Madras Agric. J., 2022; https://doi.org/10.29321/MAJ.10.000644

RESEARCH ARTICLE

Studies on Pesticide Use Behavior of Non-IPM Farmers of Rice Ecosystem in Southern Districts of Tamil Nadu

Nagulananthan M[1]*, Ravi G[1] , Balakrishnan N[1] and Lenin Raja D[2]

[1]Department of Agricultural Entomology, Agricultural College and Research Institute, Tamil Nadu Agricultural University, Killikulam, Vallanadu, Thoothukudi, Tamil Nadu, India.

[2]Department of Soil Science and Analytical Chemistry, Agricultural College and Research Institute, Tamil Nadu Agricultural University, Killikulam, Vallanadu, Thoothukudi, Tamil Nadu, India.

Abstract

Rice is the major crop cultivated in southern India and farmers resort to using pesticides intensively to realize higher productivity. The present study aimed to monitor the pesticide use behavior of the farmers, mainly relies on pesticides as a key component in pest management. This study was carried out in four southern districts of Tamil Nadu, where paddy is grown for almost two seasons in a year and a total of 75 farmers who rely on pesticide for their pest management were identified through the local pesticide dealers for the study. Rice stem borer (100%) and leaf folder (93.33%) are the key pests in the region and in all the districts surveyed, 92 percent of the farmers have indicated the rice earhead bug as a major problem during the reproductive phase for which 20 percent of them continue to take-up spraying across milking and grain maturing stages of the crop. It is apparent that the farmers in this area have the habit of using a tank mixture of pesticides and 72 per cent of the farmers interviewed use insecticides in combination with fungicides. They also use synthetic pyrethroids, which are not recommended in rice crops. Most of them (72.33%) throw the used pesticide container in open space, and 24 per cent use the containers for household and farm use. The study indicates an urgent need for creating awareness among this pesticide intense farmers to have sensible use of pesticides form minimizing pesticide residue preserving the rice ecosystem

Keywords: *Rice; Oryza sativa; Pesticide use behavior; Tamil Nadu*

INTRODUCTION

Paddy *Oryza sativa* (Linneaus), is the most popular cereal food crop supplying a large source of food nutrition for more than half of the world's population. Paddy is cultivated in an area of 438 lakh hectares in India, with 118.87 million tonnes of production and 2722 kg ha^{-1} of productivity. In Tamil Nadu, the area under paddy cultivation is 18.04 lakh hectares with 63.08 lakh metric tonnes of production and 3760 kg ha^{-1} of productivity (Indiastat.com, 2019-2020). Paddy cultivation is affected by biotic factors including insect pests and according to Bekele *et al.* (2018) yellow stem borer (*Scirpophaga incertulas*), green leafhoppers (*Nephotettix virescens*), leaf folder (*Cnaphalocrocis medinalis*), brown planthoppers (*Nilaparvata lugens*), gall midge (*Orseolia oryzae*), grasshoppers (*Hieroglyphus daganensis*), ear head bugs (*Leptocorisa acuta*) and diseases like sheath blight (*Rhizoctonia solani*), blast (*Magnaporthe oryzae*) and bacterial leaf blight (*Xanthomonas oryzae pv.oryzae*) adversely affect productivity in rice crop. Despite the intense promotion of IPM by the extension functionaries, there are farmers who continue to rely on pesticides as a sole tool for managing pest problems. The indiscriminate use of pesticides in paddy cultivation leads to a balance upsurge in the natural ecosystem and also results in contamination of harvested produce Sreeramulu *et al*. (2015). The present study was framed to survey the pesticide use pattern of farmers who mainly rely on pesticides for their pest and disease management, identify the gap in sensible use of pesticides, and suggest ways and means for policy support and adoption.

MATERIAL AND METHODS

This study was carried out in four southern districts of Tamil Nadu where paddy is grown almost in two seasons in a year viz., Tirunelveli, Thoothukudi, Kanyakumari, and Tenkasi during the

*Corresponding author E-mail: nagulananthannagul@gmail.com

year 2020-2021 using a set of questionnaires. A total of 75 farmer who relies on pesticide for their pest management were selected. The farmers were identified through the local pesticide dealers as well as with the help of extension officials. The data to pesticide usage, dose of insecticide, timing of pesticide application, type of plant production appliances used, and the socio-economic characteristics are collected and documented. The simple statistical method of frequency and percentage were used for representing the data and interpretation. The list of the villages selected for the study in different districts is indicated in Table 1.

RESULT AND DISCUSSION

The results of the study conducted on pesticide usage patterns of non-IPM pesticide-dependent farmers of four districts in southern Tamil Nadu are discussed here. The data collected in respect of socioeconomic characteristics, the package of practices adopted, pest scenario, pesticide usage patterns, and general awareness of pesticide use were interpreted for drawing the conclusion.

Socio-economic characteristics of the pesticide-dependent paddy farmers

The data collected on the socio-economic status of the pesticide-dependent Paddy farmers revealed that around 56 per cent of them are of the 40 to 50 age group and 25.33 per cent of them are middle age group (30 to 40 years) and all are from in nuclear family system (Table 2). With reference to farming experience, 41.33 per cent of them have farming experience for 20 to 30 years, 33.33 per cent of them are engaged in farming for 10 to 20 years and around 25.33 per cent of them have less than 10 years of experience in farming and are all middle age group.

Information regarding paddy cultivation

It is observed from the details gathered on the agricultural practices followed by the pesticide-dependent paddy farmers selected in the present study that all are aware of the recommended package of practices in rice crops suggested by the state Department of Agriculture. Most farmers practice the transplanting method (94.67%) of cultivation and few farmers in water scarcity areas in Thoothukdi district adopt direct seeding. With reference to fertilizer dose, 74.67 per cent of them used a higher dosage of fertilizer and only 21.33 per cent of adopting soil test-based fertilizer dose (Table 3). In a similar study conducted elsewhere in Phillipines Banayo *et al*. (2018) reported that the pest problem in paddy crops is at an alarming level when they use 30-34 per cent more nitrogen than suggested. There is considerable awareness (69.33%) among the farmers surveyed on seed rate and they use 20-25 kg/acre of seed depending upon crop duration. A high seed rate was practiced by 30 per cent of the farmers. It is observed from the data that the farmers who use higher fertilizer dose and dense planting method face an elevated level of pest and diseases problem and an elevated level of pest and diseases problem and resort to using more rounds of pesticide application.

The agronomic way of managing stem borer (*S.incertulus*) by clipping leaf tips before transplanting is not practiced by any of the farmers studied. The seed treatment technique is followed by 30.67 per cent of farmers. Most of them use antagonistic bacteria Pseudomonas supplied by the Department of Agriculture. The chemical fungicide used was carbendazim (12%) and mancozeb (63%) WP (Saaf) for protecting their crop in the nursery. A similar study conducted by Borthakur *et al.* (2015) on studying technology adoption behavior in farmers in Assam state indicated that 71 percent of rice growers treated their seeds with fungicides. However, in our present study, farmers in this area uses Pseudomonas supplied by the Department of Agriculture for nursery disease management rather than using chemical fungicides.

Occurrence of insect pests

Information gathered on insect pest problems faced by the farmers indicated that rice stem borer (100 %) and leaf folder (93.33%) are the keys constrain in both the vegetative stage and reproductive stage of the crop (Table 4). In the well-managed irrigated fields during the vegetative stage, they also recognized brown planthopper (12 %) and green leafhopper (21.33%) as a pest. In all the four districts surveyed rice earhead bug is indicated as a major problem during the reproductive phase of the crop by 92 per cent of the farmers.

Pesticide use behavior

Recording pesticide use 9.33 per cent of the farmers uses pesticide during the nursery stage itself for managing thrips problem (Table 5). Across the location, all the farmers habitually use the pesticide intensively in the crop, especially during the tillering stage. It is also observed that during the reproductive stage of the crop, 86.66 per cent of the

farmers are habitual in spraying pesticides mainly to manage rice stem borer, leaf folder, and earhead bug problems. The majority of the farmers stopped pesticide spraying before the grain harvesting stage of the crop. However, in rice ear head bug infested fields, 20 percent take up spraying in the milking and grain maturing stage.

The data collected on the type of pesticide used by the farmers for the management of insect pests indicated that there were 12 insecticides including two synthetic pyrethroids and three fungicides were used in this region.The insecticides used were in the order of Monocrotophos 36 SL (56.00%) > Profenophos 50 EC (50.67%) > Chlorantraniliprole 18.5 SC (45.33%) > Acetamiprid 20 SP (33.3%) > Chlorpyrifos 20 EC (29.33%) > Cypermethrin 25 EC (18.67%) > Dimethoate 30 EC (16.00%) > Phorate 10 G (14.66%) > Lamda cyhalothrin 5 EC (9.33%) > Dichlorvos76 EC (6.67%) > Phasalone 35 EC (5.33%) > Imidacloprid 17.8 SL (2.67%). Among the 12 insecticides the two synthetic pyrethroids used lamda cyhalothrin, cypermethrin is not recommended as they are known for causing a resurgence in sucking pests, especially in brown plant hopper. It is also noticed that 72 per cent of the farmers interviewed use insecticides combined with fungicides. (Table 6 & Figure 2). Among three fungicides, the combination fungicide carbendazim 12WP + mancozeb 63WP is used along with insecticide by 75 per cent of the farmers interviewed and 29.33 per cent of them uses tricyclozole 75 WP in combination with insecticide and 5.33 per cent of them uses propiconozole 25 EC for tank mixing with insecticides.

The majority of the farmers use a combination of insecticides and fungicides in their pest management practices.The efficacy of the individual compound on the target is unknown and another aspect of the compatibility of insecticides with fungicides is also not available. This warrants a systematic study on physical and chemical compatibility and bioefficacy with respect to these fungicides with commonly used insecticides.

General awareness of pesticides application techniques

Information gathered on general awareness of farmers on the usage of pesticides in paddy crop revealed that about 10.67 per cent of the farmers alone have awareness about the use of a correct amount of pesticides due to the training undergone with department/ Agricultural university and majority of them (89.33%) not having any knowledge/ awareness on pesticide dose recommendation. The frequency of spraying in paddy crops adopted by the farmers indicated that around 12 per cent of the farmers resort to spray around two times a month. Whereas about 88 per cent of the farmers applied pesticide more than 2 times in a month. It is apparent that the farmers in this area have the habit of using a tank mixture of pesticides with various modes of action and classes to battle pest problems. In conditions where both pest and disease were observed (sheath rot and stem borer) they use fungicides in their insecticide cocktail mixture to save time, labor, and money. In the study area, 72 per cent of them mix the insecticide with the fungicide. With reference to the measure of insecticides around 24.3 per cent of them uses an approximate quantity of pesticides which leads to over or less dosage and 78.67 per cent of the farmers uses bottle cap as a measuring device supplied with insecticides. With respect to plant protection appliances, the most commonly used spray appliance in this area are power sprayer (77.33%), and about 22.67 per cent of farmers uses knapsack sprayer for pesticide spraying in paddy crop. According to Deviprasad *et al.* (2015), the majority of farmers indicated they spray pesticides once or twice per season as a protective measure, whereas a small percentage said they use pesticides based on insect infestation. When it came to pesticide spraying intervals, some farmers sprayed once or twice a month, resulting in irregular spraying (Sai *et al*. 2019). The source of technical information data indicated that about 53.33 per cent of the farmers preferred to contact shop dealers for the recommendation of pesticides because of the travel distance to get scientists and agricultural officers and approximately 34.67 per cent of farmers surveyed contacted the Agricultural officer, 12.00 per cent of farmers contact scientist/ KVK.

Safe handling and disposal of pesticides

There is poor awareness of the safe handling of pesticides and pesticide containers among the farmers surveyed. The majority of them (65.33%) did not know about pesticide risks and were unaware of the ill effects that causes in human health and the environment. At that time of spraying, most of them wear full-hand shirts (72 %) and none of them have an awareness of protective clothing. There is no awareness among the farmers on the disposal

protocol of the pesticide container used by them. Most of them (72.33%) throw the used pesticide container in open space and 24 per cent of them use the containers for their household and farm use and a minimum proportion of 2.67 percent sell the containers to the buyers. The data were similar to Jallow *et al*. (2017), who found that most farmers did not utilize any protection equipment when mixing or spraying pesticides due to a lack of availability when needed, discomfort in the hot and humid climate, and higher cost.

Table 1. Details of number of farmers and number of villages interviewed for pesticide usage pattern studies

	Block	Village	No. of farmers contacted
Tirunelveli	Palayamkottai	Melaputhaneri	4
		Ariyakulam&Therkuariyakulam	8
	Manur	Thenpathu	3
	Nanguneri	Anikulam	4
Thoothukudi	Srivaikundam	Tholappanpannai	7
		Ktk Nagar	2
		Padmanabamangalam	3
	Satankulam	Velavanputhukulam	5
	Karunkulam	Seythunganallur	5
Kanyakumari	Thovalai	Naanalkaadu	4
		Aananthabadmanathapuram	4
	Thuckalay	Kalkurichi	5
Tenkasi	Shenkottai	Shenkottaimelur	5
		Vadakarai	4
	Kadayam	Sivasailam	4
		Pottalputhur	4
	Kilapavoor	Vellakkal	4
		Total	75

Table 2. Socio-economic characteristics of the paddy farmers

S.No.	Particulars	Frequency (N=75)	Percentage (%)
1.	Age (Years)		
	20-30	5	6.67
	30-40	19	25.33
	40-50	42	56.00
	>50	9	12.00
2.	Type of family		
	Nuclear	67	89.33
	Joint	8	10.67
3.	Gender		
	Male	72	96
	Female	3	4
4.	Farming experience (Years)		
	< 10	19	25.33
	10-20	31	41.33
	20-30	25	33.33

Table 3. Information regarding Paddy cultivation

S.No.	Particulars	Frequency (N=75)	Percentage (%)
1.	Seed rate (Kg/Acre))		
	20-25	52	69.33
	25-30	16	21.33
	30-35	7	9.33
2.	Seed treatment with fungicides	23	30.67
3.	Method of sowing		
	Transplanting	71	94.67
	Direct sowing	4	5.33
4.	Fertiliser application dosages		
	Low	3	4
	Recommended	16	21.33
	High	56	74.67

Table 4. List of key pests in Paddy recognized by respondents

S.No.	Particulars	Frequency (N=75)		Percentage (%)
		Vegetative stage	Reproductive stage	
1.	Rice leaf folder (*Cnaphalocrocis medinalis*)	65	5	93.33
2.	Stem borer (*Scirpophaga incertulas*)	15	60	100.00
3.	Brown Plant hopper (*Nilaparvata lugens*)	9	0	12.00
4.	Rice Thrips (*Stenchaetothrips biformis*)	22	7	38.66
5.	Green leaf hopper (*Nephotettix virescens*)	16	0	21.33
6.	Rice gundhi bug (*Leptocorisa acuta*)	0	69	92.00

Table 5. Insecticides applied by farmers at various growth stages of the paddy crop

S.No.	Stage of crop	Frequency (N=75)	Percentage (%)
1.	Nursery stage	7	9.33
2.	Tillering stage	75	100.00
3.	Milky and grain formation stage	15	20.00
4.	Grain maturation stage	65	86.66

Table 6. List of pesticide used for pest management in Paddy in southern districts

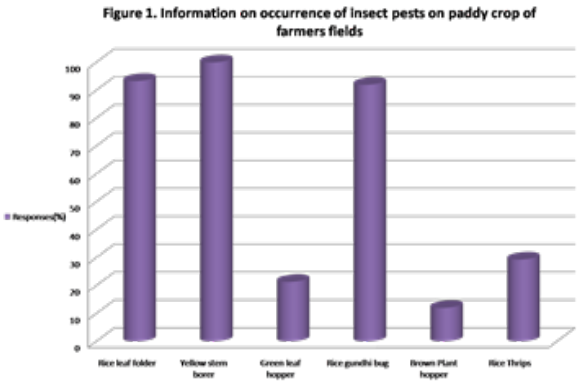
Particulars				Frequency (N=75)	Percentage (%)
S.No.	Insecticides	Type of formulation	Trade name		
1.	Acetamiprid	20 SP	Pride	25	33.33
2.	Chlorantraniliprole	18.5 SC	Coragen	34	45.33
3.	Cypermethrin	25 EC	Super killer	14	18.67
4.	Dimethoate	30 EC	Rogar,Tafgor	12	16.00
5.	Dichlorvos	76 EC	Nukem,Hyvap	5	6.67
6.	Chlorpyrifos	20 EC	Terminator, Tafaban	22	29.33

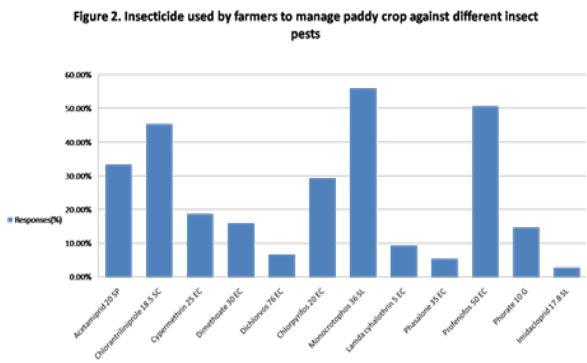
7.	Monocrotophos	36 SL	Monostar, Monoguard	42	56.00
8.	Lamda cyhalothrin	5 EC	Kozuka	7	9.33
9.	Phasalone	35 EC	Zolone	4	5.33
10.	Profenophos	50 EC	Curacron, Profex	38	50.67
11.	Phorate	10 G	Phoratops,	11	14.66
12.	Imidacloprid	17.8 SL	Confidor, Gaucho	2	2.67
Fungicides					
13.	Carbendazim + Mancozeb	12 WP + 63 WP	Saaf	56	75.00
14.	Tricyclozole	75 WP	Beam,Sivic,Baan	22	29.33
15.	Propiconazole	25 EC	Rader	4	5.33

Table 7. General awareness on handling of pesticides in Paddy

S.No.	Particulars	Frequency (N=75)	Percentage (%)
1	Period of activity in using pesticides on paddy crop		
	<5 Years	11	14.67
	>5 Years	64	85.33
2	Awareness on recommendations of pesticides		
	With Awarness	8	10.67
	Without Awarness	67	89.33
3	Farmers desire to mix different pesticides		
	Insecticide + Insecticide	14	18.67
	Insecticide + Fungicide	54	72.00
	Fungicide + Fungicide	7	9.33
4	Measurement of Pesticides		
	Bottle cap (Correct dosage)	59	78.67
	Approximately (More or less dosage)	16	21.33
5	Mixing of pesticides with water to prepare spray solution		
	Bare hands	0	0.00
	Stick	75	100.00
6	Source of Technical information		
	Agricultural officer	26	34.67
	Dealer	40	53.33
	Scientists	9	12.00
7	Frequency of application		
	Twice per month	9	12.00
	More than twice per month	66	88.00
8	Disposal method followed for empty pesticide bottles		
	Used for house or farm purpose	18	24.00
	Sell	2	2.67
	Throw into trash	55	73.33
9	Selection of spraying equipment		
	Knapsack sprayer	17	22.67
	Power sprayer	58	77.33

10	Time of pesticide application		
	Morning or evening hours	71	94.67
	Day-night hours	4	5.33
11	Precautions while application of pesticides		
	Face mask	4	5.33
	Shirts with full hands	54	72.00
	No precaution	17	22.67
12	Farmers perception of pesticide risk and occupational health hazards		
	With perception	26	34.67
	Without perception	49	65.33





CONCLUSIONS

The survey was conducted on the southern districts of Tamil Nadu among pesticide-dependent farmers. They used pesticides starting from seed treatment and nursery stage. Different groups like organophosphorus, carbamates, thiocarbamates, and neo-nicotinoids insecticides were used to control various insect pests. They mostly use insecticide during the vegetative stage and grain maturation stage. Most of them were having pesticide usage experience for more than 5 years and few farmers have awareness of pesticide recommendations for different pests and their classification of using different pesticides for different pests. The commonly used spray appliances in this are power sprayers. They don't have awareness related to the use of botanicals and bio-pesticides. Few farmers are aware of pesticide residues and their effects on health conditions. Main proposes on the harvest time spraying leads to concern for transfer of pesticide residue into produce it needs further study and there is an urgent need for creating awareness among this pesticide intense farmer to have sensible use of pesticide form minimizing pesticide residue preserving the rice ecosystem.

Funding and Acknowledgment

The authors acknowledge the assistance and financial support provided by Tamil Nadu Agricultural University, Department of Agricultural Entomology, AC & RI, Killikulam.

Ethics statement

No specific permits were required for the described field studies because no human or animal subjects were involved in this research.

Originality and plagiarism

We ensure that we have written and submit only entirely original works.

Consent for publication

All the authors agreed to publish the content.

Competing interests

The authors declare no conflict of interest in the publication of this content

REFERENCES

Annual Report. Department of Agriculture, Cooperation and Farmers Welfare, Ministry of Agriculture and Farmers Welfare, Government of India, 2018-2019.

Banayo, P.M.C., Haefele, S. M., Desamero, N. V and Y. Kato. 2017. On-far assessment of site-specific nutrient management for rainfed lowland rice in the Philippines. Field Crops Res., 220: 88-96.

Borthakur, S., Mishra, P., Talukdar, R. K and D. Bortamuly. 2015. Scaling the adoption of recommended rice production technology by the farmers in Assam state. Indian Res. J. Ext. Educ., 15(2): 32-37.

Deviprasad, A. G., Radha, and H.K. Manonmani. 2015. Pesticide usage pattern in four districts of Karnataka: A survey. J. environ. sci. toxicol. food Technol., 9 (10): 48-51

Jallow, M. F. A., Awadh, D. G., Albaho, M. S., Devi, V. Y and B. M. Thomas. 2017. Pesticide knowledge and safety practices among farm workers in Kuwait: Results of a survey. Int. J. Environ. Res. Public Health., 14 (4): 340- 347.

Sai, M. V. S., Revati, G. D., Ramya, R., Swaroop, A. M., Maheswari, E and M. M. Kumar. 2019. Knowledge and perception of farmers regarding pesticide usage in a rural farming village, southern India. Indian J. Occ. Environ. Med., 23(1): 32-36.

Sreeramulu, K. 2015. Evaluation of pesticide residue in rice, wheat and pulses of Bidar district Karnataka, Indian Biol. Sci. Pharm. Res., 3(9) :100-106.