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EVALUATION OF INSECTICIDE ROTATIONS AGAINST RICE BROWN PLANTHOPPER *NILAPARVATA LUGENS* (STAL)

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ABSTRACT

Field experiments were carried out to evaluate the efficacy of certain insecticide rotations against rice brown planthopper (BPH) *Nilaparvata lugens* (Stal) at the Regional Agricultural Research Station, Maruteru, Andhra Pradesh during kharif 2017 and rabi 2017-18. The results revealed that fipronil (1000 ml/ ha) followed by pymetrozine (300 g/ ha), buprofezin (800 ml/ha) followed by pymetrozine (300 g/ ha) and acephate (750 g/ ha) followed by pymetrozine (300 g/ ha) were the most effective insecticide rotations in a crop season. These also gave higher grain yields. The insecticide rotations, acephate (750 g/ ha) followed by pymetrozine (300 g/ ha) and fipronil (1000 ml/ ha) followed by pymetrozine (300 g/ ha) gave the maximum cost benefit ratio of 1: 6.01 and 1: 6.03, respectively.

Key words: *Nilaparvata lugens*, efficacy, acephate, buprofezin, fipronil, dinotefuran, pymetrozine, flonicamid, rotations, grain yield, cost benefit ratio

Rice (*Oryza sativa* L.) is an important staple food crop (Seni and Nayak, 2017), and provides 20% of the global dietary energy supply. Insect pests and diseases remain the key biotic stresses limiting rice production significantly. Approximately 52% is lost annually owing to the damage caused by biotic factors, of which 21% of damage is attributed to the attack by insect pests (Yarasi et al., 2008). Rice is infested by >100 species of insects and mites and about 20 of them are considered to be of major economic significance. Among these, brown planthopper (BPH) *Nilaparvata lugens* (Stal) is the major yield limiting factor (Krishnaiah, 2014). Farmers rely solely on insecticides for its management and almost 50% of the insecticides used in rice is targeted against this pest alone (Reddy et al., 2012). This pest has shown its ability to develop resistance quickly against resistant varieties and insecticides (Sarupa et al.,1998, Jhansilakshmi et al., 2010). Hence, there is a continuous need to evaluate new insecticides, and the present study evaluates the efficacy of certain insecticide rotations.

MATERIALS AND METHODS

The experiment was conducted in the experimental farm of Regional Agricultural Research Station, Maruteru (16.38^0 N, 81.44^0 E, 5 masl), Andhra Pradesh during kharif 2017 and rabi 2017-18 in a randomized block design (RBD) with ten treatments replicated thrice. Rice varieties, Swarna (MTU 7029) and Prabhat (MTU 3626) which are highly susceptible to planthoppers were used during kharif and rabi, respectively. One to two seedlings/ hill were planted with a spacing of 20 x 15 cm during kharif and 15 x 15 cm in rabi with plot size of 25 m^2. The crop husbandry operations as recommended in the package of practices of Acharya N. G. Ranga Agricultural University, Andhra Pradesh were adopted. Each treatment comprised of two insecticides used on rotation basis (Table 1).

T_{1-} Acephate 75 SP @ 750 g/ha (1^{st} spray) - Dinotefuran 20 SG @ 250 g/ha (2^{nd} spray); T_{2-}Acephate 75 SP @ 750 g/ ha (1^{st} spray) - Pymetrozine 50 WG @ 300 g/ ha (2^{nd} spray); T_{3-}Acephate 75 SP @ 750 g/ ha (1^{st} spray) - Flonicamid 50 WG @ 200 g/ ha (2^{nd} spray); T_{4-} Buprofezin 25 SC @ 800 ml/ ha (1^{st} spray) - Dinotefuran 20 SG @ 250 g/ ha (2^{nd} spray); T_{5-}Buprofezin 25 SC @ 800 ml/ ha (1^{st}spray) - Pymetrozine 50 WG @ 300 g/ ha (2^{nd} spray); T_{6-}Buprofezin 25 SC @ 800 ml/ ha (1^{st} spray) - Flonicamid 50 WG @ 200 g/ ha (2^{nd} spray); T_{7-}Fipronil 5 SC @ 1000 ml/ ha (1^{st} spray) - Dinotefuran 20 SG @ 250 g/ ha (2^{nd} spray); T_{8-}Fipronil 5 SC @ 1000 ml/ ha (1^{st} spray) - Pymetrozine 50 WG @ 300 g/ ha (2^{nd} spray); T_{9-}Fipronil 5 SC @ 1000 ml/ ha (1^{st} spray) - Flonicamid 50 WG@ 200 g/ ha (2^{nd} spray); T_{10-}Untreated control (Water spray).

The treatments were imposed twice at 60 and 80 days after transplanting (DAT) during kharif and at 60 and 75 DAT during rabi when the population of brown planthopper crossed the economic threshold level (20-25 number/ hill). A spray fluid of 500 l/ ha was used with battery operated hand sprayer. Observations were taken only on nymphs and adults of BPH though mixed population (BPH & WBPH) exists. Data on BPH was recorded from ten randomly selected hills/ plot at one day before spray (pretreatment count), five and ten days after each spray (Post-treatment).

The % reduction of *N. lugens* incidence over control was worked out following Henderson and Tilton (1955). Grain yield was recorded per plot leaving two border rows on all sides and extrapolated to express in terms of kg/ ha. The increase in yield over control in various treatments was estimated. Cost benefit ratios of different treatments were also worked out based on the market price of insecticides, cost of spraying operation and market price of produce. Data on % reduction in *N. lugens* incidence over control were converted into angular transformations and then subjected to ANOVA (Gomez and Gomez, 1984). The treatment means were compared by least significant difference (LSD) method using SPSS 16.0 statistical software package.

RESULTS AND DISCUSSION

It was observed that *N. lugens* incidence was more during rabi season than kharif at RARS, Maruteru. The mean BPH counts ranged from 271.00 to 317.00/ 10 hills during rabi 2017-18 in contrast to 183.33 to 204.00/ 10 hills during kharif 2017 before imposition of treatments. The data on cumulative mean efficacy during two successive seasons viz., kharif 2017and rabi 2017-18 are given in Table 1. These reveal that fipronil (1000 ml/ ha) followed by pymetrozine (300 g/ ha) was highly effective resulting higher grain yields, with 74.90% mean reduction of BPH population. This observation is partly in agreement with earlier ones- Neerajkumar et al. (2019) reported that highest mortality of BPH was observed in fipronil nanoformulation followed by monolithic dispersion (86.89%) and commercial formulation of fipronil (80.47%). Patil et al. (2021) also reported that fipronil 5 SC @ 2.0 ml/ l was the most effective. Pymetrozine 50WG @ 150 g a.i./ ha gave significant control and higher grain yield (Seni and Naik, 2017). Singh et al. (2018) also observed that pymetrozine as effective as also by Adhikari et al. (2019). Sulfoxaflor, pymetrozine and clothinidin were very effective against BPH (Rehman et al., 2020). Buprofezin (800 ml/ ha) followed by pymetrozine (300 g/ ha) and acephate (750 g/ ha) followed by pymetrozine (300 g/ ha) were the next best. Several researchers earlier reported the efficacy of acephate and buprofezin. Soni and Tiwari (2014) opined that most of the old molecules such as carbaryl, monocrotophos, acephate and fipronil are still very effective. Buprofezin 25 SC @ 1.00 ml/ l registered its superiority over rest of the treatments (Girish et al., 2016).

The data on the grain yield during kharif 2017 given in Table 1 reveal that among the treatments, fipronil (1000 ml/ ha) followed by pymetrozine (300 g/ ha) recorded significantly maximum grain yield (4889 kg/ ha) followed by buprofezin (800 ml/ ha) and pymetrozine (300 g/ ha) (4728 kg/ ha) and acephate (750 g/ ha) followed by pymetrozine (300 g/ ha) (4697 kg/ ha) and which were on par with each other and superior over rest of the treatments including control (3652 kg/ha). The data relating to the effect of insecticide rotations on the grain yield during rabi 2017-18 reveal that among the treatments, fipronil (1000 ml/ ha) followed by pymetrozine (300 g/ ha), buprofezin (800 ml/ ha) followed by pymetrozine (300 g/ ha) and acephate (750 g/ ha) followed by pymetrozine (300 g/ ha) gave maximum grain yields. These findings partly agree with those of Arjun et al. (2017) on fipronil 200 SC @ 50 g a.i./ha. Kirankumar (2016) also observed similar results with pymetrozine 50 WG @ 350 g a.i./ ha. Acephate 75 SP @ 1.50 g/l recorded significantly highest grain yield (Reddy et al., 2012). Based on the present results, fipronil (1000 ml/ ha) followed by pymetrozine (300 g/ ha), buprofezin (800 ml/ ha) followed by pymetrozine (300 g/ ha) and acephate (750 g/ ha) followed by pymetrozine (300 g/ ha) are the most effective insecticide rotations against *N. lugens* in rice.

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Table 1. Efficacy of insecticide rotations against *N. lugens* in rice (kharif 2017, rabi 2017-18)

T. No.	Treatment details	BPH population reduction over control (%)			Grain yield** (kg/ ha)			Value of additional yield (Rs/ ha)	Cost of inputs (Rs/ ha)	Cost benefit ratio
		Kharif 2017*	Rabi 2017-18*	Pooled	Kharif 2017	Rabi 2017-18	Mean			
T_1	Acephate 75 SP @ 750 g/ha (1st spray) -inotefuran 20 SG @ 250 g/ ha (2nd spray)	68.05 $(55.61)^{bc}$	66.13 $(54.44)^{cd}$	67.09 $(55.02)^{ef}$	4226^{bc}	4711^{d}	4469	12852	3413	1: 3.77
T_2	Acephate 75 SP @ 750 g/ ha (1st spray) -Pymetrozine 50 WG @ 300 g/ ha (2nd spray)	71.69 $(57.90)^{a}$	71.13 $(57.56)^{b}$	71.41 $(57.71)^{bc}$	4697^{ab}	5517^{ab}	5107	24336	4038	1: 6.03
T_3	Acephate 75 SP @ 750 g/ha (1st spray) -Flonicamid 50 WG @ 200 g/ha (2nd spray)	66.22 $(54.50)^{c}$	64.61 $(53.53)^{d}$	65.41 $(54.00)^{f}$	4149^{bc}	4508^{d}	4329	10332	3583	1: 2.88
T_4	Buprofezin 25 SC @ 800 ml/ ha (1st spray) -Dinotefuran 20 SG @ 250 g/ ha (2nd spray)	66.56 $(54.70)^{c}$	66.96 $(54.95)^{cd}$	66.76 $(54.83)^{f}$	4158^{bc}	4978^{bcd}	4568	14634	3880	1: 3.77
T_5	Buprofezin 25 SC @ 800 ml/ ha (1st spray) -Pymetrozine 50 WG @ 300 g/ ha (2nd spray)	72.41 $(58.36)^{a}$	72.23 $(58.23)^{b}$	72.32 $(58.29)^{b}$	4728^{ab}	5722^{a}	5225	26460	4505	1: 5.87
T_6	Buprofezin 25 SC @ 800 ml/ ha (1st spray) -Flonicamid 50 WG @ 200 g/ ha (2nd spray)	67.23 $(55.13)^{bc}$	66.99 $(54.97)^{cd}$	67.11 $(55.05)^{ef}$	4225^{bc}	4829^{cd}	4527	13896	4050	1: 3.43
T_7	Fipronil 5 SC @ 1000 ml/ ha (1st spray) -Dinotefuran 20 SG @ 250 g/ha (2nd spray)	68.99 $(56.20)^{b}$	71.07 $(57.50)^{b}$	70.03 $(56.84)^{cd}$	4562^{ab}	5314^{abc}	4938	21294	4200	1: 5.07
T_8	Fipronil 5 SC @ 1000 ml/ ha (1st spray) - Pymetrozine 50 WG @ 300 g/ ha (2nd spray)	73.83 $(59.27)^{a}$	75.97 $(60.67)^{a}$	74.90 $(59.97)^{a}$	4889^{a}	5842^{a}	5366	28998	4825	1: 6.01
T_9	Fipronil 5 SC @ 1000 ml/ ha (1st spray) - Flonicamid 50 WG @ 200 g/ ha (2nd spray)	69.01 $(56.21)^{b}$	69.36 $(56.43)^{bc}$	69.18 $(56.32)^{de}$	4585^{ab}	5213^{abc}	4899	20592	4370	1: 4.71
T_{10}	Untreated Control (Water spray)	-	-	-	3652^{c}	3857^{e}	3755	-	-	-
F test		Sig.	Sig.	Sig.	Sig.	Sig.				
CD (0.05)		1.45	2.40	1.36	612.06	589.50				
CV (%)		1.48	2.48	1.38	8.14	6.78				

*Mean of two sprays; **Mean of three replications; Figures in parentheses are angular transformed values; Acephate 75 SP - Rs. 550 per kg; Dinotefuran 20 SG - Rs. 600/ 100 g; Paddy Market rate - Rs.18/ kg; Fipronil 5 SC - Rs. 1200/ l; Pymetrozine 50 WG - Rs. 850/ 120 g; Labour charge-Rs. 750/ ha Buprofezin 25 SC - Rs. 1100/ l; Flonicamid 50 WG - Rs. 500/ 60 g; Number of sprays - 2/ season; Extra yield over untreated control=yield in treatment - yield in untreated control; Cost of inputs = Cost of insecticide/ ha + Cost of labour for spraying/ ha; Means followed by a common letter in a column not significantly different (LSD, p= 0.05)

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