

## Survey-Based Study on Farmers Knowledge and Pattern of using Pesticides in Cardamom in Tamil Nadu

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**ABSTRACT:** A detailed survey was undertaken among cardamom growing farmers in three districts of Tamil Nadu viz., Theni, Nilgiris and Namakkal. Pests recorded in the cardamom ecosystem were shoot and capsule borer, thrips, white fly, red-spotted spider mite and hairy caterpillars. The insecticides, Chlorantraniliprole 18.5% SC and Chlorpyrifos 20% EC were the most common insecticides used to control borers and profenophos 50% EC and imidacloprid 17.8% SL were used against sucking pests. Farmers mainly used pesticides belonging to organophosphorus and newer molecules as per the recommendations of pesticide dealers. Central Insecticide Board and Registration Committee (CIB & RC) approved four insecticides - quinolphos 25% EC, Monocrotophos 36% SL, lambda-cyhalothrin 4.9% CS and diafenthiuron 50 % WP and two fungicides - copper oxychloride 50% WP and fosetyl-AL 80% WP for management of pest in cardamom. Farmers' knowledge of pesticide risk improved and was shown by the use of stick to mix pesticides in spray tanks, use of measuring caps, avoiding reuse of pesticide containers for household purposes and adhering to pre-harvest intervals. Farmers understanding of prescribed pesticides, dosage, label claims and personnel protection during spray activities, on the other hand, was deficient.

**Keywords:** Cardamom, survey, pesticides, Farmer knowledge.

### INTRODUCTION

Small cardamom, *Elettaria cardamomum* (Maton), the "Queen of Spices" enjoys a unique position in the international spice market. It belongs to the family Zingiberaceae and it is native to the hills of Western Ghats of Kerala (Beevi *et al.*, 2014). India is the leading producer of small cardamom occupying an area of 45,17,000 ha. producing around 38,000 MT in 2016, followed by Guatemala where the production is around 35,000 MT in the same period (International cardamom association ICA, 2019). In India, small cardamom is grown in the states of Karnataka, Kerala and Tamil Nadu. In Tamil Nadu, cardamom is grown over 4,03,000 hectares with a production of 37,000 tonnes (INDIASTAT, 2022). Despite the fact that India has the most cardamom growing land, productivity is low, owing to insect attack at all stages of the crop (George *et al.*, 2015). Pest and disease incidence is high in cardamom which becomes a major challenge because of

the absence of sufficient population of natural enemies of pests in the cardamom hills ecosystem and also complexities in the use of biological control methods and products (Murugan *et al.*, 2017). Chemical control is the sole approach to pest management for the reasons stated above. However, pesticides used in excess and on a regular basis can leave residues in plants and soil (George *et al.*, 2015). Gulf countries such as Saudi Arabia and the United Arab Emirates (UAE) are the major importers of cardamom. Unfortunately, due to excessive levels of pesticide residues, India's cardamom exports have fallen by 80 per cent (Beevi *et al.*, 2014). Cardamom, while being a valuable export spice, has not been well investigated in terms of insect pest dynamics and pest management strategies. With this background, the present study was conducted to investigate the insect pests that attack the cardamom crop, as well as the use of pesticides and pesticide usage patterns in major cardamom growing districts of Tamil Nadu.

## MATERIALS AND METHODS

In the cardamom growing districts of Tamil Nadu, a detailed survey was undertaken. The survey was carried out in the districts of Nilgiris, Theni and Namakkal during February and March, 2022. Data on several aspects of pesticide usage such as source of information, type of pesticide usage, dose, frequency, safety precautions, knowledge on dosage recommendation, waiting period, type of disposal of

empty pesticide containers and socio-economic status is collected from each district and documented.

**Details of the study area.** To understand the pest status and pesticide usage pattern in the cardamom ecosystem in Tamil Nadu, a comprehensive survey was undertaken. The Theni, Nilgiris and Namakkal Districts (Fig. 1) were purposively selected based on the extent of cultivation (1351, 900 and 51 ha, respectively) and the survey details are presented in Table 1.

**Table 1: Details of locations selected for survey in Tamil Nadu.**

S. No.	District	Block	Village	Number of respondents per blocks	Total number of respondents per district
1.	Theni	Bodinayakanur	Bodimettu	11	15
			Manthal		
			Ahamalai		
		Andipatti	Meghamalai	5	
2.	The Nilgiris	Gudalur	Nadugani	4	10
		Panthalur	Nelliyalam	2	
3.	Namakkal	Kolli hills	Valakadu	8	15
			Valappur		
			Kulivalavu		
			Peryakovilur		
			Salakkadu		
		Melkalingam			
		Melkalingampatti	Thembalam	4	
		Pallipalayam	Asarikadu	2	
Puduvalavu					
Vennandur	Nadupatti	1			

**Nature and source of data.** The information on pest status and pesticide usage patterns was collected randomly from selected farmers from each district. Using a proper questionnaire format, information from 40 farmers were gathered for this investigation. Information from the farmers was collected individually in the study area using the prepared questionnaire. The questionnaire consisted of three major parts.

Part 1: General information about the farmers (Farmer's name, age, education details, family details).

Part 2: Crop production information (Size of holding, crop-related data, the previous crop grown).

Part 3: Crop protection information (Pest status, pesticide usage pattern which includes pesticides used, source of information on recommended pesticides, awareness about label information, pesticide application details, safety precautions, spray count, spray intervals, waiting period). The interview was conducted from February 2022 to March 2022. The questions were asked in order, from first to last, to give participants enough time to think about the question and respond appropriately. The respondents were completely volunteers and had complete discretion over whether or not to provide responses in the event of an explanation.

However, no farmers refused to participate in the interview.

## RESULTS AND DISCUSSION

### A. Selected socio-economic factors of the farmers

According to the socio-economic condition of the data obtained, majority of cardamom growers (72 per cent) were male, whereas female was low (28 per cent). Similarly, comparable findings have been reported by (Tyagi *et al.*, 2015). The respondents were an average age, farm experience and family size of 46.17 years, 10-25years and 5.04 members (Table 2). Despite the fact that the majority of the farmers were literate, knowledge of scientific pest management approaches was found to be lacking. This was in agreement with earlier report (Prakash *et al.*, 2021).

### B. Information regarding cardamom cultivation

Cardamom is a perennial herbaceous crop. All the farmers are practicing a monocropping system. The most common varieties are Nallani, Vazzhukka and Mysore are cultivated under red loamy and clay loamy soils. The majority of farmers follow drip irrigation and few farmers use sprinkler irrigation.

**Table 2: Socio-economic factors of the farmers.**

Variables	Mean	Standard deviation
Age (Years)	46.17	7.00
Family size (No.)	5.04	1.34
Education (Years)	7.22	2.36
Size of holding (Acre)	2.25	1.12
Farming experience (Years)	10	5.48

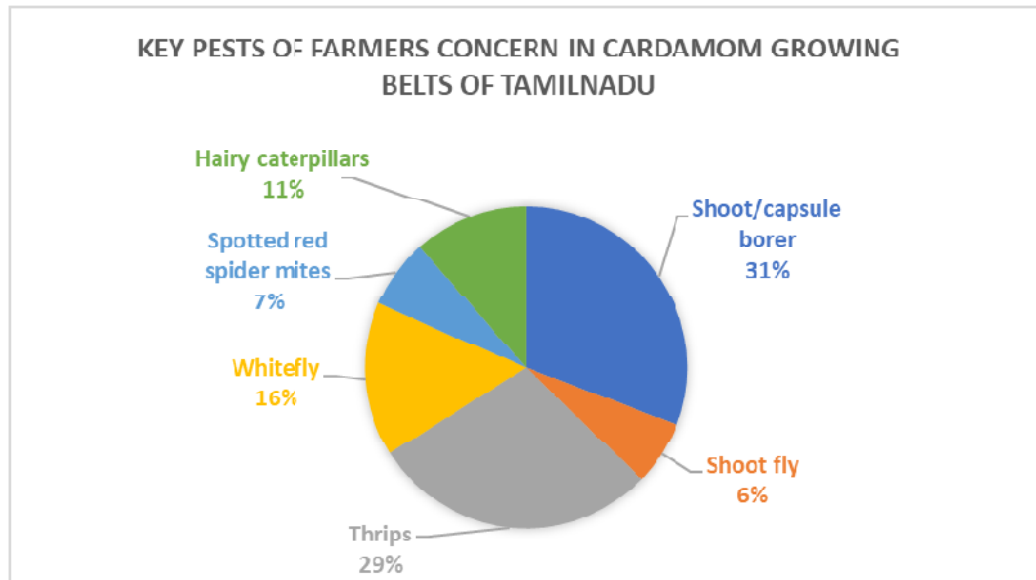
*C. Pest Status in the cardamom ecosystem*

The survey results depicted that shoot/capsule borer, *Conogethis punctiferalis* (Guenee) caused more damage (85.42 %) followed by thrips *Sciothrips cardamom* (Ramakrishna) (79.85 %), whitefly, *Kanakarajiella cardamomi* (David and Subramaniam) (43.03 %), hairy caterpillars, *Eupterote cardamom* (Reng.) (31.85 %), spotted red spider mites, *Dolyhotetranychus floridanus* (Banks) (19.43 %) and shoot fly, *Formosina flaviceps*

(Mall). similar results were recorded by (Murugan *et al.*, 2017, Vijayan *et al.*, 2018) shown in Fig. 1. In Theni district thrips incidence was high while in Nilgiris and Namakkal incidence of shoot/capsule borer was high. Shoot fly infestation was more in Theni (25%) whereas in Nilgiris and Namakkal infestation was about 16.6 and 18.05 per cent respectively. The various insect pests infesting the cardamom ecosystem are shown in Table 3.

**Table 3: Pest scenario of cardamom in surveyed area.**

Pest status			Percentage response			Mean %
Common name	Scientific name	Family / Order	Theni	The Nilgiris	Namakkal	
<b>1. Borers</b>						
Shoot/capsule borer	<i>Conogethis punctiferalis</i>	Pyraustidae; Lepidoptera	75.0	100	81.2	85.4
Shoot fly	<i>Formosina flaviceps</i> (Mall.)	Chloropidae; Diptera	25.0	16.6	12.5	18.0
<b>2. Sap feeders</b>						
Thrips	<i>Sciothrips cardamom</i>	Thripidae; Thysanoptera	87.5	83.3	68.7	79.8
Whitefly	<i>Kanakarajiella cardamomi</i>	Aleyrodidae; Hemiptera	31.2	66.6	31.2	43.0
Spotted red spider mites	<i>Dolyhotetranychus floridanus</i>	Tenuipalpidae Trombidiformes	18.7	33.3	6.25	19.4
<b>3. Defoliators</b>						
Hairy caterpillars	<i>Eupterote cardamom</i>	Eupterotidae; Lepidoptera	43.7	33.3	18.7	31.8



**Fig. 1.**

#### D. Pesticides used in the cardamom ecosystem

Survey revealed that on an average 19 pesticides are most frequently used by the farmers in the cardamom ecosystem (Table 4). The pesticides include profenophos 50% EC, quinolphos 25% EC, monocrotophos 36% SL, imidacloprid 17.80% SL, cypermethrin 5% EC, lamda cyhalothrin 5% EC, acetamiprid 20% SP, emamectin benzoate 5% SG, chlorantraniliprole 18.50% SC, fipronile 5%SC, flubendiamide 39.35% SC, chloropyriphos 20.00% EC, flonicamid 50.00% WG and spirotetramat 24 % SC. Among the pesticides, profenophos was most commonly used by the farmers (78.5 %) followed by lambda-cyhalothrin 5% EC (65.3 %). Farmers were also used insecticide mixtures like cypermethrin 5% EC + chloropyriphos 50 % EC and acephate 50% WP + buprofezin 20% WP. Shoot and capsule borer consumed

more insecticide sprays (*Conogethes functiferalis* Guen.) followed by thrips (*Sciothrips cardamomi* Ramk.), leaf feeders and whiteflies (*Basilepta fulvicorne* Jacoby) in order (Murugan *et al.*, 2014). Cardamom is also attacked by diseases like capsule rots (Azhukal disease) and rhizome rot. To manage these diseases farmers sprayed fungicides like copper oxychloride 50% WP and tebuconazole. Central Insecticide Board and Registration Committee (CIB & RC) approved four insecticides - quinolphos 25% EC, Monocrotophos 36% SL, lambda-cyhalothrin 4.9% CS and diafenthiuron 50 % WP and two fungicides - copper oxychloride 50% WP and fosetyl-AL 80% WP for management of pest in cardamom. However, the rest of pesticides registered and recommended for the control of pest in other crops.

**Table 4: List of pesticides used in cardamom ecosystem of Tamil Nadu.**

S. No	Name of pesticides	Chemical group	Percentage respondents			Mean %
			Theni	The Nilgiris	Namakkal	
<b>Insecticides</b>						
1	Profenophos 50.00% EC	Organophosphate	87.5	66.6	81.2	78.5
2	Quinolphos 25.00% EC	Organophosphate	37.5	50.0	56.2	47.9
3	Monocrotophos 36% SL	Organophosphate	50.0	33.3	43.7	42.4
4	Imidacloprid 17.80% SL	Neonicotinoid	75.0	83.3	37.5	65.3
5	Cypermethrin 5% EC	Synthetic pyrethroids	25.0	66.6	31.2	41.0
6	Lamda Cyhalothrin 5 %EC	Synthetic pyrethroids	62.5	66.6	81.2	70.1
7	Acetamiprid 20% SP	Neonicotinoid	31.2	33.3	37.5	34.0
8	Emamectin Benzoate 5% SG	Avermectins	43.7	50.0	50.0	47.9
9	Chlorantraniliprole 18.50% SC	Diamide	37.5	33.3	81.2	50.7
10	Fipronil 5%SC	Phenylpyrazoles	50.0	66.6	31.2	49.3
11	Flubendiamide 39.35 % SC	Diamide	12.5	16.6	25.0	18.1
12	Chloropyriphos 20.00% EC	Organophosphate	62.5	50.0	68.7	60.4
13	Flonicamid 50.00% WG	Pyridine carboxamide	25.0	16.6	18.7	20.1
14	Flubendiamide 39.35% SC	Diamide	12.5	33.3	25.0	23.6
15	Spirotetramat 24 % SC	Tetronic and Tetramic acid derivatives	25.0	16.6	50.0	30.6
<b>Insecticide mixtures</b>						
16	Cypermethrin 5 % EC + Chloropyriphos 50 %EC	-	50.0	50.0	62.5	54.2
17	Acephate 50% WP + Buprofezin 20% WP	-	31.2	16.6	50.0	32.6
<b>Fungicides</b>						
18	Tebuconazole 38.39% SC	Triazole	36.2	26.8	58.6	78.2
19	Copper oxychloride 50% WP	Copper	12.9	42.7	62.8	62.3

#### E. General Awareness on Handling of Pesticides by Farmers

Detailed pesticide usage pattern followed by the cardamom growing farmers depicts (Table 5.) that the majority of the farmers got the source of information on pesticide recommendations from pesticide retail shop (74.4 %) followed by fellow farmers (16 %) and

horticulture officer (16 %). (Meenambigai *et al.*, 2017; Prakash *et al.*, 2021; Ramakrishnan *et al.*, 2015; Anjali *et al.*, 2018; Ngowi *et al.*, 2007; Biradar *et al.*, 2021). Earlier reports also shown the similar result on the source of information on pesticide recommendations. Only 25.5 per cent of farmers followed recommended dosage of pesticides and the rest of the farmers don't

have knowledge of the recommended dosage for the cardamom pest management. (Gaikwad *et al.*, 2016; Abunyuwah *et al.*, 2019). While spraying pesticides 78.5 per cent of farmers used bottle caps for measurement of pesticides and most of them (91.7 %) used sticks for mixing pesticides in the spray tank. Based on time of application, 37.5 per cent of farmers spray in the morning and 75 per cent of farmers sprayed in the evening. (Jamali *et al.*, 2014). It is unfortunate to

state that 72.2 per cent of farmers are not following safety measures during the handling of pesticides (Devi, 2009; Balasha *et al.*, 2019). Before beginning spraying, 41 per cent of farmers paid attention to the label, 52.5 per cent of farmers sprayed pesticides at fortnight intervals while 79.2 per cent of farmers sprayed pesticides based on pest infestation. The waiting period, which they observed as a pre-harvest gap of seven days, was followed by all farmers.

**Table 5: Knowledge level of Cardamom farmers on pesticide use and usage pattern.**

S. No.	Pesticide usage pattern	Theni		The Nilgiris		Namakkal		Mean
		No.	%	No.	%	No.	%	
<b>1. Source of information on pesticide recommendation</b>								
1.	Fellow farmers	2	12.5	1	16.6	3	18.75	16.0
2.	Pesticide retail shop	13	75	4	66.6	13	81.25	74.4
3.	Horticulture officer	1	6.25	1	16.6	4	25	16.0
<b>2. Measurement of pesticide</b>								
4.	Bottle cap	13	81.25	4	66.6	15	87.5	78.5
5.	Approximately	3	18.75	2	33.3	2	12.5	21.5
<b>3. Mixing of pesticide</b>								
6.	Stick	14	87.5	6	100	15	87.5	91.7
7.	Hand	2	12.5	0	0	2	12.5	8.3
<b>4. Safety methods followed while spraying</b>								
8.	No safety method	11	81.25	4	66.6	11	68.75	72.2
9.	Mouth and nose cover	3	18.75	2	33.3	5	31.25	27.8
10.	Gloves	2	12.5	4	66.6	3	18.75	32.6
<b>5. Attention towards label</b>								
11.	Reading label before use	5	31.25	4	66.6	4	25	41.0
12.	No attention towards labels	11	68.75	2	33.3	12	75	59.0
<b>6. Dose</b>								
13.	Recommended dose	3	18.75	2	33.3	4	25	25.7
14.	Approximate dose	13	81.25	4	66.6	12	75	74.3
<b>7. Type Of Sprayer Used</b>								
15.	Hand sprayer	3	18.75	1	16.6	4	25	20.1
16.	Power sprayer	13	81.25	5	83.3	12	75	79.9
<b>8. Time Of Application of Fertilizers</b>								
17.	Morning	8	43.75	2	33.3	6	37.5	34.0
18.	Afternoon	1	6.25	0	0	1	6.25	4.2
19.	Evening	7	43.75	6	100	14	75	72.9
<b>9. Temporal Frequency of Application of Pesticides in Cardamom</b>								
20.	Weekly interval (7 days)	4	18.75	2	33.3	1	6.25	19.4
21.	Fortnight interval (10-14 days)	6	37.5	3	50	11	68.75	52.1
22.	Related to pest infestation	6	37.5	6	100	16	100	79.2
<b>10. Pre-harvest interval followed</b>								
23.	No waiting period	0	0	0	0	0	0	0.0
24.	1 day	0	0	0	0	0	0	0.0
25.	3 days	1	6.25	2	33.3		18.75	19.4
26.	7 days	15	93.75	4	66.6	13	81.25	80.5
<b>11. Disposal of pesticide container</b>								
27.	Buried in soil	1	6.25	1	16.6	3	18.75	13.9
28.	Leaving them randomly by the field	5	31.25	2	33.3	11	68.75	44.4
29.	Thrown in neglected area	10	68.75	3	50	6	37.5	52.1

Only a few farmers practiced good agricultural practices for disposal of used pesticide containers by burying them in the ground, while the majority of farmers (96.5 %) dumped empty pesticide containers in their own fields or in open space (Ntow *et al.*, 2006; Ali *et al.*, 2022). The present survey concluded that pesticide use and consumption patterns, frequent interventions are required to encourage the safer use of insecticides in the cardamom crop.

## CONCLUSION

Cardamom was attacked by various pests like shoot and capsule borer, thrips, whiteflies, spotted red spider mite and hairy caterpillars. In the changing scenerio, thrips, shoot and capsule borer became the most prevalent pest. Farmers mainly used pesticides belonging to organophosphorus and newer molecules as per the recommendations of pesticide dealers. Farmers' knowledge of pesticide risk as evident from the use of stick to mix pesticides, use of measuring caps, avoiding reusing of pesticide containers for household reasons and adhering to waiting periods. On the other hand, farmers' understanding of prescribed pesticides, dosage, label claims, and personnel protection during spray activities, were deficient. As a result, farmers must be educated on pesticide choices, the importance of adopting the recommended dosage, and pesticide hazards on the environment and individuals.

## FUTURE SCOPE

For the management of cardamom insect pests and diseases, farmers are advised to use recommended, less persistent pesticides and follow good agricultural practices. In Future scope, to reduce consumer risk and pesticide persistence will be evaluated by conducting supervised field trials to analyse the pesticide residues.

**Conflict of interest.** None.

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