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Trend of Pesticide use for Mango Cultivation in Tamil Nadu

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ABSTRACT: A study was conducted to know the perception of mango farmers on pesticide use and usage pattern in Krishnagiri and Dharmapuri districts of Tamil Nadu. Major pests damaging mango trees were mango hoppers, leaf webber, fruit fly, gall midge, nut weevil, shoot borer and stemborer. Most of the farmers follow calendar spray of pesticides (85%) and mango crop was sprayed three times from pre-flowering stage till harvest (45%). Imidacloprid (42.5%), malathion (17.5%), dimethoate (15%) and thiamethoxam (12.5%) were found to be widely used pesticides by farmers. Majority of the famers (77.5%) received recommendations for pesticides from pesticide dealers. Several farmers followed the common waiting period of one day after spraying. Farmers were found lacking knowledge on safe harvest interval, safety measures while undertaking a spray, label claim and pesticide residues, while they are well aware of mixing and measuring pesticides, storage and time of application of pesticides.

Keywords: Mango, pests, pesticide, farmers, safety.

INTRODUCTION

Mango (*Mangifera indica* L.), is widely acknowledged as 'King of fruits' and 'National fruit of India' due to its delicious flavour, high nutritional content, and significant socio-economic role. It is an important member of Anacardiaceae family, which is cultivated in tropical and subtropical regions. The mango fruit is climacteric and increased ethylene production occurs during ripening. Regardless of its tenderness, either mature or ripe, mango fruit has a special significance. Mature green mangos are consume draw or as pickles. Ripened mangoes are processed into juice, squash, leather, jam, jelly (Siddiq *et al.,* 2017). India tops the world in mango production with a total produce of 20.44 million m.t, which is grown in an area of 2.29 million hectares (National Horticulture Board, 2019-20). Mango exports from India in the year 2020-21 fetched 271.87 crore Rupees. Pesticide residues and quarantine pests (mango stone weevil and fruit fly) are the major reasons for notable reduction of exports from previous years (APEDA, 2021).

The mango crop is infested with around 260 insect and mite pests appearing at different stages of crop growth (Penna and Mohyuddin 1997). They attack during growth, flowering and fruiting stages which severely hampers the fruit production. To check these pests, farmers generally apply several diverse classes of pesticides. Indiscriminate use of pesticides will show adverse effects on the health of consumers (residues in commodity) and cause resurgence of pests. The load of chemicals on natural ecosystems has increased as a result of the industrialization of agriculture, which endangers the human health and environment (Nicolopoulou-Stamati *et al*., 2016). However, the positive results of pesticide use indicate that pesticides will remain an essential tool in pest management (Popp *et al.,* 2013). In the wake of this, it becomes important to carry out a survey to know pests and pesticide usage pattern in mango ecosystem.

MATERIALS AND METHODS

Study area. A survey was conducted from December, 2021 to January, 2022 to know the status of pests and pesticide usage practices in commercially grown mango orchards of major mango growing districts of Tamil Nadu *viz.,* Krishnagiri and Dharmapuri (Fig. 1), based on the extent of cultivated area of about 31,176 and 16,509 ha, respectively (GOTN, Dept. of Horticulture). Forty mango farmers spread over in 12 villages were interviewed with a questionnaire (Table 1).

Data collection. A pre-structured questionnaire was employed, which sought to evaluate socio-economic, agricultural, and pest management factors at grass root level. Data was collected from 40 farmers through direct face-to-face interviews, using a questionnaire that was prepared in English and translated to local language (Tamil) for the convenience of famers (Fig. 2). The questionnaire was based on famers demographic details, education background, pest status, pesticide usage, source of information on recommended pesticides, attention towards labels, measurement and mixing of pesticide, safety methods followed, dosage of insecticides, type of sprayer used, time of spraying, number of spray, waiting period followed, spray intervals, handling and disposal of pesticide containers.

Fig. 1. Location of the study area.

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

Sr. No.	District	Block	Village	Number of respondants per village	Total number of respondants per district
1.	Krishnagiri	Kaveripattanam	Bannihalli	3	20
			Karadihalli	4	
			Kudimenahalli	3	
		Shoolagiri	Banganahalli	4	
			Ayaranapalli	3	
			Kumbalam	3	
2.	Dharmapuri	Karimangalam	Elumichanahalli	3	20
			Erraseegalahalli	4	
			Bikkanahalli	3	
		Palacode	Booganahalli	3	
			Pulikarai	3	
			Kammalapatti	4	

Fig. 2. Interaction with farmers.

RESULTS AND DISCUSSION

Demographic factors of surveyed farmers. Demographic factors taken into consideration are age, gender, education, size of land holding, farming experience and family size of mango growers (Table 2). There are more men (92.50%) occupied in mango farming than that of women (7.50%). This finding is in

conformity with the findings of Sekar *et al*. (2014). Regardless of the fact that women's participation in agricultural and production activities are well accepted, practically, only few women farmers have rights with farmlands (Ajani, 2008).

Table 2: Socio economic factors of mango farmers.

Sr. No.	Variables	Mean ± SD
1.	**Age (Years)**	
	Young (below 35 years)	7.5± 3.53
	Middle (between 35 to50 years)	52.5± 10.60
	Old (More than 50 years)	40± 7.07
2.	**Gender**	
	Male	92.5± 3.53
	Female	7.50 ± 3.53
3.	**Education (Years)**	
	Illiterate	40.00 ± 7.07
	Primary level	17.50 ± 3.53
	Secondary level	22.50 ± 10.60
	Higher Secondary level	17.50 ± 3.53
	Graduation level	2.50 ± 3.53
4.	**Size of land holding**	
	Small (<2.5 acres)	35.00 ± 7.07
	Medium (2.5 -10 acre)	37.5 ± 10.60
	Large (>10 acres)	27.50 ± 3.53
5.	**Farming experience (Years)**	
	Low (Up to 5 years)	25.00 ± 7.07
	Medium (Above 5 to 10 years)	27.50 ± 3.53
	High (More than 10 years)	47.50 ± 3.53
6.	**Family size (No)**	5.09 ± 0.47

The average size of the family of the famers surveyed was 5.09 members. A large household size may indicate that more labour is required to carry out agricultural activities, to perform farm activities, which in turn reduces marketed surplus and prioritises subsistence over commercialization (Von Braun *et al*., 1994). Majority of the farmers (52.50%) surveyed were in the middle age group (35-50 years), while 40 percent of the farmers fall under old age group (>50 years) and around 7.5 percent belong to young age group (below 35 years). Many of the surveyed farmers (40%) were illiterate and they did not get any formal education, some farmers (17.50%) were educated till primary level and other farmers (22.50%) till secondary education and 17.5 percent farmers were educated till higher secondary level and very few (2.5%) completed their graduation. The abilities and capability to use information are improved by education, which improves awareness of adoption newer technologies. Farmers who are old and illiterate may find it difficult to accept new technologies.

Land holding of 37.50 percent of the surveyed farmers was small in size (less than 2.5 acres), while 35 percent of farmers had medium size land (2.5 – 10 acres) land and the rest of the farmers (27.50%) had large size land (more than 10 acres). Majority of the farmers (47.50%) were having high farming experience of more than 10years, some other famers (27.50%) having medium experience (5-10 years), while others (25%) having low experience (less than 5 years).

Pest status in mango ecosystem. Various pests were found affecting mango trees across surveyed districts of Tamil Nadu (Table 3), which depicts that the most notorious pest was mango hoppers (100%). Other pests like leaf webber (90%), fruit fly (70%), nut weevil (65%), gall midge (57.5%), mealybug (47.5%), shoot borer (42.5%), stem borer (40%), leaf twisting weevil (37.5%), leaf miner (30%), red banded caterpillar (25%),hairy caterpillar (10%), rugose spiralling whitefly (7.5%), termite (7.5%) and red ant (5%) were also found to cause yield loss (Fig. 3). In Nepal, Ghimire *et al*. (2019), reported similar findings. In Vietnam, seed borer (*Deanolis albizonalis*) was found to be the major pest (Mele *et al*., 2001).

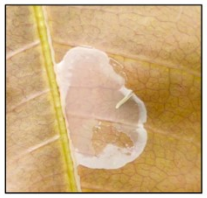
According to farmers, pests that damage the flowers are of more importance as they damage inflorescence and that has an impact on the yield. All the farmers in both the districts reported that mango hoppers are infesting mango trees and are causing severe damage. Mango hoppers commonly occurs in the flowering season, suck the sap from the inflorescence and tender shoots and cause damage to the tune of 20- 100% (Sohi and Sohi, 1990). Leaf webber was also reported as a major pest that is inflicting severe damage in the trees by webbing and scraping the leaves. Overall pest incidence was more severe in Dharmapuri. Rugose spiralling whitefly, an invasive pest damaging the leaves was observed from Krishnagiri district.

Table 3: Insect pests of mango observed in the surveyed area.

Sr. No.	Pest	Dharmapuri		Krishnagiri		Mean % ± SD
		No	%	No	%	
1.	Leaf hopper (*Amritodus atkinsoni*, *Idioscopus niveosparsus*, *Idioscopus clypealis*)	20	100	20	100	100 ± 0
2.	Mealybug (*Drosicha mangiferae*)	12	60	7	35	47.5 ± 17.67
3.	Gall midge (*Erosomyia indica, Dasineura amaramanjarae)*	9	45	14	70	57.5 ± 17.67
4.	Stem borer (*Batocera rufomaculata*)	7	35	9	45	40 ± 7.07
5.	Fruit fly (*Bactrocera dorsalis*)	16	80	12	60	70 ± 14.14
6.	Leaf webber (*Orthaga exuvinacea*)	17	85	19	95	90 ± 7.07
7.	Leaf miner (*Acrocercops syngramma*)	8	40	4	20	30 ± 14.14
8.	Shoot borer (*Chlumetia transversa*)	10	50	7	35	42.5 ± 10.60
9.	Nut weevil (*Sternochetus mangiferae*)	12	60	14	70	65 ±7.07
10.	Rugose spiralling whitefly (*Aleurodicus* sp)	0	0	3	15	7.5 ± 10.60
11.	Leaf twisting weevil (*Apoderus tranquibaricus*)	9	45	6	30	37.5 ± 10.60
12.	Red banded caterpillar (*Deanolis sublimbalis*)	6	30	4	20	25 ± 7.07
13.	Red ant (*Oecophylla smaragdina*)	2	10	0	0	5 ± 7.07
14.	Hairy caterpillar (*Euproctis fraterna*)	0	0	4	20	10 ± 14.14
15.	Termite (*Odontotermes* spp)	3	15	0	0	7.5 ± 2.12


Mango hopper (*Idioscopus* spp*)*


Fruit fly (*Bactrocera* spp)


Leaf miner (*A. syngramma*)


Red ant (*O. smaragdina*)


Rugose spiraling whitefly (*Aleurodicus sp*)


Leaf webber (*O. exuvinae*)


Gall midge damage on mango leaves


Hairy caterpillar (*E. fraterna*)


Leaf twisting weevil (*Apoderus tranquebaricus*)

Fig. 3. Major pests observed during survey.

Status of pesticides used in mango ecosystem. The data obtained from the survey revealed that commonly used pesticide for managing pests (Table 4) was imidacloprid (42.5%) followed by malathion (17.5%), dimethoate(15%), thiamethoxam (12.5%), acephate (12.5%), tolfenpyrad (10%), deltamethrin (10%), lambda cyhalothrin (7.5%), quinalphos (10%) and buprofezin (5%). Other combination products used among farmers are acephate (50%) + imidacloprid (7.5%), chlorpyriphos (50%) + cypermethrin (2.5%). Nair, (2018), reported similar results where most of the famers were using imidacloprid against mango hoppers. Among these pesticides, quinalphos, acephate, and combination products which were used to control sucking pests and borers, were actually not recommended for mango pests by Central Insecticide Board and Registration Committee (CIBRC) of India. Mango is also vulnerable to many diseases like

powdery mildew, anthracnose, fruit end rot for which farmers were also found to use fungicides such as carbendazim (15%), dinocap (12.5%) and mancozeb (12.5%) The toxicity profile of various pesticides and fungicides applied in mango ecosystem given in Table 4 was based on World Health Organisation (WHO) system of classification. No farmer was found to spray extremely hazardous (Ia) and highly hazardous pesticides (Ib). Majority of the chemicals applied by farmers fall under class (moderately hazardous group) which comprises imidacloprid, thiamethoxam, dimethoate, acephate, quinalphos, deltamethrin and dinocap, whereas malathion, buprofezin, tolfenpyrad belong to class III (slightly hazardous group). Carbendazim and mancozeb belong to class U (Unlikely to present acute hazard in normal use).

Table 4: List of pesticides used by mango farmers.

Sr. No.	Pesticide	Chemical group	Toxicity class	% Respondants		Mean Percentage use
				KGR	DPR	
Pesticides						
1.	Imidacloprid 17.80% SL	Neonicotinoids	II	45	40	42.5
2.	Thiamethoxam 25%WG	Neonicotinoids	II	15	10	12.5
3.	Malathion 50% EC	Organophosphates	III	10	25	17.5
4.	Dimethoate 30% EC	Organophosphates	II	20	10	15
5.	Acephate 75% SP	Organophosphates	II	15	10	12.5
6.	Quinalphos 25% EC	Organophosphates	II	15	5	10
7.	Deltamethrin 5% EC	Pyrethroids	II	5	15	10
8.	Lambda cyhalothrin 5% EC	Pyrethroids	II	0	15	7.5
9.	Tolfenpyrad 15% EC	METI Complex Iinhibitor	III	10	10	10
10.	Buprofezin 25% EC	Chitin Synthesis Inhibitor I	III	5	5	5
Fungicides						
11.	Carbendazim 50% WP	Benzimidazoles	U	15	15	15
12.	Dinocap 35.7% EC	Dinitrophenols	II	15	10	12.5
13.	Mancozeb 75% WP	Dithiocarbamate	U	20	5	12.5
Combination products						
14.	Acephate 50% + Imidacloprid 1.8% SP	Organophosphates + Neonicotinoids	-	10	5	7.5
15.	Chlorpyriphos 50% + Cypermethrin 5% EC	Organophosphates+ Pyrethroids	-	0	5	2.5

*Toxicity class as classified by the WHO (2019) where Ia - Extremely hazardous; Ib -Highly hazardous; II - Moderately hazardous; III -Slightly hazardous; U -Unlikely to present acute hazard in normal use.

Moreover, WHO has advised only trained individuals to use pesticides (WHO, 1991).

Pesticide usage pattern in mango ecosystem. Pesticide usage pattern practices by mango growing farmers (Table 5), shows that the source of information on pesticide recommendation was majorly from pesticide dealers (77.5%), followed by fellow farmers (12.5%) and Governments officials (10%). Similar results were reported by Singh *et al*. (2016). Majority of the farmers (87.5%) use bottle caps to measure pesticides, while few farmers (12.5%) measured pesticides approximately. Surveyed famers are less equipped when it comes to application of pesticides safely, but all the farmers (100%) are mixing pesticides using a stick. These findings are matching with the previous work done by Devi, (2010). Most of the farmers (87.5%) did not give attention to the label information, only 12.5% are reading the label before use, whereas Rijal *et al.* (2018) reported 66% of farmers were aware and follow the pesticide label. Only, 17.5% farmers sprayed pesticides at recommended doses, while majority of the farmers (82.5%) sprayed pesticides at approximate amounts.

Most of the farmers followed calendar spraying. Irrespective of the pest incidence, they spray three times with an interval of 30 days. These results were in accordance with the findings of Ghimire *et al*. (2019). Contrastingly, Cubelo and cubelo (2021) reported that majority of the farmers are spraying seven times regardless of season, Mele *et al*. (2001) reported an average of 13.4 pesticide sprays per year. Only a few farmers (2.5%) practiced burying spent pesticide containers in the ground, whereas the majority of farmers (97.5 percent) disposed of empty pesticide containers in their own fields or in neglected areas. This was in accordance with Prakash *et al*. (2021). According to the results, majority of farmers (57.5%) were not following any safety precautions during pesticide handling, while 40 percent were wearing a mask and 2.5 percent of them were wearing gloves while pesticide handling. Similar results were reported by Nyakundi *et al*. (2012); Imane *et al*. (2016). In contrast, Reddy *et al*. (2011) reported that all the farmers use face mask while spraying.

Rocker sprayer (42.5%) and Foot sprayer (40%) were employed by most of the famers and few farmers were found to be using tractor mounted sprayer (17.5%). In contrast with these findings Ghimire *et al*. (2019) reported that foot sprayer (86.40%) was used to spray mango trees. About 92.5 percent farmers choose to

spray the pesticides in the morning hours, only 7.5 percent famers were spraying at evening hours and no farmer took up spraying at the afternoon time. Around 12.5 percent farmers were not following any waiting period and they harvested fruits following the pesticide application on the same day, while 87.5% farmers followed one day waiting period. None of the farmers followed recommended waiting periods. This finding is in conformity with the findings of Sutharsan *et al.* (2014). The risk of pesticide residue on produce increased when the pesticide spray was done right before harvest (Jeyanthi and Kombairaju 2005). The result of this study was contrasting with findings of Rijal *et al*. (2018) who reported spraying interval of 15 days by 42.5 percent farmers, 30 days interval by another 42.5 percent and 15 percent were found to be spraying only when there is pest infestation.

Table 5: Knowledge level of mango growing farmers on pesticide usage pattern.

Sr. No.	Pesticide usage pattern	% Respondents		Mean percentage
		KGR	DPR	
Source of information on pesticide recommendation				
1.	Pesticide dealers	80	75	77.5
2.	Fellow farmers	10	15	12.5
3.	Government official	10	10	10
Attention towards label information				
4.	Reading label before use	10	15	12.5
5.	No attention towards labels	90	85	87.5
Dose				
6.	Recommended dose	20	15	17.5
7.	Approximate dose	80	85	82.5
Measurement of pesticide				
8.	Bottle cap	90	85	87.5
9.	Approximately	10	15	12.5
Mixing of pesticide				
10.	Stick	100	100	100
11.	Hand	0	0	0
Safety methods followed while spraying				
12.	No safety method	50	35	57.5
13.	Wearing a mask	35	50	40
14.	Gloves	15	15	2.5
Disposal of pesticide containers				
15.	Buried in soil	5	0	2.5
16.	Thrown in neglected area	60	80	70
17.	Leaving them aside in the field	35	20	27.5
Type of sprayer used				
18.	Rocker sprayer	40	45	42.5
19.	Foot sprayer	40	40	40
20.	Tractor mounted sprayer	20	15	17.5
Decision of spraying				
21.	Without observing any pest	90	85	87.5
22.	After infestation	10	15	12.5
23.	Above ETL	0	0	0
Time of application of pesticides				
24.	Morning	90	95	92.5
25.	Afternoon	0	0	0
26.	Evening	10	5	7.5
Frequency of pesticides application				
27.	15 days interval	45	40	42.5
28.	30 days interval	40	45	42.5
29.	Related to pest infestation	15	15	15
No of sprays				
30.	Once	10	15	12.5
31.	Twice	45	40	42.5
32.	Thrice	45	45	45
Pre-harvest interval followed				
33.	Waiting period as per label	0	0	0
34.	One day waiting period	85	90	87.5
35.	No waiting period	15	10	12.5

CONCLUSION

This study provides a general overview of the magnitude of pesticide usage across Krishnagiri and Dharmagiri districts of Tamil Nadu. Organophosphates and neonicotinoids were most widely used and newer molecule like tolfenpyrad was also found to be helpful among farmers. Most of the farmers are taking up spray irrespective of the pest incidence, which cause unnecessary expenses to farmers. Pesticide overuse is responsible for rising production costs, environmental pollution, and decline in numbers of beneficial insects and pollinators. Farmers employed both recommended and non-recommended pesticides in mango orchards. Farmers perception of pesticide risk is changing, as seen by their use of measuring caps, avoidance of reusing pesticide containers for household use, and mixing pesticides with a stick. There is need to educate famers on IPM practices, waiting period and its importance.

FUTURE SCOPE

Research and extension in the fields of agro-ecology, organic farming and IPM are possible and use of biopesticides could be encouraged over chemical pesticides. More ecofriendly methods for controlling pests and managing pollinators could be explored.

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Conflict of interest. None.

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