

Eco-friendly management of pests and diseases in small cardamom

**Sudhakar Soundarajan^{1*}, Preethu K Paul¹, Ashiba A¹, R Marimuthu¹,
S N Sushil², G Sivakumar², T Venkatesan², M Nagesh²,
V Venkatasubramanian³ and B T Rayudu³**

¹ICAR-Krishi Vigyan Kendra, Idukki, Kerala 685 619

²ICAR-National Bureau of Agricultural Insect Resources, Bengaluru, Karnataka 560 024

³ICAR-Agricultural Technology Application Research Institute, Bengaluru, Karnataka 560 024

Small cardamom, known as 'green gold', symbolizes India's prominence in the global spice market, originating from the Western Ghats Forest in southern India. Over time, environmental changes in this region have led to indiscriminate use of synthetic chemical pesticides by farmers, resulting in environmental degradation and high pesticide residue levels in produce. As focus shifts towards organic small cardamom production, the search for safer pest and disease management measures becomes crucial. ICAR-National Bureau of Agricultural Insect Resources (NBAIR), Bengaluru, has developed various bio-agents effective for eco-friendly management of major cardamom pests and diseases. In the last five years, ICAR-KVK, Idukki, has extensively disseminated these technologies among small cardamom farmers through various activities, leading to increased adoption of eco-friendly practices, reduced pesticide usage, improved crop health, and sustainable production. With a growing demand for organic spices, ICAR-NBAIR technologies have played a pivotal role in Idukki district, enabling the production and export of safer small cardamom and its value-added products to domestic and international markets.

Keywords: Bio-agents, Diseases, ICAR-NBAIR, ICAR-KVK, Insect pests, Small cardamom

S MALL cardamom, one of the most valued spice crops, popularly known as green gold, is a native of the evergreen rainforests of Western Ghats. Cardamom hills comprised the mountain range of southern India and southern Western Ghats are the hotspot area for cardamom cultivation. Out of three cardamom producing states (Kerala, Tamil Nadu and Karnataka), Kerala accounts for 88% of total production in India. Cardamom hill reserves within the cardamom hills of Idukki district, Kerala, comprises about 7488.40 ha of land and accounts for about 70% of the cardamom production of India. The perennial and succulent nature of the crop provides agreeable conditions for the pathogens to proliferate and perpetuate throughout the year. Also, the humid environment coupled with the partial shade under which the crop is grown creates a very suitable condition for the multiplication of the plant pathogens. This situation is challenging for the profitable cultivation of cardamom in Cardamom hill reserves of Kerala. The major pests of small cardamom

are shoot and capsule borer, thrips, root grub, whitefly, nematodes and diseases like capsule and panicle rot, clump rot, Fusarium rot, leaf blight and viral diseases are reported as major threats to commercial cardamom cultivation. Indiscriminate use of synthetic pesticides to manage these pests and diseases results in tremendous buildup of residues in export-oriented produce, which has recently invited debate and queries. This had significantly affected the world-wide acceptability of the king and queen of spices. Now, the demand for organic spices is increasing among consumers at the rate of 20% annually. The mission at the moment is to capture India's pre-eminent position as spice bowl of the world by producing and exporting safer spices and spice products to the world market. For safer and continuous higher sustainable production, attention is needed on good agricultural practices through eco-friendly management of pests and diseases. If India has to recapture its lost glory of spices, there should be considerable sincere efforts to achieve a quantum jump



Bore hole symptoms on stem and pupa



Adult borer



Dead heart symptoms on shoot



Bore hole symptoms on capsules



Apantele sp parasitoids on capsule borer



Beauveria infected adult

in the productivity of cardamom through adoption of physical, cultural and biological/botanical practices that allow co-existence of natural enemies and beneficial microorganisms which in turn bring back the ecosystem balance in small cardamom production system.

In this direction, ICAR-KVK, Idukki has disseminated eco-friendly technologies developed by ICAR-NBAIR, Bengaluru for the management of major pests and diseases of small cardamom through various activities like OFTs, FLDs, trainings, extension programmes and farm advisory services. Over the years, the salient achievements of ICAR-KVK, Idukki for the management of pests and diseases of cardamom by application of ICAR-NBAIR technologies, apart from recommended physical and cultural practices, are described hereunder.

Insect pests of small cardamom

Shoot and capsule borer (*Dichocrocis punctiferalis*):

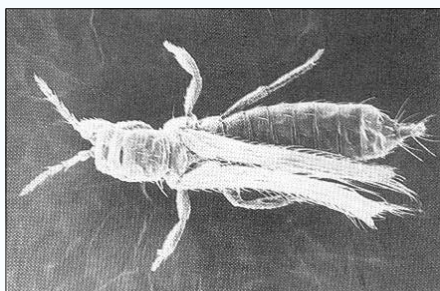
It is the most serious insect pest of cardamom and consumes major share of pesticide used in cardamom. The earlier stages of larvae bore the panicles leading to drying up of the entire panicle and also bore the immature capsules and feed on the inner contents of the seeds which lead to empty capsules. The late stages larva feed on the central core of the stem and affect the phloem vessels interrupting the passage of food materials to the growing parts finally leading to drying of central leaf tip

known as 'dead heart' symptom.

This pest was addressed through spraying of ICAR-NBAIR-*Bacillus thuringiensis* @ 5 ml/L of water at First - instar larvae stage, spraying of ICAR-NBAIR-*Beauveria bassiana* @ 5 g/L of water at 3rd and 4th instar larvae and adult stage, releasing of *Apantele* sp. @ 20,000 larval parasites/ha at 2nd and 3rd instar larvae and releasing of *Friona* sp @ 20,000 larval parasites/ha. As a result, the number of farmers who adopted this technology has increased and the number of chemical pesticides in use has decreased from 14 to 6%, thereby paving the way for a healthy and resilient farming system.

Thrips (*Sciothrips cardamomi*): This is one of the most destructive insect pests of cardamom. The population of this pest builds up rapidly during the post monsoon and summer months and declines with the onset of monsoon rains.

This pest was addressed through spraying of ICAR-NBAIR strain of entomopathogenic fungus *Lecanicillium lecani* and release of ICAR-NBAIR-Anthocorid bug and *Chrysoperla* sp. It played a significant role in acreage expansion as well as yield enhancement. It was found that the realized yield levels through demonstrations were much higher (15.0%) than the average district yield (6.40 t/ha). The total area of bio-intensive pest management of thrips in small cardamom expanded from 100 to 500 ha.



Microscopic view of adult thrips



Thrips on under leaf sheath



Green cardamom capsule damaged by thrips



Corky encrustations on pods



Lecanicillium applied green capsules



Lecanicillium applied dry capsules

Root grub: The root grub (*Basilepta fulvicorne*) is one of the serious subterranean insect pests in cardamom plantations. The larvae feed on young roots and the above ground symptoms start as yellowing of leaves, which later result in the drying up and death of the plant.

This pest was addressed through soil application of Entomopathogenic Nematode (EPN) power formulation @ 5 g per L of water in soil at the base of small cardamom plant (@5 L of EPN liquid per plant which mean two lakh to four lakh IJs of EPN). The IJs of EPN comes out from the cadaver in the soil, search for root grub and kill them. Field demonstrations of the formulation were carried out in Kerala and around 13,000 ha small cardamom fields were applied with WP formulations of *H. indica* @ 4-5 kg/acre respectively. The technology could reduce the small cardamom root grub incidence by 62-78%. ICAR-KVK, Idukki has distributed more than 11,000 kg of WP EPN formulation to the farmers for the management of root grubs in small cardamom.



Root grubs



EPN infected root grubs



Root knot nematode affected roots



Root knot nematode affected plants



Root knot nematode managed through ICAR-NBAIR bio-agents



Demonstration field of EPN



EPN applied small cardamom plantation

Nematode: Infestation of nematode in cardamom is a major problem often amounting to heavy crop loss. The root-knot nematode, *Meloidogyne incognita*, causes severe damage to crop that is widely observed in almost all cardamom plantations, while the lesion nematode *Pratylenchus coffeae* and the burrowing nematode *Radopholus similis* are noticed in mixed plantations. Infested plants exhibit stunting, reduced tillering, reduced leaf size, yellowing of foliage, immature capsule drop and increased incidence of rhizome rot.

This pest was addressed through soil application of *Paecilomyces lilacinus* strain ICAR-NBAIR Plft5 (PI55) @ 1 kg in 50 kg FYM in small cardamom and soil application of Jeevamrutha @ 10 litre along with *Azospirillum* and ICAR-NBAIR-*Trichoderma viride* (10 g each) per plant in cardamom plantations. Before the adoption of ICAR-NBAIR technology, only chemical methods were followed and incidence of root knot nematode was 57.2% and net return ₹1,72,900/ha. After adoption of ICAR-NBAIR technology, the incidence of root knot nematode was only 6.5% and yield increased by 41% with net returns of ₹4,22,000/ ha.

Diseases of small cardamom

Capsule rot/Panicle rot: This disease popularly known as azhukal which is most serious disease in cardamom. Studies on etiology of the disease confirmed that two species of *Phytophthora*, viz. *P. meadii* and *P. nicotianae* var. *nicotianae* are involved in this disease. Disease symptoms appear during the rainy season on leaves, tender shoots, panicles and capsules. On the infected leaves, water soaked lesions appear first and rotting and shredding of leaves along the veins occur thereafter. The infected capsules become dull greenish brown and rot. This emits a foul smell and subsequently shed off. Infection spreads to panicles and tillers resulting a complete decay of panicles and capsules.

This disease was addressed through application of peat formulation of ICAR-NBAIR-*Bacillus subtilis* strain Bs and prophylactic application of ICAR-NBAIR-*Pseudomonas fluorescens* (2% spray) along with



Leaf water soaked lesions and rotting

Capsules dull greenish brown and rot

basal application of *Glomus fasciculatum* (arbuscular mycorrhizal fungi AMF) @ 50 g and ICAR-NBAIR-*Trichoderma viride* @ 100 g/plant at a monthly interval during the rainy season. The cost of application of ICAR-NBAIR-*Bacillus subtilis* is ₹4,400/ha as compared to regular chemical application where it costs ₹18,900/ha. Thus, it saves the cost of chemical application at the rate of ₹14,500 per ha and net returns gained per ha is ₹2,79,000.



Capsule rot/Panicle rot disease managed through ICAR-NBAIR bio-agents

Clump rot: It is otherwise called as rhizome rot occurs during monsoon period. This disease is widely distributed across cardamom growing regions in Kerala and Karnataka as well as heavy rainfall areas of Tamil Nadu such as the Anamalai hills. This disease is caused by combined infection of *Pythium vexans*, *Rhizoctonia solani* and *Fusarium* sp. Rotting symptoms develop at the collar region resulting in softening and bristling of the tissue. The tiller breaks at this point with a discolouration, and the infected tissue in the detached portion emits a foul smell. The developing tillers of the infected plants detach from their rhizome portion with

a slight pull. Generally, root rotting and subsequent yellowing of plants are associated with the disease.



Rotting at the collar region in softening and bristling of the tissue

This disease was addressed through soil application by a consortium of ICAR-NBAIR-*Pseudomonas fluorescens* (Pf5) and ICAR-NBAIR-*Bacillus subtilis* (Bs45) and soil application of ICAR-NBAIR-*Trichoderma harzianum* multiplied in a mixture of decomposed coffee compost and cow dung at 50g/clump during May-June and August-September. Ex-trainee of ICAR-KVK, Idukki Mr. Srinivasan from Santhanpara village in the Idukki district has been involved in the bio-control program since 2011. Approximately 5.25 ha are cultivated by him for small cardamom. When it came to crop productivity, he previously employed more chemical herbicides and fertilizers. It was via ICAR-KVK, Idukki that Mr. Srinivasan participated in a number of training programs. The vermicompost he uses, generated on his own farms, amounts to approximately 200 q annually. He started multiplying ICAR-NBAIR bio-agents and selling approximately 300 liters of various bio-agents and gaining an extra ₹4,50,000 annually.

Fusarium rot: This disease is also called as stem rot or stems lodging, normally appears during post-monsoon period. The disease was first reported in the cardamom plantations of Idukki district. This disease is caused by a fungus *Fusarium oxysporum*. The pathogen usually attacks middle portion of the tillers and produces a pale discoloured lesion leading to dry rotting. The infected tillers are weakened at the point of infection and leads to partial breakage of the tillers. The partially broken tillers bend down and hang from the point of infection. The infected tillers fall off and give lodged appearance if the infection occurs at lower part of the tillers.



Clump rot disease managed through ICAR-NBAIR bio-agents by farmer Mr. Srinivasan



Pseudo stem rot



Tillers bend down and hang



Panicle blight



Wilting symptoms

This disease was addressed through prophylactic application of 2% ICAR-NBAIR-*Pseudomonas fluorescens* (Pf5) in cowdung slurry as spray and drench or single basal application of ICAR-NBAIR-*Trichoderma harzianum* (100 g) and *Glomus fasciculatum* (50 g) per plant along with 2% ICAR-NBAIR-*Pseudomonas fluorescens* (Pf5) and ICAR-NBAIR-*Bacillus subtilis* (Bs45) spray at monthly intervals during summer months. Ex-trainee of ICAR-KVK, Idukki, Mr. Manikandan belonging to Senapathy village in Idukki district has four acres of land and is cultivating small cardamom. *Fusarium* disease was affected by the disease intensity (DI) level in his farm and he attempted to suppress the disease below DI level through numerous fungicides, but remained unsuccessful. From 2016 until now, he has

been connected to the KVK and adopted ICAR-NBAIR technology. As a result, he controlled the disease and saves his annual cost of cultivation of ₹1,50,000. He now harvests good produce on his farm to the extent possible.

SUMMARY

Small cardamom, one of the most valued spice crops, popularly known as green gold, is a native of the evergreen rainforests of Western Ghats. Cardamom hill reserves within the cardamom hills of Idukki district, Kerala account for 70% of the cardamom production of India. Existing climatic situation is challenging for the profitable cultivation of cardamom in Cardamom hill reserves of Kerala as it is congenial for occurrence and incidence of insect pests and diseases, which



Fusarium rot disease managed through ICAR-NBAIR bio-agents by farmer Mr. Manikandan

invites indiscriminate use of synthetic pesticides. For safer and continuous higher sustainable production, attention is needed on good agricultural practices through eco-friendly management of pests and diseases. The ICAR-NBAIR, Bengaluru has developed several bio-agents viz., *Bacillus thuringiensis*, *Beauveria bassiana*, *Apantele* sp., *Friona* sp., entomopathogenic fungus *Lecanicillium lecani*, Anthocorid bug, *chrysoperla* sp., entomopathogenic Nematode (EPN), *Paecilomyces lilacinus* Plft5 (PI55), *Bacillus subtilis*, *Pseudomonas fluorescens*, *Glomus fasciculatum*, *Trichoderma viride* and *Trichoderma harzianum* are effective for eco-friendly management of major insect pests of cardamom - shoot and capsule borer, thrips, root grubs and nematode as well as major diseases of cardamom- capsule rot/panicle rot, clump rot and *Fusarium* rot. These technologies were widely disseminated among farmers

by ICAR-KVK, Idukki through various activities. This has led farmers to adopt ICAR-NBAIR technologies for eco-friendly management of small cardamom thereby reduced usage of chemical pesticides, saved expenditure on plant protection, grown healthy crop, harvested quality produce and brought small cardamom production system sustainable. In fact, eco-friendly technologies and practices are low input demanding, energy efficient and cause little or minimum disturbance to the production system. As the demand for organic spices is increasing among consumers at the rate of 20% annually, ICAR-NBAIR technologies played a pivotal role in Idukki district for producing and exporting safer small cardamom and its value-added products to the domestic and world market.

*Corresponding author email: sudhakarsounda@gmail.com

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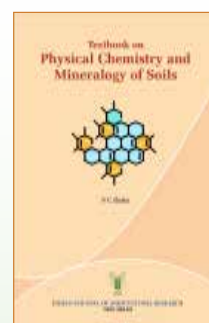
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