Research Article

Evaluation of Newer Insecticides aganist Brown Planthopper, *Nilaparvata lugens* (Stal.) Infesting Rice

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Abstract

A field trail was conducted at Agricultural College Farm, Bapatla during *kharif* 2015 to evaluate the efficacy of imidacloprid 17.8 SL, thiamethoxam 25 WG, acetamiprid 20 SP, sulfoxaflor 25 SC, dinotefuran 20 SG, pymetrozine 50 WG, buprofezin 25 SC, monocrotophos + dichlorvos 36 SL + 76 EC against brown planthopper in rice ecosystem. The data on planthoppers inferred that pymetrozine 50 WG @ 0.5 g l^{-1} proved to be the most effective insecticide in reducing population by recording highest per cent population reduction (62.98%) over untreated control. The insecticide dinotefuran 20 SG @ 0.4 g l^{-1} (59.60 %) was on par with pymetrozine in suppressing the pest population and also these three chemicals recorded with the highest grain yields 5266 and 5228 kg ha^{-1}.

Keywords: Brown planthopper, pymetrozine, dinotefuran, sulfoxaflor

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Introduction

Rice, *Oryza sativa* a cereal crop, belongs to the family Gramineae. It is staple food for more than half of human population. Rice constitutes 52 per cent of total food grain production and 55 per cent of total cereal production in India [1]. About 100 insects were recorded as pests on rice crop, of them 20 are designated as major pests [2]. Among them brown planthoppers constitute one of the most important pest causing substantial yield losses. Use of insecticides forms one of the most effective management tools and an important component of Integrated Pest Management (IPM) besides biological and cultural means. Insecticide proves to be the only option where we can rely for emergency management of insect pest reaching on or beyond ETL. The indiscriminate use of broad spectrum chemicals also reduce the biodiversity of natural enemies, reduce the natural control and induce outbreak of secondary pests and contaminate eco-system [3] result in resurgence of brown planthopper. But still chemical control forms the first line of defense [4]. As, the resistance to existing insecticides is an on-going problem that requires the development of new insect control tools [5] so there is a need to evaluate the new groups, new formulations of insecticides and their combinations for their target and non target effects. Therefore the present investigation was carried out to evaluate new insecticide molecules against BPH infesting rice.

Materials and Methods

Field experiment was conducted in Agricultural College Farm, Bapatla during *kharif* 2015 in Randomised Block Design (RBD) with nine treatments including untreated control replicated thrice. The insecticide treatments includes imidacloprid 17.8 SL, thiamethoxam 25 WG, acetamiprid 20 SP, sulfoxaflor 25 SC, dinotefuran 20 SG, pymetrozine 50 WG, buprofezin 25 SC and monocrotophos + dichlorvos 36 SL + 76 EC along with untreated control.

The planthopper susceptible variety Sambha mashuri (BPT 5204) was grown in plot of size 20 m^2 at spacing of 20 x 15 cm with recommended package of practices excluding plant protection. Sprayings were given by using a hand compression knapsack high volume sprayer during morning hours. The required spray fluid per each plot is one litre. The plot in each treatment was sprayed with respective insecticides ensuring uniform coverage of insecticide. The treatments are imposed as and when the pest reaches ETL. The data on population of BPH on 10 randomly selected hills from each plot were recorded at one day before the application of treatments, three days after spray and five days after spray.

The data on the population of planthoppers are transformed into square root values. The data subjected to ANOVA, mean values are compared by using DMRT [6]. The per cent population reduction of planthopper at each count also calculated by using Abott's formula as given by Fleming and Ratnakaran, 1985 [7].

$$\text{Percentage population reduction over control} = 1 - \left\{\frac{\text{Post treatment population in treatment}}{\text{Pre treatment population in treatment}} \times \frac{\text{Pre treatment population in untreated control}}{\text{Post treatment population in untreated control}}\right\} \times 100$$

Results and Discussion

Two sprays are imposed at 15 days interval. There was no significant difference in planthopper population among the treatments before the application of treatments during both sprays. The data regarding the efficacy of treatments after first spray revealed that (**Table 1**) at 3 days after first spray pymetrozine 50 WG @ 0.5 g l^{-1} proved to be the effective insecticide (8.59/hill) followed by buprofezin 25 SC @ 1.6 ml l^{-1} (10.54/hill) by recording highest per cent population reduction of 59.03 and 49.19 respectively. However, on 5 days after first spray, pymetrozine 50 WG @ 0.5 g l^{-1} proved superior (7.03/hill) followed by dinotefuran 20 SG @ 0.4 g l^{-1} (7.60/hill) and sulfoxaflor 25 SC @ 0.75 ml l^{-1} (7.90/hill) by recording 66.14, 63.38 and 60.85 per cent population reduction over untreated control repsectively. The mean efficacy after first spray inferred that pymetrozine 50 WG @ 0.5 g l^{-1} was effective in suppressing the pest population and was on par with dinotefuran, buprofezin and sulfoxaflor.

Table 1 Efficacy of new insecticide molecules against brown planthopper, *Nilaparvata lugens* after first spray during *kharif* 2015

T. No.	Name of the Insecticide	Mean population number/ hill *			Per cent population reduction over control **		
		Pre count	3 DAS	5 DAS	3 DAS	5 DAS	Overall reduction (%)
1	Imidacloprid 17.8 SL @ 0.25 ml l^{-1}	20.86 (4.56)	14.07 (3.75)^{b}	9.90 (3.13)^{ab}	27.21 (30.03)^{f}	48.26 (39.70)^{a}	37.72 (35.19)^{d}
2	Thiamethoxam 25 WG @ 0.2 g l^{-1}	21.97 (4.68)	13.60 (3.68)^{b}	9.10 (3.01)^{ab}	33.16 (33.05)^{def}	54.82 (42.27)^{a}	43.99 (37.94)^{bc}
3	Acetamiprid 20 SP @ 0.2 g l^{-1}	22.70 (4.76)	12.77 (3.57)^{ab}	8.97 (2.97)^{ab}	39.36 (35.93)^{cd}	56.99 (43.08)^{a}	48.17 (39.67)^{abcd}
4	Sulfoxaflor 25 SC @ 0.75 ml l^{-1}	22.00 (4.69)	13.00 (3.60)^{b}	7.90 (2.81)^{ab}	36.19 (34.49)^{cde}	60.85 (44.50)^{a}	48.52 (39.81)^{abc}
5	Dinotefuran 20 SG @ 0.4 g l^{-1}	22.63 (4.75)	11.45 (3.38)^{ab}	7.60 (2.75)^{ab}	45.37 (38.52)^{b}	63.38 (45.40)^{a}	54.38 (42.10)^{abc}
6	Pymetrozine 50 WG @ 0.5 g l^{-1}	22.63 (4.75)	8.59 (2.93)^{a}	7.03 (2.65)^{a}	59.03 (43.84)^{a}	66.14 (46.36)^{a}	62.58 (45.12)^{a}
7	Buprofezin 25 SC @ 1.6 ml l^{-1}	22.40 (4.73)	10.54 (3.24)^{ab}	8.80 (2.95)^{ab}	49.19 (40.08)^{b}	57.17 (43.15)^{a}	53.18 (41.64)^{abcd}
8	Moncrotophos+Dichlorvos 36 SL + 76 EC @ 2.2 ml l^{-1} + 1 ml l^{-1}	21.76 (4.66)	14.13 (3.75)^{b}	10.27 (3.20)^{b}	29.89 (31.43)^{ef}	48.57 (39.83)^{a}	39.23 (35.87)^{bc}
9	Untreated control	22.46 (4.73)	20.80 (4.56)^{c}	20.60 (4.54)^{c}	-	-	-
	SEm±	0.308	0.213	0.191	2.683	2.691	2.203
	Fcal	NS	Sig	Sig	Sig	Sig	Sig
	CD (0.05)	-	0.6	0.5	8.0	8.1	6.6
	CV (%)	11.40	10.58	10.02	14.36	12.14	10.79

Sig - Significant, NS – Non significant
* Figures in parentheses are square root transformed values
**Figures in parentheses are arc sine transformed values
Mean with same letters are not significantly different at 5 % level by Duncan's Multiple Range test.

The data after second spray (**Table 2**) showed that at 3 days after second spray lowest mean population of BPH was observed in dinotefuran 20 SG @ 0.4 g l^{-1} (8.07/hill) by recording 60.75 per cent population reduction over control. The insecticide treatments pymetrozine 50 WG @ 0.5 g l^{-1} and sulfoxaflor 25 SC @ 0.75 ml l^{-1} were on par with each other and with dinotefuran. On 5 days after second spray, pymetrozine 50 WG @ 0.5 g l^{-1} was found to be superior with lowest mean population of BPH (5.03/hill) followed by dinotefuran 20 SG @ 0.4 g l^{-1} (6.33/hill) and sulfoxaflor 25 SC @ 0.75 ml l^{-1}(6.33/hill) and on par with each other and recorded 74.43, 68.91 and 65.53 per cent reduction of BPH over untreated control respectively. The data on overall efficacy indicated that after second spray dinotefuran 20 SG @ 0.4 g l^{-1} (64.83 %) proved to be effective insecticide in suppressing the pest population compared to other treatments.

Table 2 Efficacy of new insecticide molecules against brown planthopper, *Nilaparvata lugens* after second spray during *kharif* 2015

T. No	Particulars of the insecticides	Mean population number/ hills *			Population reduction over control (%) **		
		Pre count	3 DAS	5 DAS	3 DAS	5 DAS	Overall reduction (%)
1	Imidacloprid 17.8 SL @ 0.25 ml l^{-1}	19.96 (4.46)	13.40 $(3.66)^{c}$	10.30 $(3.36)^{d}$	29.02 $(30.98)^{c}$	46.37 $(38.93)^{c}$	37.71 $(35.18)^{d}$
2	Thiamethoxam 25 WG @ 0.2 g l^{-1}	20.30 (4.50)	11.63 $(3.41)^{bc}$	8.33 $(3.11)^{bcd}$	39.39 $(35.95)^{bc}$	56.20 $(42.79)^{abc}$	47.80 $(39.51)^{cd}$
3	Acetamiprid 20 SP @ 0.2 g l^{-1}	20.30 (4.50)	12.40 $(3.52)^{c}$	9.53 $(3.24)^{cd}$	35.42 $(34.13)^{bc}$	49.90 $(40.36)^{bc}$	42.66 $(37.37)^{cd}$
4	Sulfoxaflor 25 SC @ 0.75 ml l^{-1}	20.53 (4.58)	10.60 $(3.25)^{abc}$	6.63 $(3.10)^{abc}$	45.40 $(38.53)^{ab}$	65.53 $(46.15)^{ab}$	55.47 $(42.51)^{abc}$
5	Dinotefuran 20 SG @ 0.4 g l^{-1}	21.73 (4.63)	8.07 $(2.84)^{a}$	6.33 $(3.06)^{ab}$	60.75 $(44.46)^{a}$	68.91 $(47.31)^{ab}$	64.83 $(45.91)^{a}$
6	Pymetrozine 50 WG @ 0.5 g l^{-1}	21.00 (4.58)	9.47 $(3.08)^{ab}$	5.03 $(2.83)^{a}$	52.32 $(41.31)^{ab}$	74.43 $(49.15)^{a}$	63.38 $(45.40)^{ab}$
7	Buprofezin 25 SC @ 1.6 ml l^{-1}	20.30 (4.50)	11.73 $(3.42)^{bc}$	8.03 $(3.14)^{bcd}$	38.81 $(35.68)^{bc}$	57.64 $(43.32)^{abc}$	48.23 $(39.69)^{bcd}$
8	Moncrotophos+Dichlorvos 36 SL + 76 EC @ 2.2 ml l^{-1} + 1 ml l^{-1}	21.33 (4.61)	12.93 $(3.59)^{c}$	10.67 $(3.40)^{d}$	35.88 $(34.35)^{bc}$	46.65 $(39.05)^{c}$	41.27 $(36.77)^{d}$
9	Untreated control	20.20 (4.49)	19.10 $(4.37)^{d}$	18.63 $(4.31)^{e}$	-	-	-
	SEm±	0.271	0.220	0.195	2.448	2.370	1.959
	Fcal	NS	Sig	Sig	Sig	Sig	Sig
	CD (0.05)	-	0.6	0.5	7.3	7.1	5.9
	CV(%)	10.50	10.90	10.74	12.70	10.60	9.34

Sig - Significant, NS – Non significant
* Figures in parentheses are square root transformed values; **Figures in parentheses are arc sine transformed values
Mean with same letters are not significantly different at 5 % level by Duncan's Multiple Range test.

Based on the results after two sprays (**Table 3**), pymetrozine 50 WG @ 0.5 g l^{-1}, dinotefuran 20 SG @ 0.4 g l^{-1} and sulfoxaflor 25 SC @ 0.75 ml l^{-1} provided superior control of BPH as compared to other traditional neo nicotinoids like imidacloprid, acetamiprid and thiamethoxam. Present findings are also experimentally corroborated by earlier workers. In former studies dinotefuran 25 g a.i. ha^{-1} performed very good spectrum of action throughout the seasons against brown planthopper [8]. Pymetrozine 50 WG @ 400, 350, 300, 250 and 200 g a.i ha^{-1} was superior in minimizing the population of BPH in rice [9]. Similarly the efficacy of pymetrozine (24 g a.i. ha^{-1}) against BPH after three and seven days after application was 73.69 % and 64.92 % respectively over control [10]

In case of grain yield buprofezin (5400 kg ha^{-1}) pymetrozine (5266 kg ha^{-1}) and dinotefuran (5228 kg ha^{-1}) recorded highest grain yields and were on par with each other by recording 67.98, 63.81 and 62.62 per cent increase over control respectively (Table 3). These results are in agreement with previous studies where buprofezin 25 SC @ 1 ml l^{-1} recorded the highest yield (5621 kg ha^{-1}) [11]. The other treatments also recorded with higher grain yield were sulfoxaflor (4967 kg ha^{-1}), acetamipirid (4763 kg ha^{-1}), imidacloprid (4633 kg ha^{-1}), thiamethoxam (4613 kg ha^{-1}) and monocrotophos + dichlorvos (4133 kg ha^{-1}) compared to untreated control.

Table 3 Cumulative efficacy of new insecticide molecules against brown planthopper, *Nilaparvata lugens* and their effect on grain yield after two sprays during *kharif* 2015

Particulars of the insecticides	Population reduction over control			Grain yield	
	First Spray	Second spray	Mean	Mean Yield	Per cent increase over control
Imidacloprid 17.8 SL @ 0.25 ml l^{-1}	37.72 (35.19)^{c}	37.71 (35.18)^{d}	37.71 (35.19)^{c}	4633^{ab}	44.12
Thiamethoxam 25 WG @ 0.2 g l^{-1}	43.99 (37.94)^{bc}	47.80 (39.51)^{cd}	45.8 (38.73)^{bc}	4613^{ab}	43.49
Acetamiprid 20 SP @ 0.2 g l^{-1}	48.17 (39.67)^{bc}	42.66 (37.37)^{cd}	45.42 (38.54)^{bc}	4763^{ab}	48.16
Sulfoxaflor 25 SC @ 0.75 ml l^{-1}	48.52 (39.81)^{abc}	55.47 (42.51)^{abc}	51.99 (41.18)^{ab}	4967^{ab}	54.51
Dinotefuran 20 SG @ 0.4 g l^{-1}	54.38 (42.10)^{ab}	64.83 (45.91)^{a}	59.60 (44.04)^{a}	5228^{a}	62.62
Pymetrozine 50 WG @ 0.5 g l^{-1}	62.58 (45.12)^{a}	63.38 (45.40)^{ab}	62.98 (45.26)^{a}	5266^{a}	63.81
Buprofezin 25 SC @ 1.6 ml l^{-1}	53.18 (41.64)^{abc}	48.23 (39.69)^{bcd}	50.70 (40.67)^{abc}	5400^{a}	67.98
Moncrotophos+Dichlorvos 36 SL + 76 EC @ 2.2 ml l^{-1} + 1 ml l^{-1}	39.23 (35.87)^{bc}	41.27 (36.77)^{d}	40.25 (36.33)^{bc}	4133^{b}	28.57
Untreated control	-	-	-	3214^{c}	-
SEm±	2.203	1.959	1.928	282.72	
Fcal	Sig	Sig	Sig	Sig	
CD (0.05)	6.6	5.9	5.8	847.6	
CV	10.79	9.34	9.31	10.43	

Sig - Significant
Figures in parentheses are arc sine transformed values
Mean with same letters are not significantly different at 5 % level by Duncan's Multiple Range test

Conclusion

The overall results on incidence of brown planthopper and grain yield revealed that pymetrozine (50 WG @ 0.5 g l^{-1}) and dinotefuran (20 SG @ 0.4 g l^{-1}) were found to be highly effective against brown planthopper and also recorded with the highest grain yields.

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