Journal of Entomology and Zoology Studies

Available online at www.entomoljournal.com

E-ISSN: 2320-7078
P-ISSN: 2349-6800
JEZS 2019; 7 (2): 194-197

Received: 06-01-2019
Accepted: 10-02-2019

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Efficacy of new molecules against green leafhopper 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 green leafhopper 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 green leafhopper exhibiting maximum per cent reduction over control followed by pymetrozine 50 % WG 125 g a.i./ha. and the above chemicals did not exercise any adverse effect on the spider.

Keywords: pymetrozine, sulfoxaflor, leaf hopper, rice, spider

1. Introduction
A single crop that can truly define life and culture of Asian countries is rice (*Oryza sativa* L.). Rice is life for more than half of the humanity. This crop has been cultivated for centuries and has played a crucial role not only in supplying the staple food but also shaping the social life and economic progress of the nation. 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.

Quite a good number of technical and socio-economic constraints stand on the way of boosting of rice production. 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 hundreds of 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, green leafhopper (*Nephotettix virescens* Dist.) do noticeable damage to the rice crop causing 15-20 % reduction in yield [5]. In case of green leafhopper (GLH) the damage is caused by both adults and nymphs due to feeding, oviposition and sucking of xylem 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 green leafhopper (GLH) and to study its effect on natural enemy.

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 green leafhopper (GLH) and spiders 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. Results and Discussion

The data generated on population of GLH in terms of numbers per hill at pre-treatment and post- treatment periods have been presented in Table 1 and 2 respectively. It was apparent from the Table 1 that lowest population of GLH was observed in the treatment of pymetrozine 50 % WG @ 150 g a.i./ha (0.21/hill) followed by pymetrozine 50 % WG @ 125 g a.i./ha (0.35/hill) which were on par with sulfoxaflor 24 SC @ 175 g a.i./ha (0.58/hill) and dinotefuran 20 SG @ 30 g a.i/ha (0.70/hill) at 3 DAS of first round spray. At 7 and 14 DAS the pyridine azomethine group insecticide at 125 and 150 g a.i./ha differed significantly from rest of the insecticidal treatments recording a population of 0.70, 0.42 and 1.15, 1.05 per hill, respectively. However, the treatment including the same pyridine azomethine group of insecticide at 125 and 150 g a.i./ha was at par with sulfoxaflor 24 SC @ 175 g a.i./ha (1.12/hill) at 10 DAS. GLH population 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 ranged from 0.84 – 2.80, 0.91 – 2.62 and 0.78 – 1.60/hill, respectively from 3 DAS to 14 DAS. The per cent reduction in the population of GLH over control varied between 85.20 and 94.93 in the post spray period.

The pre-treatment count of GLH population at 70 DAT prior to second round of spray remained between 6.82 and 7.87 per hill (Table 2). At 3 DAS imidacloprid 20 SL and buprofezin 25 SC at 25 and 200 g. a.i./ha, respectively recorded more number of GLH population (0.78 and 0.91/hill) as compared to rest other insecticidal treatments. At 7 DAS the GLH population varied between 0.71 and 8.19 per hill. Pymetrozine 50 % WG at 125 and 150 g a.i./ha recorded less number of GLH population at 10 and 14 DAS (0.91, 0.81 and 1.04, 0.92), which differed significantly from rest of the treatments at 10 DAS; but at par with sulfoxaflor 24 SC @ 175 g a.i./ha and dinotefuran 20 SG @ 30 g a.i/ha at 14 DAS. During the post spray period 83.22 % (Imidacloprid 200 SL @ 25 g a.i./ha) to 92.17 % (Pymetrozine 50 % WG @ 150 g a.i./ha) reduction in GLH population was recorded over control. All the insecticides were effective in restricting GLH population till 14 days after spraying as compared to untreated control.

The present research findings regarding green leafhopper (GLH) incidence indicated that all the insecticides tested were effective in restricting GLH population till 14 DAS compared to untreated control. However, pymetrozine 50 WG at 125 and 150 g a.i/ha proved superior than other treatments.

Ramu *et al.* [6], noticed that maximum reduction of GLH was recorded with imidacloprid @ 0.25 ml/l with 84.54 % decrease over control. Shashank *et al.* [7] observed that buprofezin @ 0.20 kg a.i./ha registered highest reduction in GLH population (75.08 %). According to Vinothkumar [8], imidacloprid 17.8 SL @ 30 g a.i./ha and buprofezin 25 SC @ 200 g a.i./ha were highly effective in checking the population of green leafhopper by registering almost cent per cent control after three rounds of spray. Misra [9] found that significantly lowest GLH population (0.67 & 0.87/ hill) was recorded with the new molecule flonicamid 50 WG @ 150 g and @ 75 g a.i. /ha with a reduction of 94.5 and 92.8 % over control. Hence, the present finding derived ample support from the findings of the above authors.

The mean population of spider after first and second round of spray is presented in Table 3. With respect to performance of various treatments imposed it was evident that there was no significant difference among the treatments and control at 1 DBS, 3, 7, 10 and 14 DAS. A general reduction in spider population was observed compared to untreated control at 3 DAS. However, the population was built up at 7 DAS (0.76 – 0.86/hill) and continued to increase till 14 DAS (0.84 – 0.97/hill). The least per cent reduction in spider population (6.18 %) over control at 14 DAS was witnessed in the treatment of pymetrozine 50 % WG @ 125 g a.i./ha and imidacloprid 200 SL @ 25 g a.i./ha followed by pymetrozine 50 % WG @ 100 g a.i./ha and buprofezin 25 SC @ 200 g a.i./ha (10.31 %) respectively.

The present research findings regarding spider population revealed that, no significant difference was noticed among all the treatments. Bhabani and Rao [10] suggested that imidacloprid 200 SL occupied the first in safety to spiders as per pest: defender (P:D) ratio. Mean spider population in the Imidacloprid 200 SL treated plots remained at 0.36 /hill while untreated control exhibited 1.21spiders/hill. Bhanu *et al.* [11] observed that sulfoxaflor 24SC @ 75 and 90 g a.i./ha recorded significantly lowest number of spiders (15.0 and 10.7 per 10 hills). According to Ghosh *et al*. [12] dinotefuran at four different doses 15, 20, 25 and 30 g ai./ha and imidacloprid 17.8 SL at 25 gai./ha have no significant effect on the mean number of spider population (2.67 – 3.33/hill) up to 15 days after both the sprays. Reddy *et al*. [13] noticed that the population of spider was significantly higher in the treatment of buprofezin 25 SC @ 1.6 ml/l. According to Kiran kumar [14] pymetrozine 50 WG @ 250, 300 and 350 g/ha, imidacloprid 17.8 SL @ 125 g/ha and buprofezin 25 SL @ 500 ml/ha recorded 2.07, 2.60, 2.80, 1.80 and 1.53 spiders per hill, respectively without having any significant difference among the different treatments.

4. Conclusion

The effect of various treatments imposed at 50 and 70 DAT on GLH revealed that all the treatments were superior than the control. Pymetrozine 50 % WG at both 125 and 150 g a.i./ha exercised its highest effect towards reduction on GLH after both the sprays resulting in 92 – 93 % average reduction, whereas, other treatments viz, sulfoxaflor 24 SC @ 175 g a.i./ha, dinotefuran 20 SC @ 30 g a.i./ha and flonicamid 50 WG @ 75 g a.i./ha were very effective treatments. Buprofezin 25 SC @ 200 g a.i./ha did not register any spectacular effect as compared to above treatments. With regards to spider population, none of the test chemicals exercised any lethality on them which clearly depicted the non-target effect of the chemicals. It is noteworthy that the insecticides simultaneously control the insects effectively and did not influence the activity of the spiders. Spiders being the major

beneficial arthropod in the rice ecosystem need to be unaffected by the chemicals and the above chemicals did not exercise any adverse effect on the spider.

5. Acknowledgment
Dr. S. K. Panda, Professor and Head of the Department, Department of Entomology, O.U.A.T and Dr. L. M. Garnayak, Former Dean, College of Agriculture, O.U.A.T, are highly acknowledged.

Table 1: Effect of various insecticides against green leafhopper (GLH) at 50 DAT during *Kharif*, 2015 at Bhubaneswar

Tr. No.	Insecticides	Dose g a.i./ha	Green leafhopper population / hill						
			1 DBS	3 DAS	7 DAS	10 DAS	14 DAS	Mean population after post spray	Reduction over control (%)
T_1	Pymetrozine 50 % WG	100	11.18 (3.42)	0.81 (1.14)	1.45 (1.40)	1.68 (1.48)	1.81 (1.52)	1.44	88.03
T_2	Pymetrozine 50 % WG	125	10.92 (3.38)	0.35 (0.92)	0.70 (1.09)	0.91 (1.19)	1.15 (1.28)	0.78	93.52
T_3	Pymetrozine 50 % WG	150	9.70 (3.19)	0.21 (0.84)	0.42 (0.96)	0.78 (1.13)	1.05 (1.24)	0.61	94.93
T_4	Imidacloprid 200 SL	25	10.74 (3.35)	0.84 (1.18)	1.52 (1.42)	1.95 (1.57)	2.80 (1.82)	1.78	85.20
T_5	Dinotefuran 20 SG	30	11.02 (3.39)	0.70 (1.09)	1.03 (1.24)	1.22 (1.31)	1.39 (1.37)	1.08	91.02
T_6	Sulfoxaflor 24 SC	175	9.76 (3.20)	0.58 (1.04)	0.84 (1.18)	1.12 (1.27)	1.35 (1.36)	0.97	91.94
T_7	Flonicamid 50 WG	75	10.71 (3.35)	0.78 (1.13)	1.40 (1.38)	1.52 (1.42)	1.60 (1.45)	1.32	89.03
T_8	Buprofezin 25 SC	200	10.75 (3.35)	0.91 (1.19)	1.47 (1.40)	1.81 (1.52)	2.62 (1.77)	1.70	85.87
T_9	Untreated control		9.98 (3.24)	10.53(3.32)	11.32(3.44)	12.81(3.65)	13.48(3.74)	12.03	-
	SE (m) ±		0.063	0.059	0.071	0.050	0.035		
	CD (P=0.05)		NS	0.18	0.21	0.14	0.10		

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 green leafhopper (GLH) at 70 DAT during *Kharif*, 2015 at Bhubaneswar

Tr. No.	Insecticides	Dose g a.i./ha	Green leafhopper population / hill						
			1 DBS	3 DAS	7 DAS	10 DAS	14 DAS	Mean population after post spray	Reduction over control (%)
T_1	Pymetrozine 50 % WG	100	7.08 (2.75)	0.71 (1.10)	1.12 (1.27)	1.47 (1.40)	1.91 (1.55)	1.30	85.46
T_2	Pymetrozine 50 % WG	125	7.35 (2.80)	0.40 (0.95)	0.78 (1.13)	0.91 (1.19)	1.04 (1.24)	0.78	91.27
T_3	Pymetrozine 50 % WG	150	7.87 (2.89)	0.36 (0.93)	0.71 (1.10)	0.81 (1.14)	0.92 (1.19)	0.70	92.17
T_4	Imidacloprid 200 SL	25	6.82 (2.70)	0.78 (1.13)	1.36 (1.36)	1.68 (1.48)	2.2 (1.64)	1.50	83.22
T_5	Dinotefuran 20 SG	30	7.35 (2.80)	0.61 (1.05)	0.92 (1.19)	1.15 (1.28)	1.39 (1.37)	1.02	88.59
T_6	Sulfoxaflor 24 SC	175	7.87 (2.89)	0.52 (1.01)	0.84 (1.16)	1.12 (1.27)	1.28 (1.33)	0.94	89.48
T_7	Flonicamid 50 WG	75	6.87 (2.71)	0.65 (1.07)	1.05 (1.24)	1.39 (1.37)	1.73 (1.49)	1.20	86.58
T_8	Buprofezin 25 SC	200	6.90 (2.72)	0.91 (1.19)	1.26 (1.33)	1.56 (1.44)	2.06 (1.60)	1.45	83.78
T_9	Untreated control		6.82 (2.70)	7.84 (2.89)	8.19 (2.95)	9.36 (3.14)	10.37 (3.28)	8.94	-
	SE (m) ±		0.69	0.062	0.055	0.042	0.073		
	CD (P=0.05)		NS	0.18	0.17	0.12	0.22		

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

Table 3: Spider population on rice crop treated with different insecticides during *Kharif*, 2015 at Bhubaneswar

Tr. No.	Insecticides	Dose g a.i./ha	Spider population / hill					
			1 DBS	3 DAS	7 DAS	10 DAS	14 DAS	Reduction over control at 14 DAS
T_1	Pymetrozine 50 % WG	100	0.71 (1.10)	0.60 (1.05)	0.76 (1.12)	0.84 (1.16)	0.87 (1.17)	10.31
T_2	Pymetrozine 50 % WG	125	0.77 (1.13)	0.66 (1.08)	0.80 (1.14)	0.86 (1.17)	0.91 (1.19)	6.18
T_3	Pymetrozine 50 % WG	150	0.66 (1.08)	0.60 (1.05)	0.79 (1.14)	0.84 (1.16)	0.88 (1.17)	9.27
T_4	Imidacloprid 200 SLss	25	0.68 (1.09)	0.63 (1.06)	0.80 (1.14)	0.87 (1.17)	0.91 (1.19)	6.18
T_5	Dinotefuran 20 SG	30	0.70 (1.09)	0.67 (1.08)	0.82 (1.15)	0.82 (1.15)	0.86 (1.17)	11.34
T_6	Sulfoxaflor 24 SC	175	0.69 (1.09)	0.66 (1.08)	0.78 (1.13)	0.83 (1.15)	0.88 (1.17)	9.27
T_7	Flonicamid 50 WG	75	0.63 (1.06)	0.57 (1.03)	0.76 (1.12)	0.80 (1.14)	0.84 (1.16)	13.40
T_8	Buprofezin 25 SC	200	0.66 (1.08)	0.63 (1.06)	0.77 (1.13)	0.83 (1.15)	0.87 (1.17)	10.31
T_9	Untreated control		0.69 (1.09)	0.77 (1.13)	0.86 (1.17)	0.92 (1.42)	0.97 (1.21)	
	SE (m) ±		0.06	0.05	0.05	0.02	0.03	
	CD (P=0.05)		NS	NS	NS	NS	NS	

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

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