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Insecticide Usage Pattern on Rice Crop in Godavari Delta of Andhra Pradesh

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ABSTRACT

The survey carried during *kharif* 2016 on insecticide usage pattern by the rice growers revealed that farmers solely depended on chemical pesticides for controlling insect pests. Nineteen insecticides (19) belonging to six (6) chemical groups are being used by the farmers to control insect pests. Survey also revealed that none of the farmers have any idea about economic threshold level (ETL) based sprayings and they simply resorted to calendar based application of insecticides leading to escalation of production costs; half of the farmers (49.00%) have applied insecticides as schedule sprays irrespective of pest incidence on their own decision. Majority of the farmers (87.50%) used insecticides as mixtures rather than applying single insecticide at a time; calendar based sprays irrespective of pest and disease incidence, use of non-recommended synthetic pyrethroids for controlling insect pests, application of insecticides at higher doses than the recommended level, mixing more than one pesticide (cock tails) to control insect pests and diseases simultaneously and defective spraying *etc.* are some of the practices followed by the rice growers contributing to the flare up of insect pests in general and planthoppers in particular infesting rice.

Keywords: *Awareness and insecticide usage pattern, Farmers, Insect pests, Insecticides and Rice.*

Rice (*Oryza sativa* L.) is an important staple food crop for more than half of the world population and accounts for more than 50 per cent of the daily calorie intake (Khush, 2005). Warm and humid climate is essential for rice cultivation and also favours the survival and multiplication of insect pests and diseases. Insect pests and diseases remain the key biotic stresses limiting rice production significantly. Rice is infested by more than 100 species of insects and mites and about 20 of them are considered to be the major in economic significance.

Farmers rely solely on pesticides for the management of insect pests and diseases on account of their effectiveness, ease of application and immediate results but insecticidal misuse and overuse often results in problems such as induction of resurgence, development of resistance against insecticides and residues on farm produce besides environmental contamination. However, the consumption pattern of insecticides belonging to different chemical groups varies across the geographic locations primarily based on the dealer recommendations, intensity of pests and diseases, influence of peer groups, efficacy of particular insecticides, knowledge levels of the farmers, availability of a particular insecticide and socio economic status of the farmer (Lingappa *et al*.,1993). Indiscriminate as well as misuse of insecticides by the rice farmers often results in lower grain yields on account of failure to control insect pests and increased production costs. In this connection, a survey was undertaken to assess the knowledge levels of farmers on insect pest management, insecticide usage pattern, pesticide application techniques and cultivation practices adopted by the rice farmers and to suggest recommended practices to solve different pest problems and minimize input costs in certain rice growing areas of Godavari delta of Andhra Pradesh.

MATERIAL AND METHODS

Survey was conducted during *kharif* 2016 in ten mandals each of East Godavari district and West Godavari district of Andhra Pradesh, where rice is grown and insecticide usage is intense (Table 1) to generate information on insecticides usage pattern, pest management tactics, cultivation practices adopted by the rice growers using a structured questionnaire.

A total of 100 farmers were randomly selected from each district *i.e.* ten farmers per mandal and 10 mandals per district for collecting the required information for this study. The respondents were not pre-informed so as to avoid biased responses and to gain actual insight of the farming practices. Data was collected by means of a structured questionnaire, formal and informal interviews and group discussions to gather information on commonly prevalent insect pests, type of insecticides used, dosage used per application, frequency of insecticide sprays, application method, safety measures followed *etc*. Information on cultivation practices adopted by the rice growers was also collected.

The collected data was classified according to the required information and analyzed using SPSS 16.0 statistical software package to draw valid conclusions.

RESULTS AND DISCUSSION

Farmers' knowledge levels on insect pest management and insecticide usage pattern followed in rice, based on their responses to the questionnaire was presented in Tables 2 to 3 and Figures 1 to 8.

Types of insecticides used

The results of the survey presented in Table 2 indicated that 19 insecticides belonging to six (6) chemical groups are being used by the farmers to control insect pests. Farmers thought that the only solution to insect pest problems is to spray more frequently and using different combinations of insecticides. The results on group stratification of insecticides usage (Fig.1) revealed that insecticides of organophosphate (35.00%) were the most commonly used insecticides by the farmers followed by synthetic pyrethroids (26.00%), novel insecticides (20.00%), neonicotinoids (7.00%), carbamates (6.00%) and nereistoxin analogues (6.00%) in the surveyed area of East Godavari and West Godavari districts of Andhra Pradesh.

Among the organophosphates, phorate was the widely used insecticide followed by monocrotophos, chlorpyriphos, acephate and profenophos in the descending order of their share (Fig. 2) in the total consumption. Similarly, lambda cyhalothrin was the primary choice of insecticide accounting for 27 per cent of the synthetic pyrethroid group followed by cypermethrin (26.00%), bifenthrin (24.00%) and deltamethrin (23.00%) (Fig. 3).

Thiamethoxam, imidacloprid and dinotefuran were frequently used against insest pests particularly planthoppers in rice with their share of 17.00 per cent, 41.00 per cent and 42.00 per cent, respectively in the total consumption of the neonicotinoids (Fig. 4). Pymetrozine and chlorantraniliprole are the primary choice of insecticides for the management of plant hoppers, stem borer and leaf folder followed by fipronil, buprofezin and flonicamid in the decreasing order of their share in the consumption of novel insecticides group (Fig. 5).

Data contained in the Table 2 revealed that some of the insecticides *viz*., chlorpyriphos, profenophos and phorate (Organophosphates) and cypermethrin, deltamethrin, bifenthrin and lambda cyhalothrin (Synthetic pyrethroids) and imidacloprid (Neonicotinoids) were frequently used by the farmers against early season insect pests that led to resurgence of rice planthoppers. These findings are similar to the survey reports of IIRR, Hyderabad (IIRR, 2016; IIRR, 2017 and IIRR, 2018).

Toxicity class of majority of insecticides used by the farmers belonged to class-II (WHO recommended classification of pesticides by hazard). The use of extremely hazardous insecticide (phorate) and highly hazardous insecticide (carbofuran) by the farmers was also noticed in the surveyed area.

Farmers knowledge on insect pest management and insecticide usage pattern in rice

About 88.00 per cent and 94.00 per cent of the farmers cultivating the most popular and recommended rice varieties like Swarna, MTU1010, MTU1001, MTU1121, MTU3626, MTU 1061, MTU 1064 and BPT 5204 in the surveyed areas of East Godavari and West Godavari districts respectively. Whereas, 12.00 per cent of the respondents in East Godavari and 6.00 per cent of the respondents in West Godavari districts cultivating the varieties/hybrids promoted by the private seed firms. Majority of the farmers (85.00%) could identify the major insect pests of rice like stem borer, gall midge, leaf folder and planthoppers (Table 3).

Over eigthty per cent (83.50 %) of the respondents have no idea of natural enemies found in rice ecosystem and could not differentiate between the harmful and the beneficial insects. None of the farmers have any idea about economic threshold level (ETL) based sprayings and they simply resorted to calendar based application of insecticides leading to increased cost of plant protection. Similar findings were made by Bharathi *et al*., (2012) who reported that none of the farmers paid attention to the economic threshold levels recommended for stem borers and leaf folder in paddy and for aphids in wheat. Eighty four (84.00%) per cent of the farmers were aware of recommended insecticides against various insect pests in rice (Table 3).

Decision making by whom when to spray (Time of insecticide application)

Usually farmers apply insecticides to control insect pests based on their own decision or advice from the fellow farmers/agricultural extension personnel/ agro-chemical dealer.

In the surveyed area, half of the farmers (49.00%) have applied insecticides as schedule sprays irrespective of pest incidence on their own decision. Similar observations were also made by Shetty *et al*. (2010), who reported that most of the farmers followed their own spraying schedules and pesticide doses to manage ever increasing pest and disease problems. Over 20.00 per eent of the respondents (22.50%) resorted to spraying operation on the advice of agro-

Table 1. Details of locations where survey conducted in East Godavari and West Godavari Districts of Andhra Pradesh

S.No.	District	Mandal	Sample size (No. of farmers)
1	East Godavari	Amalapuram	10
		Mummidivaram	10
		P. Gannavaram	10
		Kothapeta	10
		Mandapeta	10
		Alamuru	10
		Ramachandrapuram	10
		K. Gangavaram	10
		Pedapudi	10
		Kakinada (R)	10
		Total	**100**
2	West Godavari	Penumantra	10
		Attili	10
		Iragavaram	10
		T. P. Gudem	10
		Nallajerla	10
		Bhimadole	10
		Unguturu	10
		Narasapuram	10
		Palakollu	10
		Achanta	10
		Total	**100**

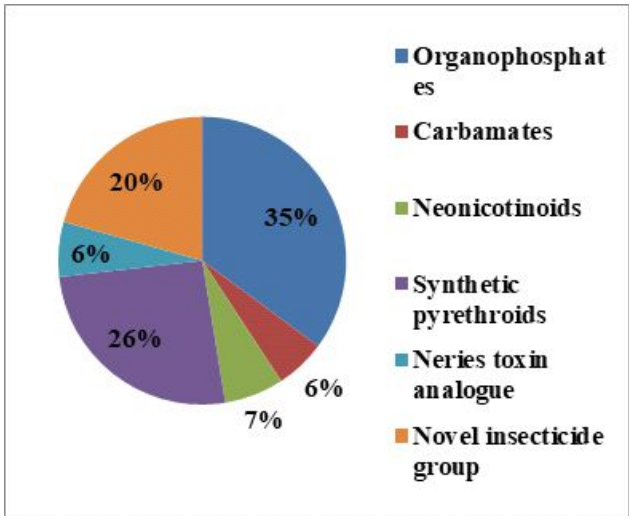

Fig 1. Different groups of insecticides used by the farmers in the study area

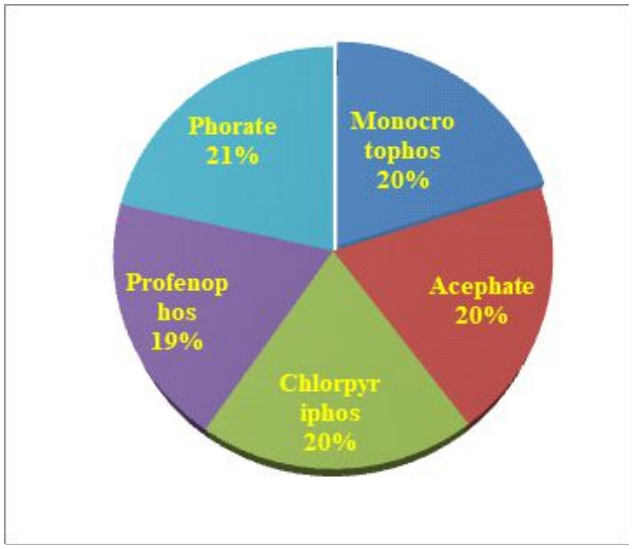

Fig 2. Organophosphate group of insecticides used by the farmers in the study area

Table 2. Types of insecticides used by the farmers in the study area of Godavari delta of Andhra Pradesh

S. No.	Insecticide	Toxicity class [@]	E. G. Dist.		W. G. Dist.		Mean	
			Positive response (%)	Negative response (%)	Positive response (%)	Negative response (%)	Positive response (%)	Negative response (%)
I. Organophosphates								
1	Monocrotophos	Ib	78.00	22.00	72.00	28.00	75.00	25.00
2	Acephate	II	78.00	22.00	69.00	31.00	73.50	26.50
3	Chlorpyriphos	II	75.00	25.00	73.00	27.00	74.00	26.00
4	Profenophos	II	74.00	26.00	68.00	32.00	71.00	29.00
5	Phorate	Ia	78.00	22.00	82.00	18.00	80.00	20.00
II. Carbamates								
6	Carbofuran	Ib	56.00	44.00	64.00	36.00	60.00	40.00
III. Neonicotinoids								
7	Imidacloprid	II	28.00	72.00	30.00	70.00	29.00	71.00
8	Thiamethoxam	-	13.00	87.00	11.00	89.00	12.00	88.00
9	Dinotefuran	-	31.00	69.00	29.00	71.00	30.00	70.00
IV. Synthetic pyrethroids								
10	Bifenthrin	II	63.00	37.00	67.00	33.00	65.00	35.00
11	Cypermethrin	II	70.00	30.00	73.00	27.00	71.50	28.50
12	Deltamethrin	II	62.00	38.00	66.00	34.00	64.00	36.00
13	Lambda-cyhalothrin	II	77.00	23.00	70.00	30.00	73.50	26.50
V. Nereis toxin analogue								
14	Cartap hydrochloride	II	63.00	37.00	68.00	32.00	65.50	34.50
VI. Novel group of insecticides								
15	Fipronil	II	23.00	77.00	25.00	75.00	24.00	76.00
16	Chlorantraniliprole	U	72.00	28.00	78.00	22.00	75.00	25.00
17	Buprofezin	III	24.00	76.00	21.00	79.00	22.50	77.50
18	Flonicamid	-	15.00	85.00	19.00	81.00	17.00	83.00
19	Pymetrozine	-	79.00	21.00	83.00	17.00	81.00	19.00

@Toxicity class of pesticides as classified by the WHO, 2009.
Ia- Extremely hazardous,Ib- Highly hazardous, II-Moderately hazardous,
III-Slightly hazardous, U- Unlikely to present acute hazard in nor

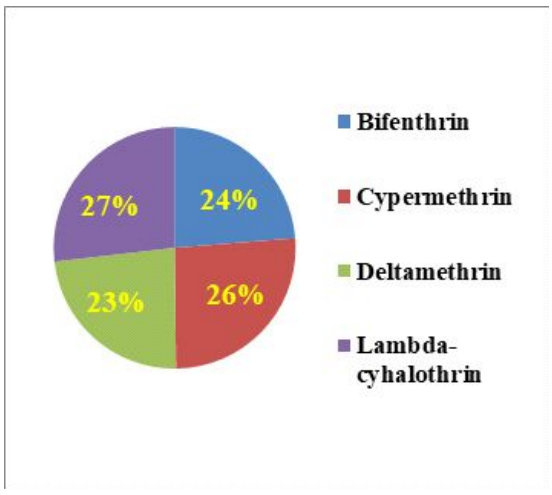

Fig 3. Synthetic pyrethroids used by the farmers in the study area

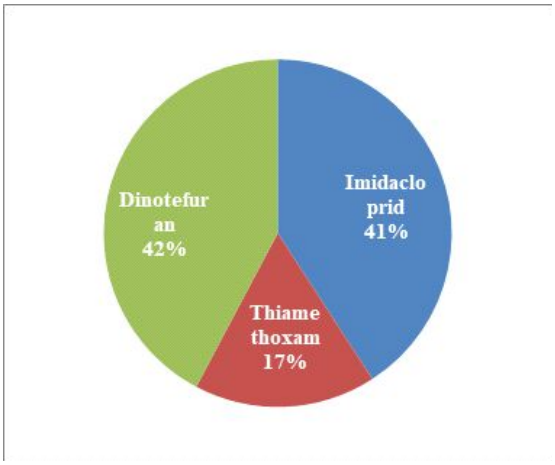

Fig 4. Neonicotinoids used by the farmers in the study area

Table 3. Insecticide usage pattern followed by the farmers in the study area of Godavari delta of Andhra Pradesh

S. No.	Variable	Positive Responses (%)		
		E. G. Dist.	W. G. Dist.	Mean
1	Cultivation of rice varieties recommended by ANGRAU	88.00	94.00	91.00
2	Identification of major insect pests of rice	84.00	86.00	85.00
3	Identification of natural enemies	18.00	15.00	16.50
4	Economic threshold level based spraying	0.00	0.00	0.00
5	Insecticides recommended in rice	85.00	83.00	84.00
6	Decision making by whom when to spray			
	a) Own decision	52.00	46.00	49.00
	b) Colleague farmer recommendation	15.00	20.00	17.50
	c) Agril. Extension Personnel	12.00	10.00	11.00
	d) Agro chemical dealer recommendation	21.00	24.00	22.50
7	Method of application practiced by the farmers			
	a) Single spray	11.00	13.00	12.00
	b) Mixed spray	89.00	87.00	88.00
8	Dosage of insecticides used by rice farmers			
	a) Higher than the recommended dose	89.00	87.00	88.00
	b) Recommended dose	5.00	6.00	5.50
	c) Lower than the recommended dose	6.00	7.00	6.50
9	Frequency of application in a season			
	a) 4 times	22.00	26.00	24.00
	b) 5 times	29.00	30.00	29.50
	c) 6 times	33.00	32.00	32.50
	d) > 6 times	16.00	12.00	14.00
10	Synthetic pyrethroids used or not			
	a) Yes	68.00	69.00	68.50
	b) No	32.00	31.00	31.50
11	Who sprays the insecticides			
	a) Farmer himself	8.00	10.00	9.00
	b) Hired labour	92.00	90.00	91.00
12	Use of protective clothing during spray			
	a) Yes	5.00	7.00	6.00
	b) No	95.00	93.00	94.00

chemical dealer. Other factors such as advice of fellow farmer (17.50%) and agricultural extension personnel (11.00%) also influenced the time of insecticide application by the farmers (Table 3).

Method of insecticide application

In the survey area, farmers were applying insecticides alone or as mixtures. Majority of the farmers (88.00%) used insecticides as mixtures rather than applying single insecticide at a time, may be to save time, labour and money. Farmers in the surveyed area were resorted to spraying operation by mixing 2 to 3 or even 4 insecticides with or without fungicides to control two or more insect pests and diseases simultaneously (Table 3 and Fig. 6). Similar observations were also reported by several workers earlier (Shetty *et al*., 2010; Sutharsan *et al*., 2014; IIRR, 2016; IIRR, 2017 and IIRR, 2018). Among the respondents, only a few farmers (about 12.50%) applied single insecticide at a time which indicates their knowledge in using insecticides.

Dosage of insecticides

Around ninety per cent of the farmers (88.00%) did not follow the recommended dose of insecticides in their sprays targeting insect pests. Some of the respondents said that they use over doses of insecticides as their neighbour is using the same dosage (Table 3 and Fig. 7). These observations are in agreement with the findings of Sutharsan *et al*. (2014),

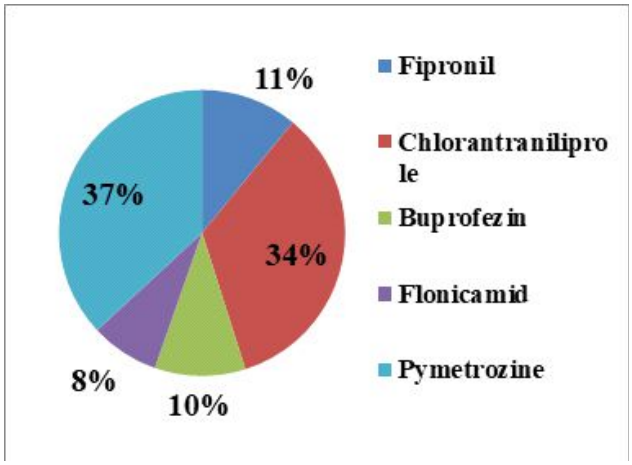

Fig 5. Novel insecticides used by the farmers in the study area

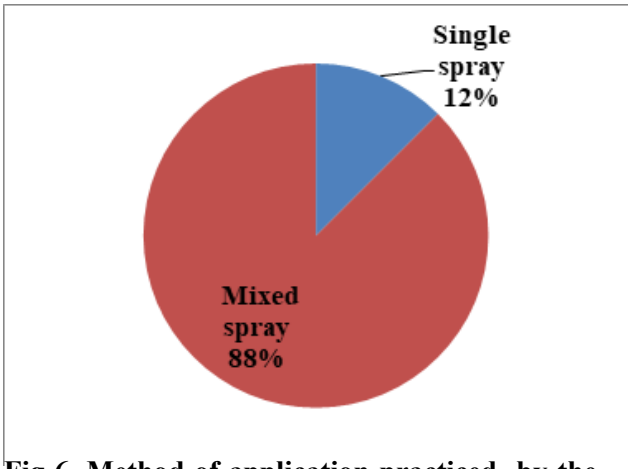

Fig 6. Method of application practiced by the farmers in the study area

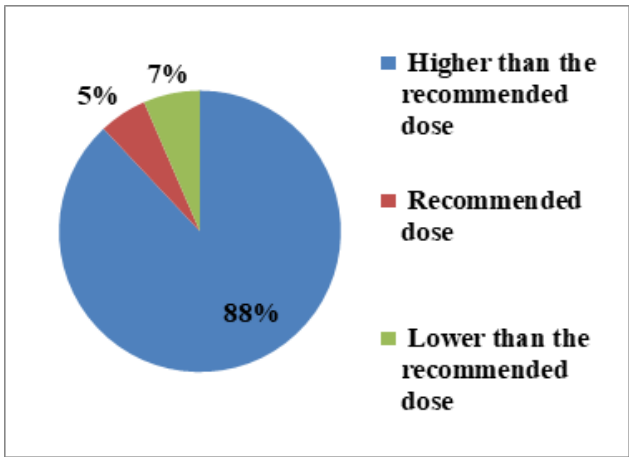

Fig. 7. Dosage of insecticides used by the farmers in the study area

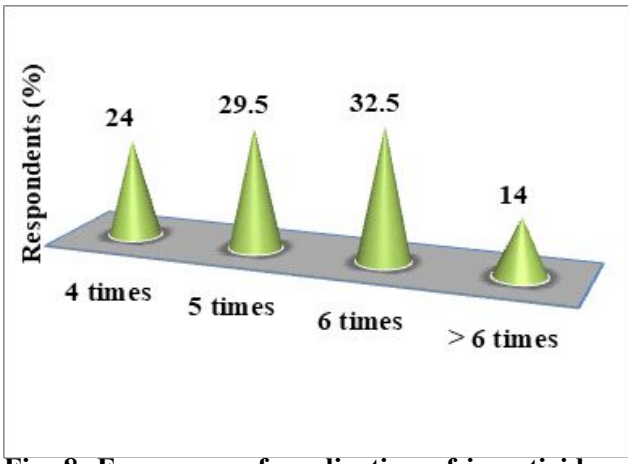

Fig. 8. Frequency of application of insecticides in a crop season (*Kharif* 2016)

who reported that majority of the farmers use pesticides at higher doses than the recommended level. In contrast, a few respondents (6.50%) are using lower doses than the recommended levels. Non-availability of small packs of insecticides in the market and lack of knowledge on insecticide application rates mainly attributed to the insecticide usage at lower dosages. Hardlly six per cent (5.50%) of the farmers follow the recommended doses in the preparation of spray fluids.

Frequency of insecticide application

Farmers tend to apply insecticides more frequently at seven to ten days interval against stem borer, gall midge, leaf folder and planthoppers which appeared round the year due to double cropping in the study area.

It was evident from the Table 3 and Fig. 8 that over ten per cent (14.00%) of the rice farmers applied insecticides more than six times in one growing season and 62.00 per cent of the respondents applied insecticides for about five to six times in a crop season. Half of the total sprays were targeted against planthoppers. Rest of the respondents (24%) in the survey area applied insecticides four times in a crop season. On an average, farmers used to apply insecticides in a range of 4-8 times to manage insect pests of rice. The results of the survey are in agreement with findings of IIRR, 2015 and IIRR, 2018.

Synthetic pyrethroids

It was noticed from the data presented in Table 3 that around seventy per cent (68.50%) of the respondents were using non-recommended synthetic pyrethroids like cypermethrin, deltamethrin, bifenthrin and lambda cyhalothrin alone or in combination with other insecticides for the control of rice leaf folder, stem borer and early season insect pests on account of their quick knock down effect. The observations made in the present survey are in agreement with works of Sarao and Mahal, (2007); IIRR, (2016); IIRR, (2017) and IIRR, (2018), who reported that frequent usage of synthetic pyrethroids to combat early season insect pests led to resurgence of brown planthopper in rice.

Over thirty per cent (31.50%) of the farmers were well aware of negative effects of synthetic pyrethroids and avoided their usage on rice (Table 3).

Who sprayed insecticides

It was observed that farmers were not supervising the spraying operation and spray operations were generally done by hired labour (91.00%), keeping nozzles much above the crop canopy level thus leading to drift (Table 3). While spraying against planthoppers, sprays were not targeted towards the base of the plant for achieving effective kill. On most occasions, proper droplet size was not maintained due to loose setting of nozzles leading to drain off of the spray fluid from the leaves to the ground, thus reducing the efficacy of the chemical used. Hardly nine (9.00%) of the farmer respondents themselves attended the spraying operation.

Use of protective clothing

Most of the farmers (94.00%) were not wearing personal protective clothing while spraying (Table 3). This was due to lack of awareness about pesticides toxicity and hazards associated with them. Deviprasad *et al*. (2015) and Anilkumar *et al*. (2017) also made similar observations in their survey studies. Hardly 6.00 per cent of the respondents in the study area wore protective clothing while attending spraying operation. Most common health problems reported by the respondent farmers those engaged in spraying operation were skin irritation, breathlessness, eye-irritation, head ache and cough.

CONCLUSION

From the present survey on the insecticide usage pattern followed by the rice growers, it was observed that the awareness levels of farmers related to insecticide usage is very less. Hence, there is a greater need for educating the farmers about the insect pests, insecticides, rotation and rational use of insecticides so as to avoid indiscriminate use and to prevent a chain of problems that affect environment and human health.

Further, surveys on insecticide usage pattern in major crops shold be carried out as a routine practice to monitor the actual field use of insecticides and if needed, re-evaluation of recommended insecticides shold be carried out so as to rationalize their usage.

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