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SURVEY ON PESTS AND THE PESTICIDE USAGE PATTERN OF CAPSICUM IN TAMIL NADU

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ABSTRACT

An extensive survey was carried out among capsicum farmers in districts of Tamil Nadu *viz*., Krishnagiri and The Nilgiris. The Pests like thrips, chilli mite, whitefly, fruit borer, aphid, mealybug, tobacco cut worm, leaf miner and root grub were reported byfarmers in capsicum ecosystem. Among all the insecticides, imidacloprid 17.80% SL was most commonly used in crop protection practices by farmers followed by spirotetramat 15.31%OD.Majority of farmers (71.15%) trusted local pesticide shop dealers for recommendation of pesticides. Only few farmers (29.62%) used recommended dosage of pesticides for spraying. The awareness among farmers onfew aspects of pesticide risk has increased, as seen by usage of measuring caps, avoidance of reusing empty pesticide containers for household activities.In contrast, farmers knowledge onpesticide recommendation, dose, label claims and safety precautions while spray operations were lacking.

Keywords: Capsicum, survey, pesticides, farmer perceptions

1. Introduction

Capsicum (*Capsicum annuum* (L.) var. grossum Sendt.) belongs to the family Solanaceae. The primarycentre of origin of capsicum is Mexico and Guatemala is of secondaryorigin. In India, capsicum was first introduced in the Shimla hills by the British in the 19th century (Sreedhara*et al*., 2013).Capsicum is cultivated all over the world; primarily in temperate regions of Central and South America, as well as in European countries. It is also grown in tropical and subtropical regions of Asia, including India and China. At global level, China stands first in the capsicum production with 16.65 MT. In India, capsicum is cultivated under 0.37lakh ha area with a

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production of 0.56 MT(FAOSTAT, 2020; Indiastat, 2022).Major capsicum growing districts of Tamil Nadu includesKrishnagiri (214 ha), The Nilgiris (19 ha) with a production of 0.51 lakhtonnes(DH and PC, 2020).On worldwide scale, capsicums are among the most popular vegetables that are consumed as raw in salads and sandwiches. Dietary intake of hundred grams of capsicumprovides1.2 g of protein, 870 IU of vitamin A, 11 mg of calcium, 175 mg ofascorbic acid and 2 mg offolic acid with minerals like sodium, potassium, phosphorus, magnesium, iron and selenium to human body and the bioactive compounds help in preventing oxidative cell damage and other degenerative diseases like cardiovascular disease, cancer, alzheimer's disease, parkinson's disease and diabetesin humans (Agarwal *et al*., 2007; Mendoza *et al*., 2015).The yielding potential is affected due to pest infestation like thrips, mites, aphids, whitefly and fruit borers during commercial cultivation. A combined infestation of thrips and mites will account for 50 per cent yield reduction of capsicum (Pathipati*et al*., 2017). Thus, insecticideswere commonly employed in crop protection practices to combat pests and increase the yieldand the practice which mayleave residues on fruiting parts(Indu *et al*., 2022).The United States, Food and drug administration made 41 capsicum refusals from India due to presence of higher pesticide levels than approved (Goyal *et al*., 2017). Despite being an important fresh vegetable, capsicum has limited studies regarding pest dynamics and the pesticide usage pattern in crop protection. With this background, a detailed study was conducted to determine information about pest incidence and pesticide usage pattern in capsicum.

2. Materials and methods

A detailed survey has been under taken in capsicum growing districts of Tamil Nadu *viz*., Krishnagiri and The Nilgirisunder open field and polyhouse condition during the month of January, February and March, 2022. Majority of farmers cultivated capsicum under polyhouse whereas very few farmers cultivate under open field condition.Information regarding the source of information on pesticides, dosage, frequency of spraying, precaution measures, knowledge regarding recommended dosage, safe waiting period, disposal of empty pesticide containers and their socio-economic status were documented.

2.1.Details of study area

The major capsicum growing districts of Tamil Nadu were Krishnagiri and The Nilgiris(Figure 1). Personal effort and information from the Assistant Director of Horticulture office of respective districts were used to identify capsicum growing farmers. A detailed survey was undertaken to investigate the pest status and the pesticide usage pattern in capsicum

ecosystem. Based on the extent of cultivation of capsicumthe districts *viz*., Krishnagiri (214 ha), The Nilgiris (19 ha)were selected and the details of the current survey are given in Table 1.

2.2.Nature and source of data

The present statuson insect pests and pesticide usage pattern was randomly collected from capsicumfarmers of each district. A total of 75 farmers were surveyed from the selected districts. Out of 75 farmers surveyed, only four farmers cultivated capsicum under open field condition, thus the data is majorly related to farmers growing capsicum under polyhouse condition. Farmers were surveyed individually during the study period using the standard questionnaire. The family members involved in field operation activities were also interviewed on input usage, crop protection activities and crop yield. Before starting of the survey, the farmers were clearly mentioned about the purpose of the study, confidentiality of the data and time duration ofthe interview. The general information aboutthe farmers, agronomic practices, crop protection details, pest status, pesticide usage pattern, application methods, source of information on recommended pesticides, awareness on pesticide label information, dosage of insecticides, time of spraying, spray interval, safe waiting period, disposal of empty pesticide containers, knowledge on environment friendly crop protection practices were recorded. The interview was conducted in farmer's native language, tamil.

3.0. Results and discussion

3.1.Socio-economic factors of surveyed farmers

The survey findings showed that, 93.85 per cent of farmers were males and only 6.15 per cent of farmers were females in capsicum cultivation. Similar results have been reported by Berni*et al*. (2021) that 90.3 per cent of farmers were males and 9.7 per cent farmers were females among 402 farmers surveyed. Majority of farmers were in the age of 31-40 (50.38%) and 41-50 (31.15%). Some farmers were in the age greater than 50 (16.92%) with good farming experience. Very few farmers were in the age of 20-30 (1.54%). This result was in line with the findings of Tripathi *et al*. (2020) who stated that the average age of vegetable growers was 30 to 40 years (25%) followed by 40 to 50 years (33%) and 60 years or older (5%).The farmers undergone high school level of education was 31.15 per cent and that of secondary school was 20.77 per cent. Some farmers have done only till primary schooling (18.85%). Very few farmers have completed graduation (8.85%) while 20.38 per cent farmers were illiterate. Regarding farming experience, 44.23 per cent of surveyed farmers possess experience more than 25 years, 16.92 per cent between 16-20 years, 22.31 per cent between 11-15 years, 12.69 per cent between 6-10 years and 4.62 per cent less than 5 years (Table 2).

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3.2.Information on capsicum cultivation

Capsicum is an annual herbaceous crop belongs to the family Solanaceae that is cultivated under monocropping system under open field and polyhouse condition. The common hybrid varieties like Rizwan, Namdhari and Green gold were cultivated under red loamy soil. Most of the farmers followed drip irrigation whereas very few farmers practiced furrow type of irrigation.

3.3.Pests ofcapsicum ecosystem

From the survey it is known that thrips (*Thrips parvispinus*Karny) causes more damage (91.16 %) followed by chilli mite (*Polyphagotarsonemus latus*Banks) (68.08 %), whitefly (*Bemisia tabaci*Gennadius) (43.08 %), fruit borer (*Helicoverpa armigera*Hubner) (56.93 %), aphid (*Aphis gossypii*Glover) (42.31 %), mealybug (*Phenococcussolenopsis*Tinsley) (33.46 %), tobacco cut worm(*Spodoptera litura*Fabricius) (60.39%), leaf miner (*Lyriomyzatrifolii*Burgess) (39.23 %)and root grub (*Holotrichia serrate*Fabricius) (20.00 %).Similar outcomes were recorded by Roopa and Kumar, 2014 where eight different pest species that limits crop production were noted in capsicumecosystem. The pest details infesting under capsicum ecosystem are given in the Table 3, Figure 2.

3.4.Pesticides used in the capsicum ecosystem

According to the survey, farmers spray an average of 21 pesticides for crop protection practices*viz.*,acephate 75% SP, chlorantraniliprole 18.50% SC, chlorfenapyr 10% SC, diafenthiuron 50% WP, chlorpyriphos 20% EC, dimethoate 30% EC, fenazaquin 10% EC, fenpyroximate 5% EC, fipronil 5% SC, flonicamid 50% WG, flubendiamide 39.35% SC, imidacloprid 17.80% SL, hexythiazox 5.45% EC, profenophos 50% EC, propargite 57% EC, spinosad 45% SC, spiromesifen 22.90% SC, spirotetramat 240 SC and combination products likeBeta-Cyfluthrin + Imidacloprid 300 OD (8.49 + 19.81 % w/w), Spirotetramat 11.01% + Imidacloprid 11.01% SC and exodus (Table 4). Among all the pesticides, imidacloprid 17.80% (84.62 %) was most commonly used by farmers followed by spirotetramat 240 SC (71.54 %) for pest managementEven though there is no insecticide approved for usage in capsicum by Central Insecticides Board and Registration Committee (CIB&RC) farmers used pesticides recommended on other crops like chilli, brinjal, tomato, rice and cabbage for the management of sucking pests and borers.

3.5.Farmers general awareness on pesticide handling

The detailed survey on pesticide usage pattern followed by capsicumfarmers shows that the majority of farmers seeks information on pesticide recommendations from pesticide

retail shops (71.15%), followed by neighbour farmers (18.46%) and very few contacthorticultural officers (9.62%). Previous studies found a similar pattern in the source of information on pesticide recommendations (Ramakrishnan *et al*., 2015; Meenambigai*et al*., 2017;Anjali *et al*., 2018;Biradar*et al*., 2021).Among all the farmers only 26.62 per cent followed pesticide dose recommendations, while the remaining farmers were unaware of the practice. Similar and earlier reports are available(Gaikwad and Jirali, 2016; Abunyuwah*et al*., 2019). For spraying, 79.62 per cent of farmers used bottle caps to measure pesticides and majority of them (91.15%) used sticks to mix pesticides in the spray tank.Most of the farmers (67.69 %) sprayed in morning hours, evening hours (18.46 %) and during afternoon hours (13.85%), repectively.It was found that 65.00 percent of farmers do not follow pesticide safety precautions (Balasha*et al*., 2019). Before spraying only 17.69 per cent of farmers paid attention to the labelinformation.About 65.38 per cent farmers sprayed insecticides at weekly intervals, 22.69per cent of farmers sprayed at every fortnightinterval while only 11.92 per cent of farmers sprayedinsecticides based on pest infestation. Majority of the farmers followed a safe waiting period of only one day (56.92%), three days (17.31%), seven days (16.15%) and few farmers (9.62%) followed no safe waiting period and harvested the fruits immediately after spraying.Very few farmers (13.85%) buried empty pesticide containers, whereas majority of farmers (68.46%) dispose pesticides bottles in neglected area, few farmers (18.46%) leave them on the field itself(Table 5). The results were in accordance with Ali *et al*. (2022). The survey on pesticide usage patterns showed thatmore awareness on safe usage of pesticides is required among farmers.

4.0. Conclusion

Capsicum was frequently infested by various pests like thrips, mites, whitefly, green house whitefly, aphid, fruit borer, mealy bug, root grub, leaf miner and beet armyworm. Among all pests, thrips and mites play an important role in reduction of capsicum fruits. To combat the pest damage, farmer's spray pesticides belonging to organophosphorus, neonicotinoid and newer pesticide molecules that is recommended by the pesticide dealers. Farmer's use of measuring caps, use of stick for mixing pesticides and their avoidance of reusing pesticide containers for domestic use are all indications that they are aware of the risks associated with pesticides. In contrast, farmer's knowledge of recommended pesticides, dose, label claims and safety during spraying operations were inadequate.Thus, awareness among farmers is needed on selection of pesticide, significance of spraying recommended dosage and risksassociated with pesticides on the environment and living organisms. During

the survey period farmers are advised to use recommended pesticides for crop protection practices and to follow Good Agricultural Practices.

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Competing Interests

"The authors affirm that they have no conflict of interests"

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

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S. No.	District	Block	Village	Number of respondents per blocks	Total number of respondents per district
1.	Krishnagiri	Kelamangalam	Anusunai	15	65
			Akkondapalli		
		Sholagiri	Alur	10	
			Berigai		

			Chembarasanapalli		
		Hosur	Bagalur	10	
			Gudisetlu		
			Lingapuram		
			Nagondapalli		
			Sathyamangalam		
		Denkanikotai	Bithireddi	25	
			Kempatti		
			Ulimangalam		
		Thally	H. Settipalli	5	
2.	The Nilgiris	Udhagamandalam	Masagal	7	10
			Masinagudi		
			Ebbanad		
			Dhavani		
		Gudalur	Nellakotta	3	
			Srimadurai		

Table 2. General characteristics of capsicum farmers

S. NO.	Particulars	Respondents (%)
1.	**Age (years)**	
	20-30	1.54
	31-40	50.38
	41-50	31.15
	>50	16.92
2.	**Education**	
	Illiterate	20.38
	Primary school	18.85
	Secondary school	20.77
	High school	31.15
	College	8.85

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3.	**Farming experience**	
	>5	4.62
	6-10	12.69
	11-15	22.31
	16-20	16.92
	>25	44.23

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Table 3. Pests recorded in capsicum ecosystem, Tamil Nadu

S. No.	Common name	Scientific name	Family; Order	Respondents*				Mean %
				Krishnagiri		The Nilgiris		
	Borer			**No**	**%**	**No**	**%**	
1.	Fruit borer	*Helicoverpa armigera* (Hubner)	Noctuidae; Lepidoptera	35	53.85	6	60.00	56.93
	Root grub	*Holotrichia serrate* (Fabricius)	Scarabaeidae; Coleoptera	13	20.00	2	20.00	20.00
2.	**Sap feeder**							
	Thrips	*Thrips parvispinus* (Karny)	Thripidae; Thysanoptera	60	92.31	8	80.00	91.16
	Aphid	*Aphis gossypii* (Glover)	Aphididae; Hemiptera	29	44.62	4	40.00	42.31
	Whitefly	*Bemisia tabaci* (Gennadius)	Aleyrodidae; Hemiptera	43	66.15	2	20.00	43.08
	Chilli mite	*Tetranychusurticae*(Koch)	Tetranychidae; Trombidiformes	56	86.15	5	50.00	68.08
	Mealy bug	*Phenacoccussolenopsis*(Tinsley)	Pseudococcidae; Hemiptera	24	36.92	3	30.00	33.46
3.	**Leaf feeder**							
	Leaf miner	*Lyriomyzatrifolii*(Burgess)	Agromyzidae; Diptera	25	38.46	4	40.00	39.23
	Tobacco cut worm	*Spodoptera litura*(Hubner)	Noctuidae; Lepidoptera	33	50.77	7	70.00	60.39

* Multiple answers possible

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Table 4. Information on pesticides used by farmers in capsicum ecosystem, Tamil Nadu

S. No	Name of pesticides	Respondents*				Mean percentage
		Krishnagiri		The Nilgiris		
		No.	%	No.	%	
1	Acephate 75.00% SP	3	4.62	3	30.00	17.31
2	Chlorantraniliprole 18.50% SC	5	7.69	4	40.00	23.85
3	Chlorfenapyr10% SC	37	56.92	0	0.00	28.46
4	Chlorpyriphos 20.00% EC	1	1.54	1	10.00	5.77
5	Diafenthiuron50 % WP	7	10.77	0	0.00	5.38
6	Dimethoate 30.00% EC	1	1.54	2	20.00	10.77
7	Fenazaquin10 % EC	5	7.69	2	20.00	13.85
8	Fenpyroximate5 % EC	4	6.15	0	0.00	3.08
9	Fipronil 5 % SC	0	0.00	3	30.00	15.00
10	Flonicamid 50.00% WG	39	60.00	7	70.00	65.00
11	Flubendiamide 39.35% SC	2	3.08	4	40.00	21.54
12	Hexythiazox 5.45% EC	49	75.38	5	50.00	62.69
13	Imidacloprid 17.80% SL	58	89.23	8	80.00	84.62
14	Profenopos 50.00% EC	1	1.54	4	40.00	20.77

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15	Propargite57 % EC	1	1.54	1	10.00	5.77
16	Spinosad 45 % SC	0	0.00	1	10.00	5.00
17	Spiromesifen 22.90% SC	30	46.15	6	60.00	53.08
18	Spirotetramat 15.31%OD	41	63.08	8	80.00	71.54
Pesticides mixtures						
19	Imidacloprid 19.81 % + Beta cyfluthrin 8.49% w/w	35	53.85	1	40.00	46.92
20	Spirotetramat 11.01% + Imidacloprid 11.01% w/w SC	9	13.85	2	10.00	11.92
Others						
21	Exodus	10	15.38	2	20.00	17.69

***** Multiple answers possible

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Table 5. Knowledge level of farmers on pesticide usage pattern on capsicum ecosystem, Tamil Nadu

S. No.	Pesticide usage pattern	Respondents*				Mean %
		Krishnagiri		The Nilgiris		
		No.	%	No.	%	
1.	**Source of information on pesticide recommendation**					
	Fellow farmers	11	16.92	2	20.00	18.46
	Pesticide retail shop	48	73.85	7	70.00	71.15
	Horticulture officer	6	9.23	1	10.00	9.62
2.	**Measurement of pesticide**					
	Bottle cap	58	90.00	7	70.00	79.62
	Approximately	7	7.500	3	30.00	20.38
3.	**Mixing of pesticide**					
	Stick	60	97.50	9	90.00	91.15
	Hand	5	2.50	1	10.00	8.85
4.	**Safety methods followed while spraying**					
	No safety method	39	62.50	7	70.00	65.00
	Mouth and nose cover	14	25.00	0	0	10.94
	Gloves	11	12.50	3	30.00	23.59
5.	**Attention towards label**					
	Reading label before use	10	12.50	2	20.00	17.69

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	No attention towards labels	55	87.50	8	80.00	82.31
6.	**Dose**					
	Recommended dose	19	22.50	3	30.00	29.62
	Approximate dose	46	77.50	7	70.00	70.38
7.	**Type of sprayer used**					
	Hand sprayer	14	15.00	2	20.00	20.77
	Power sprayer	51	85.00	8	80.00	79.23
8.	**Time of application of pesticides**					
	Morning	49	77.50	6	60.00	67.69
	Afternoon	5	10.00	2	20.00	13.85
	Evening	11	12.50	2	20.00	18.46
9.	**Temporal frequency of pesticides application in capsicum**					
	Weekly interval (7 days)	46	70.77	6	60.00	65.38
	Fortnight intervel (10-14 days)	10	15.38	3	30.00	22.69
	Related to pest infestation	9	13.85	1	10.00	11.92
10.	**Pre-harvest interval followed**					
	No waiting period	6	9.23	1	10.00	9.62
	1 day	35	53.85	6	60.00	56.92
	3 days	16	24.62	1	10.00	17.31
	7 days	8	12.31	2	20.00	16.15

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11.	**Disposal of pesticide container**					
	Buried in soil	5	7.69	2	20.00	13.85
	Leaving them randomly by the field	11	16.92	2	20.00	18.46
	Thrown in neglected area	50	76.92	6	60.00	68.46
12.	**Pest management practices**					
	Predators	8	12.31	2	20.00	16.15
	Parasitoids	11	16.92	3	30.00	23.46
	Entomopathogens	16	24.62	7	70.00	47.31
	IPM	22	33.85	8	80.00	56.92
	Pheromone traps	9	13.85	3	30.00	21.92
	Yellow sticky traps	16	24.62	6	60.00	42.31
	Plant products	14	21.54	7	70.00	45.77
	Synthetic pesticides	65	100	10	100	100.00

*Multiple answers possible

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Figure 1. Major capsicum growing districts of Tamil Nadu

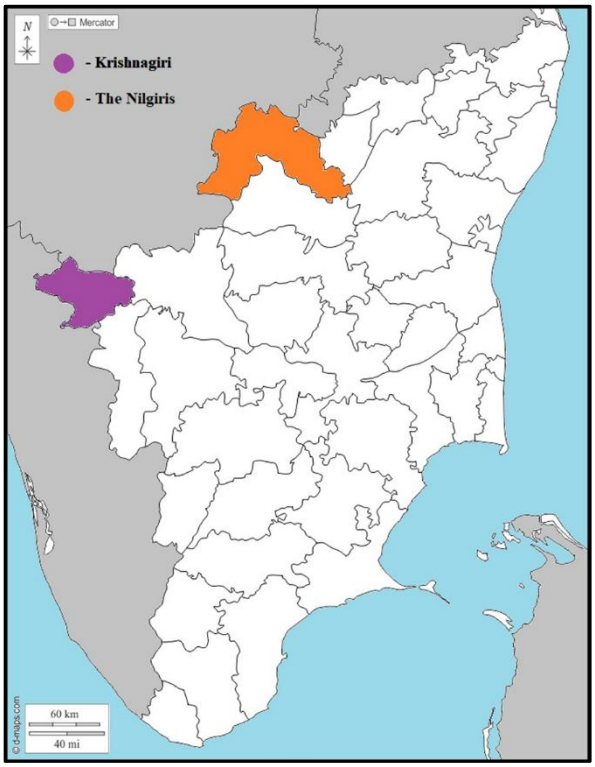

Fig. 2. Per cent respondents on pests recorded in capsicum ecosystem of Tamil Nadu