Survey on the Pesticide Usage Pattern in Paddy Crop Grown in Southern Agro-Climatic Zone of Andhra Pradesh

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Abstract: The results of the field survey which was conducted at paddy growing farmers fields of Southern agro-climatic zone (Chittoor, S P S Nellore and Y S R Kadapa districts) of Andhra Pradesh on pesticide usage pattern during *rabi*, 2016-17 and 2017-18 revealed that, most of the rice growing farmers were males with an age group ranging between 40-50 years leading nuclear family and without any education (illiterates). A higher seed rate of 25-30 kg/acre and the adoption of seed treatment with fungicides were followed by majority of farmers. During the crop growing stages, most of the farmers applied higher dosages of fertilisers and to control the weeds preferred manual weed control. Among the insect pests and diseases, the yellow stem borer and blast caused infestation in all the farmers (100.00%) fields. During tillering, panicle initiation, milky and grain formation stages of the paddy crop, all the farmers (100.00%) applied insecticides and fungicides. Most of the farmers used insecticides belonging to organophosphates, followed by fungicides and herbicides during the crop growing season. Before application of pesticides most of them preferred to contact pesticide dealers for pesticide recommendations and used approximate quantity of pesticides while preparation of spray solutions. Most of the farmers used power sprayer for spraying during the morning or evening hours by wearing shirts with full hands. After the application of pesticides at weekly interval, the majority of the farmers threw the empty bottles in trash.

Key words: Paddy, Pesticides, Insect pests and Diseases

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1. Introduction

Pesticides constitute the key control tactics for management of pests and diseases and the productivity of crops depends on their effective control. Together with high-yielding crop varieties and fertilizers, pesticides had helped the Indian farmers in achieving a substantial increase in agricultural productivity. The persistence of the pesticide depends on its physical and chemical properties (partition coefficients, degradation rates, deposition rates *etc*.,) and the characteristics of the environment (Farha *et al*., 2016). The credits of pesticide use include enhanced economic potential in terms of food production and amelioration of vector-borne diseases. However, poor agricultural practices adopted by the farmers including the extensive usage of pesticides with the thinking ‘‘if a little is good, more will be better’’ and adoption of insufficient waiting periods before harvesting resulted in widespread environmental contamination. Currently, India is the largest producer of pesticides in Asia and is placed twelfth with respect to usage of pesticides. Among the states in India, Andhra Pradesh, Uttar Pradesh and Punjab are amongst the highest consumers of pesticides (Tomer *et al*.,

2015). The pattern of pesticide usage in India was different from that of the world in general. In India, 76 per cent of the pesticides were used as insecticides as against 44 per cent globally. The use of herbicides and fungicides were correspondingly less (Dey *et al*., 2013). Use of insecticides showed a positive impact on paddy production (Mishra and Parida, 2004), but had some environmental impact also (Khan *et al*., 2010). The paddy crop was the second highest pesticide consuming crop after cotton in India with different spray schedules (Arora *et al.,* 2008). This results in contamination of paddy with pesticide residues (Ravikumar *et al.*, 2013).

2.Material and Methods

Survey was conducted on paddy crop in Southern Agro-climatic zone of Andhra Pradesh *viz*., Chittoor, S P S Nellore and Y S R Kadapa districts at fortnight interval during *rabi* season of 2016-17 and 2017-18.

2.1 Selection of Villages

Out of considerable area under paddy cultivation, in each district of Southern Agro-climatic zone, two mandals were selected and in each mandal, two villages were choosen randomly. Thus a total of twelve villages were selected. The details of locations for the study are presented in Table 3.1.

2.2 Nature and Source of Data

In each village, five paddy farmers were selected based on the pesticides (insecticides, fungicides and herbicides) usage pattern in the village. Regular surveys and interaction with farmers were conducted as per standard proforma and obtained information on varieties of paddy, fertilizers used, major paddy pests, pesticides used including type of formulations of pesticides to control different pests, trade name, pesticide application methods and frequency of spraying in one paddy farming season.

A popular paddy variety, BPT-5204 (Samba mashuri), was selected for the present study in Southern Agro-climatic zone of Andhra Pradesh. In each village, five farmers were selected, thus a total of 60 BPT-5204 growing farmers were selected in Southern Agro-climatic zone of Andhra Pradesh in both seasons of *rabi*, 2016-17 and 2017-18.

Table 3.1 Name of the locations for study in Southern Agro-climatic zone of Andhra Pradesh

District	Mandal	Village	No. of farmers
Chittoor	Yerpedu	Madibaka	5
		M.D. Puttur	5
	Kalahasthy	Kalahasthy	5
		Modhugulapalem	5
SPS Nellore	Nellore rural	Kaakupalli	5
		M.R. Gudur	5
	Kovvur	Kovvur	5
		Veguru	5
YSR Kadapa	Vallur	Vallur	5
		Chinna Lebaka	5
	Chintakommadinne	Chinthakommadinne	5
		Tadigotla	5
Total		12	60

2.3 Analytical Tools and Techniques Employed

Simple statistical tools like frequency and percentage were used to analyse the data.

3. Results and Discussion

3.1 Socio-economic Characteristics of Farmers Growing Paddy Crop During *Rabi,* 2016-17 and 2017-18

Data pertaining to general characteristics of farmers during *rabi*, 2016-17 and 2017-18 seasons were presented in the Table 1.

Table 1 Socio-economic characteristics of the paddy farmers during *rabi,* 2016-17 and 2017-18

Particulars		*Rabi*, 2016-17 (n=60)		*Rabi*, 2017-18 (n=60)	
Sl.No.	**Particulars**	**Frequency (no.)**	**Percentage (%)**	**Frequency (no.)**	**Percentage (%)**
1	**Age (Years)**				
	20-30	4	6.67	5	8.33
	30-40	13	21.67	12	20.00
	40-50	37	61.67	35	58.33
	>50	6	10.00	8	13.33
2	**Educational Status**				
	Illiterate	43	71.67	41	68.33
	Primary school	10	16.67	12	20.00
	Secondary school	5	8.33	5	8.33
	College	2	3.33	2	3.33
3	**Type of family**				
	Nuclear	54	90.00	56	93.33
	Joint	6	10.00	4	6.67
4	**Gender**				
	Male	60	100.00	60	100.00
	Female	0	0.00	0	0.00
5	**Farming experience (Years)**				
	< 10	12	20.00	10	16.67
	10-20	22	36.67	17	28.33
	20-30	26	43.33	33	55.00

Age, level of education, gender and farming experience of farmers were found to be major influential factors in their pest management decisions. Most of the farmers who were growing paddy crop were male of age group ranging 40-50 years leading nuclear family and without any education (illiterates). Eventhough the families were nuclear, they gained the farming practices either from their parents or neighbours. The results which were obtained during the survey studies were in conformity with the observations of Sharifzadeh *et al*. (2019) who reported that most of the paddy farmers had mean age and farming experience of 45.2 and 21.8 years with secondary education. Rodenburg *et al*. (2019) reported that the gender of most of the paddy cultivating farmers was men. Marin *et al*. (2018) observed that average age, years of schooling and agricultural experience of the paddy cultivating male (92.79%) farmers were 52.35, 6.01 and 26.91 years. As reported by Mazlan and Mumford (2005), farming experience was not much different between generations because they gained from their friends and parents through working experience.

3.2 General Information Regarding Paddy Cultivation During *Rabi*, 2016-17 and 2017-18

During *rabi*, 2016-17 and 2017-18, the obtained results (Table 2) revealed that most of the farmers followed higher seed rate of 25-30 to 30-35 kg acre^{-1} and least was 20-25 kg acre^{-1}. Most of the farmers followed seed treatment with fungicides before sowing in nursery to protect the seedlings from diseases. A nursery seedlings of 25-30 days age were preferred by most of the farmers and sown by transplantation method with a spacing of 10×10 cm. It was cultivated in an area of 3-4 acres during early *rabi* (October) season and maintained upto five months by many farmers. During the crop growing stages, most of the farmers applied higher dosages of fertilisers and to control the weeds mostly preferred manual weed control and less number of farmers used the post-emergence herbicides.

The obtained results were in coincidence with the results of Borthakur *et al*. (2015) who reported that due to traditional mindset of farmers which prevent from usage of accurate seed rates, only 1.38 per cent adopted the correct paddy seed rate while the remaining adopted more (88.61%) or less (10.00%) seed rate and majority (74.71%) adopted the practice of seed treatment with fungicides. Devkota *et al*. (2019), who reported that 25 to 30 day old seedlings were manually transplanted into the puddled field by most of the farmers. Abdollahzadeh *et al*. (2019), reported that the paddy farmers (37.33%) who were cultivating the paddy crop in areas having average farm size of less than five acres. Arora *et al*. (2019) reported that farmers cultivated the paddy crop during the *kharif* (June to October) and long *kharif* seasons (May to October) having warm and humid climate. Stuart *et al*. (2017) reported that the dry season paddy crop was maintained for five months (January to May) and harvested at the end of fifth month. More than half of the farmers (56%) established their paddy crop by direct sowing, whereas others (44%)

transplanted paddy seedlings from nurseries and most commonly used weed management practice by paddy farmers was hand weeding, followed by herbicide application and mechanical weeding using sine hoes, machetes, push or rotary weeders according to the findings of Rodenburg *et al*. (2019). Anitha and Chellappan (2011) observed that all farmers planted at 20x15 cm spacing to increased paddy productivity compared to irregular pattern of spacing. Banayo *et al*. (2017) reported that total N applied by paddy farmers was 30-34 per cent higher than recommended rate while P and K input were almost same with the recommended dosages.

Table 2 General information on paddy cultivation during *rabi,* 2016-17 and 2017-18

Particulars		***Rabi,* 2016-17 (n=60)**		***Rabi,* 2017-18 (n=60)**	
Sl.No.	**Particulars**	**Frequency (no.)**	**Percentage (%)**	**Frequency (no.)**	**Percentage (%)**
1	**Seed rate (Kg/Acre)**				
	20-25	4	6.67	6	10.00
	25-30	44	73.33	43	71.67
	30-35	12	20.00	11	18.33
2	**Seed treatment with fungicides**	49	81.67	47	78.33
3	**Age of nursery used (Days)**				
	25-30	47	78.33	46	76.67
	30-35	9	15.00	11	18.33
	35-40	4	6.67	2	3.33
4	**Crop area (Acres)**				
	< 0.5	0	0.00	1	1.67
	0.5-1	5	8.33	4	6.67
	1 -2	14	23.33	16	26.67
	2 -3	11	18.33	9	15.00
	3 -4	26	43.33	25	41.67
	>4	4	6.67	5	8.33
5	**Season of cultivation**				
	Early *rabi* (October)	42	70.00	47	78.33
	Late *rabi* (November/ December)	18	30.00	13	21.67
6	**Crop duration (Months)**				
	5	57	95.00	56	93.33
	>5	3	5.00	4	6.67
7	**Method of sowing**				
	Transplanting	54	90.00	52	86.67
	Drum seeder	6	10.00	8	13.33
8	**Spacing (cm×cm) adopted in transplantation**				
	15 × 10	24	44.44	19	36.54
	10 × 10	30	55.56	33	63.46
9	**Weed control**				
	Manual	42	70.00	43	71.67
	Herbicides (Pre-emergence)	13	21.67	11	18.33
	Herbicides (Post-emergence)	5	8.33	6	10.00
10	**Fertiliser application dosages**				

	Low	5	8.33	7	11.67
	Recommended	10	16.67	10	16.67
	High	45	75.00	43	71.67

3.3 Information on Occurence of Insect Pests and Diseases of Paddy Crop of Farmers Fields during *Rabi*, 2016-17 and 2017-18

During *rabi*, 2016-17 and 2017-18, among the insect pests, the yellow stem borer caused infestation in all the fields of sample farmers and the panicle mite infestation was observed in less number of sample farmers fields while among the diseases, the paddy blast was infected in more number and bacterial leaf blight was infected in less number of sample farmers fields (Table 3).

The insect pests and diseases observed during survey were in conformity with the outcome of Arora *et al.* (2019) who reported that the major insect pests identified in the paddy growing region were leaf folder, yellow stem borer, plant hoppers, hispa and gundhi bug. The bacterial blight and blast were observed as major diseases.

Table 3 Information on occurrence of insect pests and diseases on paddy crop of farmers fields during *rabi*, 2016-17 and 2017-18

Particulars		***Rabi*, 2016-17 (n=60)**		***Rabi*, 2017-18 (n=60)**	
Sl.No.	**Insect Pests**	**Frequency (no.)**	**Percentage (%)**	**Frequency (no.)**	**Percentage (%)**
1	Yellow stem borer (*Scirpophaga incertulas*)	60	100.00	60	100.00
2	Rice leaf folder (*Cnaphalocrocis medinalis*)	54	90.00	56	93.33
3	Brown Planthopper (*Nilaparvata lugens*)	19	31.67	17	28.33
4	Green leaf hopper (*Nephotettix virescens*)	37	78.33	39	86.67
5	Rice gundhi bug (*Leptocoris acuta*)	6	10.00	7	11.67
6	Rice gall midge (*Orseolia oryzae*)	20	33.33	23	38.33
7	Panicle mite (*Steneotarsonemus spinki*)	5	8.33	3	5.00
	Diseases				
8	Blast (*Pyricularia oryzae*)	60	100.00	58	96.67
9	Brown spot (*Dreschlera oryzae*)	41	68.33	43	71.67

10	Sheath blight (*Rhizoctonia solani*)	48	80.00	52	86.67
11	Sheath rot (*Saraclodium oryzae*)	45	75.00	42	70.00
12	Stem rot (*Sclerotium oryzae*)	39	65.00	35	58.33
13	Bacterial leaf blight (*Xanthomonas oryzae* pv. *oryzae*)	7	11.67	4	6.67

3.4 Application of Pesticides by Farmers at Various Growth Stages of the Paddy Crop During *Rabi,* 2016-17 and 2017-18

The usage of insecticides and fungicides by the farmers to control different insect pests and diseases during *rabi*, 2016-17 and 2017-18 (Table 4) revealed that, during tillering, panicle initiation, milky and grain formation stages all the farmers were applied and while during the nursery and grain maturation stages, only less percentage of farmers applied.

Majority of the farmers confirmed that the pesticide spray was given even during harvesting while a few farmers reported that they stop pesticide application almost one week to ten days before harvesting the crop. The results which were obtained about the application of different pesticides (insecticides and fungicides) at different growth stages of the paddy crop were in conformity with the observations of Cabasan *et al* .(2019), who reported that, farmers apply pesticides in the whole crop growth period. As early as 15 days after transplanting, at the seedling stage of the crop, farmers already applied insecticides. Most of the farmers (64%) applied pesticides during the tillering stage of the crop. Pesticide application was repeated as and when needed or perceived. Although farmers applied pesticides according to the growth stages of paddy, some farmers applied more than once per paddy growth stage when needed.

Table 4 Pesticides applied by farmers at various growth stages of the paddy crop during *rabi,* 2016-17 and 2017-18

	Particulars	***Rabi,* 2016-17 (n=60)**		***Rabi,* 2017-18 (n=60)**	
Sl.No.	**Stage of crop**	**Frequency (no.)**	**Percentage (%)**	**Frequency (no.)**	**Percentage (%)**
	Insecticides				
1	Nursery stage	54	90.00	56	93.33
2	Tillering stage	60	100.00	60	100.00
3	Panicle initiation stage	60	100.00	60	100.00
4	Milky stage	60	100.00	60	100.00
5	Grain formation stage	60	100.00	60	100.00

6	Grain maturation stage	55	91.67	56	93.33
	Fungicides				
7	Nursery stage	52	86.67	54	90.00
8	Tillering stage	60	100.00	60	100.00
9	Panicle initiation stage	60	100.00	60	100.00
10	Milky stage	60	100.00	60	100.00
11	Grain formation stage	60	100.00	60	100.00
12	Grain maturation stage	53	88.33	52	86.67

3.5 Pesticide usage pattern on paddy crop against different insect pests, diseases and weeds during *rabi*, 2016-17 and 2017-18

Data pertaining to pesticides used by farmers on paddy crop against different insect pests and diseases during *rabi*, 2016-17 and 2017-18 was presented in the Table 5. Most of the farmers preferred to use different formulations of insecticides, followed by

Table 4.5 Pesticide usage pattern on paddy crop against different insect pests, diseases and weeds during *rabi*, 2016-17 and 2017-18

Particulars (Pesticides)				*Rabi*, 2016-17 (n=60)		*Rabi*, 2017-18 (n=60)	
Sl.No.	**Insecticide**	**Type of formulations**	**Trade name/s**	**Frequency (no.)**	**Percentage (%)**	**Frequency (no.)**	**Percentage (%)**
1	Acephate	75 SP	Orkem, Missile, Asataf	17	28.33	14	23.33
2	Acetamiprid	20 SP	Manik	8	13.33	5	8.33
3	Carbofuran	3 G	Carbofuran, Furadan	16	26.67	19	31.67
4	Cartap hydrochloride	50 WP, 4 G	Caldan, Padan, Sanvex	20	33.33	18	30.00
5	Chlorantraniliprole	18.5 SC, 0.4 GR	Coragen, Cover, Ferterra	24	40.00	21	35.00
6	Chlorpyrifos	20 EC	Chloroguard, Dursban	29	48.33	41	68.33
7	Dichlorvos	76 EC	Nuvan, Nukem, Hyvap	15	25.00	17	28.33
8	Dimethoate	30 EC	Rogar, Tara-909, Tafgor	6	10.00	2	3.33
9	Flubendiamide	20 WDG, 480 SC	Takumi, Fame	12	20.00	10	16.67
10	Imidacloprid	17.8 SL, 600 FS	Confidor, Gaucho	12	20.00	9	15.00
11	Monocrotophos	36 SL	Monokem, Monocil, Hycrophos	39	65.00	36	60.00
12	Phorate	10 G	Moto-X, Thimet	14	23.33	10	16.67
13	Phosalone	35 EC	Zolone	8	13.33	4	6.67
14	Profenofos	50 EC	Pivot, Profigan	36	60.00	34	56.67
15	Triazophos	40 EC	Rider, Ghatak	2	3.33	0	0.00

Cont..

Particulars (Pesticides)				*Rabi*, 2016-17 (n=60)		*Rabi*, 2017-18 (n=60)	
	Fungicide	**Type of formulations**	**Trade name**	**Frequency (no.)**	**Percentage (%)**	**Frequency (no.)**	**Percentage (%)**
16	Tricyclazole	75 WP	Beam, Sivic, Baan	19	31.67	17	28.33
17	Propiconazole	25 EC	Tilt, Radar	26	43.33	30	50.00
18	Hexaconazole	5 EC	Contaf Plus, Sitara	15	25.00	13	21.67
	Herbicide						
	Pre emergence						
19	Butachlor	50 EC	Machete	4	6.67	5	8.33
20	Oxadiargyl	80 WP, 400 SC	Topstar	7	11.67	5	8.33
	Post emergence						
21	Bispyribac Sodium	10 SC	Nominee Gold	5	8.33	4	6.67
22	Metsulfuron-methyl 10%+Chlorimuron-ethyl 10%	20 WP	Almix	2	3.33	3	5.00

fungicides and herbicides during the cropping season. Different groups like oraganophosphorus, carbamates, thiocarbamates, neonicotinoids, anthranilic diamides were used pertaining to insecticides to control various insect pests. While, in case of fungicides, propiconazole, tricyclazole and hexaconazole were used against different fungal infections. In case of pre emergence herbicide application, farmers used butachlor and oxadiargyl while in case of post emergence herbicide application, farmers used bispyribac sodium and metsulfuron-methyl 10 per cent+ chloimuron-ethyl 10 per cent. Based on the survey during *rabi* season of 2016-17 and 2017-18, it was concluded that farmers used more insecticides followed by fungicides and herbicides to reduce the insect pests, diseases and weeds.

These results were similar with the observations of Sai *et al.* (2019) who reported that insecticides (72%) were the most commonly used among pesticides, followed by fungicides and bactericides (18%) and herbicides (6%). From the obtained results it was revealed that among different pesticides, farmers used different formulations of insecticides and fungicides which were available in different trade names. The results were in conformity with the survey done by Ahmad *et al*. (2014) who reported that, most of the insecticides which were used frequently by the famers contains active ingredients of thiamethoxam, lambda-cyhalothrin, chlorpyrifos, cypermethrin, buprofezin and cartap hydrochloride and among the fungicides, difenoconazole and isoprothiolane were the active ingredients used to control fungal pathogens (*Rhizoctonia solani* and *Pyricularia oryzae)*. Plainbangchang *et al.* (2009) reported that chlorpyrifos was the most frequently used by farmers, followed by cypermethrin, whereas the combination of difenoconazole and propiconazole was the most frequently mentioned fungicides. According to Rodenburg *et al*. (2019) observations farmers more often applied herbicides of post weed emergence than pre-emergence herbicides and the most frequently used herbicides were 2,4-D and bensulfuron.

4.1.6 General Awareness of Farmers on Usage of Pesticides on Paddy Crop During *Rabi,* 2016-17 and 2017-18

Data pertaining to awareness of farmers on pesticides and their usage pattern on paddy during *rabi,* 2016-17 and 2017-18 were presented in the Table 4.6.

Since most of the famers had an experience of 10-15 years on different crops, many farmers had a chance of applying atleast one pesticide on paddy crop. These results were similar with the findings of Sankoh *et al.* (2016) who reported that most of the respondents used at least one type of pesticide on their farms throughout their farming experience.

The results were similar with the outcome of Kumar (2015) who reported that 33.75 per cent of farmers were aware of recommended pesticides against different pests, and 22.50 per cent were aware of pesticide classification based on the toxicity.

Table 4.6 General awareness of farmers on usage of pesticides on paddy crop during *rabi*, 2016-17 and 2017-18

Sl.No	Particulars	*Rabi*, 2016-17 (n=60)		*Rabi*, 2017-18 (n=60)	
		Frequency (no.)	Percentage (%)	Frequency (no.)	Percentage (%)
1	**Period of activity in using pesticides on paddy crop**				
	< 5 years	8	13.33	9	15.00
	>5 years	52	86.67	51	85.00
2	**Awareness on recommendations of pesticides**				
	With awareness	6	10.00	6	10.00
	Without awareness	54	90.00	54	90.00
3	**Farmers desire to mix different pesticides**				
	Insecticide + insecticide	44	73.33	40	66.67
	Insecticide + fungicide	16	26.67	18	30.00
	Fungicide + fungicide	8	13.33	7	11.67
4	**Measurement of pesticides**				
	Bottle cap (correct dosage)	14	23.33	15	25.00
	Approximately (more or less dosage)	46	76.67	45	75.00
5	**Mixing of pesticides with water to prepare spray solution**				
	Bare hands	0	0.00	0	0.00
	Stick	60	100.00	60	100.00
6	**Source of technical information**				
	Agricultural officer	20	33.33	21	35.00
	Dealer	32	53.33	31	51.67
	Scientist	8	13.33	8	13.33

cont..

7	**Frequency of application**				
	4 days interval	10	16.67	9	15.00
	5 days interval	21	35.00	21	35.00
	Weekly interval	29	48.33	30	50.00
8	**Disposal method followed for empty pesticide bottles**				
	Used for house or farm purpose	8	13.33	10	16.67
	Sell	6	10.00	7	11.67
	Throw into trash	46	76.67	43	71.67
9	**Selection of spraying equipment**				
	Knapsack sprayer	13	21.67	17	28.33
	Power sprayer	47	78.33	43	71.67
10	**Time of pesticide application**				
	Morning or evening hours	52	86.67	54	90.00
	Day light hours	8	13.33	6	10.00
11	**Precautions while application of pesticides**				
	Face masks	0	0.00	0	0.00
	Hand gloves	0	0.00	0	0.00
	Shirts with full hands	43	71.67	49	81.67
	No precautions	17	28.33	11	18.33
12	**Farmers perception on pesticide risks and occupational health hazards**				
	With perception	20	33.33	22	36.67
	Without perception	40	66.67	38	63.33

The results were similar with the outcome of Kumar (2015) who reported that 33.75 per cent of farmers were aware of recommended pesticides against different pests, and 22.50 per cent were aware of pesticide classification based on the toxicity.

Majority of the paddy farmers used combination of pesticides with different modes of action and different classes to save time, labour, money and to combat two or more pests with a single spray. The results obtained were in conformity with the outcome of Kumar (2015) who observed that majority of the farmers (63.75%) used pesticide mixtures rather than applying single pesticide at a time.

More number of the paddy farmers measured chemicals approximately as most of them did not follow recommendations while a few farmers measured chemical by bottle cap. All the farmers mixed chemical in water with stick and not with bare hands because they were concerned about pesticide consumption along with the food they eat. The results obtained were in conformity with the observations of Kumar (2015) in which 51.25 per cent farmers measured chemical by bottle cap and 48.75 per cent of farmers measured approximate quantity and 100 per cent of farmers mixed chemical by using stick, not with bare hands.

Since majority of the farmers were illiterates and unaware of mode of action the pesticide for different pest control, more number of farmers contact either Agricultural Officers or Scientists or pesticide shop dealers for recommendations. The results obtained were similar with the findings of Rahaman *et al*. (2018) who reported that most of the paddy farmers contacted pesticide dealers or company agents (69.16%) followed by neighbours (11.66%), extension workers (7.50%), relatives (5.83%), fellow farmers (4.16%) and radio or television (1.66%) for pesticide recommendations against different pests observed on paddy crop. According to Kumar (2015) maximum number of farmers preferred to contact pesticide dealers (71.25%) followed by Agricultural Officers (17.5%) and Scientists (11.25%) for pesticide recommendations.

Most of the farmers applied pesticides at weekly intervals on paddy indicated that farmers were given some time for action of pesticide to act upon pests. The rest of the famers followed their own spray schedule inspite of presence or absence of pests infestation. The obtained results were in conformity with the observations of Deviprasad *et al.* (2015) who reported that most of the farmers indicated preventive spraying of pesticides once or twice per season, a few farmers reported spraying of pesticides depending on pest manifestation. With regard to time between spraying of pesticides, some farmers sprayed once or twice per month and thus the sprayings were not uniform.

Proper disposal of empty pesticide bottles without using them for house or farm purpose is essential in order to avoid health hazards due to pesticides. Few farmers were using pesticide bottles for house or farm purposes as they were unaware of bad effects of pesticides. Disposal of theses empty pesticides bottles was not carried out in a satisfactory way, as majority of the farmers simply threw

bottles in trash. The results obtained were in conformity with the survey studies of Jallow *et al.* (2017) who observed that the common way of disposing of empty pesticide containers was placing them in garbage containers and/or dumpsters for disposal at the landfill (50%), incinerating them on the farm (43%), or delivering them to the municipality hazardous waste collection sites for disposal (39%). Respondents (25%) also buried the containers on-farm or discarded them on the farm (27%). Alarmingly, six per cent of the farmers reported re-using empty pesticide containers for household purposes.

To reduce time and speedy application, most of the farmers preferred to use power sprayers. These results were in relation with the observations of Devkota *et al*. (2019) who reported that all the farmers used hand operated knapsack sprayers fitted with a flat fan nozzle.

Most of the farmers sprayed pesticides in the morning or evening times because the weather was calm and wind speed was less to avoid drift at the time of pesticide application. This output was similar with the findings of Hamsan *et al.* (2017) who observed that 89.60 per cent of farmers sprayed in the morning or evening and only 4.0 per cent sprayed pesticides while it was so hot in the afternoon.

Due to lack of awareness about pesticide toxicity, high cost and uncomfortableness in wearing equipment, the farmers or men labour who hired for pesticide application did not take any proper precautions while handling with pesticides and spraying equipments. The results obtained were in conformity with the findings of Jallow *et al.* (2017) who reported that the majority (58%) of the farmers did not use any protection equipment when mixing or spraying pesticides due to lack of availability when needed, being uncomfortable in the local hot and humid climate and too expensive.

The obtained results showed that only less number of farmers knew about pesticide risks and occupational health hazards. Most of the paddy farmers were unaware of pesticide residues, their ill effects, pre-harvest intervals and this might be attributed to illiteracy level of the farmers, insufficient extension activities and improper precautions at the time of pesticide application. The obtained results were in conformity with the survey studies of Rahaman *et al*. (2018) who reported that about 90 per cent of the surveyed farmers knew about the health risks to farm workers due to pesticide sprayings.

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