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Pesticide Usage Pattern by Paddy Growers in Palnadu District of Andhra Pradesh

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ABSTRACT

Background: Over the years, pesticides have been crucial in ensuring food security since novel compounds have been produced in response to changing pest scenarios, environmental concerns and food safety regulations.

Methods: The study was carried out on pesticide usage pattern followed in paddy fields of Palnadu district, Andhra Pradesh during *rabi* 2020-21 in 15 villages of five mandals. Fortnightly observations on pesticide usage pattern in individual farmer field was collected using a questionnaire prepared in the regional language (Telugu).

Result: Farmers in the Palnadu district during *rabi* 2020-21 applied 345 pesticides in 177 applications/sprayings, with an average of 4.32 sprayings/applications per farmer and 8.41 pesticides in each field during the crop season, while ZBNF farmers have not used any pesticide. The commonly used pesticides in the area were acephate, flubendiamide and propineb, out of a total of 34 pesticides, 17 insecticides; 12 fungicides; 4 herbicides and one bio-chemical product were used by the farmers.

Key words: Paddy, Palnadu, Pesticides, Recommendations.

INTRODUCTION

Pesticides are the chemical or biological components used for crop protection in the field, food protection during storage and pest control in the home (Cherukuri *et al*., 2021) and have become key tool for plant protection. These pesticides have played an important role in achieving food security over the years, with new molecules being introduced in response to changing times, pest scenarios and environmental and food safety requirements (Cherukuri, 2016). Pesticide consumption pattern in India differs from those in world as whole (Sai *et al*., 2019 and Nayak and Solanki, 2021), where the order of pesticide use in India was, insecticides (51%) > fungicides (33%) > herbicides (16%) and world was, herbicides (56%) > fungicides (25%) > insecticides (19%) (FAO, 2018). Out of the insecticide consumption in India 17% alone accounts for rice crop (Kumar *et al*., 2019). In India the main use of pesticides accounts for cotton crop followed by paddy and wheat (Cherukuri, 2016). FICCI (2016) reported that major application of insecticides was found in cotton and rice (Cherukuri, 2016), whereas for herbicides the major application areas were rice and wheat and for fungicides it was fruits, vegetables and rice. Organophosphates, carbamates and pyrethroids were the most often used insecticides (Sarao and Mahal, 2007; Gilbert, 2012; Anand Kumar *et al*., 2020 and Nayak and Solanki, 2021). Anand Kumar *et al*. (2020), reported that majority of the paddy farmers in Godavari area of Andhra Pradesh used pymetrozine (79%), monocrotophos (78%), acephate (78%), phorate (78%), lambda cyhalothrin (77%) and chlrorpyriphos (75%) in *kharif* 2016 where majority of the pesticides used by them belonged to class II toxicity classification by WHO. According to report of “Production oriented survey in 2019”, by ICAR-IIRR, 2020, carbofuran, chlorantriniliprole and chlorpyriphos among insecticides; hexaconazole, tricyclazole and carbendazim among fungicides were the most common pesticides reported for use by farmers in rice ecosystems of Andhra Pradesh for effective management of insect pests, diseases and weeds respectively. ICAR-IIRR, 2021, reported the use of insecticides *viz*., triflumezopyrim, dinotefuran, pymetrozine, profenofos, carbofuran, acephate, monocrotophos and fungicides *viz*., hexaconzole, chlorantraniliprole, tricyclazole, thifluzamide, azoxystrobin for control of insect

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pests and diseases in Andhra Pradesh. Hemanth *et al.* (2021) reported that majority of the farmers used acephate, flubendiamide and chlorantraniliprole at recommended dose whereas, chlorpyriphos, dinotefuran and pymetrozine were used at high dose. Sutharsan *et al*. (2014) and Anand Kumar *et al*. (2020) found that ninety per cent of the farmers did not follow the recommended dose of pesticides. Farmers in Godavari area of Andhra Pradesh underwent for 4-8 foliar application of pesticides, in combination of 2-3 chemicals as advocated by pesticide dealers/neighbouring farmers/company agents/commission agents *etc*., (Yassin *et al*., 2002; Shetty *et al*., 2010; Anand Kumar *et al*., 2020 and ICAR-IIRR, 2021).

MATERIALS AND METHODS

This study was carried out among 45 farmers in five mandals *i.e*., Vinukonda, Savalyapuram, Ipuru, Bollapalle and Nuzendla, with three villages from each mandal and three farmers from each village in paddy growing region of Palnadu district, Andhra Pradesh, India during *rabi* 2020-21. Every farmer field considered for the study was regarded as an individual unit and the observations on pesticide

Table 1: Details of the pesticides used by rice growers in Palnadu district.

Pesticide	Formulation	Chemical group	Toxicity class*	CIB and RC recommendation
Insecticides				
Chlorpyriphos	20 EC	Organo phosphate	II	Recommended
Monocrotophos	36 SL	Organo phosphate	Ib	Recommended
Profenofos	50 EC	Organo phosphate	II	Not recommended
Acephate	75 SP	Organo phosphate	II	Recommended
Acephate	97 DF	Organo phosphate	II	Recommended
Chlorantraniliprole	18.5 SC	Diamide	U	Recommended
Flubendiamide	39.35 SC	Diamide	III	Recommended
Lambda cyhalothrin	5 EC	Synthetic pyrethroid	II	Recommended
Indoxacarb	14.5 SC	Oxadiazine	II	Not recommended
Thiamethoxam	25 WG	Neonicotinoid	II	Recommended
Dinotefuran	20 SG	Neonicotinoid	III	Recommended
Buprofezin	25 SC	Insect growth regulator	III	Recommended
Emamectin Benzoate	5 SG	Macrocyclic lactone	II	Not recommended
Fipronil	5 SC	Phenyl pyrazole	II	Recommended
Cartap Hydrochloride	50 SP	Neriestoxin analogue	II	Recommended
Chlorpyriphos + cypermethrin	50 + 5 EC	Combination product	II and II	Recommended
Chlorantraniliprole + thiamethoxam	0.5 + 1 GR	Combination product	U and II	Recommended
Fungicides				
Propiconazole	25 EC	Triazole	II	Recommended
Hexaconazole	5 SC	Triazole	III	Recommended
Tricyclazole	75 WP	Triazole	II	Recommended
Tebuconazole	25.9 EC	Triazole	II	Recommended
Isoprothiolane	40 EC	Dithiolane	II	Recommended
Propineb	70 WP	Dithiocarbamates	U	Recommended
Zineb	75 WP	Dithiocarbamate	U	Recommended
Mancozeb	75 WP	Dithiocarbamate	U	Recommended
Carbendazim	50 WP	Benzamidazole	U	Recommended
Tebuconazole + trifloxystrobin	50 + 25 WG	Combination product	II and U	Recommended
Carbendazim + mancozeb	12 + 63 WG	Combination product	U and U	Recommended
Hexaconazole + zineb	4 + 68 WP	Combination product	III and U	Recommended
Herbicides				
Butachlor	50 EC	Acetanilide	III	Recommended
Pretilachlor	37 EW	Chloro acetanilide	U	Recommended
Pretilachlor	50 EC	Chloro acetanilide	U	Recommended
Pyrazosulfuron ethyl	10 WP	Sulfonyl urea	U	Recommended
Bio chemical pesticide		Unknown	Unknown	Not recommended

*Toxicity class as classified by WHO (2019) where Ia- Extremely toxic, Ib- Highly toxic, II- Moderately toxic; III- Slightly toxic; U- Unlikely to present acute toxicity in normal use.

use namely, name of the pesticide used, dosage and time of application, type of application, use of pesticide mixtures and combination products of pesticide used were recorded from all the units at fortnightly intervals during the crop period from sowing to harvesting through direct field observations and personal interactions. The data collected was tabulated, segregated and analyzed using descriptive statistics in Microsoft Excel spreadsheets. The list of pesticides recommended along with their recommended dosages given by CIB and RC on rice crop against target pests were considered for analysis.

RESULTS AND DISCUSSION

Types of pesticides used

Farmers in the Palnadu district used a wide range of pesticides in paddy to control various pests *viz*., weeds, insects, fungal and bacterial pathogens. A perusal of Table 1 unveils that a total of 34 pesticide formulations were used, which includes 17 insecticides, 12 fungicides, 4 herbicides and one bio chemical product. The bio chemical pesticide used in the study area was not registered as per Insecticide Act, 1968, whereas the remaining pesticides used were registered for use. Insecticides used belong to different chemical groups *viz*., organophosphates, diamides, synthetic pyrethroid, oxadiazine, neonicotinoids, insect growth regulators, macrocyclic lactone, phenyl pyrazole and neriestoxin analogue. According to Insecticide Act, 1968, recommendation as per Insecticide Act, 1968, non-recommended pesticides used by farmers in the study area belong to insecticides alone, which includes three insecticides *i.e*., profenofos, which was not recommended against target pests in rice crop; indoxacarb 14.5 SC and emamectin benzoate 5 SG which were recommended for use in rice crop but the formulations used here were not recommended.

Majority of the fungicides used belong to triazoles and dithiocarbamates, whereas, the remaining were grouped under dithiolanes and benzimidazoles. The three herbicides *viz*., butachlor, pretilachlor and pyrazosulfuron ethyl used in the study area associated with three different chemical classes *i.e*., acetanilides, chloro acetanilides and sulfonyl ureas respectively. As per WHO (2019), classification, among the insecticides used monocrotophos was highly toxic and likely to cause many ill-effects whereas, chlorantaniliprole, unlikely to pose any acute toxicity in normal use. Among fungicides used, propineb, mancozeb, zineb and carbendazim and among herbicides pretilachlor and pyrazosulfuron ethyl belongs to class 'U' which is unlikely to present any acute toxicity in normal use. The number of pesticide applications given by each individual rice farmer was presented in Fig 1 which reveals that four farmers had not used any chemical pesticide in the crop growth period as these farmers followed Zero Budget Natural Farming (ZBNF) and the remaining 41 farmers were found dependent on chemical pesticides for the control of wide range of pests. This result was in accordance with the report given by DPPQ and S, 2021 where majority of area under cultivation in India was under the use of chemical pesticides. The study also revealed that over all 345 pesticide applications were used by 41 farmers in the entire crop period with an average of 8.41 pesticide per each field (Table 2). The number of pesticide applications (pesticide wise) given by rice farmers presented in Table 2 revealed that acephate was the highest used pesticide with 40 applications where almost all the farmers used acephate as a preventive chemical because it has broad spectrum of activity against various pests of rice with residual systemic activity. According to the study, acephate, propineb and pretilachlor were the

Table 2: Pesticide applications by rice farmers.

Name of the pesticide	Total
Chlorpyriphos	17
Monocrotophos	3
Profenofos	1
Acephate	40
Chlorantraniliprole	6
Flubendiamide	31
Lambda cyhalothrin	24
Indoxacarb	2
Thiamethoxam	8
Dinotefuran	1
Buprofezin	6
Emamectin Benzoate	2
Fipronil	1
Cartap Hydrochloride	1
Chlorpyriphos + cypermethrin	1
Thiamethoxam + chlorantraniliprole	6
Sub total	**150**
Propiconazole	18
Hexaconazole	24
Tricyclazole	22
Tebuconazole	3
Isoprothiolane	3
Propineb	29
Zineb	2
Mancozeb	3
Carbendazim	17
Tebuconazole + trifloxystrobin	10
Carbendazim + mancozeb	14
Hexaconazole + zineb	1
Sub total	**146**
Herbicides	
Butachlor	2
Pretilachlor	17
Pyrazosulfuron Ethyl	10
Sub total	**29**
Others	
Bio chemical pesticide	20
Sub total	**20**
Total	345

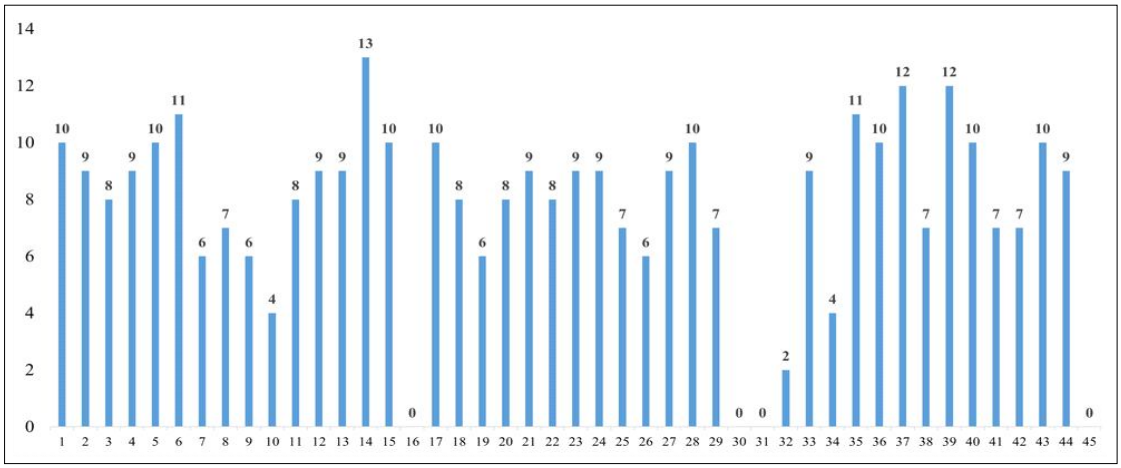

Fig 1: Number of pesticide applications given by rice farmers (farmer wise).

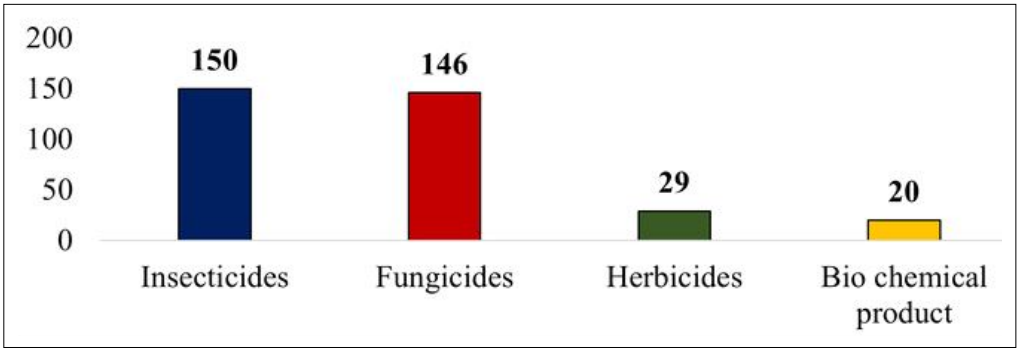

Fig 2: Number of pesticide applications given by rice farmers (category-wise).

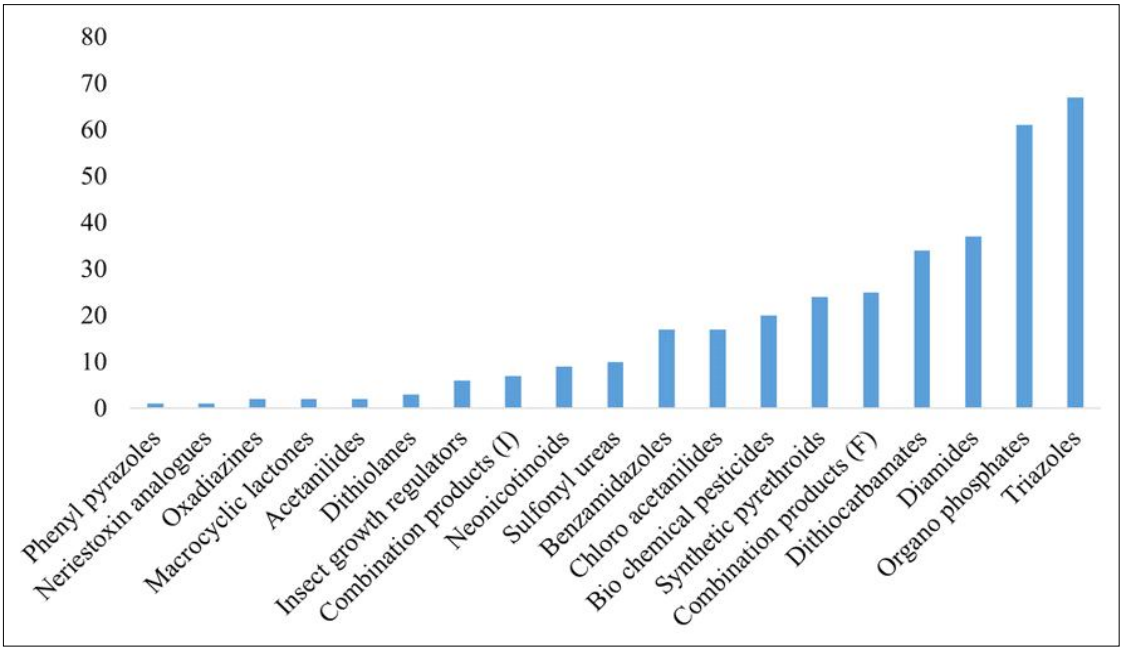

Fig 3: Number of pesticide applications given by rice farmers (chemical group-wise).

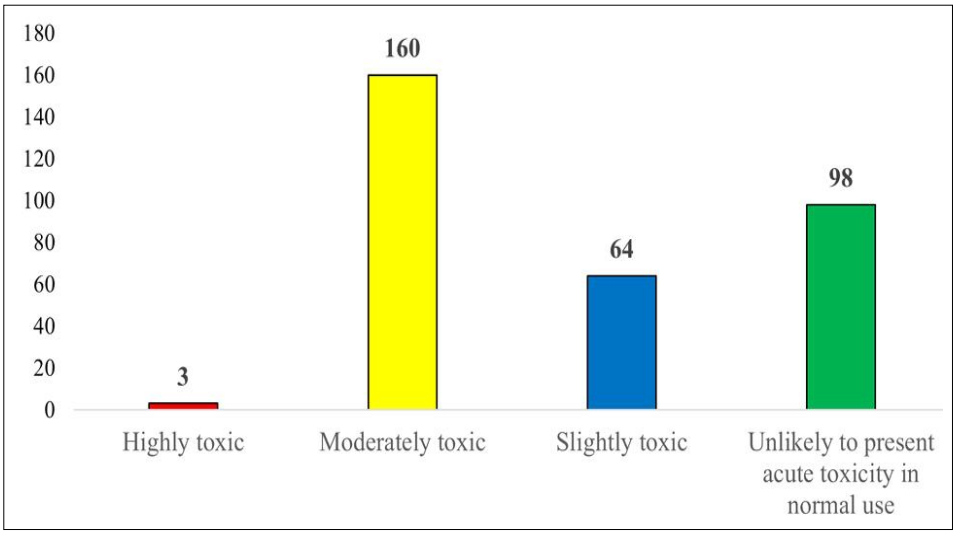

Fig 4: Number of pesticide applications given by rice farmers (toxicity class-wise).

Fig 5: Pesticide applications w.r.t percentage of farmers during the crop season.

highest used insecticide, fungicide and herbicide respectively. Whereas, in India, according to the data given by MoAandFW (2022), for the crop year 2020-21 acephate (5th), propineb (4th) and pretilachlor (2nd) were among the top five highly consumed pesticides in their respective category. Fig 2 showed that insecticides (150) and fungicides (146) were predominant among the chemical pesticides used followed by herbicides (29). This outcome of the study was in concurrence with the study conducted by Yadav and Dutta (2019) in Rajasthan. The highest usage of triazoles (67) and organophosphates (61) followed by diamides (37) and dithiocarbamates (34) was evident from Fig 3. Similarly, highest consumption of organophosphates was documented in studies conducted by Gilbert (2012) and Nayak and Solanki (2021). Toxicity class of majority of pesticide applications given by farmers in the study area belonged to class - II, "Moderately toxic" (160) and the use of "highly toxic" pesticide of class - Ib (3) was also noticed in the study area (Fig 4). Anand Kumar *et al.* (2020), also reported that majority of the paddy farmers in Andhra Pradesh used pesticides that belonged to class II toxicity classification by WHO.

Majority of the farmers were found to use acephate (73.17%), flubendiamide (70.73%) and propineb (70.73%); whereas hexaconazole (58.54%), lambda cyhalothrin (56.10%) and tricyclazole (53.66%) were used by more than fifty percent of the rice farmers atleast once during their crop growth period (Fig 5). Pesticides like profenofos, dinotefuran, fipronil, cartap hydrochloride, chlorpyriphos + cypermethrin and hexaconazole + zineb were used only by 2.44 per cent of the farmers *i.e.*, only by one member among the total 41 farmers that were found using pesticides; whereas, butachlor, zineb, emamectin benzoate and indoxacarb were used only by 4.88 per cent *i.e.*, two farmers.

Use of recommended pesticides

Out of the total 345 pesticide applications used 25 were not recommended against the target pests of the crop which include 20 biochemical pesticidal applications and

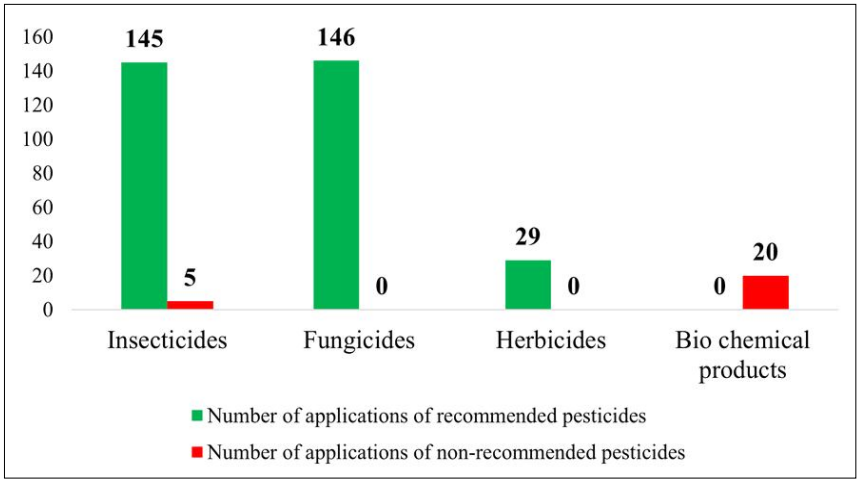

Fig 6: Application of recommended and non-recommended pesticides.

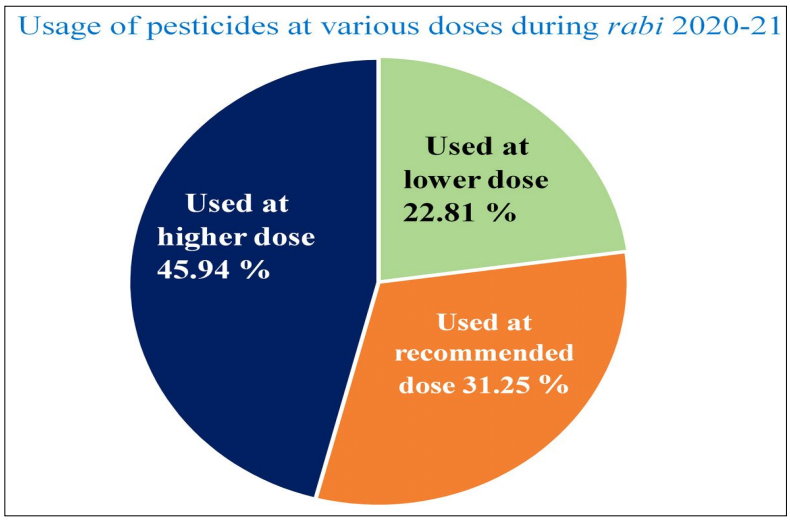

Fig 7: Usage of pesticides at various doses.

five insecticidal applications *i.e*., emamectin benzoate 5 SG (2), indoxacarb 14.5 SC (2) and profenophos 50 EC (1), where the former two insecticides were recommended with different formulations in the crop but the later insecticide was not recommended in any formulation against any insect pests of rice (Fig 6 and Table 3).

Use of recommended dosages

Usage of pesticides at various dosages presented in Fig 7. revealed that 45.94 per cent of the pesticide applications involved use of pesticides at higher doses, while 22.81 per cent were at lower doses. Majority of the pesticide sprays against target pests did not follow the recommended

Table 3: Usage of non-recommended pesticides.

Pesticide	Formulation	Classification	Number of applications
Emamectin benzoate	5 SG	Insecticide	2
Indoxacarb	14.5 SC	Insecticide	2
Profenophos	50 EC	Insecticide	1
Bio chemical pesticide	-	Unknown	20
Total			25

Table 4: Usage of different pesticides at higher/recommended/lower doses.

Pesticide	Formulation	Number of applications			Total
		Recomme nded dose	High dose	Low dose	
Chlorpyriphos	20 EC	7(41.18)	0 (0.00)	10 (58.82)	17
Monocrotophos	36 SL	3 (100.00)	0 (0.00)	0 (0.00)	3
Profenofos	50 EC	0(0.00)	0 (0.00)	0 (0.00)	1
Acephate	75 SP	1 (2.56)	38 (97.44)	0 (0.00)	39
Acephate	97 DF	1 (100.00)	0 (0.00)	0 (0.00)	1
Chlorantraniliprole	18.5 SC	4 (66.67)	1 (16.67)	1 (16.67)	6
Flubendiamide	39.35 SC	31 (100.00)	0 (0.00)	0 (0.00)	31
Lambdacyhalothrin	5 EC	0 (0.00)	24 (100.00)	0 (0.00)	24
Indoxacarb	14.5 SC	2 (100.00)	0 (0.00)	0 (0.00)	2
Thiamethoxam	25 WG	0 (0.00)	2 (25.00)	6 (75.00)	8
Dinotefuran	20 SG	1 (100.00)	0 (0.00)	0 (0.00)	1
Buprofezin	25 SC	0 (0.00)	6 (100.00)	0 (0.00)	6
EmamectinBenzoate	5 SG	0 (0.00)	0 (0.00)	0 (0.00)	2
Fipronil	5 SC	0 (0.00)	0 (0.00)	1 (100.00)	1
CartapHydrochloride	50 SP	1 (100.00)	0 (0.00)	0 (0.00)	1
Chlorpyriphos + Cypermethrin	50+5 EC	1 (100.00)	0 (0.00)	0 (0.00)	1
Chlorantraniliprole + Thiamethoxam	0.5+1GR	5 (83.33)	1 (16.67)	0 (0.00)	6
Propiconazole	25 EC	1 (5.56)	17 (94.44)	0 (0.00)	18
Hexaconazole	5 SC	12 (50.00)	9 (37.50)	3 (12.50)	24
Tricyclazole	75 WP	16 (72.73)	3 (13.64)	3 (13.64)	22
Tebuconazole	25.9 EC	3 (100.00)	0 (0.00)	0 (0.00)	3
Isoprothiolane	40 EC	0 (0.00)	3 (100.00)	0 (0.00)	3
Propineb	70 WP	0 (0.00)	0 (0.00)	29 (100.00)	29
Zineb	75 WP	0 (0.00)	0 (0.00)	2 (100.00)	2
Mancozeb	75 WP	0 (0.00)	0 (0.00)	3 (100.00)	3
Carbendazim	50 WP	0 (0.00)	17 (100.00)	0 (0.00)	17
Tebuconazole + Trifloxystrobin	50+25WG	3 (30.00)	1 (10.00)	6 (60.00)	10
Carbendazim + Mancozeb	12+63WG	0 (0.00)	14 (100.00)	0 (0.00)	14
Hexaconazole + Zineb	4+68 WP	0 (0.00)	0 (0.00)	1 (100.00)	1
Butachlor	50 EC	2 (100.00)	0 (0.00)	0 (0.00)	2
Pretilachlor	37 EW	5 (38.46)	0 (0.00)	8 (61.54)	13
Pretilachlor	50 EC	3 (75.00)	1 (25.00)	0 (0.00)	4
PyrazosulfuronEthyl	10 WP	0 (0.00)	10 (100.00)	0 (0.00)	10
Total 100 (31.25)	147 (45.94)	73 (22.81)	320		

*Figures in parenthesis indicates percentage of applications.

dose and only about 31.25 per cent were done with recommended doses. Some respondents that used higher doses mentioned that, they use overdose of pesticides as their neighbouring farmer found using the same dose. Non-availability of required quantity packs of pesticides in the market and lack of knowledge on dosages of pesticides also attributed to the usage at lower or higher doses. The highly used insecticides, acephate (97.44%) and lambda cyhalothrin (100%) were used majorly at higher dose and flubendiamide (100%) was used at recommended dose. In case of fungicides the majorly used fungicide propineb was used only at lower dose in all the applications, whereas, other highly used fungicides tricyclazole (72.73%) and hexaconazole (50%) were used majorly at recommended dose and some other commonly used fungicides, propiconazole (94.44%) and carbendazim (100%) were mostly used at higher doses (Table 4). Anand Kumar *et al.* (2020) also reported that majority (88%) of the farmers had not followed recommended doses of pesticides.

CONCLUSION

A total of 34 pesticide formulations were used, which includes 17 insecticides, 12 fungicides, 4 herbicides and one bio chemical product. Four farmers had not used any chemical pesticide in the crop growth period as these farmers followed Zero Budget Natural Farming (ZBNF) and the remaining 41 farmers were found dependent on chemical pesticides for the control of wide range of pests. Toxicity class of majority of pesticide applications given by farmers in the study area belonged to class - II, “Moderately toxic”. Out of the total 345 pesticide applications used 25 were not recommended against the target pests of the crop and 45.94 per cent of the pesticide applications involved use of pesticides at higher doses, while 22.81 per cent were at lower doses.

Conflict of interest

All authors declare that they have no conflicts of interest.

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