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T Hemanth
Department of Entomology, Agricultural College, Bapatla, Andhra Pradesh, India

Ch. Sreenivasa Rao
Department of Entomology, Director (P&M cell), ANGRAU, lam, Guntur, Andhra Pradesh, India

D Sudha Rani
Senior Scientist (Entomology), ARS, Vuyyuru, ANGRAU, Guntur, Andhra Pradesh, India

G Bindu Madhavi
Principal Scientist (Plant Pathology), o/o Director of Research, ANGRAU, lam, Guntur, Andhra Pradesh, India

D Ramesh
Assistant Professor, Department of Statistics and Computer Applications, Agricultural College, Bapatla, Andhra Pradesh, India

Corresponding Author:
T Hemanth
Department of Entomology, Agricultural College, Bapatla, Andhra Pradesh, India

Perception and practices of rice farmers on pesticide use and handling in Krishna Delta of Andhra Pradesh

T Hemanth, Ch. Sreenivasa Rao, D Sudha Rani, G Bindu Madhavi and D Ramesh

Abstract
The present study was conducted among 30 farmers' in five mandals of Krishna delta area in Krishna district of Andhra Pradesh to study the knowledge and practices of rice farmers with reference to pesticide use and handling during *rabi* 2022-23 and *kharif* 2023-24. The study revealed that education level had significant influence on the selection of pest control strategies and majority of the farmers exhibited low levels of knowledge on safe pesticide use. Most of the farmers had poor knowledge on recommended pesticides (70.00%), classification of pesticides based on toxicity (73.33%) and awareness on pesticide residues & export rejections due to pesticide residues (66.67%). Most of the farmers got the advisories on pesticide recommendation from pesticide shop dealers (63.33%). It was also revealed that 40 and 33.33 per cent of the farmers disposed empty containers in the field and garbage, respectively and few (10%) were found reusing empty pesticide containers. With regard to handling of pesticides, 80 per cent of them used bottle cap for measurement and about 63.33 per cent were found using stick for mixing the spray fluid. During spraying, most of the farmers (56.67%) were found drinking water, while 43.33 per cent of them didn't eat or drink. It was also found that 76.67 per cent were not having the habit of smoking and drinking during spraying. About 40 per cent used full sleeves and only 26.67 per cent of farmers didn't follow any safety measure during pesticide application. Majority of the farmers were aware of the first aid practices to be followed in case of accidental poisoning (70.00%). There is no change in the knowledge and practices of farmers from *rabi* 2022-23 to *kharif* 2023-24. However, it is crucial to create awareness on responsible and safe use of pesticides.

Keywords: Rice, knowledge, awareness, measurement, pesticide residue

Introduction
Pesticides are widely used and play an important role in modern farming due to their capability and high reliability in protecting crops and thus ensuring high crop yields (Govindharaj *et al.*, 2021) [8]. Recent reports suggested that, still 5 billion kg of pesticides are used in the agricultural fields throughout the world even after introduction of novel insecticides (FAO, 2020) [6]. Pesticides are the chemical used for crop protection in the field, food protection during storage, and pest control in the home and have become key tool for plant protection (Cherukuri *et al.*, 2016) [3], but pesticides also associated with serious problems like harmful impacts on non-target organisms including humans, contamination of soil, water, air and residues in primary and derived agricultural products, all of which endanger both the environment and human health (Jallow *et al.*, 2017., Mahapatra *et al.*, 2017., Bondori *et al.*, 2018 and Jagadeesh *et al.*, 2021) [10, 14, 2, 9].

Rice is the second most consumed cereal in the world, providing around 21% of global human per capita energy and is a rich source of macronutrients such as protein (20%), dietary fiber and micronutrients (FAO, 2020) [6]. It is an economically important crop cultivated throughout South Asia. Rice in this region is susceptible to insect pests and diseases (Yadav *et al.*, 2021) [22]. In order to control the pests and diseases and to reduce the yield losses pesticides were used in rice ecosystem (Valluri *et al.*, 2022) [21]. 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 (Nagulananthan *et al.*, 2022) [16].

According to the Food and Agricultural Organization, 23% of Indian farmers and farm workers in rice ecosystems have been reported to suffer from work-related pesticide poisoning particularly in rural areas of developing countries because of lack of knowledge and education and unintentional application errors like careless handling of pesticides (Ali *et al.*, 2020) [1]. A recent report from the Food Safety Standards Authority of India (FSSAI), which analyzed

1177 rice samples revealed that 256 samples (21.7%) exceeded the FSSAI's maximum residue level (MRL), raising serious concerns about clean production practices. Additionally, 65 rice samples (5.5%) were found to contain non-approved pesticides, leading to questions about farmers' awareness (FSSAI, 2019) [7]. The utilization of pesticides on agricultural farms frequently leads to a range of health problems in humans. These issues can vary from short to long-term effects, such as mild to severe poisoning (Fan *et al.*, 2015) [5]. It is crucial to have a fundamental grasp of farmers' actions and factors influencing their pesticide usage. This knowledge is vital for devising, promoting, and executing widespread pesticide use policies (Uikey and Patil, 2023) [20]. Keeping in view of the above points, the present study was planned and mainly focused on farmer's knowledge in relation to the pesticide usage pattern in rice crop.

Materials and Methods

The study was conducted during *rabi* 2022-2023 and *kharif* 2323-2024 in Krishna Delta area of Krishna district of Andhra Pradesh. A total of 30 rice farmers were selected from 5 mandals with highest area under rice cultivation *viz.*, Kankipadu, Penamaluru, Vuyyuru, Thotlavalluru, Gannavaram with 2 villages from each mandal and 6 farmers were selected. The selected respondent farmers were interviewed personally with the help of a well framed questionnaire which was designed in English and translated into Telugu, the local language that can be easily understood by majority of the farmers. The questionnaire contained two sections one was socio-demographic profile contains information pertaining to age, education level and crop acreage and the second section contained the information on pesticide usage, handling practices in rice crop. The questionnaire mainly focused on awareness and behaviour of rice farmers on pesticide usage pattern in the study area *viz.*, awareness on pesticide recommendation, classification, toxicity, residues, disposal, spray men practices (pesticide measuring, mixing, PPE), effect of pesticide on health of spray men and first aid methods in case of accidental poisoning. The data collected was analysed by using descriptive statistical tools *viz.*, percentage, chi-square test and meaningful conclusions were drawn. Data analysis was carried out using SPSS for Windows (version 20.0) and Microsoft Office Excel 2013.

Results and Discussions

Profile of the rice farmers under study

Majority of the respondents (50%) belonged to middle age group followed by old age (36.67%) and young age (13.33%) group. The frequency distribution was highly skewed towards the middle age group farmers. Regarding the educational status of respondents, results showed that a majority (73.33%) of them were above 5th class (5th class to post graduation) and 26.67% of farmers were below 5th class (1st to 4th class). About 36.67 per cent of them were having hand holding size of 2-4 ha (Table 1). Prior studies (Nagulananthan *et al.*, 2022 [16] and Uikey and Patil, 2023) [20] also reported similar observations.

Table 1: Demographic characteristics of rice farmers in the study area

S. No	Parameter	Details	Frequency (n=30)	Percent (%)
1	Age	20-35	4	13.33
		36-50	15	50.00
		>50	11	36.67
2	Education	Above 5th class	22	73.33
		Below 5thclass	8	26.67
3	Crop area (ha)	<1.0	6	20.00
		1.0-2.0	8	26.67
		2.0-4.0	11	36.67
		>4	5	16.67

Total no of respondents n=30

Awareness on recommended pesticides and toxicity classification

The data in Table 2 reveals that majority of the farmers in the study area had poor knowledge on registered and recommended pesticides (70.00%) against various pests and toxicity-based classification of pesticides (73.33%). Only a few farmers had good knowledge on pesticide recommendation and classification i.e., 30.00% and 26.67%, respectively. Chi-square analysis revealed significant relation between education level of the farmer and awareness on pesticide classification (p value 0.031) and pesticide recommendation (p value 0.046), respectively (Table 2). Most of the farmers didn't read the labels, which might be due to farmers' inability to understand the language used on the label and lack of knowledge on pesticide toxicity classification. This result corroborates the findings of Sai *et al.* (2021) [18], Valluri *et al.* (2022) [21], Jagadeesh *et al.* (2022) [9] and Mounika *et al.* (2023) [15] that majority of the farmers were unaware of recommended pesticides and pesticide classification based on toxicity.

Source of Pesticide Advisories Get by the farmers

Out of 30 respondent farmers, 63.33% respondents got advice from Pesticide dealer, 26.67% respondents got advice from neighbour farmer and 6.67% and 3.33% respondents were adviced by mandal agriculture officers and scientists, respectively. Table 2 concluded that the advice provided by pesticide dealers emerged as the foremost and pivotal source of information for pest management in the study area. The efficiency of scientists and agriculture officers was found meager in delivering the information to the farmers because they must travel a distance to contact them and they have less rapport with these officials compared to pesticide dealers, even though they believe dealers have experience in recommending pesticides. Similar results were reported by Rahaman *et al.*, 2018 [17]., Sanjeeth *et al.*, 2018 [19]., Joshi *et al.*, 2022 [11] and Uikey and Patil, 2023 [20] with respect to source of information on pesticide advisory.

Farmer's perception towards pesticide usage

Most of the farmers (76.67%) stated that high dosage of

pesticides increases the crop yields and a very few farmers replied, other alternate methods of pest control also increase the crop yields, which was in line with who reported that 30.8% of the farmers felt using pesticides extensively was the only way to control pests. Based on chi-square analysis p value 0.068 clearly indicated no association between education and perception towards pesticide usage (Table 2). Most of farmers were unaware of pesticide dosages and believed that a high dosage gives better control of pest populations.

Disposal and Re-use of pesticide containers

Majority of the farmers were conscious about ill-effects of reusing empty pesticide containers and only 10% found to reuse them at home / farm (Table 1) and most the farmers (40%) were found leaving empty pesticide containers in the field corners. About 33.33% farmers disposed empty containers in garbage and a few farmers sold the empty containers after well rinsing (13.33%). Yadav and Dutta (2019) [23] also noticed that 72.8% of the farmers had thrown the pesticide containers on the field and 15.2% of them reused the empty pesticide containers. Previous findings (Lari *et al.*, 2021., Sai *et al.,* 2021 and Valluri *et al.,* 2022) [12, 21, 18] stated that most of the farmers disposed the pesticide containers by leaving them in the field corners.

Awareness on pesticide residues

It was found that 66.67% farmers have poor knowledge on pesticide residues and export rejection due to pesticide residues however, 33.33% farmers have good knowledge on pesticide residues. The results of Chi-square analysis revealed (p value 0.02) that there was a significant association between education and awareness on pesticide residues and export rejection (Table 2). Mounika *et al.* (2023) [15] also conducted similar study and revealed that 76.67% farmers had poor knowledge on pesticide residues & export rejection due to pesticide residues and 23.33% farmers had good knowledge on pesticide residues.

Table 2: Awareness of rice farmers on pesticide usage

S. No.	Particulars	Response	Frequency n=30	Percentage %	Chi square Value
1.	Awareness on recommended pesticide	Good knowledge	9	30.00	0.031*
		Poor Knowledge	21	70.00	
2.	Awareness on pesticide classification and toxicity symbols on packing	Good knowledge	8	26.67	0.046*
		Poor Knowledge	22	73.33	
3.	Advisories / Source of information on pesticide recommendation	AO	2	6.67	0.817
		Scientist	1	3.33	
		Pesticide dealer	19	63.33	
		Neighbour farmers	8	26.67	
4.	Perception on usage of pesticides	High dose of pesticides will Increase Crop yields	23	76.67	0.068
		Other methods	7	23.33	
5.	Disposal of empty containers	Garbage	10	33.33	0.062
		Leave in the Field	12	40.00	
		Burrying	0	0.00	
		Sell	5	16.67	
		Reuse	3	10.00	
6.	Re-use of empty containers	Reusing empty containers	3	10.00	0.099
		Not using empty containers	27	90.00	
7.	Awareness on pesticide residues	Good knowledge	10	33.33	0.02*
		Poor Knowledge	20	66.67	
8.	Awareness on export rejections due to pesticide residues	Good knowledge	10	33.33	0.02*
		Poor Knowledge	20	66.67	

Total no of respondents N=30
*Significant at 5 % level of significance $p < 0.05$
**Significant at 5 % level of significance $p < 0.01$

Practices followed by spray men before, during and after pesticide application

Majority of the farmers (63.33%) in the study area used stick and a significant number of farmers (36.67%) used bare hands for mixing of pesticides. The above finding was similar to the results of Jagadeesh *et al.* (2022) [9], where 54.00% and 33% of farmers used stick and hand for mixing of pesticides, respectively. Chi-square analysis revealed (p value 0.004) a significant association between education and mixing of pesticides. Most of the farmers (80.00%) used bottle cap and a very few farmers (20.00%) approximately measured of the pesticides. Most of the farmers (40%) used full sleeves and significant proportion of farmers (16.67%) used mask and a very few of them (10%) used mask and full sleeves during pesticide application, while 26.67% farmers did not use any kind of personal protection equipment (PPE). Most of the farmers (56.67%) were found drinking water in between the sprayings, while 43.33% of the farmers did not eat or drink during spraying. It was also found that 76.67% of the farmers did not followed smoking and drinking alcohol during spraying, while a small number of farmers practiced smoking (23.33%) in between spraying. Chi square analysis revealed a significant association between education and other practices during spraying (Table 3). Valluri *et al.* (2022) [21] also reported that majority of the farmers didn't consume food/water/alcohol or the habit of smoking during spraying.

Awareness of spray men on symptoms of poisoning and first aid

A large proportion of farmers (66.67%) did not observe any

kind of ill-effects of pesticides on spray men, while 33.33% of the farmers observed ill-effects on spray men. Common health ailments observed during or after pesticide spraying was cough (3.33%), skin irritation (13.33%), breathlessness (3.33%), headache (6.67%) and eye irritation (6.67%). Study conducted by Mounika *et al.* (2023) [15] showed symptoms *viz.*, cough (3.33%), skin irritation (6.66%), breathlessness (6.66%), headache (3.33%) and eye irritation (13.33%). Most of the farmers (70.00%) were aware of first aid practices to be taken in case of accidental poisoning. First aid methods followed by farmers was inducing vomiting if swallowed (13.33%), cleaning the affected area with water (30.00%), moving the person to fresh air (26.67%) (Table 4). The results indicted lack of awareness among farmers, even above 5th class, which indicated the requirement of extension activities such as campaigns on the issues of responsible and safe use of pesticides.

Table 3: Spray men practice on before, during and after spraying pesticides

S. No	Particulars	Details	Frequency (n = 50)	Percentage %	Chi square value
1	Measuring of pesticides	Bottle cap	24	80.00	0.099
		Approximate	6	20.00	
2	Mixing of pesticides	Stick	19	63.33	0.004**
		Bare hands	11	36.67	
3	Usage of PPE during spraying	Wearing Mask	5	16.67	0.189
		Full sleeves	12	40.00	
		Mask + Full sleeves	3	10.00	
		Eye shield	2	6.67	
		Not using any kind of PPE	8	26.67	
4	**Other practices during spraying**				
	a) Eating food and drinking Water	Eating Food	0	0.00	0.004**
		Drinking water	17	56.67	
		Both	0	0.00	
		None	13	43.33	
	b) Smoking and alcohol consumption	Smoking	7	23.33	0.002*
		Alcohol	0	0.00	
		Both	0	0.00	
		None	23	76.67	

*Significant at 5 % level of significance p < 0.05
**Significant at 5 % level of significance p < 0.01

Table 4: Spray men observed health issues due to spraying and awareness on first aid methods

S. No.	Particulars	Details	Frequency n=30	Percentage %	Chi square Value
1.	Observation of ill-effects of pesticides on spray men	Observed	10	33.33	0.00**
		Not observed	20	66.67	
2.	Common health ailments/ issues observed during spraying	Cough	1	3.33	0.01*
		Skin irritation	4	13.33	
		Breathlessness	1	3.33	
		Headache	2	6.67	
		Eye irritation	2	6.67	
		Dizziness	0	0.00	
		Not observed	20	66.67	
3.	Awareness on first aid practices	Yes	21	70.00	0.149
		No	9	30.00	
4.	First aid methods followed	Inducing vomiting if swallowed	4	13.33	0.102
		Cleaning the affected area with water	9	30.00	
		Moving the person to fresh air	8	26.67	
		Not aware about first aid methods	9	30.00	

*Significant at 5 % level of significance p < 0.05
**Significant at 5 % level of significance p < 0.01

Conclusions

It may be concluded that farmers were solely dependent on chemical pesticides for the control of pests and diseases in rice crop and they were using a variety of pesticide formulations. The consciousness level of farmers regarding usage of insecticides, using protective aids during spraying, following label claim on container and deleterious effect of insecticides *etc.* were highly minimal which might be due to the lack of awareness. The input dealers were acting the role of major information and service provider on pesticide use which causes the risk of adoption of incorrect practices. Thus, agricultural extension need to be employed to follow a systemic, well planned and coordinated approach in the area for improving the knowledge status of rice farmers. This should encompass critical aspects such as the optimal pre-harvest interval for pesticides, appropriate dosage, pesticide toxicity thresholds, ideal application timing and safety precautions during spraying, which will not only help to

reduce the health hazards of farmers, but will also promote cleaner and sustainable production in the long run.

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