Biological Forum – An International Journal **15(9): 54-60(2023)**

ISSN No. (Print): 0975-1130
ISSN No. (Online): 2249-3239

Survey on Pesticide use and usage Pattern in Papaya Crop cultivated in Tamil Nadu

Jayashree E.[1], Suganthi A.[2*], Bhuvaneswari K.[3], Renukadevi P.[4] and Kavitha C.[5]

[1]M.Sc. Scholar, Department of Agricultural Entomology,
Tamil Nadu Agricultural University (Tamil Nadu), India.
[2]Associate Professor, Department of Agricultural Entomology,
Tamil Nadu Agricultural University (Tamil Nadu), India.
[3]Professor, Department of Agricultural Entomology,
Tamil Nadu Agricultural University (Tamil Nadu), India.
[4]Professor (Plant Pathology), Department of Medicinal and Aromatic crops,
Tamil Nadu Agricultural (Tamil Nadu), India.
[5]Associate Professor, Department of Fruit Science,
Tamil Nadu Agricultural University (Tamil Nadu), India.

(Corresponding author: Suganthi A.)*
(Received: 27 June 2023; Revised: 17 July 2023; Accepted: 18 August 2023; Published: 15 September 2023)
(Published by Research Trend)

ABSTRACT: A survey was conducted to assess the farmer's knowledge on pest, pesticide use and usage pattern in three major growing districts of Tamil Nadu during the year 2022-2023. Papaya mealybug, whitefly, fruit fly, ash weevil, aphids, scales, grasshoppers were found to infest papaya, among which papaya mealybug caused more damage (90%). It was observed that most of the farmers use pesticide mixtures for the pest management. The most used pesticide was Spirotetramat 11.01% + Imidacloprid 11.01% w/w SC, followed by Acephate 50% + Imidacloprid 7.5% SP, Azoxystrobin 11% + Tebuconazole 18.3% SC and Azoxystrobin 8.3% + Mancozeb 66.7% WDG. Only 23.33 % of farmers spray pesticides at recommended dose. The results revealed that majority of farmers (63.33%) consult pesticide retailers for the selection of pesticides. Farmers were not aware of safe waiting period before harvest, attention towards label, safety measures while spraying pesticide in field. The pesticides are applied at fortnight intervals in papaya ecosystem.

Keywords: Papaya, Papaya mealybug, Pesticide use.

INTRODUCTION

Papaya (*Carica papaya*) a member of family Caricaceae is native to South Mexico and Costa Rica. It is widely grown in tropical and subtropical regions both commercially and as a home garden crop for its delicious and high nutritive value fruit. It is a semi-woody herbaceous plant that exist in three sexes: female, male, and hermaphrodite (flowers that have both male and female reproductive organs) (Koul *et al*., 2022). The leaves and fruits of papaya contains phytonutrients, thiamine, folate, riboflavin, niacin, vitamins A, B1, B2, and C, and fibre content. It is one among the top five fruits (together with kiwi, watermelon, grapefruit, and guava) (Alara *et al*., 2020). Nowadays, papaya cultivation is gaining importance due to its high nutritive value and affordable price for consumption. In 2021-2022, papaya was cultivated in 3,240 ha area across Tamil Nadu and the major papaya growing districts are Dharmapuri, Erode, Vellore, Coimbatore and Dindigul (NHB, 2021-2022). During the growth period, papaya is susceptible to insect pests and diseases which causes huge yield loss. The most commonly found insect pests are papaya mealy bug, whitefly and aphids (Abraham *et al.,* 2007). Among these pests, aphids act as the vector for Papaya Ring Spot Virus (PRSV) and transmits the virus in a non-persistent manner (Ahlawat *et al.,* 1995). Despite the presence of a variety of natural enemies on papaya, chemical control are also followed for pest management. When pesticides are indiscriminately used, it causes health hazards to human beings during consumption. The knowledge on insect pest dynamics and pest management strategies that pertain to the papaya crop in Tamil Nadu is minimal. With this perspective in mind, survey was carried out to assess the insect pests affecting the papaya crop, pesticide usage patterns, and pesticide consumption.

MATERIALS AND METHODS

A detailed random survey was conducted to examine the scenario of pests and pesticide usage practices among farmers in major papaya-growing tracts of Tamil Nadu.

A. Selection of study area

A survey was conducted to know the status of pests and pesticide usage practices of major papaya farmers in the districts of Tamil Nadu *viz.*, Coimbatore, Dindigul and Tiruppur (Fig. 1) based on the extent of papaya cultivation. In addition, papaya cultivating blocks and villages were identified within each district using

data collected from Dept. of Horticulture Offices in respective region. Table 1 shows the surveyed blocks and villages of papaya cultivation.

C. Nature and source of data

The knowledge on pest status and pesticide usage pattern of papaya crop were collected from ten farmers of each districts randomly. As a result, a group of thirty papaya farmers from Tamil Nadu's major papaya growing tracts were surveyed. Based on the objectives of the research, a relevant interview schedule was created and utilized to collect data by interviewing individual farmers. The questionnaire was divided into three sections.

Section 1- Socio economic status of farmers (farmer name, address, age, education, family particulars).

Section 2-Questions regarding pest and diseases in field and pesticides used for the pest management.

Section 3- Knowledge level of farmers on pesticide usage pattern (pesticide usage recommendation, number of sprays, attention towards the label, pesticide measurement, mixture of pesticide, pesticide application interval, waiting period, types of sprayers, safety measures while spraying and disposal of pesticide containers)

The interview was conducted from December 2022 to February 2023 using the prepared questionnaire in selected survey area.

C. Data Analysis

The survey data was categorized according to the required information and examined using many descriptive statistical analysis such as mean, per cent, and standard deviation to analyze the factors influencing pesticide usage and consumption patterns.

RESULTS AND DISCUSSION

A. Socio-economic status of papaya-growing farmers

The socio-economic status of papaya farmers includes gender, educational status, size of land holding, farming experience and family size are presented in Table 2.

The findings of the survey indicated that majority of papaya growing farmers are male (83.33%) were as the female farmers are only (16.66%). This was in accordance with Constantine *et al*. (2023) who reported 61.35 per cent male farmers and 38.64 per cent female farmers involved in management practice of papaya mealybug in Kenya. Among the interviewed farmers, 23.33% have undergone secondary and higher secondary education, 20% were graduates and primarily educated. Only 13.33% of papaya-growing farmers were illiterate. Land holding of 46.66 per cent of the surveyed farmers was small in size (less than 2.5 acres), while 23.33 per cent of farmers had medium size (2.5 – 10 acres) land and the rest of the farmers 30.00 per cent had large size land (more than 10 acres). Majority of the farmers (53.33 %) surveyed were in the old age group (> 45years), while 46 per cent of the farmers fall under middle age group (35-45 years) and around 6.66 per cent belonged to young age group (below 25 years). Among the surveyed farmers, 46.66 per cent were having medium farming experience, while 33.33 per cent of farmers have high experience in farming and only 20 per cent of the farmers have low experience in farming (Fig. 2).

B. Pest Status

Insect pests recorded in papaya crop of surveyed area as per farmer's perception shown in the Table 3. Survey results revealed that papaya mealy bugcauses more damage (90 per cent) followed by whitefly (76.67 per cent), Fruit fly (20 per cent), grasshopper (10 per cent), ash weevil and scales (6.67%) are the pest causing damage to papaya crop. Among the noted pests, papaya mealybug *Paracoccus marginatus*, (Williams and Granara de Willink) (Hemiptera: Pseudococcidae) and whitefly *Bemisia tabaci* (Gennadius) (Hemiptera: Aleyrodidae) are the major pests observed in surveyed districts (Fig. 3). Revathy (2010) also reported severe incidence of Papaya mealybug in papaya crops of Erode and Coimbatore districts. The maggots of fruit fly *Bactrocera cucurbitae* (Hendel) were observed in the infested papaya fruits. The pests such as Grasshopper *Poecilocerus pictus* (Fabricus), Scale insect *Aspidiotus destructor* (Signoret) and Ash weevil *Myllocerus* spp, are the minor pests recorded in the papaya ecosystem of surveyed districts. Muniappan (2008) recorded *P.marginatus* infesting the papaya crop for the first time in Coimbatore. Regupathy and Ayyasamy (2014) reported that papaya crops in the districts of Coimbatore, Tirrupur, Erode, and Dindigul were highly infested by papaya mealybug. Sakthivel *et al*. (2012) revealed the presence of *P.marginatus* on 133 plant species and the families like Malvaceae, Solanaceae, Asteraceae and Euphorbiaceae were highly infested by papaya mealybug. The major reason for the occurrence of mealybug may be due to warm to hot climate with moist air and availability of wide host range.

B. Status of Pesticides

According to the survey, the most commonly used pesticide for management of papaya insect pests in Tamil Nadu were Spirotetramat 11.01% + Imidacloprid 11.01% w/w SC that was used by maximum number of farmers (47.5 per cent) followed by Acephate 50% + Imidacloprid 7.5% SP (30 per cent), Imidacloprid 70% WG (27.5 per cent), Spirotetramat 15.31% W/W (25 per cent), Acephate 75% SP (22.5 per cent) and Chlorpyriphos 50% + Cypermethrin 5% EC (7.5 per cent). Papaya is also susceptible to diseases like anthracnose, powdery mildew, fruit rot, leaf curl and other diseases. To manage this, farmers spray fungicides like Azoxystrobin 11% + Tebuconazole 18.3% SC (42.5 per cent) followed by Azoxystrobin 8.3% + Mancozeb 66.7% WDG, Azoxystrobin 18.2% + Difenoconazole 11.4% SC, Propiconazole 13.9% + Difenoconazole 13.9% EC, Propiconazole 25% EC, Mancozeb 75% WP and Thiophanate Methy l70% WP (Table 4). According to Reddy *et al*. (2019), the pesticide mixture Azoxystrobin 11%+ Tebuconazole 18.3% W/W SC was effective in management of grape Downy and Powdery mildew. A few papaya farmers have made use of bio-fertilizers, bio-control agent and botanicals like neem oil and neem seed kernel in their farming practices. From the survey, it was found that

combination products were highly preferred by farmers than individual pesticides.

Central Insecticides Board and Registration Committee (CIB&RC) of India has not approved any insecticide for use in papaya. Thiophanate Methyl l70% WP is a recommended fungicide in papaya for powdery mildew management, although only a few farmers sprayed it based on recommendation of pesticide retailers. Farmers have been using Spirotetramat 11.01% + Imidacloprid 11.01% w/w SC pesticide mixture for the management of papaya mealybug since the combination product was approved by CIB&RC for the management of mango mealybug. Lozano *et al*. (2008) reported that the formulation of spirotetramat and imidacloprid had shown an outstanding property against sucking pests. In order to minimize yield loss and meet consumer demands, farmers increasingly use chemical control for the management of pests and diseases. However, the chemical control is only partially effective and requires multiple applications which causes insecticide resistance, non-target effects on natural enemies, health hazard to human while consumption. Farmers use seven pesticide mixtures and six individual pesticides for management of pest and diseases which were not recommended for papaya. Being literate they were not aware of efficient molecules of pesticide that have a lower persistence.

C. Pesticide usage pattern

Current study reported that principle source of information on pesticide recommendation was pesticide retail shop with 63.33 per cent whereas 16.67 per cent of farmers acquire knowledge from fellow farmers, 13.33 per cent from TNAU and 6.67 per cent of farmers receive information from Government agricultural officers (Table 5). Similar trend was reported by Sheikh *et al*. (2011); Jamali *et al*. (2014); Suryawanshi and Patil (2016); Naveen Prakash *et al*. (2021); Vallarasu *et al*. (2022). The studies reveal that pesticide retailers play an important role in enhancing the crop protection and production knowledge of farmers. According to this survey, 90 percent of farmers did not pay attention to the label information that was supplied in pesticide containers; instead, they used the bottle caps consisting of measurement marks that were provided along with the pesticide package to measure the pesticide. Farmers may have lack of knowledge on active ingredient, toxicity classification of pesticide, signal word, first aid statement and hazardous symbols. Similarly, Meenambigai *et al*. (2017) reported that 92.5% didn't read label before use and measured the pesticide in bottle cap. Majority of farmers (73.33 per cent) did not follow safety precautions, only 20 per cent of farmers wear mask while spraying. According to studies, around 50% of farmers spray insecticides with their bare hands (Shrestha, 2010). Nearly 76.67 per cent of farmers take spraying in the morning hours. But this disagreed with earlier work that around 67 per cent of farmers spray pesticide during evening hours (Jamali *et al*., 2014). Power sprayers (90.00 per cent) were mostly used by the farmers than rockers sprayers and mixing of pesticides was mostly done with the help of sticks (100 per cent).

The application of insecticides at recommended dose was practiced by 23.33 per cent farmers while rest of the farmers spray pesticide approximately. It shows that farmers are not familiar with the CIBRC's rules and regulation on pesticide application. According to Al-Saed *et al*. (2011), farmers rarely adhere to the recommended pesticide application. Although farmers have interest in pest management, they lack complete knowledge about the adverse effects of pesticides. Graduated farmers have a good knowledge on pesticide application at recommended dose by attending training courses on pesticide usage and safety measures. In the current investigation, 86.67 per cent of farmers throw the empty pesticide container in neglected area while 10 per cent of them buried containers in soil and only 3.3 per cent of farmers leave randomly in their field. This contradicts with Budhathoki *et al.* (2019) who reported that 56.1 per cent of respondents throw the empty pesticide containers inside the field and only 2.45 per cent dispose it in neglected area. Pesticides are applied at 15 days interval by 90 per cent of farmer between two spraying.

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

Sr. No.	District	Block	Village	Number of respondents per village	Total number of respondents per district
1.	Coimbatore	Pollachi	Rasakapalayam	3	10
			Kinathukadu	2	
		Annur	Kovilpalayam	3	
			Annur	2	
2.	Dindigul	Palani	Amarapoondi	2	10
			Erramanaickenpatti	2	
			Karadikuttam	1	
		Thoppampatti	Vallakundapuram	2	
			Porulur	1	
			Thoppampatti	2	
3.	Tirrupur	Avinashi	Avinashi	1	10
		Madathukulam	?appankulam	1	
		Udumalaipettai	Andigoundanur	2	
			Kannamanaickanur	2	
			Valavadi	2	

Table 2: Socio-economic status of the papaya farmers.

Sr. No.	Parameters	Mean ± SD*
1.	**Gender**	
	Male	83.33±33.44
	Female	16.66±6.55
2.	**Educational status**	
	Illiterate	13.33±4.71
	Primary	20.00±8.16
	Secondary	23.33±4.71
	Higher Secondary	23.33±4.71
	Graduates	20.00±8.16
3.	**Size of land holding**	
	Small (<2.5 acre)	46.66±5.77
	Medium (2.5 -10 acre)	23.33±5.77
	Large (>10 acre)	30.00±10.00
4.	**Farming experience**	
	Low (Up to 5 years)	20.00±10.00
	Medium (Above 5 to 10 years)	46.66±5.77
	High (More than 10 years)	33.33±11.54
5.	**Age (Years)**	
	Young (Up to 25 years)	6.66±2.16
	Middle (Above 35 to 45 years)	40.00±12.00
	Old (More than 45 years)	53.33±15.83
6.	**Family size (No's)**	
	Nuclear family	70.00±8.16
	Joint/Extended family	30.00±8.16

*SD – Standard deviation, Mean – Average of ten Farmer's

Table 3: Pest scenario of papaya in surveyed areas as per farmer's perception.

	Pest	Coimbatore		Dindigul		Tiruppur		Mean ± SD
		No.	PI	No.	PI	No.	PI	
1.	Papaya Mealybug *Paracoccus marginatus*	8	80	10	100	9	90	90.00±10.00
2.	Whitefly *Bemisiatabaci*	9	90	6	60	8	80	76.67±15.28
3.	Aphid *Myzuspersicae*	0	0	0	0	0	0	0.00±0.00
4.	Fruit fly *Bactrocera cucurbitae*	1	10	2	20	3	30	20.00±10.00
5.	Grasshopper *Poecilocerus pictus*	1	10	1	10	1	10	10.00±0.00
5.	Ash weevil *Myllocerus* spp	0	0	1	10	1	10	6.67±5.77
6.	Scales *Aspidiotus destructor*	1	10	1	10	0	0	6.67 ± 5.77

No.- Number of respondents; PI – Percentage of incidence

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

Sr. No.	Particulars	Chemical groups	Percentage respondent			Mean %
			CBE	DIN	TIR	
Pesticide mixtures						
1.	Spirotetramat 11.01% + Imidacloprid 11.01% w/w SC	Ketoenols +Neonicotinoid	40	80	70	**47.5**
2.	Azoxystrobin 8.3% + Mancozeb 66.7% WDG	Strobilurin + Sulphur	50	60	50	**40**
3.	Propiconazole 13.9% w/w + Difenoconazole 13.9% EC	Triazole	20	50	10	**20**
4.	Azoxystrobin 18.2% + Difenoconazole 11.4% SC	Strobilurin +Triazole	30	40	20	**22.5**
5.	Acephate 50% + Imidacloprid 7.5% SP	Organophosphate + Neonicotinoid	40	50	30	**30**
6.	Chlorpyriphos 50% + Cypermethrin 5% EC	Organophosphate + Synthetic pyrethroid	10	10	10	**7.5**
7.	Azoxystrobin 11% + Tebuconazole 18.3% SC	Strobilurin +Triazole	40	60	70	**42.5**
	Insecticides					
8	Imidacloprid 70% WG	Neonicotinoid	50	30	30	**27.5**
9.	Acephate 75% SP	Organophosphate	30	40	20	**22.5**
10.	Spirotetramat 15.31% W/W	Ketoenols	10	50	40	**25**
Fungicides						
11.	Thiophanate Methy l70% WP	Thiourea	10	10	0	**6.67**
12.	Propiconazole 25% EC	Triazole	20	20	10	**16.67**
13.	Mancozeb 75% WP	Sulphur	10	10	10	**10.00**

CBE- Coimbatore; DIN- Dindigul TIR-Tiruppur

Table 5: Knowledge level of farmers about pesticide applied in papaya, Tamil Nadu.

Sr. No.	Pesticide usage pattern	Percentage respondent			Mean %
		CBE	DIN	TIR	
1.	**Source of information on pesticide recommendation**				
	Pesticide retail shop	50	60	80	63.33
	Fellow farmers	20	20	10	16.67
	Government agricultural officers	10	10	0	6.67
	TNAU	20	10	10	13.33
2.	**Measurement of pesticide**				
	Bottle cap	90	90	80	86.67
	Approximately	10	10	20	13.33
3	**Mixing of pesticide**				
	Stick	100	100	100	100
	Hand	0	0	0	0
4.	**Safety methods followed while spaying**				
	No safety method	70	80	70	73.33
	Wearing mask	20	20	20	20.00
	Gloves	10	0	10	6.67
5.	**Attention towards label**				
	Reading label before use	10	0	20	10
	No attention towards labels	90	100	80	90
6.	**Dose**				
	Recommended dose	40	10	20	23.33
	Approximate dose	60	90	80	76.67
7.	**Type of sprayer used**				
	Knapsack sprayer	10	0	0	3.33
	rocker sprayer	0	20	0	6.67
	Power sprayer	90	80	100	90.00
8.	**Time of application of pesticides**				
	Morning	70	60	100	76.67
	Afternoon	0	0	0	0.00
	Evening	30	40	0	23.33
9.	**Temporal frequency of pesticides application in papaya**				
	Weekly interval (7 days)	0	0	0	0
	Fortnight intervel (10-14 days)	90	80	100	90
	Related to pest infestation	10	20	0	10
10.	**Pre-harvest interval followed**				
	No waiting period	80	90	70	80
	Waiting period followed	20	10	30	20
11.	**Disposal of pesticide container**				
	Buried in soil	20	0	10	10.00
	Thrown in neglected area	80	90	90	86.67
	Leaving them randomly by the field	0	10	0	3.33
12.	**Decision of spraying**				
	Without observing any pest	40	30	50	40.00
	After infestation	60	70	50	60.00
	Above ETL	0	0	0	0.00

CBE- Coimbatore ; DIN- Dindigul; TIR-Tiruppur

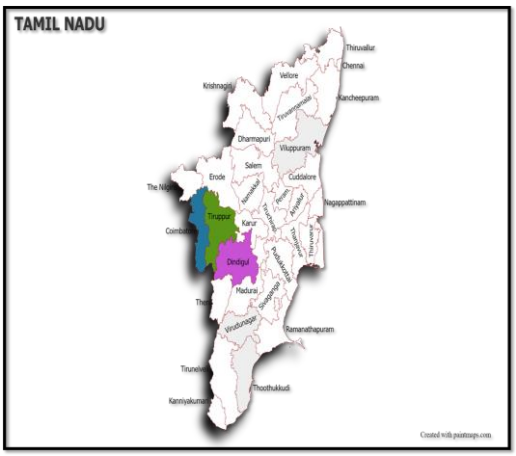

Fig. 1. Surveyed areas for pesticide usage patterns of papaya in Tamil Nadu.

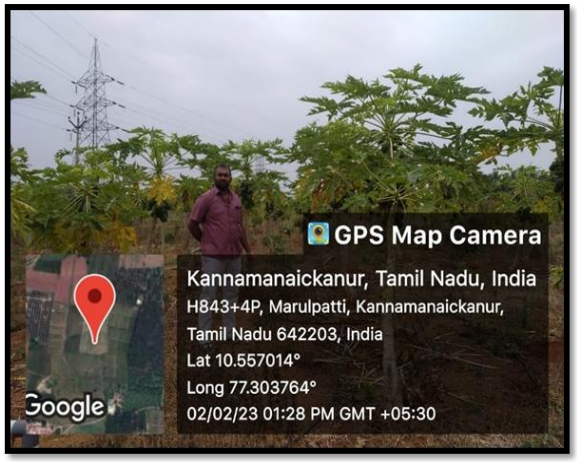

Fig. 2. Survey of papaya-growing farmers in Tamil Nadu.

Fig. 3. Papaya mealybug infestation in surveyed area of Tamil Nadu.

Around 80 per cent of farmers did not follow the waiting period and the fruits are also harvested after pesticide application. Only 20 per cent of farmers follow the waiting period before the harvest of fruits. This may be the one of the reasons for the detection of pesticide residue in papaya while monitoring the samples.

CONCLUSIONS

Papaya cultivation is gaining importance due to its high nutritive value and affordable price for consumption; therefore, we must ensure the appropriate pesticide usage to avoid residues in papaya fruits. Farmers' knowledge is changing, as seen by the use of a stick for mixing, the use of measuring cups, and the avoidance of recycling pesticide containers for home use. However, farmer's awareness on the usage of recommended pesticides, following pre-harvest intervals, label claims, and safety measures during spray operations was lacking. In order to grow pesticide residue-free papaya fruit, farmers must be educated about the importance of following regular pre-harvest intervals, colour, and symbols on pesticide containers, identifying active ingredients, ration use, and safe handling of pesticides. Application of pesticides can be reduced by adopting the Integrated Pest Management practices in papaya.

FUTURE SCOPE

Knowing the importance of pests in papaya, appropriate and less persistent pesticides can be sprayed to ensure the food safety to humans.

Acknowledgement. The authorsare grateful to the Department of Agricultural Entomology, Tamil Nadu Agricultural University, Coimbatore, India.
Conflicts of Interest. None.

REFERENCES

Abraham, V., Kalleshwaraswamy, C. M., and Kumar, H. R. A. (2007). Pests of papaya and their management with special reference to aphid vectors. *Acta Horticulturae*, *740*, 259-264.

Al-Sa'ed, R., Ramlawi, A. M., and Salah, A. (2011). A survey on utilization of agricultural pesticides in selected Palestinian districts.

Ahlawat, Y. S., Byadgi, A. S., Varma, A., and Chakraborty, N. K. (1995). Detection of ringspot virus and greening BLO in citrus and their management. *Detection of Plant Pathogens and their Management*, 27-44.

Alara, O. R., Abdurahman, N. H., and Alara, J. A. (2020). *Carica papaya*: comprehensive overview of the nutritional values, phytochemicals and pharmacological activities. *Advances in traditional medicine*, 1-31.

Budhathoki, N. R., Acharya, P. R., and Karki, D. (2019). Handling pattern of pesticides in vegetables: A case study of Bhaktapur.

Constantine, K., Makale, F., Mugambi, I., Rware, H., Chacha, D., Lowry, A., and Williams, F. (2023). Smallholder farmers' knowledge, attitudes and practices towards biological control of papaya mealybug in Kenya. *CABI Agriculture and Bioscience*, *4*(1), 1-15.

Jamali, A. A., Solangi, A. R., Memon, N., & Nizamani, S. M. (2014). Current scenario of pesticide practices among farmers for vegetable production: A case study in Lower Sindh, Pakistan. *International Journal of Development and Sustainability*, *3*(3), 493-504.

Koul, B., Pudhuvai, B., Sharma, C., Kumar, A., Sharma, V., Yadav, D. and Jin, J. O. (2022). *Carica papaya* L.: a tropical fruit with benefits beyond the tropics. *Diversity*, *14***(**8), 683.

Lozano, F., Kemper, K. and Tundisi, H. (2008). Field development of Movento Plus for sucking pest insect control in Brazil. *Bayer Crop Sci J.*, *61*, 329–341.

Meenambigai, C., Bhuvaneswari, K., Mohan, K., & Sangavi, R. (2017). Pesticides usage pattern of okra, Abelmoschus esculentus (L) Moench in Tamil Nadu. *Journal of Entomology and Zoology Studies*, *5*(6), 1760-1765.

Muniappan, R., Shepard, B. M., Watson, G. W., Carner, G. R., Sartiami, D., Rauf, A., and Hammig, M. D. (2008). First report of the papaya mealybug, *Paracoccus marginatus* (Hemiptera: Pseudococcidae), in Indonesia and India. *Journal of Agricultural and Urban Entomology*, *25*(1), 37-40.

Naveen Prakash, P., Suganthi, A., Bhuvaneswari, K., and Senthil Kumar, M. (2021). Insect pests, Pesticide use and Usage Pattern in Beetroot Crop Cultivated in Tamil Nadu. *Biological Forum – An International Journal*, *13*(4), 719- 727.

Reddy, G. R., Kumari, D. A., and Vijaya, D. (2019). Efficacy of new ready-mix formulation of azoxystrobin and tebuconazole (Azoxystrobin 11% w/w+ Tebuconazole

18.3% w/w SC) against downy mildew and powdery mildew disease and its safety assessment on grape. *Int. J. Faun. Bio. Res.*, *6*, 05-09.

Regupathy, A., and Ayyasamy, R. (2014). Sustainable Management of Papaya Mealybug in Small Scale Papaya Farming System Associated with Papain Industry in Tamil Nadu, India.

Revathy, R. (2010). Chemical control of papaya mealybug, *Paracoccus marginatus* (Williams and Granara de Willink) on papaya. *M. Sc.(Agri) Thesis*, 125.

Sheikh, S., Nizamani, S., Jamali, A., & Kumbhar, M. (2011). Pesticides and associated impact on human health: a case of small farmers in southern Sindh, Pakistan. *Journal of Pharmacy and Nutrition Sciences*, *1*(1), 82-86.

Shrestha, P., Koirala, P., and Tamrakar, A. S. (2010). Knowledge, practice and use of pesticides among commercial vegetable growers of Dhading district, Nepal. *Journal of Agriculture and Environment*, *11*, 95-100.

Sakthivel, P., Karuppuchamy, P., Kalyanasundaram, M., and Srinivasan, T. (2012). Host plants of invasive papaya mealybug, *Paracoccus marginatus* (Williams and Granara de Willink) in Tamil Nadu. *Madras Agricultural Journal*, *99*(jul-sep), 1.

S. Vallarasu, A. Suganthi, S. V. Krishnamoorthy and H. Usha Nandhini Devi (2022). Farmer Perception and Pesticide usage Pattern in Snake gourd and Ridge gourd grown in Tamil Nadu. *Biological Forum – An International Journal*, *13*(4), 719- 727.

How to cite this article: Jayashree E., Suganthi A., Bhuvaneswari K., Renukadevi P. and Kavitha C. (2023). Survey on Pesticide use and usage Pattern in Papaya Crop cultivated in Tamil Nadu. *Biological Forum – An International Journal*, *15*(9): 54-60.