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Insect Pests, Pesticides and their usage Pattern in Coriander in Tamil Nadu

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ABSTRACT: A systematic purposive random survey was undertaken to better understand farmers' attitude on pesticide use and usage patterns in coriander from five main growing areas in Tamil Nadu, India. Coriander aphid, whiteflies, thrips and tobacco caterpillar were found to infest coriander crop among which coriander aphid is a major insect pest. For the management of aphid and other sucking pests, the most often applied pesticides were imidacloprid 17.8% SL, imidacloprid 70% WG, flonicamid 50% WG, acetamiprid 20% SP and monocrotophos 36% SL. Pesticide dealers are an important source of information for farmers when it comes to pesticide recommendations (61.33%). The Central Insecticide Board and Registration Committee has not given any recommendation of insecticides in coriander. Survey revealed usage of restricted pesticide and that insecticides usage was dominated by neonicotinoids followed by organophosphates and the newer molecule, flonicamid. Neonicotinoids are highly lethal to honey bees which play a major role is seed yield in coriander. Flonicamid recommended by CIBRC for management of all sucking pests in cotton may be a good alternative to neonicotinoids against pests of coriander.

Keywords: Coriander, Survey, Pests, Pesticides, Neonicotinoids.

INTRODUCTION

Coriander (*Coriandrum sativum* L.) also known as Chinese parsley, dhania or cilantro is an annual herb. Although all parts of the plant are edible, the fresh leaves with strong aroma and dried seeds (used as a spice) are more commonly utilised in India. Its name is derived from the Greek word koris, which means "stink insect". The presence of trans-tridecen in the oil of immature fruits and leaves produces a foul odour known as "stink bug odour" (Mandal *et al*., 2015). Coriander originated from Italy but today it is cultivated across the world including Central and Eastern Europe, the Mediterranean region, China, India, and Bangladesh (Baliga *et al.*, 2015**)**. It's leaves, blossoms, seeds and roots are used to flavour rice, sausages and soups (Kumar *et al*., 2016). The coriander seed, in addition to its culinary application, has many medicinal importance and has been used to treat respiratory, digestive and urinary system illnesses. It has a wide range of pharmacological actions, including carminative, diaphoretic, and diuretic properties. Antihypertensive, antimutagenic, sedative-hypnotic, anticonvulsant, cholesterol-lowering, anticancer, anxiolytic, and anti-ulcer properties are also reported (Baliga *et al*., 2015: Nimish *et al*., 2011). Vitamin C, vitamin A, iron, manganese, thiamine, and dietary fibre are all abundant in coriander leaves while the seeds are rich in potassium, calcium, phosphorus, magnesium, sodium, and zinc. It's essential oil and extracts have antibacterial, antifungal, and antioxidative properties, and thus help to extend the shelf life of foods by preventing rotting (Bhat *et al*., 2014).

India's annual production of coriander seeds is over 710 thousand metrics (Horticultural Statistics at a Glance, 2018) that amounts to 80% of the total coriander seeds produced worldwide (Sharma *et al*., 2014).

Among biotic stresses, insects play crucial role in determining the yield of coriander. The insect pests that infest coriander are aphids, *Hyadaphis coriandri*, (Hemiptera: Aphididae), whitefly, *Bemisia tabaci* (Hemiptera: Aleyrodidae), thrips, *Thrips tabaci* (Swami *et al*., 2018). Other minor insect pests are cut worm, *Agrotis* spp. (Lepidoptera: Noctuidae), seed chalcid fly *Systole coriander* (Hymenoptera: Chalcididae) and tobacco caterpillar, *Spodoptera litura* (Satyagopal *et al*., 2014), pentatomid bug, *Nezara viridula* and storage pests *Lasioderma serricorne* and *Trogoderma granarium* (Butani, 1984). Mite pest, *Petrobia latens* was reported by Swami *et al*. (2018). Coriander, despite its importance as a vegetable, has not been well

studied in terms of insect pest dynamics and pesticides usage pattern. With this background detailed survey was done to know pest incidence and pesticide usage pattern in coriander crop.

MATERIALS AND METHODS

A detailed survey was conducted in major coriander growing districts of Tamil Nadu, *viz*., Virudhunagar, Tiruppur, Coimbatore, Dharmapuri and Krishnagiri during November, December of 2021 and January, February of 2022.

Survey on insect pests and pesticide usage pattern in coriander. As information pertaining to crop production practices in coriander was meagre, a detailed survey was carried out to collect data on different elements such as pests incidence, pest severity, type of pesticide used, dose, frequency, type of sprayer used, source of information and safety precautions taken during coriander cultivation.

Details of study area. Major coriander growing districts of Tamil Nadu *viz*., Virudhunagar, Tiruppur, Coimbatore, Dharmapuri and Krishnagiri (Fig. 1). Furthermore, blocks and villages were selected in each district based on information obtained from office of the Assistant Director of Horticulture located in respective districts.

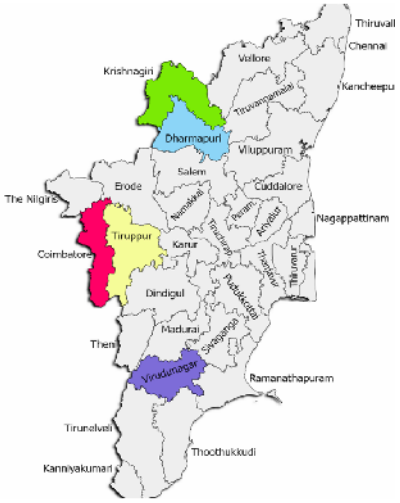

Fig. 1. Area surveyed for pest and pesticide usage patterns in coriander in Tamil Nadu.

Nature and source of data. The information on pest and pesticide use pattern in coriander was collected from around 15 farmers from each district. A total of 75 farmers were questioned, and data was gathered using an appropriate questionnaire. Each district, block and village from where the survey was conducted is given in the Table 1. Face-to-face interaction was carried out with individual farmers in a casual manner with simple questions to collect the required information Fig. 3. The questionnaire had 43 items with 3 major parts that gives information about farmer, crop production practices, insect pests, type of insecticides used, insecticide use and spray pattern. The purpose of interaction and survey was clearly explained to farmers for their fair reply.

Table 1: Details of coriander fields surveyed in Tamil Nadu.

Sr. No.	District	Block	Village	Number of respondents per village	Number of respondents per district
1	Tiruppur	Udumalaipettai	Anthiyur	9	15
			Mukkonam	4	
			Ragalbavi	2	
2	Krishnagiri	Hosur	Hospalli	2	15
			Ulagam	6	
			Palavanapalli	3	
		Uttangarai	Singarpettai	4	
3	Virudhunagar	Aruppukottai	Kurundamadam	5	15
			P.Puliampatti	5	
			Kovilangulam	10	
4	Dharmapuri	Karimangalam	Elumichanahalli	4	15
			Bommahalli	3	
			Erraseegalahalli	2	
		Pennagaram	Madhehalli	6	
5	Coimbatore	Thondamuthur	Muthipalayam	3	15
			Booluvampatti	4	
			Kempanur	2	
		Sultanpet	Poorandampalayam	3	
			Vadavedampatti	3	

Questionnaire format had three major parts.
Part 1: The farmers' basic information (Name, age, education and family details)
Part 2: Production information (Size of land area, crop data and previous crop grown)
Part 3: Pesticides use information (Pest status, pesticides used, source of information, awareness about label information, pesticide details, dose, number of sprays, gap between sprays waiting period and safety precautions).

Morphological identification of coriander thrips: Thrips were collected form coriander field from Coimbatore and preserved in 70% alcohol solution which was used for taxonomic identification.
To get a meaningful conclusion, the survey data was categorized according to requirement and data was analysed using various descriptive statistical tools like mean, percentage and standard deviation to analyse the factors influencing pesticide usage pattern.


Thrips nymph


Damage

Fig. 2. Thrips nymph and its damage symptom in coriander.

RESULTS AND DISCUSSION

Socio-economic factors of surveyed farmers. Socio-economic factors of farmers is given in Table 2. Survey revealed that majority of farmers involved in coriander farming are males (77.33%) and females (22.67%). These findings are in line with the World Bank's data on female labour force participation rate which is around 26.2 percent (World bank, 2022). The average age of surveyed farmers was 46.62 ± 9.73. It is accordance with the results of input survey (DAC&FW, 2016) which indicates that the average age of Indian farmers was 50.1 years. According to the survey, the maximum number of operational land holders belonged to the age group of 51-60 years, followed by the age group of 41-50 years. Land holding of coriander farmers ranged from 0.08 to 3.6 ha with average land holding of 0.738 ± 0.43 ha. This result is in line with the report of policy note 2021, which states that average size of land holding in Tamil Nadu is 0.75 ha (GOTN Policy Note, 2021). Majority of the respondents (77.33%) were marginal farmers (below 1.00 ha.) that was consistent with the data of the Agriculture Census (DAC&FW, 2019) which reported that 68.45% of Indian agriculture landowners are marginal farmers.

Pest status in coriander ecosystem. The insect pests that infest coriander in different coriander ecosystems in Tamil Nadu are shown in Table 3. Present research survey revealed that aphids, whiteflies and thrips are the major insect pests attacking coriander crop. Thrips nymph and its damage symptom in coriander is given in Fig. 2. Coriander is attacked majorly by various sucking and few chewing insect pests. Aphids (*Hyadaphis coriandri*, *Aphis gossypii* and *Myzus persicae*), thrips (*Thrips tabaci*, *Scirtothrips dorsalis* and *Frankliniella schultzei*), seed wasp (*Systole albipennis*), painted bug (*Bagrada hilaris*) and tobacco caterpillar (*Spodoptera litura*) were reported to have pest status (Meena *et al*., 2017). The thrips infecting coriander crop in Coimbatore and Tiruppur region during the survey was confirmed to be *Thrips* spp. The species has to be confirmed again. District wise aphid problem was high in Tiruppur and Coimbatore followed by Krishnagiri and Dharmapuri. Again, aphid emerged as a serious problem across the insect pest spectrum infesting coriander. Swami *et al*. (2018) reported coriander aphid (*H. coriandri*) as a serious pest in coriander belt of India. In Krishnagiri, aphids and whiteflies were the major insect pests infesting coriander. In Virudhunagar, very less/no incidence of insect pests in was observed as said by farmers.

Table 2: Socio-economic factors of the farmers.

Variables	Mean	Standard deviation
Age (Years)	46.62	9.73
Family size	5.21	1.26
Education (Years)	5.84	5.34
Farming experience (Years)	9.44	6.28
Size of the holding (Hectare)	0.74	0.43

Table 3: Pest scenario of coriander crop in surveyed areas and crop production information.

Pest status			Percentage respondents					Mean (%)
Common name	Scientific name	Family / Order	Tiruppur	Krishnagiri	Virudhu nagar	Dharma puri	Coimbatore	
I) Leaf feeders								
Tobacco caterpillar	*Spodoptera* spp.	Noctuidae; Lepidoptera	30	13	-	13	-	11.33
II) Sap feeders								
Aphid	*Hyadaphis coriandri*	Aphididae; Hemiptera	80	73	13	60	80	61.33
Whitefly	*Bemisia tabaci*	Aleyrodidae: Hemiptera	20	73	13	27	40	34.67
Thrips	*Thrips* spp.	Thripidae; Thysanoptera	67	47	7	47	87	50.67

Sr. No.	Crop production information		Tiruppur	Krishnagiri	Virudhu nagar	Dharm puri	Coimba tore
1.	Previous crops		Maize, bengal gram, horse gram.	Groundnut, tomato chilli and mint.	Maize, sorghum, green gram.	Sorghum, ragi, brinjal and Indian bean	Onion, groundnut and tomato.
2.	Coriander crop duration	Seed purpose	75-80 Days	-	70 -75 Days	75-85 Days	70-75 Days
		leaf purpose	-	40- 45 Days	-	35- 40 Days	35- 45 Days
3.	Cropping pattern	Mono cropping	93	100	13	93	100
		Multiple cropping	7	-	87	7	-

Tiruppur

Virudhunagar

Fig. 3. Interaction with farmers.

Duration of coriander crop depended on the purpose of the crop. For leaf purpose, the crop was maintained for 30 to 40 days and for seed purpose, it varied from 90 to 100 days. Farmers of Virudhunagar and Tiruppur grew coriander crop mainly for seeds. In Dharmapuri, Krishnagiri and Coimbatore, coriander was mainly raised for leaf purpose. Most of the farmers of Tiruppur (93%), Coimbatore (100%), Dharmapuri (93%) and Krishnagiri (100%) followed monocropping whereas respondents of Virudhunagar (87%) followed intercropping with carom, *Trachyspermum ammi*.

Pesticides used in coriander ecosystem. Survey revealed that sucking insect pests are the major insect problem in coriander. The most common insecticides used for the management of sucking pests were imidacloprid 17.8% SL, imidacloprid 70% WG, acetamiprid 20% SP, acephate 75 % SP, flonicamid 50% WG, thiamethoxam 25 % WG and monocrotophos 36% SL (Table 4). Coriander crop is also susceptible to diseases like grain mould and powdery mildew which cause significant yield loss. To manage diseases, commonly used fungicides are carbendazim 12%+ mancozeb 63% WP, sulphur 85% DP and propiconazole 25% EC. Although the Central Insecticide Board and Registration Committee (CIBRC)has not approved any pesticides for the coriander crop, all of the above insecticides are recommended for the control of sucking insect pests in other crops (CIBRC, 2021). Out of 11 pesticides used in coriander in surveyed area, two were pre mix pesticides. The survey result shows the prevalent use of non-recommended pesticides for pest management in coriander. Insects that attack coriander may develop cross resistance if non-recommended premix combo insecticides are used. Insecticide usage in coriander crop is dominated by neonicotinoids followed by organophosphates. Neonicotinoids such as imidacloprid and thiamethoxam are highly lethal to honey bees (Decourtye *et al*., 2010). Again, neonicotinoids are odourless and tasteless chemicals which put the bee colony at risk of pesticide exposure (Sowmiya *et al*., 2022). Flonicamid, which is recommended by CIBRC for management of aphids, jassids, thrips and whiteflies in cotton may be a good alternative to neonicotinoids against pests of coriander. Monocrotophos which is banned for usage in vegetables (GOI DPPQ&S, 2022) is said to be used by majority of respondents of Tiruppur Dt. This indicates lack of awareness among the farmers and the failure of implementation of regulations.

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

Sr. No.	Pesticides used	Chemical group	Percentage respondents					Mean (%)
			Tiruppur	Krishna giri	Virudhu nagar	Dharma puri	Coimba tore	
Pesticide mixtures								
1.	Carbendazim 12%+ Mancozeb 63% WP	Benzimidazoles + Dithiocarbamate	0	40	0	13	20	14.67
2.	Acephate 50% + Imidacloprid 18% SP	Organophosphate + Neonicotinoids	20	20	0	7	13	12.00
Insecticides								
3.	Imidacloprid 17.8% SL	Neonicotinoid	20	33	0	33	27	22.67
4.	Imidacloprid 70% WG	Neonicotinoid	20	27	0	13	13	14.67
5.	Acetamiprid 20% SP	Neonicotinoid	0	33	0	20	27	16.00
6.	Monocrotophos 36% SL	Organophosphate	47	20	0	0	0	13.33
7.	Acephate 75 % SP	Organophosphate	0	13	0	13	20	9.33
8.	Flonicamid 50% WG	Pyridinecarboxamide	0	0	0	7	27	6.67
9.	Thiamethoxam 25 % WG	Neonicotinoid	0	20	0	13	20	10.67
Fungicides								
10.	Sulphur 85% DP	Inorganic Sulphur	80	40	33	33	40	45.33
11.	Propiconazole 25% EC	Triazole	20	13	0	13	27	14.67

Pesticide usage pattern in coriander ecosystem. Pesticide usage pattern of coriander farmers of Tamil Nadu is given in Table 5. Survey data indicated that over 61.33% of farmers get information on pesticide recommendation from pesticide retailers followed by fellow farmers (30.6%) and very less from extension functionaries (8.00%). Similar results were obtained by many other researchers (Shetty *et al*., 2010; Prakash *et al*., 2021; Satya Sai *et al*., 2019). The vast majority of farmers (52.63 percent) learned about pesticides through retailers (Satya Sai *et al*., 2019). According to survey findings, 98.67 percent of farmers used bottle caps to measure pesticides, while 1.33 percent measured insecticides, approximately. Pesticides are mixed with a stick by all of the respondents (100%). Only 8 percent of farmers paid attention towards the pesticide label. This is much less when compared with the results of Jallow *et al.* (2017) who reported 30 percent response towards label claim. Majority of respondents (89.33%) used no personal protective equipment while spraying the pesticides. Only 9.33 percent of respondents used mouth and nose cover during pesticide spraying and just 1.33 percent of respondents used gloves while pesticides mixing. This is comparable with the result of Sharifzadeh *et al.* (2017) which report that more then 75 percent of farmers don't prefer personal protective equipment and the reason being low availability and high price.

The majority of responders (84.0%) used pesticides in approximate amounts, whereas the rest used pesticides at prescribed doses. Around 94 percent of respondents used power sprayer for pesticides application. Majority of respondents sprayed pesticides during morning hours. These results are in accordance with the findings of Meenambigai *et al*. (2017). In coriander, 136% increase in fruit yield was reported in open pollinated coriander crop in comparison with insect exclusion plots which revealed the importance of pollinator service. Among the insects habituating coriander, honey bees visited most (> 65%) during flowering period (Bhowmik *et al.*, 2017). In this view point, farmers must be educated to take up insecticide spray during evening hours or before the blooming period and advised to go for selective insecticides with lesser persistence and higher safety to honeybees.

Over 88.0 percent of respondents were unaware of waiting period after insecticide application. This waiting period allows to get a reside free produce. For disposal of the pesticide containers, 1.33 percent farmers followed burial in soil, 88.0 percent followed throwing in neglected area and 10.67 percent left empty containers/packets randomly in the field. These findings are comparable with results of Huici *et al*. (2017).

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

Sr. No.	Parameters	Percentage respondents					
		Tiruppur	Krishna giri	Virudhu nagar	Dharma puri	Coimbatore	Mean (%)
Source of information on pesticide recommendation							
1.	Pesticide retail shop	47	67	60	60	73	61.33
2.	Fellow farmers	40	27	27	33	27	30.67
3.	Extension personnel	13	7	13	7	0	8.00
Measurement of pesticide							

4.	Bottle cap	100	93	100	100	100	98.67
5.	Approximately	0	7	0	0	0	1.33
Mixing of pesticide							
6.	Stick	100	100	100	100	100	100.00
7.	Hand	0	0	0	0	0	0
Safety methods followed while spaying							
8.	No safety method	93	93	93	87	80	89.33
9.	Mouth and nose cover	7	7	7	13	13	9.33
10.	Gloves	0	0	0	0	7	1.33
Attention towards label							
11.	Reading label before use	13	7	7	0	13	8.00
12.	No attention towards labels	87	93	93	100	87	92.00
Dose							
13.	Recommended dose	20	13	7	13	27	16.00
14.	Approximate dose	80	87	93	87	73	84.00
Type of sprayer used							
15.	Hand sprayer	7	13	0	7	0	5.33
16.	Power sprayer	93	87	100	93	100	94.67
Time of application of pesticides							
17.	Morning	80	87	87	93	100	89.33
18.	Afternoon	7	7	0	0	0	2.67
19.	Evening	13	7	7	7	0	6.67
Temporal frequency of pesticides application in coriander							
20.	Weekly interval (7 days)	33	27	40	40	53	38.67
21.	Fortnight interval (10-14 days)	40	60	53	40	33	45.33
22.	Related to pest infestation	27	13	7	20	13	16.00
Pre-harvest interval followed							
23.	No waiting period	87	93	100	80	80	88.00
24.	Waiting period followed	13	7	0	20	20	14.47
Disposal of pesticide container							
25.	Buried in soil	7	0	0	0	0	1.33
26.	Thrown in neglected area	73	80	87	100	100	88.00
27.	Leaving them randomly by the field	20	20	13	0	0	10.67

CONCLUSION

Coriander being an important spice and leafy vegetable crop, more importance is required for the development of suitable integrated pest management practices. Implementation of policy regulations by authorities and training of farmers on judicious use of insecticides is needed to ensure quality and safe produce.

FUTURE SCOPE

Considering the importance of sucking pests in coriander, suitable, effective and less persistent insecticides should be selected based on supervised field trials following good agriculture practices.

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