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Pymetrozine: An effective insecticide for management of planthoppers in rice

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Abstract

Eight insecticidal treatments including pymetrozine 50% WG at 100, 125, and 150 g a.i./ha, imidacloprid 200 SL @ 25 g a.i./ha, dinotefuran 20 SG @ 30 g a.i/ha, sulfoxaflor 24 SC @175 g a.i/ha, flonicamid 50 WG @ 75 g a.i./ha and buprofezin 25 SC @ 200 g a.i/ha were field evaluated against brown panthopper and white-backed planthopper in rice along with untreated control at Central Research Farm, Department of Entomology, Orissa University of Agriculture and Technology (OUAT), Bhubaneswar during *Kharif*, 2015. It was revealed that pymetrozine 50% WG 150 g a.i./ha proved to be the superior insecticide against brown planthoppers and white backed planthoppers exhibiting maximum per cent reduction over control followed by pymetrozine 50% WG 125 g a.i./ha. The least effective insecticide was imidacloprid 200 SL @ 25 g a.i./ha.

Keywords: Pymetrozine, sulfoxaflor, planthopper, rice

1. Introduction

Rice (*Oryza sativa* L.) is the second largest cultivated crop worldwide after wheat [1]. It is the most important cereal crop for more than two third of the population of India. Rice occupies one quarter of the total cropped area, contributes about 40-43% of total food grain production as well as 65% of total cereal production and continues to play a vital role in national food and livelihood security system in our country.

Quite a good number of technical and socio-economic constraints stand on the way of boosting of rice production. These bottlenecks are such as lack of proper infrastructure, proper irrigation facilities, input availability, output marketing, transport and storage, socio-economic constraints of farmers, size of land holding, and at last the biotic and abiotic stresses which adversely affect the crop yield. Among the various biological constraints insect pest problem is one of the major constraints accounting for 50% damage in vegetative, 30% in reproductive and 20% in the ripening stage of rice [2]. Due to insect pest attack 40% the average yield reduction in rice occurs [3].

The rice plant is attacked by 100 insect species throughout the world among which 30 insect species cause a remarkable loss in production due to their infestation [4]. Among the various insect pests damaging rice, planthoppers *viz*., brown planthopper (*Nilaparvata lugens* Stal.) and white-backed planthopper (*Sogatella furcifera* Horvath.) do noticeable damage to the rice crop causing reduction in yield by 20-25% and 11-39%, respectively [5]. In case of brown planthopper (BPH) and white-backed planthopper (WBPH) the damage is caused by both adults and nymphs due to feeding, oviposition and sucking of phloem sap.

The conventional insecticides are becoming ineffective against these insect pests within a short span of time as they have either lost their efficacy or become obsolete due to the development of resistance in insect against them or for their residual toxicity problem. An investigation was carried out to evaluate the efficacy of some new molecules in the field to keep these molecules in the pipeline for management of planthoppers.

2. Materials and Methods

A field trial was laid out in a randomised block design (RBD) at the Central Research Station Farm, Department of Entomology, Orissa University of Agriculture and Technology (OUAT), Bhubaneswar (20^0 15' N, latitude and 85^0 52' E, longitude) at an elevation of 25.9 m above MSL during *kharif*, 2015 in plots of size 3.8m.x3.7m. Rice cv "*Swarna*" was planted at a spacing of 20×15 cm using a chemical fertilizer dose of 100:50:50 kg N: P_2O_5: K_2O /ha. Other recommended package of practices for the state except plant protection was followed.

The trial was replicated thrice with a total of nine treatments *viz*. pymetrozine 50% WG at 100, 125, and 150 g a.i./ha, imidacloprid 200 SL @ 25 g a.i./ha, dinotefuran 20 SG @ 30 g a.i/ha, sulfoxaflor 24 SC @175 g a.i/ha, flonicamid 50 WG @ 75 g a.i./ha and buprofezin 25 SC @ 200 g a.i/ha along with the untreated check. All the treatments were applied in the form of foliar sprays by means of high volume and hand compression sprayer using 500 litres of spray solution per hectare to ensure thorough coverage of the plants. Sufficient care was taken to avoid drifting of insecticides while spraying. The insecticides were applied at 50 and 70 days after transplanting (DAT) of the crop. Spraying was made on test crop basing on the ETL value of the pests. During cropping season of *Kharif*, 2015 observations were recorded on the population of planthoppers (BPH and WBPH) from ten randomly selected hills per subplot in each replication, one day before and 3, 7, 10 and 14 days after spraying and then average was calculated. The data so generated was subjected to transformation and analysed to arrive at a meaningful conclusion.

3. Result and Discussion

The data generated on population of BPH and WBPH in terms of numbers per hill at pre-treatment and post- treatment periods rop have been presented in Table 1 and 2 respectively. From Table 1, it is clearly evident that the pre-treatment population of BPH i.e. one day before spraying (DBS) ranged between 10.49 to 12.55 per hill at 50 DAT and 8.05 to 9.30 per hill at 70 DAT. After 3 days of spraying (DAS) least number of BPH population (0.42/hill) was observed in the treatment of pymetrozine 50% WG @ 150 g a.i./ha which was at par with pymetrozine 50% WG @ 125 g a.i./ha, sulfoxaflor 24 SC @ 175 g a.i./ha and dinotefuran 20 SG @ 30 g a.i/ha. At 7 DAS both pymetrozine 50% WG @ 125 and 150 g a.i./ha differed significantly from rest of the insecticidal treatments registering a population of 0.92 and 0.73 per hill at 50 DAT as well as 0.84 and 0.68 per hill at 70 DAT respectively. At 10 and 14 DAS the similar insecticide i.e. pymetrozine 50% WG both at 125 and 150 g a.i./ha were significantly different from other insecticides except sulfoxaflor 24 SC @ 175 g a.i./ha which has got a quite good support from findings of some other scientists [6] which indicated that significantly lowest planthopper population per 10 hills, at 60, 70, 80 and 90 DAT was recorded with sulfoxaflor 24 SC @ 75 g a.i./ha (13.3, 34.5, 40.0 and 37.8per 10 hills, respectively) followed by 17.0, 54.5, 43.5 and 35.0 per 10 hills, respectively at 90 g a.i./ha.

After spraying the per cent reduction of BPH population over control ranged from the lowest of 85.51% and 84.08% at 50 and 70 DAT respectively by Imidacloprid 200 SL @ 25 g a.i/ha to the highest of 92.85% and 92.77% at 50 and 70 DAT respectively by Pymetrozine 50% WG @ 150 g a.i./ha which is supported by the findings of some eminent researchers [7] which indicated that pymetrozine 50 WG @ 125 g a.i and 150 g a.i /ha exhibited higher toxicity to BPH. The bio-efficacy of pymetrozine 50 WG against brown planthopper (BPH)was also previously evaluated in rice during Kharif 2007 and Rabi 2007-08 with five dosages viz., 100, 125, 150, 175 and 200 g a.i./ha in Kharif and four dosages in Rabi. The results revealed that all the dosages of pymetozine 50 WG recorded more than 90 per cent reduction in the population of BPH over the untreated control and superior to neonicotinoids like imidacloprid and thiamethoxam 25 g a.i./ha and chitin bio-synthesis inhibitor like buprofezin 25 SC @ 125 g a.i./ha which gives ample support to the present findings [8]. The result also derives support from the findings of a previous research concluding that pymetrozine 50 WG @ 350 g a.i./ha significantly superior in controlling BPH population [9]. It was also reported that Pymetrozine 50% WG (GSP sample) @ 300 and 400 g/ha and Pymetrozine 50% WG (Market sample) @ 300 g/ ha effectively controlled BPH followed by Imidacloprid 17.8% SL @ 125 ml/ha and Fipronil 5% SC @ 1500 ml/ha [10]. The research findings are also partly similar with the previous findings which reported that significantly low BPH population (1.40 and 1.60/hill) was observed with flonicamid 50 WG @ 150 g a.i. /ha and @ 75 g a.i. /ha with a reduction of 88.73 and 87.12% over untreated control, respectively [11]. The current findings also supported by the findings concluding that by the application of dinotefuran @ 600 g /ha the BPH population was reduced by 11.97 and 46.59 per cent at 70 and 85 DAT whereas, the same insecticide at 800 g a.i/ha exhibited a population reduction of 15.16 and 56.48 per cent at 70 and 85 DAT [12].

The population of white-backed planthopper remained low during the period of investigation, but was continuously present from vegetative to reproductive stage. The data pertaining to WBPH population have been presented in Table 2. During *Kharif*, 2015, after the first round of spray at 50 DAT pymetrozine 50% WG at 125 and 150 g a.i/ha recorded less population of WBPH (0.35 and 0.21/hill) which were on par with sulfoxaflor 24 SC @ 175 g a.i./ha and dinotefuran 20 SG @ 30 g a.i/ha exhibiting WBPH population of 0.42/hill in each treatment at 3 DAS. Similar trend was observed at 7 DAS. The population of WBPH ranged from 0.75 to 12.80 and 1.03 to 13.90 per hill at 10 and 14 days, respectively. Least number of WBPH population was witnessed in the treatment of pymetrozine 50% WG @ 150 g a.i./ha (0.75/hill) at 10 DAS which was on par with the same insecticide at 125 g a.i./ha (1.10/hill) and sulfoxaflor 24 SC @ 175 g a.i./ha (1.35/hill). At 14 DAS pymetrozine 50% WG @ 150 g a.i./ha registered least population of WBPH (1.03/hill) which differed significantly from rest of the insecticidal treatments and untreated control. A population variation of 0.80 – 2.41, 0.90 – 2.10 and 0.52 – 1.86 per hill was observed from 3 DAS to 14 DAS in the treatment of imidacloprid 200 SL @ 25 g a.i/ha, buprofezin 25 SC @ 200 g a.i./ha and flonicamid 50 WG 75 g a.i./ha, respectively. The post spray period recorded 87.04 to 95.24% reduction of WBPH population over control. Similar results found at 70 DAT. Pymetrozine 50% WG @ 125 and 150 g a.i./ha proved to be the superior treatment registering the WBPH population of 0.56 and 0.31 per hill, respectively at 3 DAS which were significantly differed from other treatments. Rice crop treated with sulfoxaflor 24 SC @ 175 g a.i./ha, dinotefuran 20 SG @ 30 g a.i/ha, flonicamid 50 WG @ 75 g a.i./ha were at par exhibiting WBPH population of 0.70, 0.84 and 0.92 per hill, respectively. The treatment of pymetrozine 50% WG, imidacloprid 20 SL and buprofezin 25 SC @ 100, 25 and 200 a.i./ha recorded a population of 0.94, 1.15 and 1.20 per hill, respectively. At 7 DAS mostly similar trend was observed. The population of WBPH in the treatment of T_2, T_3, T_5, T_6 and T_7 were on par at 10 and 14 DAS which significantly differed from the treatment of T_1, T_4, T_8 and T_9. The per cent reduction in WBPH population over control was maximum in the treatment of pymetrozine 50% WG @ 150 g a.i./ha (92.10%). However, all the insecticides were effective in restricting WBPH population till 14 DAS compared to untreated control. The above findings derives ample support from various results. One of the previous experimental findings of indicated that pymetrozine 50 WG @ 125 g a.i and 150 g a.i /ha exhibited higher toxicity to WBPH [7]. It was also reported that Pymetrozine 50% WG (GSP sample) @ 300 and 400 g/ha and Pymetrozine 50% WG (Market sample) @ 300 g/ ha effectively controlled WBPH followed by Imidacloprid 17.8% SL @ 125 ml/ha and Fipronil 5% SC @ 1500 ml/ha [10].

The current result is also partly supported by the previous findings in which it wasobserved that buprofezin 25 SC @ 1 ml/ha registered lowest WBPH population, while imidacloprid 17.8 SL @ 0.3 ml/l was on par with buprofezin 25 SC @ 0.75 ml/l and significantly superior to all the remaining treatments [13]. Another experimental findings also suggested that Sulfoxaflor @ 82 and 68 g a.i./ha lowered the WBPH to 7.3 and 7.5 per ten hills at 46 DAT [14]. Study conducted by a group of researchers also indicated that significantly lowest planthopper population per 10 hills, at 60, 70, 80 and 90 DAT was recorded with sulfoxaflor 24 SC @ 75 g a.i./ha (13.3, 34.5, 40.0 and 37.8per 10 hills, respectively, which support the present finding [6].

Table 1: Effect of various insecticides against Brown planthoppers during *Kharif*, 2015

Tr. No	Insecticides	Dose g a.i/ha	1 DBS		3 DAS		7 DAS		10 DAS		14 DAS		Mean population after post spray		Reduction over control (%)	
			50 DAT	70 DAT	50 DAT	70 DAT	50 DAT	70 DAT	50 DAT	70 DAT	50 DAT	70 DAT	50 DAT	70 DAT	50 DAT	70 DAT
T_1	Pymetrozine 50% WG	100	10.49 (3.31)	8.50 (3.00)	0.94 (1.20)	0.92 (1.14)	1.57 (1.44)	1.36 (1.36)	2.10 (1.61)	1.86 (1.54)	2.98 (1.86)	2.62 (1.76)	1.90	1.69	88.08	87.00
T_2	Pymetrozine 50% WG	125	11.51 (3.46)	8.53 (3.00)	0.52 (1.01)	0.56 (1.03)	0.92 (1.19)	0.84 (1.16)	1.62 (1.46)	1.32 (1.35)	1.98 (1.57)	1.68 (1.48)	1.26	1.10	92.09	91.54
T_3	Pymetrozine 50% WG	150	11.58 (3.47)	8.05 (2.92)	0.42 (0.96)	0.31 (0.90)	0.73 (1.11)	0.68 (1.09)	1.53 (1.42)	1.29 (1.34)	1.87 (1.53)	1.47 (1.40)	1.14	0.94	92.85	92.77
T_4	Imidacloprid 200 SL	25	11.86 (3.51)	8.58 (3.01)	0.94 (1.20)	0.94 (1.20)	1.98 (1.57)	1.55 (1.43)	2.61 (1.73)	2.25 (1.66)	3.70 (2.05)	3.54 (2.01)	2.31	2.07	85.51	84.08
T_5	Dinotefuran 20 SG	30	11.23 (3.42)	9.30 (3.13)	0.70 (1.09)	0.70 (1.09)	1.31 (1.34)	1.15 (1.28)	1.89 (1.54)	1.53 (1.42)	2.66 (1.78)	2.10 (1.61)	1.62	1.37	89.84	89.46
T_6	Sulfoxaflor 24 SC	175	12.55 (3.61)	8.98 (3.08)	0.70 (1.09)	0.61 (1.05)	1.13 (1.28)	0.97 (1.21)	1.65 (1.47)	1.50 (1.41)	2.27 (1.66)	1.97 (1.57)	1.44	1.26	90.97	90.31
T_7	Flonicamid 50 WG	75	11.79 (3.50)	8.45 (2.99)	0.76 (1.12)	0.84 (1.16)	1.39 (1.37)	1.26 (1.33)	1.98 (1.57)	1.84 (1.53)	2.94 (1.85)	2.31 (1.68)	1.77	1.56	88.89	88.00
T_8	Buprofezin 25 SC	200	11.79 (3.50)	8.75 (3.04)	1.05 (1.24)	1.13 (1.28)	1.43 (1.39)	1.26 (1.33)	2.34 (1.68)	1.86 (1.54)	3.27 (1.94)	3.25 (1.94)	2.02	1.87	87.33	85.61
T_9	Untreated control		11.76 (3.50)	8.75 (3.04)	14.35 (3.85)	11.76 (3.50)	15.75 (4.03)	12.80 (3.65)	16.06 (4.06)	13.44 (3.73)	17.60 (4.25)	14.01 (3.82)	15.94	13.00	---	
	SE(m) ±		0.095	0.132	0.068	0.126	0.032	0.059	0.037	0.031	0.052	0.045				
	CD (P=0.05)		NS	NS	0.20	0.38	0.10	0.18	0.11	0.09	0.16	0.13				

Figures in parentheses are (X + 0.5) square root transformed values DBS: Days before spraying DAS: Days after spraying NS: Non significant

Table 2: Effect of various insecticides against White backed planthoppers during *Kharif*, 2015

Tr. No	Insecticides	Dose g a.i/ha	1 DBS		3 DAS		7 DAS		10 DAS		14 DAS		Mean population after post spray		Reduction over control (%)	
			50 DAT	70 DAT	50 DAT	70 DAT	50 DAT	70 DAT	50 DAT	70 DAT	50 DAT	70 DAT	50 DAT	70 DAT	50 DAT	70 DAT
T_1	Pymetrozine 50% WG	100	9.10 (3.09)	7.77 (2.87)	0.70 (1.09)	0.94 (1.20)	1.15 (1.28)	1.26 (1.33)	1.54 (1.43)	1.78 (1.51)	1.89 (1.54)	2.41 (1.70)	1.32	1.60	89.17	86.11
T_2	Pymetrozine 50% WG	125	8.92 (3.07)	8.53 (3.00)	0.35 (0.92)	0.56 (1.03)	0.53 (1.01)	0.68 (1.09)	1.10 (1.26)	1.35 (1.36)	1.55 (1.43)	1.68 (1.48)	0.88	1.07	92.78	90.71
T_3	Pymetrozine 50% WG	150	9.45 (3.15)	8.05 (2.92)	0.21 (0.84)	0.31 (0.90)	0.35 (0.92)	0.56 (1.03)	0.75 (1.19)	1.30 (1.34)	1.03 (1.24)	1.47 (1.40)	0.58	0.91	95.24	92.10
T_4	Imidacloprid 200 SL	25	8.92 (3.07)	8.58 (3.01)	0.80 (1.14)	1.15 (1.28)	1.32 (1.35)	1.47 (1.40)	1.80 (1.52)	1.89 (1.54)	2.41 (1.70)	2.62 (1.77)	1.58	1.78	87.04	84.55
T_5	Dinotefuran 20 SG	30	9.45 (3.15)	7.69 (2.86)	0.42 (0.96)	0.84 (1.16)	0.73 (1.11)	0.97 (1.21)	1.48 (1.41)	1.47 (1.40)	1.78 (1.51)	1.86 (1.54)	1.10	1.28	90.98	88.88
T_6	Sulfoxaflor 24 SC	175	9.30 (3.13)	8.98 (3.08)	0.42 (0.96)	0.70 (1.09)	0.70 (1.09)	0.84 (1.16)	1.35 (1.36)	1.42 (1.32)	1.76 (1.50)	1.80 (1.52)	1.05	1.19	91.39	89.67
T_7	Flonicamid 50 WG	75	9.20 (3.11)	8.78 (3.05)	0.52 (1.01)	0.92 (1.19)	1.03 (1.24)	1.15 (1.28)	1.50 (1.41)	1.68 (1.48)	1.86 (1.54)	1.97 (1.57)	1.22	1.43	89.99	87.59
T_8	Buprofezin 25 SC	200	8.75 (3.04)	8.25 (2.96)	0.90 (1.18)	1.20 (1.30)	1.25 (1.32)	1.36 (1.36)	1.54 (1.43)	1.86 (1.54)	2.10 (1.61)	2.45 (1.72)	1.47	1.72	87.94	85.06
T_9	Untreated control		8.92 (3.07)	8.40 (2.98)	10.52 (3.32)	9.56 (3.17)	11.56 (3.47)	10.75 (3.35)	12.80 (3.65)	12.10 (3.55)	13.90 (3.79)	13.69 (3.77)	12.19	11.52	--	--
	SE(m) ±		0.065	0.194	0.044	0.048	0.066	0.035	0.058	0.049	0.055	0.071				
	CD (P=0.05)		NS	NS	0.13	0.14	0.20	0.10	0.17	0.15	0.17	0.21				

Figures in parentheses are (X + 0.5) square root transformed values DBS: Days before spraying DAS: Days after spraying NS: Non-Significant.

4. Conclusion

The effect of various treatments imposed at 50 and 70 DAT on BPH revealed that all the treatments were superior than the control and among the treatments, pymetrozine 50% WG at 125 and 150 g a.i./ha was the best treatment during the period of investigation accounting for more than 90% reduction in BPH population. The other better efficacious treatments were sulfoxaflor 24 SC @ 175 g a.i./ha, dinotefuran 20 SC @ 30 g a.i./ha, flonicamid 50 WG @ 75 g a.i./ha and buprofezin 25 SC @ 200 g a.i./ha that also accounted for nearly 90%

reduction in BPH population. Similarly as regards to WBPH, pymetrozine 50% WG @ 150 g a.i./ha was the superior insecticide which accounted for nearly 93% reduction in population when averaged for two sprays. The other efficacious treatments were pymetrozine 50% WG at 125 g a.i./ha followed by sulfoxaflor 24 SC @ 175 g a.i./ha and dinotefuran 20 SC @ 30 g a.i./ha. So we hope it will be useful for farmers to manage these two major sucking pests in rice.

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