala 1



Appangala 2



IISR Sujyothi



IISR Kaveri

5. Propagation

Cardamom can be propagated through vegetative propagation using suckers, seed propagation and tissue culture techniques. Among these methods, vegetative propagation through suckers is the most widely adopted by farmers because it ensures true-to-type plants and maintains the desirable characteristics of the mother plant.

Healthy, vigorous and disease-free suckers selected from high-yielding mother clumps should be used for planting. Seed propagation is primarily employed for raising seedlings and breeding programmes, while tissue culture offers opportunities for rapid multiplication of disease-free planting material. However, tissue culture plants require proper hardening before field establishment.

5.1 Clonal Nursery

Clonal nurseries are established for large-scale multiplication of elite cardamom planting material. The nursery site should be located in an open, well-drained area with access to a reliable perennial water source.

For establishing a clonal nursery, trenches of 45 cm width and 45 cm depth are prepared with convenient lengths. The trenches are filled with a mixture of topsoil, sand or coir pith, and well-decomposed compost to provide a favourable medium for root growth and sucker development.

Planting units are established at a spacing of 1.8 m × 0.6 m. Neem cake @ 100–150 g per plant should be applied at the time of planting. Fertilizers may be applied at the rate of 48:48:96 g N₂O₅2O per sucker in 2–3 split doses commencing two months after planting.

Under proper management, a single mother clump can produce about 15–20 planting units within 10 months.

Figure: Clonal nursery trench system



(a) Trench for clonal multiplication



(b) Trench with compost and manure



(c) Planted clones



(d) Clonal nursery

5.2 Seedling Nursery Management

Cardamom seedlings are generally raised in two stages, namely the primary nursery and secondary nursery. Proper nursery management is essential for producing healthy and vigorous planting material.

5.2.1 Primary Nursery

The nursery should be established in an open, well-drained area close to a reliable water source. Nursery beds measuring 6 m × 1 m × 0.2 m are prepared and covered with a thin layer of humus-rich forest soil.

Fully ripened, bold capsules should be collected from high-yielding and disease-free mother plants, preferably during the second and third harvests. Seeds obtained from 1 kg of fresh capsules (approximately 500–800 capsules) are sufficient to raise about 3000–5000 seedlings.

Seeds are extracted by gently pressing the capsules, followed by washing three to four times in water to remove the mucilaginous coating. The cleaned seeds are mixed with wood ash and dried under shade. Since seed viability declines rapidly during storage, sowing should preferably be completed within 15 days of extraction.

The recommended sowing period varies with location. In Karnataka, sowing is generally carried out during September, whereas in Kerala and Tamil Nadu, sowing is undertaken between November and January.

Seed germination can be improved through acid scarification. For this purpose, seeds wrapped in a nylon cloth are immersed in 25% nitric acid for 10 minutes and subsequently washed thoroughly with clean water to remove all traces of acid.

Seeds are sown in rows spaced 10 cm apart, maintaining 1–2 cm spacing between seeds within the row. A seed rate of 30–50 g per nursery bed is generally sufficient. After sowing, the seeds should be covered with a thin layer of sand, mulched with paddy straw and protected with tree twigs to conserve moisture. Regular watering should be provided to maintain adequate soil moisture. Germination normally commences within 20–25 days after sowing.



(a) Nursery beds for sowing seeds



(b) Line sowing of cardamom seeds

5.2.2 Polybag Nursery

Cardamom seedlings can be raised successfully in polybags, which facilitate better root development and minimize transplanting shock. Polybags of 20 × 20 cm size with adequate drainage holes are recommended.

The potting mixture should consist of fertile topsoil, well-decomposed cow dung and sand mixed in a ratio of 3:1:1. Seedlings at the 3–4 leaf stage are transplanted into the polybags and maintained under suitable shade and moisture conditions.

Raising seedlings in polybags offers several advantages, including uniform growth, better field establishment, higher survival rate and a shorter nursery period compared to conventional nursery methods.



Polybag nursery

6. Field Preparation and Planting

Cardamom is generally planted during the rainy season to ensure adequate soil moisture for establishment and early growth. Healthy and disease-free planting material should be selected from high-yielding sources.

6.1 Planting Material

The planting unit used in cardamom cultivation is known as a **sucker**, which consists of a grown-up tiller with two developing shoots. Vigorous suckers with a well-developed root system should be used for planting.

6.2 Recommended Age of Seedlings for Planting

Region	Age of seedlings
Karnataka	10 months
Kerala and Tamil Nadu	18 months

6.1 Planting Material

The planting unit used in cardamom cultivation is known as a **sucker**, which consists of a grown-up tiller with two developing shoots. Vigorous suckers with a well-developed root system should be used for planting.

6.3 Land Preparation and Planting

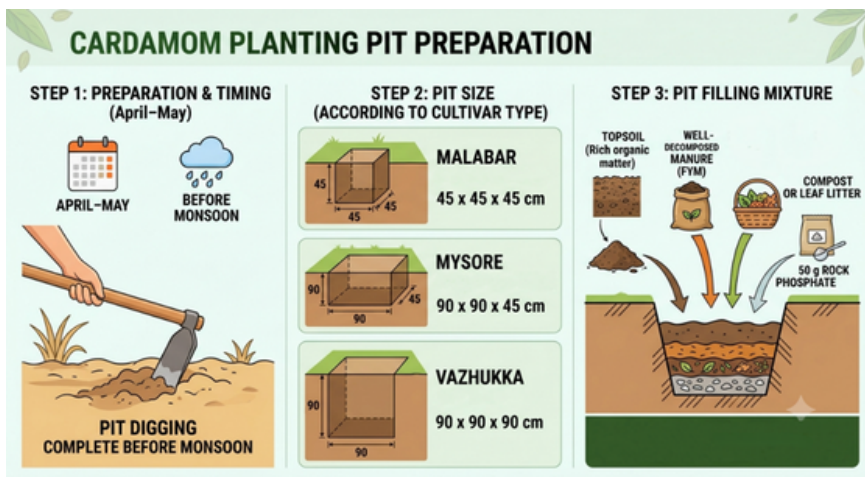
Proper land preparation is essential for successful establishment and long-term productivity of cardamom plantations. On sloping lands, contour terracing should be adopted to minimize soil erosion and conserve moisture. Shade regulation and removal of unwanted vegetation should be carried out before planting.

6.3.1 Planting Pits

Planting pits should be prepared during April–May before the onset of the monsoon. The recommended pit size varies according to cultivar type.

Cultivar type	Pit size (cm)
<i>Malabar</i>	45 × 45 × 45
<i>Mysore</i>	90 × 90 × 45
<i>Vazhukka</i>	90 × 90 × 90

The pits should be filled with a mixture of topsoil, well-decomposed farmyard manure, compost or leaf litter, and 50 g of rock phosphate.



Cardamom planting pit preparation and pit filling (AI generated image)

6.3.2 Planting Season

Planting is normally carried out during June–July with the onset of the southwest monsoon. In low-lying areas, planting should be undertaken after the cessation of heavy monsoon showers to avoid waterlogging and poor establishment.

At the time of planting, 50 g neem cake and 50 g rock phosphate should be applied per pit. Care should be taken to avoid deep planting, as it suppresses the emergence and growth of new shoots.

6.3.3 Spacing

Recommended spacing for different cultivar types:

Cultivar	Spacing	Plants per hectare
<i>Malabar</i>	1.8 × 1.8 or 2 × 2 m	2500–3000
<i>Mysore</i>	3 × 3 m	1111
<i>Vazhukka</i>	2.4 × 2.4 m	1736

Planting diagonally across slopes helps reduce runoff.

In sloping lands, contour terraces at 2–3 m intervals are recommended.

7. Irrigation

Adequate irrigation is essential for maintaining growth, flowering and capsule development in cardamom, particularly during the dry period from January to May. The frequency of irrigation depends on soil type, weather conditions and moisture availability; however, irrigation at intervals of 10–15 days is generally sufficient under most growing conditions.

Various irrigation methods such as hose irrigation, sprinkler irrigation, mini-sprinkler irrigation and drip irrigation can be adopted depending on water availability and farm resources.

Under drip irrigation, approximately 4–9 litres of water per clump per day may be applied to maintain optimum soil moisture. In sprinkler irrigation systems, application of about 25 mm of water at 12–15 day intervals is generally recommended. Mini-sprinkler irrigation operated for about two hours daily during summer helps maintain adequate soil moisture and reduces moisture stress.

Mulching in combination with irrigation improves water-use efficiency, conserves soil moisture and promotes healthy crop growth.

8. Soil and Water Conservation

Soil and water conservation measures are essential in cardamom plantations, particularly on sloping lands where heavy rainfall can result in soil erosion and nutrient loss. Adoption of appropriate conservation practices helps improve soil moisture retention, reduce runoff and sustain long-term productivity.

Silt pits measuring 1.0 m × 0.5 m × 0.6 m may be constructed between four plants to collect runoff water and trap eroded soil. The accumulated silt can be periodically removed and redistributed within the plantation.

In steeply sloping areas, stone pitching walls may be constructed at intervals of 10–20 m to stabilize the soil and reduce erosion. Drainage trenches should also be provided along the slope to safely channel excess runoff and prevent waterlogging and soil loss.

Regular maintenance of these conservation structures is essential for effective soil and water management in cardamom plantations.

9. Cultural Practices

9.1 Weeding

Cardamom is a shallow-rooted, surface-feeding crop that is highly sensitive to weed competition. Regular weeding is therefore essential, particularly during the establishment phase and periods of active growth.



Weeding is generally carried out during May, September and December/January. In addition to manual weeding around the clumps, slash weeding in the interspaces may be undertaken to reduce weed growth and facilitate field operations.

9.2 Mulching

Mulching is an important practice in cardamom cultivation and is usually carried out using fallen leaves from shade trees. A mulch layer of 5–10 cm thickness helps conserve soil moisture, suppress weed growth and improve soil organic matter content. Mulching also protects the soil from erosion and promotes favourable soil conditions for root growth. To facilitate the movement and foraging activity of honey bees during the flowering period, the mulch should be removed during May–June.

9.3 Trashing

Trashing refers to the removal of old shoots, dried leaves and senile tillers from cardamom clumps. This operation is normally carried out once a year in rainfed plantations and two to three times a year in irrigated plantations. Trashing improves aeration and sunlight penetration within the clump, promotes the production of healthy tillers and helps reduce pest and disease incidence.

9.4 Earthing Up

Earthing up should be carried out during October–December by placing topsoil around the base of the clumps. This practice promotes root growth, improves anchorage and enhances nutrient uptake. During the operation, drainage channels may also be constructed or repaired to facilitate the safe disposal of excess rainwater and prevent waterlogging.

10. Shade Management

Cardamom is a shade-loving crop that requires filtered sunlight for optimum growth, flowering and capsule development. In valleys and grasslands, suitable shade trees should be established well in advance of planting. An ideal shade level of 40–60% filtered light is considered optimum for achieving higher productivity and better capsule quality.

Proper shade plays an important role in maintaining favourable microclimatic conditions within the plantation. It helps conserve soil moisture, regulate temperature, prevent scorching of leaves and improve capsule quality. Adequate shade also protects the crop from moisture stress during dry periods and enhances overall plant vigour.

Shade regulation should be carried out during March–April before the onset of the monsoon. Excess shade may be reduced by pruning or lopping branches of shade trees uniformly on all sides to ensure adequate light penetration. Maintenance of a balanced shade canopy promotes reproductive tiller formation, improves flowering and contributes to higher capsule yield.

The shade requirement varies with topography. South-western slopes generally require more shade than north-eastern slopes because of greater exposure to sunlight. Commonly used shade trees in cardamom plantations include *Erythrina lithosperma* (Dadap), *Albizia* spp., *Vernonia arborea* (Karuna), *Acrocarpus fraxinifolius*, *Toona ciliata*, *Syzygium cumini* (Jamun) and *Artocarpus heterophyllus* (Jackfruit).

11. Pollination Management

Pollination plays a crucial role in fruit set and capsule development in cardamom. The flowers are predominantly pollinated by honey bees, of which *Apis cerana indica* is the principal pollinating species in cardamom-growing regions.

Efficient pollination contributes to higher fruit set, increased capsule yield and improved capsule uniformity. To enhance pollination efficiency, maintenance of approximately four honey bee colonies per hectare during the flowering period is recommended.

Farmers should adopt bee-friendly crop management practices and avoid pesticide spraying during peak bee foraging hours. If pesticide application becomes necessary, it should be carried out during late evening hours when bee activity is minimal. Indiscriminate use of broad-spectrum insecticides during the flowering period should be avoided to conserve pollinator populations and ensure effective pollination.

12. Nutrient Management

Balanced nutrient management is essential for sustaining productivity, improving capsule yield and maintaining soil fertility in cardamom plantations. Application of organic manures, chemical fertilizers and micronutrients in recommended quantities ensures healthy plant growth, improved root development and enhanced yield potential.

12.1 Organic Manure Application

Application of organic manures improves soil structure, nutrient availability and microbial activity. Farmyard manure (FYM) or compost should be applied at the rate of 5 kg per plant during May–June. Organic amendments such as neem cake, vermicompost and bone meal may be applied at 1 kg per plant to promote root proliferation and vigorous plant growth.

12.2 Fertilizer Application

The fertilizer requirement of cardamom varies with plant age and production level. Before fertilizer application, mulch should be removed from the plant basin and panicles should be carefully coiled to avoid damage. Fertilizers should be applied in a circular band approximately 15 cm wide, maintaining a distance of about 30 cm from the base of the clump. After fertilizer application, the basin should be mulched again to conserve soil moisture and improve nutrient-use efficiency.





Soil application of fertilizer (AI generated image)

12.2.1 Recommended fertilizer schedule

The fertilizer dose should be adjusted according to the age of the crop as given below.

Plant age	Fertilizer dose
First year	One-third of recommended dose
Second year	One-half of recommended dose
Third year onwards	Full recommended dose

Fertilizers should be applied in two or three split doses during the year depending on the production system and irrigation availability.

Table 3. Fertilizer recommendation for small cardamom

A. Soil application (recommended schedule)

Condition	NPK (kg/ha/year)	No. of splits	Time of application
Rainfed	75:75:150	2 splits	May–June; September–October
Irrigated	125:125:250	3 splits	May–June; September; January

B. Alternative practice (soil + foliar nutrition)

Method	Details
Soil application	Apply 50% of recommended NPK during May–June
Foliar spray	Apply remaining 50% in September, November and January

C. Foliar spray composition

Fertilizer	Concentration
Urea	1.0%
Single Super Phosphate	0.5%
Muriate of Potash	1.0%

12.2.2 Site-Specific Nutrient Management

Site-specific nutrient management based on soil test values can be adopted to achieve targeted yields and improve fertilizer-use efficiency.

Table 4. Site-specific nutrient management for targeted yield in cardamom

(a) Nitrogen (N)

Soil Test Value (kg/ha)	For 6.5 q/ha	For 11 q/ha
<150	255	400
150–250	200	370
250–400	100	320
>400	50	150

(b) Phosphorus (P_2O_5)

Soil Test Value (kg/ha)	For 6.5 q/ha	For 11 q/ha
<25	225	275
25–50	175	225
>50	100	175

(c) Potassium (K_2O)

Soil Test Value (kg/ha)	For 6.5 q/ha	For 11 q/ha
<250	350	550
250–500	280	500
500–800	180	450
>800	50	250

12.3 Lime Application

Cardamom grows best under slightly acidic soil conditions. In soils with a pH below 5.0, agricultural lime should be applied at the rate of 1 kg per plant per year in two split doses during May and September. Fertilizers should be applied 15–20 days after lime application to ensure efficient nutrient utilization.

12.4 Micronutrient Management

Micronutrients play an important role in improving plant growth, capsule yield and quality.

Zinc application: Zinc sulphate should be sprayed at 250 g per 100 litres of water during April–May and September–October. Zinc should be sprayed separately and should not be mixed with pesticides.

Boron application: Borax should be applied at 7.5 kg per hectare in two split doses along with fertilizers.

Foliar micronutrient mixture: Foliar application of IISR micronutrient mixture at 5g per litre of water during May–June and September–October has been found effective in improving yield and capsule quality.

13. Soil Testing

Soil testing is an important component of Good Agricultural Practices (GAP) and provides valuable information on soil fertility status and nutrient availability. Regular soil analysis helps in the adoption of balanced fertilizer schedules, improves nutrient-use efficiency, reduces unnecessary fertilizer application and enhances crop productivity and profitability.

Cardamom growers are advised to undertake soil testing at least once in three years and adopt nutrient management practices based on soil test recommendations.

Soil testing facilities for cardamom-growing regions are available at institutions such as the Indian Cardamom Research Institute, Myladumpara, Kerala, and the Regional Research Station, Saklespur, Karnataka.

Detailed guidelines for soil sample collection and submission are provided in Annexure I.

14. Diseases of Cardamom

Cardamom is affected by several fungal diseases during nursery and field stages. Disease incidence is influenced by factors such as prolonged rainfall, poor drainage, excessive shade and inadequate field sanitation. Adoption of integrated disease management practices involving healthy planting material, proper shade regulation, drainage management, biological control agents and need-based fungicide application is essential for minimizing yield losses.

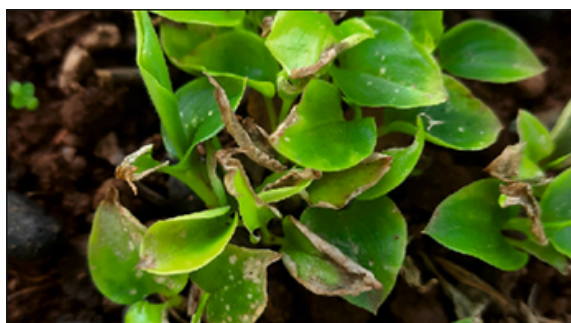
14.1 Nursery Diseases

14.1.1 Nursery Leaf Spot

Nursery leaf spot caused by *Phyllosticta elettariae* is commonly observed in primary nurseries. In secondary nurseries, similar symptoms may be caused by *Cercospora zingiberi*.

Symptoms

- Small round or oval spots on leaves.



Nursery leaf spot

- Dull white lesions with necrotic centres.
- Development of shot-hole symptoms under severe infection.
- Rectangular reddish-brown lesions in secondary nursery seedlings.

Management

- Sow seeds during August–September
- Avoid raising nurseries repeatedly in the same location.
- Provide adequate overhead shade.
- Spray Copper oxychloride 50 WP @ 2.5 g/L at fortnightly intervals during March–April.
- Alternatively, spraying Tebuconazole @ 2 ml/L was found effective.

14.1.2 Nursery Leaf Rot

Nursery leaf rot is caused by fungi such as *Fusarium* spp. and *Alternaria* spp.

Symptoms

- Water-soaked lesions on leaves.
- Development of necrotic patches.
- Rotting of leaf tips.
- Decay of petiole and leaf sheath.

Management

- Avoid excessive watering and water stagnation.
- Remove and destroy infected leaf portions.
- Spray any approved fungicide twice at 15-day intervals.

14.1.3 Damping Off (Seedling Rot)

Damping off is caused by soil-borne fungi such as *Pythium vexans*, *Rhizoctonia solani* and *Fusarium oxysporum*.

Symptoms

- Seedlings collapse and die in patches.
- Wilting and drying of young plants.
- Poor stand establishment in nursery beds.

Management

- Practice thin sowing.
- Maintain good drainage in nursery beds.
- Remove infected seedlings promptly.
- Drench nursery beds with Copper oxychloride 50 WP (0.2%).
- Treat seeds with *Trichoderma* or *Pseudomonas* @ 10 g/kg seed before sowing.

14.2 Field Diseases

14.2.1 Capsule Rot (Azhukal)

Capsule rot caused by *Phytophthora* spp. is the most destructive disease of cardamom. Severe outbreaks occur during prolonged monsoon periods and crop losses may exceed 40% under favourable conditions.

Symptoms

- Water-soaked lesions on leaves and capsules.
- Yellow halo around infected areas.
- Rotting of leaves and capsules.
- Premature capsule drop.

Management

- Regulate shade and maintain good drainage.
- Remove and destroy infected plant debris.
- Spray Bordeaux mixture (1%) or Pyraclostrobin 80 WP (0.3%) during May–June and July–August.
- A third spray may be given during September if monsoon persists.
- Alternatively, Fosetyl aluminium (0.2%) or Potassium phosphonate (0.3%) may be used.
- Apply *Trichoderma* @ 1 kg per plant basin during May and September.



Capsule Rot

14.2.2 Rhizome Rot

Rhizome rot, also known as clump rot, is caused by soil-borne fungi such as *Pythium vexans*, *Rhizoctonia solani* and *Fusarium* spp. The disease is more severe during periods of high soil moisture and poor drainage.

Symptoms

- Yellowing and drooping of leaves.
- Brittleness of the collar region.
- Rotting of rhizomes and roots.
- Foul smell from infected rhizomes.
- Collapse of severely affected tillers and clumps.



Rhizome Rot

Management

- Remove and destroy infected clumps.
- Improve drainage within the plantation.
- Undertake trashing and field sanitation before monsoon.
- Maintain optimum shade levels.
- Drench plant basins with Copper oxychloride (0.25%) and spray Bordeaux mixture (1%) during May–June.
- Repeat drenching and spraying during August–September and October, if required.
- Alternatively, Metalaxyl + Mancozeb (0.125%) or Potassium phosphonate (0.3%) were also found to be effective.
- Apply *Trichoderma harzianum* @ 1 kg per plant basin during May and September.
- Cultivate the tolerant variety IISR Avinash in rhizome rot-prone areas.

14.2.3 Leaf Blight

Leaf blight caused by *Colletotrichum gloeosporioides* generally appears during the post-monsoon period.

Symptoms

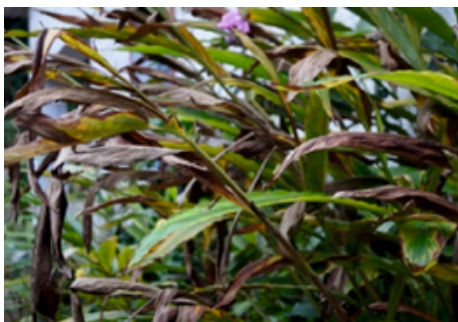
- Water-soaked lesions on leaves.
- Yellowish-brown patches.
- Reddish-brown necrotic areas.
- Burnt appearance of affected leaves.
- Drying of leaves under severe infection.



Early Symptoms

Management

- Remove and destroy infected leaves and plant debris.
- Maintain optimum shade levels (40–60%).
- Spray Bordeaux mixture (1%) during May–June before the onset of monsoon.
- Repeat spraying during August–September.
- Spraying Hexaconazole (2 ml/L) or Tebuconazole (1 ml/L) during pre-monsoon (June) and post-monsoon (September) periods was found effective.



Late Symptoms

14.2.4 Minor Diseases

Minor diseases affecting cardamom include leaf blotch (*Phaeodactylum alpiniae*), stem lodging (*Fusarium oxysporum*) and capsule tip rot (*Rhizoctonia solani*).

Management

- Maintain field sanitation and optimum shade.
- Spray approved fungicides as recommended.
- Spraying Carbendazim (0.2%), Hexaconazole (0.2%) or Mancozeb (0.3%) has been found effective.
- Two sprays at 30-day intervals are generally sufficient for disease management.

15. Viral Diseases

Viral diseases are among the most important constraints in cardamom cultivation, causing significant reductions in growth and yield. Unlike fungal diseases, viral infections cannot be cured once plants become infected. Therefore, the use of virus-free planting material, early detection and removal of infected plants, and effective management of insect vectors are essential for disease management.

15.1 Mosaic Disease (Katte)

Mosaic disease, commonly known as Katte disease, is caused by Cardamom Mosaic Virus (CdMV) and is considered the most destructive viral disease of cardamom. Infection at an early stage can result in severe yield loss and may render plantations uneconomical.

Symptoms

- Mosaic or stripe patterns on leaves.
- Mottling of leaf sheaths.
- Reduction in leaf size.
- Stunted plant growth.
- Reduced tillering and shorter panicles.
- Yield reduction of up to 70% under severe infection.

Transmission

- The virus is transmitted by the aphid *Pentalonia caladii*.
- The disease is not transmitted through seeds or soil.



Katte symptoms on leaf

15.2 Vein Clearing Disease (*Kokke Kandu*)

Vein clearing disease is caused by Cardamom Vein Clearing Virus (CdVVCV) and has been reported mainly from cardamom-growing areas of Karnataka.

Symptoms

- Vein chlorosis and vein clearing.
- Rosetting of leaves.
- Loosening of leaf sheaths.
- Hook-shaped tillers.
- Cracking of fruits.
- Progressive decline and death of infected plants within 1–2 years.



Kokke kandu symptoms

15.3 Chlorotic Streak Disease

Chlorotic streak disease is caused by a strain of Banana Bract Mosaic Virus (BBrMV) and has emerged as an important viral disease in recent years.

Symptoms

- Spindle-shaped yellow streaks on leaves.
- Yellowing of veins.
- Streaks on pseudostems.
- Reduced tillering.
- Stunted growth under severe infection.



Chlorotic Streak Symptoms

15.4 Integrated Management of Viral Diseases

Since viral diseases cannot be cured, emphasis should be placed on preventing disease spread and reducing vector populations.

Management

- Use virus-free and healthy planting materials.
- Establish nurseries using virus-indexed planting materials.
- Regularly monitor plantations for disease symptoms.
- Remove and destroy infected clumps immediately upon detection.
- Cultivate tolerant varieties such as IISR Vijetha wherever recommended.
- Manage aphid vectors through integrated pest management practices.
- Use neem-based insecticides (0.1%) for suppression of aphid populations.
- Avoid using planting material from infected fields.
- Maintain strict nursery sanitation and field hygiene.

16. Indicative Disease Management Schedule

The following schedule summarizes fungicides reported to be effective against major diseases of cardamom. Farmers should use only products approved and registered for cardamom by the competent regulatory authorities and strictly follow label instructions, waiting periods and safety precautions.

Fungicide	Method	Period	Target disease
Bordeaux mixture (1%)	Spray	May–June	Capsule rot, Rhizome rot
Bordeaux mixture (1%)	Spray	July–August	Capsule rot
Carbendazim + Mancozeb	Spray	August–September	Leaf blight
Copper oxychloride (0.25%)	Drench	May–June	Rhizome rot

Note: Use only fungicides approved and registered for cardamom by the Central Insecticides Board and Registration Committee (CIB&RC), Government of India. Follow the recommended dosage, waiting period, safety precautions and label instructions. The inclusion of any fungicide in this schedule does not constitute a recommendation for use unless it is approved for cardamom at the time of application.

17. Insect Pests of Cardamom

Several insect pests attack cardamom at different stages of crop growth and may cause significant reductions in yield and quality. Adoption of integrated pest management (IPM) practices involving field sanitation, shade regulation, biological control and need-based application of approved insecticides is essential for sustainable pest management.

17.1 Cardamom Thrips (*Sciothrips cardamomi*)

Cardamom thrips is the most destructive insect pest of cardamom. Both nymphs and adults feed on leaves, flowers and capsules, resulting in substantial yield and quality losses.

Symptoms

- Corky, scab-like patches on capsules.
- Shedding of flowers.
- Malformed and shrivelled capsules.
- Poor capsule quality and reduced market value.

Severe infestations may result in yield losses of up to 80%. Thrips populations are generally high during February–May.



(a) Thrips infestation on fresh capsules



(b) Thrips infested capsules after drying

Management

- Maintain optimum shade levels in the plantation.
- Undertake periodic trashing and field sanitation.
- Remove and destroy heavily infested plant parts.
- Spray approved insecticides as recommended during March, April, May, August and September.
- Under Karnataka conditions, spraying Fipronil (0.005%) or Spinosad (0.0135%) during February–March, March–April, April–May, September and October was found effective.
- Avoid insecticide spraying during peak honey bee activity.

17.2 Shoot and Capsule Borer (*Conogethes punctiferalis*)

Shoot and capsule borer is an important pest affecting both nursery seedlings and field-grown plants. The larvae bore into pseudostems, panicles and capsules, causing significant damage.

Symptoms

- Bore holes on pseudostems.
- Drying of shoots (dead heart symptom).
- Drying of panicles beyond the point of entry.
- Empty capsules due to seed feeding.



(a) Shoot borer infestation on cardamom pseudostem (b) larva (c) bore hole on capsule

The pest occurs throughout the year, with higher incidence during January–February, May–June and September–October.

Management

- Remove and destroy infested shoots, panicles and capsules.
- Collect and destroy adult moths wherever feasible.
- Spray approved insecticides during February–March and September–October.
- Insecticide application should coincide with the emergence of new shoots and panicles.

17.3 Root Grub (*Basilepta fulvicorne*)

Root grubs are serious pests of both nursery and field-grown cardamom. The larvae feed on roots and rhizomes, weakening the plants and, under severe infestation, may destroy the entire root system.

Symptoms

- Yellowing of foliage.
- Stunted growth.
- Poor tillering.
- Drying of plants under severe infestation.



(a) Root grub affected plant (b) grubs (c) adult beetle

Adult beetles emerge mainly during April–May and September–October.

Management

- Maintain optimum shade levels in the plantation.
- Monitor plantations regularly during April–May for emergence of adult beetles and early symptoms of infestation.
- Collect and destroy adult beetles manually during peak emergence periods to reduce egg laying.
- Maintain field sanitation by removing severely affected clumps and plant debris.
- Lightly rake the soil around affected clumps to expose grubs and improve management effectiveness.
- Apply well-decomposed organic manure along with neem cake @ 250–500 g per clump.

- Conserve soil moisture through mulching and irrigation during dry periods.
- Apply entomopathogenic fungi such as *Metarhizium anisopliae* or *Beauveria bassiana* under adequate soil moisture conditions.
- Use entomopathogenic nematodes such as *Heterorhabditis* spp. for biological suppression.
- Avoid indiscriminate use of broad-spectrum soil insecticides to conserve beneficial soil organisms.
- Follow only need-based and approved plant protection measures.

17.4 Minor Pests

Capsule Borers

Caterpillars bore into flowers and capsules, resulting in flower drop and capsule damage. The pest is generally more severe during the monsoon period.

Management

- Monitor plantations regularly during flowering and capsule development stages.
- Remove and destroy infested flowers and capsules.
- Spray approved insecticides during March, April, May, August and September as recommended.

Hairy Caterpillars (*Eupterote* spp. and *Lenodera vittata*)

Hairy caterpillars feed on leaves and may cause severe defoliation under outbreak conditions.

Symptoms

- Irregular feeding on leaves.
- Partial or complete defoliation.

Management

- Collect and destroy caterpillars congregating on tree trunks.
- Use light traps to attract and monitor adult moths.
- Spray approved insecticides against early larval stages, if required.

Shoot Fly (*Formosina flavipes*)

Shoot fly attacks young plants and damages emerging shoots, affecting plant establishment and growth.

Symptoms

- Dead heart formation.
- Drying of young shoots.
- Reduced tillering and poor plant vigour.



(a) Shoot fly damage



(b) Shoot fly maggot

Management

- Remove and destroy affected shoots.
- Maintain optimum shade levels to reduce pest incidence.
- Avoid excessive nitrogen application, particularly during the tillering stage.
- Install fish meal traps for monitoring and suppression of adult populations.
- Replace fish meal bait periodically to maintain trap effectiveness.

18. Indicative Insect Pest Management Schedule

The following schedule summarizes insecticides reported to be effective against major insect pests of cardamom. Farmers should use only products approved and registered for cardamom by the competent regulatory authorities and strictly follow label instructions, waiting periods and safety precautions.

Insecticide	Dose	Method	Target pest
Fipronil	0.005%	Spray	Cardamom thrips
Spinosad	0.0135%	Spray	Cardamom thrips
Acephate	0.10% (1.0 g/L)	Spray	Shoot and capsule borer, Thrips
Lambda-cyhalothrin 4.90% CS	400 ml/ha (0.04 ml/L)	Spray	Shoot and capsule borer, Thrips
Diafenthiuron 50% WP	0.08% (0.8 g/L)	Spray	Shoot and capsule borer, Thrips
Flubendiamide 39.35% SC	500 ml/ha (0.5 ml/L)	Spray	Shoot and capsule borer

Note: Use only insecticides approved and registered for cardamom by the Central Insecticides Board and Registration Committee (CIB&RC), Government of India. Follow the recommended dosage, waiting period, safety precautions and label instructions. Avoid spraying during peak honey bee activity and adopt integrated pest management practices wherever possible.

19. Nematodes

Root-knot nematodes (*Meloidogyne incognita* and *M. javanica*) are important soil-borne pests affecting cardamom nurseries and plantations. The nematodes attack feeder roots, impair nutrient and water uptake, and may cause yield losses ranging from 32–47% under severe infestations.

Symptoms

- Stunted plant growth.
- Yellowing of leaves.
- Reduced tillering.
- Premature drying of leaves.
- Delayed flowering and poor capsule production.
- Poor root growth and reduced vigour.

Management

– Nursery

- Use nematode-free planting material.
- Establish nurseries in nematode-free areas.
- Treat nursery beds with appropriate biological or soil treatments before sowing.

– Plantation

- Apply neem cake @ 250–1000 g per plant.
- Maintain adequate mulching to improve soil health and moisture conservation.
- Apply well-decomposed organic manures regularly.
- Apply *Pochonia chlamydosporia* (1%) @ 10 L per plant along with neem cake @ 1 kg per plant to reduce nematode populations.
- Maintain field sanitation and avoid movement of infested soil and planting material.

Note: Integration of organic amendments, biological control agents and healthy planting material is the most effective approach for sustainable management of root-knot nematodes in cardamom.

20. Harvesting

Cardamom plants generally commence bearing two years after planting suckers and about three years after planting seedlings. The capsules attain harvest maturity approximately 120–135 days after fruit set.

Harvesting Season

Region	Harvest period
Kerala and Tamil Nadu	June–February
Karnataka	August–January

Harvesting is usually carried out at intervals of 15–30 days depending on the cultivar, season and market requirements.

Harvest Maturity

Proper harvesting at the correct stage of maturity is essential for obtaining high-quality capsules. Mature capsules are identified by the development of a dark green rind and fully developed black seeds. Harvesting should be carried out carefully to avoid mechanical injury to capsules and panicles.

Harvesting of over-mature capsules may result in loss of green colour and increased splitting during curing, whereas harvesting immature capsules adversely affects capsule weight, appearance and market quality.

21. Processing and Curing

Processing and curing are important post-harvest operations that determine the final quality, colour, aroma and market value of cardamom. Curing involves reducing the moisture content of freshly harvested capsules from about 80% to 10–12%, thereby improving storability and preserving quality.

Two methods of curing are commonly employed:

1. Sun drying
2. Flue curing

21.1 Sun Drying

In this method, freshly harvested capsules are spread in thin layers under sunlight and dried for about 5–6 days. Although the method is simple and inexpensive, it often results in poor retention of green colour, capsule splitting and lower market value. Consequently, sun drying is practiced only in limited areas and is generally not preferred for producing premium-quality cardamom.

21.2 Flue Curing

Flue curing is the recommended method for producing high-quality cardamom capsules with superior colour and aroma. A typical curing chamber consists of a furnace, flue pipes and drying trays arranged to ensure uniform heat distribution.

Fresh capsules are initially cured at a temperature of 40–45°C and the temperature is gradually increased to 50–55°C. The entire curing process generally requires 24–30 hours. Temperatures exceeding the recommended range may result in browning of capsules and loss of essential oils, thereby reducing quality.

Improved curing systems utilizing LPG, kerosene or diesel-fired dryers are also available. These systems facilitate uniform drying and can reduce the curing period to about 16–18 hours while maintaining capsule quality.

21.3 Improved Cardamom Curing Devices

Improved cardamom curing systems are designed to utilize alternative fuels either independently or in combination with conventional firewood, thereby reducing dependence on fuelwood thus improving energy efficiency. These systems help preserve the desirable green colour and overall quality of the cured capsules while reducing the curing duration to approximately 16–24 hours. In addition to conventional improved dryers, biomass gasifier-based curing systems and heat pump-assisted dehydrator dryers are recommended for producing premium-quality cardamom. These advanced technologies provide precise control over drying temperature and humidity, ensuring uniform moisture removal, better colour retention, improved preservation of volatile oils, and superior quality of the cured capsules.

21.4 Cleaning, Grading, Packing and Storage

After curing, dried cardamom capsules should be polished before marketing to improve their appearance and commercial value. Polishing may be carried out manually by gently rubbing the warm, dried capsules against a hard, smooth surface or mechanically using specially designed polishing machines. Mechanical polishers, operated either manually or electrically, provide greater efficiency and uniform polishing. Machines fitted with appropriately sized meshes can simultaneously polish and grade the capsules according to size.

After grading, the capsules may be stored under suitable conditions for extended periods. To preserve their characteristic green colour and maintain quality during storage, the moisture content should be reduced to 10–12% before packing. The dried capsules should be packed in 300-gauge black polythene-lined gunny bags, which provide effective protection against moisture and help maintain product quality. For prolonged storage, the packed capsules should be kept in clean, dry wooden boxes at ambient temperature in the curing house or another cool, dry and well-ventilated storage facility to minimize quality deterioration.

Grade	Category	Size (mm)	Bulk Density (g/L)	Colour	Description
AGB	Alleppey Green Bold	7	435	Green	Kiln dried, ribbed capsules
AGS	Alleppey Green Superior	5	385	Green	Good quality capsules
AGS-1	Alleppey Shipment	4	320–350	Light green	Medium grade
AGL	Alleppey Light	3.5	260	Light	Small capsules
CGEB	Coorg Green Extra Bold	8	450	Golden green	Bold round capsules
CGB	Coorg Green Bold	7.5	435	Green	Bold capsules
CG-1	Coorg Superior	6.5	415	Light green	Good quality
CG-2	Coorg Mota Green	6	385	Green	Medium bold
CG-3	Coorg Shipment	5.5	350	Cream	Medium
CG-4	Coorg Light	3.5	280	Brown	Small/light
BL-1	Bleached Grade 1	8.5	340	Pale	Fully developed capsules
BL-2	Bleached Grade 2	7	340	Creamy	Medium capsules
BL-3	Bleached Grade 3	5	300	Dull white	Small capsules

24. GAP Checklist for Cardamom Farmers

Before and during crop production, farmers should ensure compliance with the following Good Agricultural Practices (GAP):

- ✓ Use healthy, disease-free and certified planting materials.
- ✓ Maintain optimum shade levels (40–60%) in the plantation.
- ✓ Follow recommended spacing, pit preparation and planting methods.
- ✓ Apply fertilizers and soil amendments based on soil test recommendations.
- ✓ Use quality irrigation water and adopt appropriate soil and water conservation measures.
- ✓ Practice regular weeding, mulching, trashing and field sanitation.
- ✓ Adopt integrated pest, disease and nematode management practices.
- ✓ Conserve pollinators and avoid pesticide spraying during peak honey bee activity.
- ✓ Use only approved pesticides and follow recommended dosages and waiting periods.
- ✓ Wear appropriate personal protective equipment (PPE) while handling agrochemicals.
- ✓ Maintain records of fertilizer application, pesticide use and harvesting operations.
- ✓ Harvest capsules at the recommended stage of maturity.
- ✓ Follow recommended curing, grading and storage practices.
- ✓ Store cured capsules under clean, dry and hygienic conditions.
- ✓ Maintain traceability records to ensure quality assurance and market compliance.

Adoption of these Good Agricultural Practices helps improve productivity, enhance capsule quality, ensure food safety and promote sustainable cardamom cultivation.

Annexure I. Soil Sampling Procedure for Cardamom Plantations

Importance of Soil Sampling

Accurate soil testing depends on proper collection of representative soil samples. Soil analysis helps determine the nutrient status of the soil and enables farmers to adopt balanced fertilizer schedules for improving productivity, soil health and fertilizer-use efficiency.

GUIDELINES FOR SOIL SAMPLING

GENERAL GUIDELINES

- Collect soil samples preferably during February–April, before fertilizer application.
- Divide the plantation into separate plots based on differences in slope, soil type, management practices and crop condition.
- Each sampling unit should generally represent an area of about 5 acres (2 ha).
- Avoid collecting samples from abnormal locations (see alongside).



AVOID SAMPLING FROM

- Compost pits
- Fertilizer storage sites
- Recently fertilized spots
- Waterlogged areas
- Bunds and field boundaries
- Areas near tree trunks or shade tree bases



METHOD OF SOIL SAMPLING

- Remove weeds, dry leaves, mulch and other surface debris from the sampling spot.
- Using a spade, dig a V-shaped pit to a depth of about 15 cm.
- Scrape a thin and uniform slice of soil from both sides of the pit.
- Collect soil samples from at least 10 representative locations in a zig-zag or diagonal pattern within each plot.
● = Sampling points
- Place all collected samples on a clean polythene sheet and mix thoroughly to form a composite sample.
- Reduce the quantity of soil by the quartering method until approximately 500 g of soil remains.
- This composite sample should be used for laboratory analysis.

PACKING AND SUBMISSION OF SAMPLES



- Air-dry the composite soil sample under shade.
- Remove stones, roots and other foreign materials.
- Pack the sample in a clean cloth bag or polythene bag.
- Label the sample clearly with:
 - Name of farmer
 - Address and contact details
 - Village and location
 - Survey/field number
 - Crop and plantation age
 - Date of sampling

The sample should be submitted to a recognized soil testing laboratory for analysis and fertilizer recommendations.

SOIL TESTING FREQUENCY

YEARS					
1	2	3	4	5	6
✓			✓		✓

Soil testing should be carried out at least once in three years.

Where intensive cultivation is practiced or nutrient-related problems are observed, more frequent testing may be undertaken.

SOIL TESTING FACILITIES



- Indian Cardamom Research Institute (ICRI), Myladumpara, Kerala
- Regional Research Station, Saklespur, Karnataka
- State Department of Agriculture Soil Testing Laboratories
- Other accredited soil testing laboratories of State Agricultural Universities



NOTE: Fertilizer recommendations should be based on soil test results and crop requirements to ensure balanced nutrient management and sustainable cardamom production.



(AI generated image)

Annexure II. Preparation of Important Inputs for Plant Protection

A. Preparation of Bordeaux Mixture

Bordeaux mixture is a widely used fungicidal preparation for the management of important fungal diseases of cardamom, particularly capsule rot and rhizome rot.

PREPARATION OF 1% BORDEAUX MIXTURE

For Management of Fungal Diseases

INGREDIENT SUMMARY

1 kg
Copper Sulphate
+ dissolve in 10 L water

+

1 kg
Quicklime
+ dissolve and dilute
to 90 L water



1% Bordeaux
Mixture
(Ready to use)

PREPARATION STEPS

- 1** Dissolve 1 kg copper sulphate in 10 litres of water in a non-metallic container.



1 kg Copper Sulphate
+ 10 litres water

- 2** In a separate container, dissolve 1 kg quicklime in water.



1 kg Quicklime

- 3** Dilute the lime suspension to about 90 litres of water.



90 L

- 4** Slowly add the copper sulphate solution into the lime solution with constant stirring.



- 5** Stir thoroughly to obtain 100 litres of 1% Bordeaux mixture.



100 L

1% Bordeaux
Mixture

TESTING THE MIXTURE

- Dip a clean bright iron knife into the mixture.



- If the knife remains bright, the mixture is properly prepared.



- If rust appears on the knife, add additional lime solution and retest.



PRECAUTIONS



Use only plastic, wooden or earthen containers.



Use fresh quicklime.



Strain the mixture before filling sprayers.



Prepare only the quantity required for immediate use.



Use the mixture on the same day of preparation.



Note: Bordeaux mixture is effective when used properly. Follow the steps and precautions for safe and effective disease management

(AI generated image)

B. Preparation and Use of Fish Meal Traps for Shoot Fly Management

Fish meal traps can be used as an eco-friendly method for monitoring and reducing populations of shoot fly (*Formosina flavipes*) in cardamom plantations.

Materials Required

- Plastic container or bottle (1–2 L capacity) with side openings
- Fish meal or dried fish waste
- Water
- Wire or rope for hanging the trap

Preparation of Fish Meal Trap

1. Take a plastic container or bottle (1–2 L capacity) and make suitable side openings for entry of adult flies.
2. Add approximately:
 - 100–150 g fish meal or dried fish waste
 - 1–1.5 L water
3. Allow the mixture to ferment for 24–48 hours before installation to enhance its attractiveness to adult flies.

Installation

- Install traps at canopy level or slightly above the cardamom clumps.
- Place traps during October–November or towards the end of the monsoon period when adult activity generally begins.
- Install about 6–10 traps per hectare depending on pest incidence and plantation conditions.
- Traps may be placed:
 - between cardamom rows, or
 - on suitable shade trees within the plantation.

Maintenance

- Replace the bait mixture at 7–10 day intervals.
- Remove trapped insects regularly.
- Ensure that the bait remains moist and active throughout the trapping period.
- Clean traps periodically and replace damaged containers when necessary.

Advantages

- Eco-friendly and residue-free pest management approach.
- Useful for monitoring adult emergence and population build-up.
- Helps reduce egg laying and subsequent infestation.
- Compatible with integrated pest management (IPM) programmes.
- Compatible with integrated pest management (IPM) and export-oriented production systems.



Annexure III. Worker Safety, Hygiene and Safe Use of Pesticides



(AI generated image)

Annexure IV. Measures to Minimize Pesticide Residues in Cardamom

Production of residue-safe cardamom is essential for domestic consumption, export markets and compliance with food safety standards.

The following practices are recommended to minimize pesticide residues:

- Adopt Integrated Pest Management (IPM) practices.
- Use only approved pesticides and recommended dosages.
- Follow prescribed waiting periods before harvest.
- Avoid repeated use of the same pesticide molecule.
- Avoid indiscriminate or blanket spraying.
- Prefer spot treatment whenever feasible.
- Maintain proper field sanitation and plantation hygiene.
- Calibrate spraying equipment regularly.
- Maintain records of pesticide applications and harvesting dates.
- Avoid pesticide application immediately before harvest.

Adherence to these practices helps ensure compliance with maximum residue limits (MRLs) and enhances market acceptability of cardamom.

Annexure V. Approved Pesticides for Use in Cardamom

S. No.	Recommended pesticide	Name of the target pest(s)	Dosage (g/ha)	Waiting period (days)	Toxicity class
Insecticides					
1	Acephate 95 SG	(a) Shoot and capsule borer, <i>Conogethespunctiferalis</i> (b) Cardamom thrips, <i>Sciothripscardamomi</i>	1000	14	Blue
2	Lambda-cyhalothrin 04.90 % CS	(a) Shoot and capsule borer, <i>Conogethespunctiferalis</i> (b) Cardamom thrips, <i>Sciothripscardamomi</i>	400	34	Yellow
3	Diafenthiuron 50 % WP	(a) Shoot and capsule borer, <i>Conogethespunctiferalis</i> (b) Cardamom thrips, <i>Sciothripscardamomi</i>	800	07	Blue
4	Flubendiamide 39.35%w/w SC	a) Shoot and capsule borer, <i>Conogethespunctiferalis</i>	500	15	Green
Fungicides					
5	Copper oxychloride 50% WP	Clump rot (<i>Pythium vexans</i> , <i>Rhizoctonia solani</i> & <i>Fusarium</i> sp.) Leaf spot, <i>Phyllostictaelettariae</i>	750-1000	-	Blue
6	Pyraclostrobin AL 80% WP	Azukhal Disease, <i>Phytophthora</i> sp. and Damping off (<i>Pythium vexans</i> , <i>Rhizoctonia solani</i> & <i>Fusarium</i> sp.)	750-1000	90	Blue

Disclaimer: The list of pesticides included in this annexure is subject to revision by the Central Insecticides Board and Registration Committee (CIB&RC), Government of India. Users are advised to verify the latest approved recommendations, dosage, waiting period and label claims before use.



For Further Information

Manager

Agricultural Technology Information Centre (ATIC)

ICAR – Indian Institute of Spices Research

Kozhikode – 673012, Keralam

Phone: 0495-2731410

Email: atic.spices@icar.org.in