



Precision Farming
CARDAMOM
With Jain Technology™



JAIN®

Jain Irrigation Systems Ltd.

Small Ideas. Big Revolutions.®

HIGHTECH CULTIVATION OF CARDAMOM



Cardamom (*Elettaria cardamomum* Maton) known as the “Queen of Spices” originated in the Western Ghats of South India. It is one of the most highly priced and exotic spices in the world.

The total world production of this spice is around 35,000 MT per annum and the largest producing country is Guatemala followed by India. Tanzania, Sri Lanka, EL Salvador, Vietnam, Laos, Cambodia and Papua New Guinea are the other cardamom growing countries. Cardamom is used for flavoring various food preparations, confectionary, beverages and liquors. It is also used for medicinal purpose, both in Allopathy and Ayurveda systems. The major consuming countries of cardamom are the Middle Eastern countries, India, Pakistan, European countries, the U.S and Japan. Middle Eastern countries such as Saudi Arabia and the United Arab Emirates, and South-East Asian countries such as India account for more than 60 % of the world’s consumption.

In India, Cardamom cultivation is confined mainly to the Western Ghats of Kerala, Karnataka and Tamil Nadu. Kerala accounts for 60% of the cultivation and production followed by Karnataka 30 % and Tamil Nadu 10 %. Idukki district in Kerala is the major cardamom producing area.

Habit

It is a perennial tropical herbaceous plant. Cardamom requires a wet humid rainfall regime. Hence, along with the year-to-year fluctuations in rainfall-both its quantum and distribution-the output and productivity of cardamom also shows considerable year-to-year fluctuations.

Climate

- Cardamom is usually cultivated in rain-fed conditions, under forest cover and is sensitive to micro-climatic conditions and moisture stress.
- Requires evenly distributed rainfall of 1500- 4000mm/year.
- The optimum altitudinal range for growing cardamom is 600 to 1200 meters above MSL.
- A temperature range of 10-35°C is ideal for cardamom

Soil

- Cardamom grows well in forest loamy soils
- Soil pH: 4.2 to 6.8.
- Soil nutrient status: High in organic matter and nitrogen, low to medium in available phosphorus and medium to high in available potassium.

Varieties

Two varieties of cardamom plants are identified, and they are *Elettaria cardamomum* Maton, variety Major composed of wild indigenous types of Sri Lanka and *Elettaria cardamomum* Maton, variety Minor comprising of cultivars like, Mysore, Malabar and “Vazhukka”.

These types are grown in different tracts and are mostly identified on the nature of panicles, size of plants and other morphological characters.

Cardamom varieties are highly location specific. High yielding varieties of cardamom released include ICRI 1, 2, 3; TDK 4 & 11; PV 1, CCS 1 Mudugiri 1&2; NCC 200; MCC 12, 16 & 40; RR1

Planting Material

Seedlings or suckers.

Nursery Management

Seedlings can be raised in nurseries.

Primary Nursery

- Sowing is done on beds of 1 m width, 20 cm height and 6 m length.
- Sowing time is September.
- Before sowing fumigate the beds with 2 % formalin to eliminate pathogens and other soil pests.
- Seeds collected from high yielding and disease free mother clumps should be washed and mixed with wood ash and dried in shade.
- Storage of seed will reduce germination rate.
- Seed treatment with acid or other chemicals improves germination.
- Best time for sowing is September and sowing in winter and during south west monsoon should be avoided.
- Seed rate is 30 to 50 g per 6x1 m bed.
- Sowing can be done in lines in rows at a distance of 10 cm.
- Irrigate with low impact micro sprinklers.

Secondary Nursery

- Seedlings of three to four leaf stages from the primary nursery beds can be transplanted in the secondary nursery at a distance of 20-25 cm.
- Irrigate with low impact micro sprinklers or Jain Acumisters.
- Planting in main field is done during last week of May or first week of June

Vegetative Propagation

- For vegetative propagation, rhizomes with not less than three shoots are used.
- Vegetatively propagated plants come to bearing one year earlier than the seedling-propagated plants.
- But this method has the disadvantage of spreading the 'katte' disease, which is of viral origin.
- This disease is not transmitted through seeds.
- Hence in areas where the disease is widespread, it would be safer to use seedlings for propagation.

Field Planting

- Trenches of 0.45 m width and 0.45 m deep and convenient length are to be taken at 1.8 m apart.
- Fill the trenches with equal quantity of humus rich top soil, sand and cattle manure

Cultivation Practices

For planting in new area

- Ground should be cleared or if it is replanting area, old plants should be removed.
- Shade regulation, Terracing and Preparation of pits should be done during summer months.

Major cultivation practices include

- Shade regulation,
- Field preparation,
- Planting,
- Weed control,
- Irrigation,
- Forking
- Mulching,
- Trashing &
- Earthing up.
- The plant to plant spacing recommended for Mysore and Vazhukka cultivars are 3x3 m or 2.4x2.4 m
- Recommended spacing for Karnataka region is 1.8 x 1.8 m or 1.2x1.8 m.
- Plant base should be mulched well with dried leaves to protect soil from erosion and conservation of moisture.
- Planting should be done diagonally to the slope.
- Irrigation during summer months ensures increase in yield by 50 %.

Micro Irrigation of Cardamom

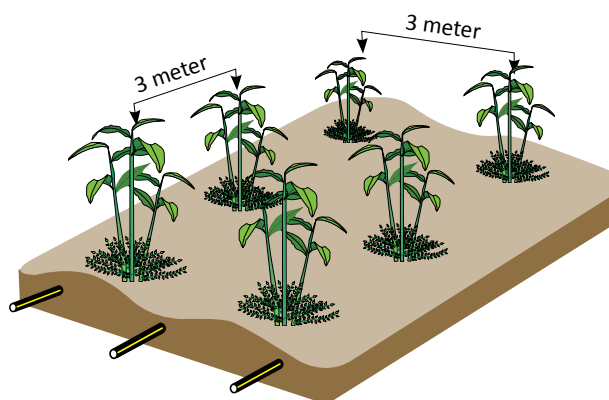
Cardamom requires irrigation even in wet tropical region receiving copious monsoon rain. The period from October to June first week is rainless and even during the monsoon (June- September) period irrigation is required during the breaks in the rainy season. Traditionally, Cardamom clumps (groups of plants originating from one seedling) were irrigated by pot irrigation or hose irrigation methods. Almost all of the cardamom is grown on slopes with plenty of shade trees amongst them furrow or channel irrigation method is impractical. Impact sprinkler irrigation, though practiced in some areas is found to be less efficient and does not give facility for fertigation and also enhances weed growth in the inter-clump spaces.

Mist irrigation using very fine misters (Jain Acumister)



Acumisters are installed on PVC risers (1m tall) and connected to the water carrying Lateral tubes through 8 mm micro tubes. Each clump will have one acumister placed at its centre (Photographs).

Subsurface drip irrigation; (Cardamom SDI)

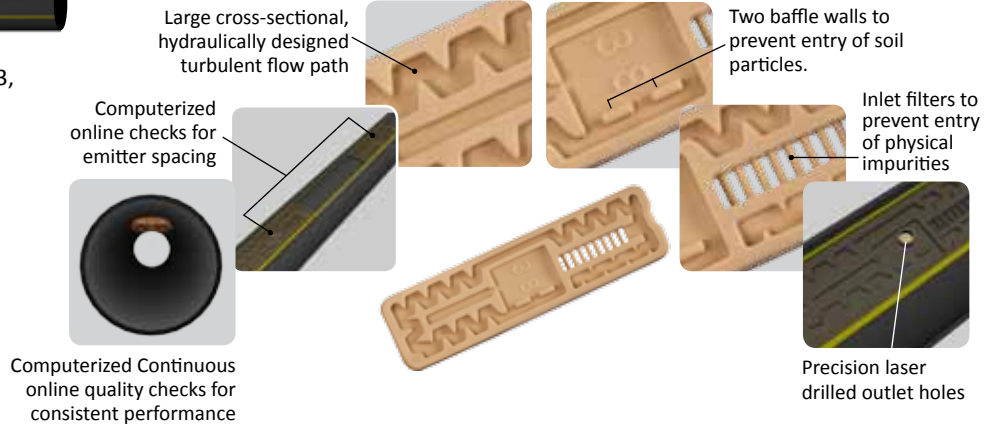


In-line lateral tubes with drippers fitted at every 50 cm is placed at 20 cm below the soil surface on the sides of the clumps, as shown below in the drawing. The laterals are installed subsurface in order to facilitate the forking operation done in the inter-clump spaces. Drip lines on the surface will obstruct this important operation.

J-Turbo Aqura®



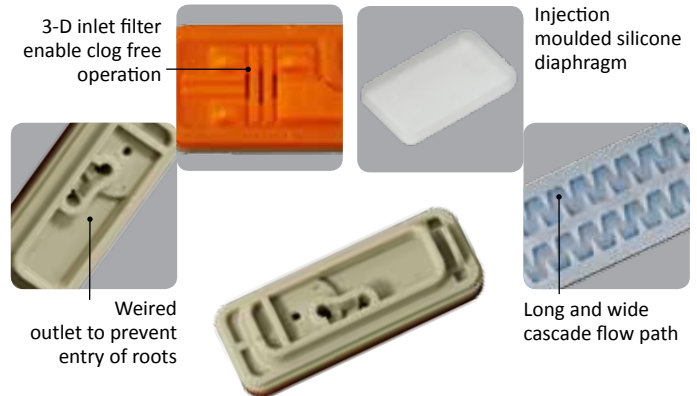
- Available discharge rates - 0.8, 1.3, 1.6, 2.4 & 4 lph at 1 kg/cm².
- Clog resistant dripper
- Available in 12, 16 & 20 mm nominal diameter.
- Suitable for surface as well as subsurface installations.



Jain Turbo Top™



- Available discharge rates – 1 & 1.6 lph
- Injection moulded silicone rubber compensates with pressure and discharge gives uniform performance.
- Anti Syphone feature (optional) prevents suction of sand and silt particles inside the dripper.
- Cascade labyrinth gives strong, self-cleaning turbulence.
- Available in 16 & 20mm nominal diameter.
- Suitable for surface as well as subsurface installations.



Why Jain Drip Irrigation ?

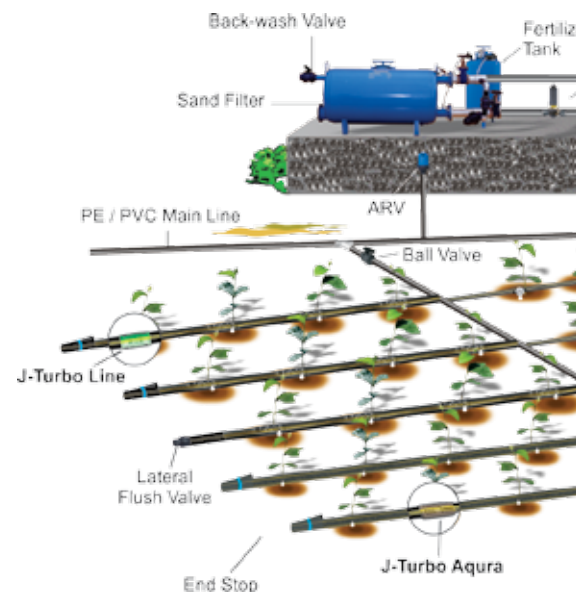
Water is not the only need of the plant. To uptake this water efficiently, it requires proper air-water balance within the root zone. Drip irrigation, with its low application rate, prevents the saturation of water within the root zone and continuously maintains field capacity. This provides favorable condition for the growth of the plant. Drip irrigation also helps to use fertilizer efficiently. With drip irrigation water can be provided at frequent interval which helps to maintain required soil moisture level within the vicinity of the plant roots.

Jain is the pioneer of drip irrigation. Ours is the only company in the world, which fulfills your entire irrigation systems requirement under one roof.

Characteristics of drip irrigation:

1. Water is applied at a low rate to maintain optimum air-water balance within the root zone.
2. Water is applied over a long period of time.
3. Water is applied to the plant and not to the land.
4. Water is applied every day equivalent to Evapotranspiration of the day.
5. Water is applied via a low pressure delivery system.

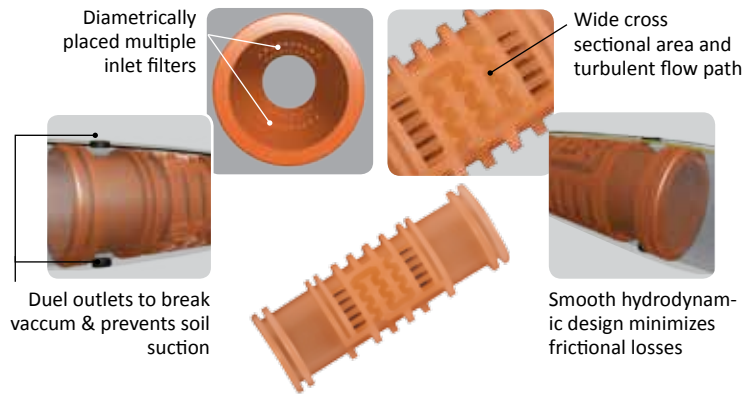
More Crop



J-Turbo Line® & J-Turbo Line Deluxe



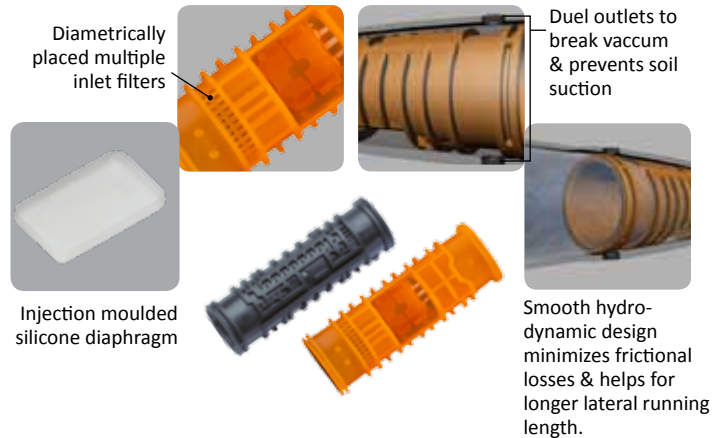
- Available discharge rates - 2.4, 4 lph at 1 kg/cm² Pressure.
- Cylindrical shape permits wide flow path cross section along with multiple inlet filter improves clog resistance.
- J-Turbo Line Deluxe model is provided with innovative, clog resistance cascade labyrinth.
- Available in 12,16 & 20 mm nominal diameter.
- Suitable for surface as well as subsurface installation.



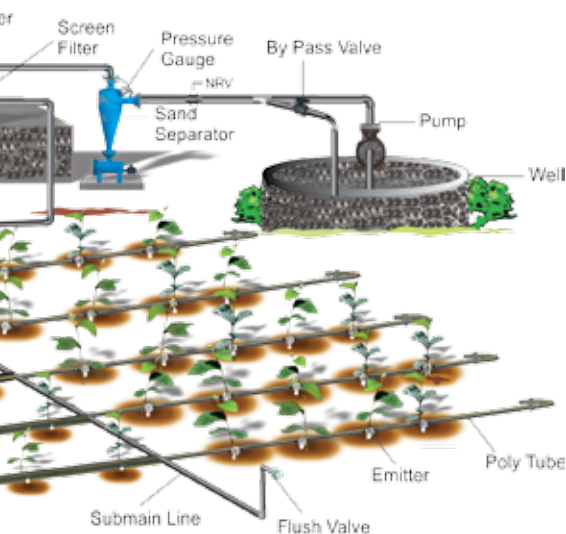
Turboline PC®



- Available discharge rates - 1.3, 1.6, 2.6 & 4.5 lph at 1 kg/cm² Pressure.
- Injection moulded silicone rubber compensates with pressure and discharge gives uniform performance
- Application on the undulating land/ Terrains/ Steep slopes.
- Application where ever longer lateral length is necessary.
- Available in 16 & 20 mm nominal diameter.
- Suitable for surface as well as subsurface installation.



Per Drop®



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Advantages of Jain Drip Irrigation

- 💧 Increase in yield from 50 to 200%.
- 💧 Acts as a catalyst to achieve the highest potential yield of the crop.
- 💧 Improved quality, uniformity in grain size and fruit size.
- 💧 Early maturity of the crop. Early in the market, higher is the price.
- 💧 Minimized fertilizer loss due to localized application and reduced leaching.
- 💧 High water application efficiency – Water saving up to 70% .
- 💧 Reduction in manpower requirement.
- 💧 Saves Energy upto 50%.
- 💧 Control over weed growth and reduction in weedicide expenses.
- 💧 Improved disease control.
- 💧 Difficult and undulating terrain can be irrigated efficiently.
- 💧 Ideal for saline/alkaline soil conditions.
- 💧 No soil erosion.
- 💧 Technology for social justice & equity
- 💧 Efficient tool to overcome the challenges of water security, food security and energy security for the nation.

In SDI irrigation and fertigation can be done with a minimum of one labour for the entire plantation.

Month	Pan E mm	l/ ha	l /clump/day
January	3.5	27222	27.2
February	4.1	31889	31.9
March	4.4	34222	34.2
April	3.7	28778	28.8
may	3	23333	23.3
June	3.3	25667	25.7
July	2.7	21000	21
August	2.4	18667	18.7
September	3.2	24889	24.9
October	3	23333	23.3
November	2.6	20222	20.2
December	2.4	18667	18.7

** The above irrigation schedule is estimated for Idukki district. The quantum of irrigation will differ if pan E varies.

These estimates are for 5 yr plus clumps. For newly planted seedlings irrigation of 6 l /seedling is enough till the clump is established.

In the mist irrigation an average of 10-20 liter of misting is recommended daily depending on the diameter of the clump. This has to be given in two or three spurts in a day.

Fertigation

Fertigation is easily done in SDI either daily, alternate days or weekly doses; depending upon the readiness of the grower.

Preliminary studies have shown that 52 equal weekly doses of N and K has helped in improving yield of cardamom.

Fertigation schedule

Fertilizer recommendation	150 N: 150 P: 300 K (kg/ha) for full year.
Schedule of Fertigation	52 weekly doses
Fertilizer per dose per ha	4.21 kg UREA per ha/ week; 4.7 kg MAP per ha/week; 9.6 kg MOP per ha/week

Entire plantation and particularly the plant base are to be kept under mulch.

Plant base has to be mulched at a thickness of 5-10 cm.

Crop hygiene

Remove old tillers, dry leaves and leaf sheaths once in a year.

Disease Management

Nursery Diseases

Nursery Leaf Spot (*Phyllosticta elettariae*)

Mostly appear during February-April months. Small round or oval spots appeared as dull white in colour.

Treatment : Spray Difolatan or Foltaf (Captafol) 0.2 % or with Dithane M-45 (Mancozeb) or Indofil M 45 0.3 % .

Nursery Leaf Spot (*Cercospora zingiberi*)

Yellowish to reddish brown coloured rectangular patches seen on the lamina.

Treatment : spray Difolatan or Foltaf (Captafol) 0.2 % or with Dithane M-45 (Mancozeb) or Indofil M 45 0.3 %.

Nursery Leaf Rot

Development of water soaked lesions on the leaves which results in decay of affected areas

Treatment : Avoid excessive watering of seedlings. Spray 0.3 % Dithane (Mancozeb) twice at 15 days interval.

Damping off or Seedling Rot

It appears in germination nursery due to excessive soil moisture.

Treatment : Avoid overcrowding of seedlings. Provide adequate drainage facilities and remove affected seedlings

Clump Rot (*Rhizome Rot*)

This disease occurs in mature seedlings (6 to 18 months old) due to excess soil moisture. Uproot and destroy all the affected seedlings in the nursery

Treatment : Irrigate with micro sprinklers and scheduling of irrigation to avoid excess of soil moisture.

Drench the nursery beds with Copper oxychloride (COC, 0.3%) at the rate of 3 to 5 litres/m².



BENEFITS OF SDI in Cardamom

- ◆ Increase in yield by 55%
- ◆ Uniform, early and regular podding
- ◆ Uniform distribution of fertilizer and water
- ◆ Enhanced uniformity in podding and clump growth.
- ◆ Higher efficiency water and fertilizer use.
- ◆ Labour use for irrigation and fertilizer application reduced considerably.
- ◆ SDI does not obstruct Forking, weeding and other field operations.
- ◆ Rodent damage (by squirrels) is less
- ◆ Mechanical damage to irrigation system by labour or animal movement is avoided.

Plantation Diseases

'Katte'(Mosaic) Disease

Spindle shaped chlorotic flecks appear on the youngest leaf of affected tillers. Later develop into discontinuous stripes of pale green and dark green areas, running parallel to the veins from the midrib of leaf margin.

Treatment : Avoid rhizome planting using materials taken from disease affected gardens.

Avoid raising nursery near katte affected areas.

Nilgiri Necrosis Disease / Viral & Systemic disease

Plants show alternate light green and whitish to yellowish streaks on the leaves in the form of mosaic.

Treatment : Plant sanitation by rouging of affected plants can control the disease

Kokke kandu disease (Cardamom vein clearing)

Systemic viral disease.

Mottling develops on the foliage and later shows severe vein clearing. Tillers are stunted.

Treatment : Plant sanitation is the only preventive measure.

'Azhukal' or Capsule Rot disease

Water soaked lesions appear on the young leaves and on capsules. Provide proper drainage & regulate thick shade by gentle topping of tree branches

Treatment : Treat with Bordeaux mixture 1% (at the rate of 500 ml to 1 litre per plant) or Aliette 80 WP 0.3% (at the rate of 750 ml per plant)

Clump Rot or Rhizome Rot

Yellowing of leaves and decay of tillers occurs. Rhizomes become soft, dark brown coloured and results in total death of the plant

Treatment : Plant sanitation. Drenching of plant base with 2 to 3 litres of COC (0.25%)

Application of bio-agent Trichoderma after phytosanitation at the rate of 1 kg/100 kg of cowdung can control some extent of rhizome rot and azhukal disease

Capsule Canker and Capsule Brown Spots

Canker observed as glaucous discoloured eruptions on the capsule rind. Capsule brown spot appear as small round reddish brown lesions on the pericarp of the capsule.

Treatment : It can be controlled by spraying with 0.2% Bavistin or 0.2% Dithane M45

Leaf Blight

Drying of leaves occurs during October to February months

Treatment : It can be controlled by one or two rounds of spraying with 1% Bordeaux mixture or 0.3% Aliette or 0.4% Akomin.

Insect Pest Management

Pests in Nursery

Shoot Borer

Appearance of excreted material at the mouth of the bore hole indicates the presence of larva in the shoot. Its caterpillars bore in to the shoots and feed on its core.

Treatment : The pest can be controlled by spraying insecticides within 15-20 days after the appearance of moths. Monocrotophos or Fenthion 0.075%

Root Grubs

Grubs reduce the uptake of nutrients and leads to yellowing of leaves.

Treatment : Early stages of the grub can be controlled by applying Phorate or Sevidol @30 to 40 grams per clump.

Shoot Fly

Results in wilting and drying off of the terminal unopened leaves.

Treatment : Remove and destroy affected shoots at ground level. Apply Dimethoate or Quinalphos or Methylparathion at 0.05% conc.

Spotted Red Spider Mite

Spider mites spin web and colonise under the surface of leaves. They suck plant sap from leaves.

Treatment : Spray dicofol @ 200 ml/100 litre water or Sulphur 80 WP 250 gm./100 litre or Dimethoate @167 ml/100 litre or Phosalone 200 ml/100 litre on lower surface of leaves

Cutworm

It feed on leaves of seedlings and it pupates in soil.

Treatment : Spray Monocrotophos at the base of the seedlings

Nematodes

Necrosis of leaf tips and margins, narrowing of leaves, thickening of veins, reduction of intermodal length, appearance of leaves as rosette and reduction in plant growth.

Treatment : Apply Carbofuran @80 gm/6 m² bed in primary nursery and @200 gm./6 m² bed in secondary nursery.

During plantation, apply Carbofuran @60-80 gm. per plant or 20-40 gm. of Phorate with 300-500 gm of neem oil cake per plant

Insect Pests in Plantations

Cardamom Thrips

Insects cause damage to panicles, flowers and capsules.

It results in stunted growth; flower dropping and the injury produced on tender capsules.

Treatment : Remove collateral host plants of thrips. Remove dry drooping leaves, dry leaf sheaths, old panicles and other dry plant parts.

Shoot /Panicle/Capsule Borer

Flower production stopped and larvae feed on the seed

Treatment : Apply Monocrotophos or Fenthion 0.075 %.

Early Capsule Borer

These insects bore and feed flower buds, flowers and capsules.

Treatment : Spary Methylparathion or Monocrotophos 0.05%

Cardamom Whitefly

Black sooty mould develops on these and interrupts photosynthesis of the leaves.

Treatment : It can be controlled by spraying on lower surface of leaves a mixture of neem oil (500 ml) and Triton (500 ml) in 100 litre of water.

Apply Acephate 0.075% and Triazophos 0.04% .

Pollination

- Cardamom is a cross pollinated plant. Pollination is assisted by external agents like honey bees.
- Fruit setting increases in bee pollinated flowers
- For effective pollination, four bee colonies per hectare are required.

Yield

An average yield per picking of 278 kg/ha (cardamom is harvested 6-7 times a year) under drip fertigation (average yield in conventional irrigation and soil fertilization is only 180 kg/ha).

Dos

- Ensure good drainage in the field.
- Adopt Subsurface drip irrigation.
- Compulsorily apply organic manure as per recommendation
- Select high yielding, disease and pest tolerant variety.
- Strictly follow the irrigation schedule given by the engineer.
- Follow the drip system maintenance schedule given by the engineer.
- Compulsorily weed/ inter-cultivate, timely operation helps in crop growth.
- Follow fertigation schedule as given by the engineer.
- Apply micronutrient as and when needed.

- Follow disease and pest control measures timely and effectively.
- Apply sprays in the evening or early morning only.

Don'ts

- Don't over irrigate cardamom at any time.
- For fertigation don't mix solid fertilizers and dissolve them together. Prepare individual solutions and mix them for application.
- Don't make a fire in the field with Drip system.
- Don't use the fertigation unit for bulky organic manure and fertilizers that are not soluble in water
- Don't add solid fertilizer from the gunny bag directly to the fertilizer tank. Prepare solution separately and pour the solution to the fertilizer tank. Prepare solution only in plastic buckets. Don't use metal container.
- Don't stir the solution with naked unprotected hand. Use wooden spoon or stick.
- Don't heat the fertilizer solution to increase solubility.

Frequently asked questions (FAQ's)

1. Whether the meagre quantity of water supplied through drip irrigation is enough?

Irrigation rate in Drip method is estimated based on the Evapotranspiration of the location and therefore it is enough. With conventional hose irrigation water completely replaces the air in root zone thereby suffocating the plant. The last few days of the irrigation cycle the crop also suffers from water stress. The periodical water logging and stress affects growth and production of cardamom.

2. Can I prefer Sprinkler method of irrigation for Cardamom ?

No. it is not suitable as it spreads water over the canopy. Moreover wastage of water per irrigation will be high. Sprinkler irrigation will induce diseases because the excess humidity is ideal for fungal and bacterial growth. It also results in persistent weed growth.

3. How long the SDI lateral will remain in the field?

The laterals will remain functioning for 7-10 years with proper maintenance with care for avoiding mechanical damage. The head control (filters and fertigation systems) will remain functional for 15 years.

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Tel: +91-257-2258011; **Fax:** +91-257-2258111; **E-mail:** jisl@jains.com; **Website:** www.jains.com;

Toll Free: 1800 599 5000

