Journal of Entomology and Zoology Studies
Available online at www.entomoljournal.com

E-ISSN: 2320-7078
P-ISSN: 2349-6800
JEZS 2017; 5(4): 1617-1620

Received: 29-05-2017
Accepted: 30-06-2017

K Deekshita
Department of Entomology, Agricultural College, Bapatla, Guntur, Andhra Pradesh, India

CV Rama Rao
Principal Scientist & Head, Rice Research Unit (RRU), Bapatla, Guntur, Andhra Pradesh, India

C Sandhya Rani
Associate Professor, Department of Entomology, Agricultural College, Bapatla, Guntur, Andhra Pradesh, India

V Prasanna Kumari
Assistant Professor, Department of Plant Pathology, Agricultural College, Bapatla, Guntur, Andhra Pradesh, India

Correspondence
K Deekshita
Department of Entomology, Agricultural College, Bapatla, Guntur, Andhra Pradesh, India

Effect of new insecticide molecules on predators of rice ecosystem

K Deekshita, CV Rama Rao, C Sandhya Rani and V Prasanna Kumari

Abstract
Field experiment was conducted to evaluate the toxicity of newer insecticide molecules *viz.,* 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 spiders and mirid bugs of rice ecosystem in Agricultural College Farm, Bapatla during *kharif* 2015. Among all the insecticides pymetrozine 50 WG @ 0.5 g l^{-1} proved safer to the green mirid bugs with lowest percent mortality of 16.96 redcution over precount after two rounds of spray. The safest treatment to spiders is sulfoxaflor with 20.40 percent mortality of spiders over precount followed by pymetrozine 50 WG @ 0.5 g l^{-1} (23.89 percent).

Keywords: Toxicity, pymetrozine, sulfoxaflor, mirid bugs, spiders

1. Introduction
Rice (*Oryza sativa* L.) is an important staple food crop for more than half of the world population and accounts for more than 50 percent of the daily calorie intake [5]. Approximately 21 percent of the global production losses of rice are attributed to the attack of insect pests [10]. Among the 20 serious insect pests of rice, brown planthopper (BPH), *Nilaparvata lugens* Stal. (Homoptera: Delphacidae), are considered to be most destructive insect pests in Asian countries [8].

To combat these pests, chemical insecticides are used as frontline defense sources. Though, the over dependence and excessive use of pesticides may resulted in development of resistance to the insecticides, induces secondary outbreak of pests, reduces the bio diversity of natural enemies and contamination of the natural ecosystem. But still under such circumstances several new molecules selective to target pests are required to be evaluated for the justification of chemical control as the first line of defence [9]. As, the use of insecticides remains an important component of integrated pest management (IPM), it is necessary to evaluate the new groups, new formulations of insecticides and their combinations for their bio efficacy. Hence it is necessary to protect and preserve the natural enemies of the pests. Among the natural enemies, spiders and mirids are important in rice ecosystem. These natural enemies are directly exposed to the chemicals during spraying, as well as to the left over insecticides. Keeping in mind the ill effects of indiscriminate use of insecticides and the importance of the natural enemies the present work was carried out to evaluate the effect of newer insecticide molecules against natural enemies in the rice ecosystem.

2. Materials and Methods
Field experiment was conducted at Agricultural College Farm, Bapatla during *kharif* 2015 to evaluate the effect of newer insecticide molecules on natural enemies of rice. The experiment was carried out with the variety Sambha mashuri (BPT 5204) in plots of 5x4 m size in a Randomised Block Design (RBD). In this experiment nine treatments were tested *viz.,* 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 and untreated control, and were replicated thrice. The treatments were imposed at 15 days intervals with hand compressed knapsack sprayer. The spray fluid required per plot is 1 litre. Applications were made during morning hours.

Observations on the population of spiders and mirid bugs were recorded in ten randomly selected hills per plot before and after three days and five days after application. The percent reduction of natural enemies over precount was worked out.

2.1 Statistical Analysis

The pooled mean after first spray was represented and analysed statistically. The data on percentage were transformed into arc sine values and the population number into square root values. The data was subjected to ANOVA and the mean values were compared using Duncan's Multiple Range Test (DMRT) [2].

3. Results and Discussion

In the experimental field, population of natural enemies was moderate to good during *kharif* 2015. The species observed in the field was green mirid bugs and spiders. The abundant spider species are *Lycosa pseudoannulata*, *Argiope catenulate* and *Tetragnatha maxillosa.*

3.1 Green mirid bugs

It was evident from the Table 1 that the population of mirid bugs before spray did not vary significantly among the treatment and the mean number of mirid bugs per hill after spray was comparatively low in all insecticidal treatments than the untreated control. Among the treatments pymetrozine 50 WG @ 0.5 g l^{-1} recorded the highest mean population of green mirid bugs (5.90/hill) followed by dinotefuran 20 SG @ 0.4 g l^{-1} (5.67/hill) and monocrotophos + dichlorvos 36 SL + 76 EC (5.63/hill). Percent population reduction over precount was significantly higher in pymetrozine 50 WG @ 0.5 g l^{-1} (21.65%) and was on par with dinotefuran (27.58%). During second spray the untreated control recorded the highest mean population of mirid bugs. Among the treatments pymetrozine 50 WG @ 0.5 g l^{-1} recorded highest mean population of mirid bugs (5.47/hill). The lowest mortality of mirid bugs was observed in pymetrozine 50 WG @ 0.5 g l^{-1} i.e., 12.28 percent followed by sulfoxaflor 25 SC @ 0.4 g l^{-1} which recorded 17.54 percent reduction over precount.

After two rounds of sprays pymetrozine 50 WG @ 0.5 g l^{-1} recorded with lowest reduction of population *i.e.,* 16.96 percent followed by buprofezin 20 SP @ 1.6 ml l^{-1} which recorded 25.13% over precount. The other insecticides dinotefuran 20 SG @ 0.4 g l^{-1}, thiamethoxam 25 WG @ 0.2 g l^{-1}, sulfoxaflor 25 SC @ 0.75 ml l^{-1}, monocrotophos + dichlorvos 76 EC + 36 SL @ 2.2 ml l^{-1} + 1 ml l^{-1}, imidacloprid 17.8 SL and acetamiprid 20 SP @ 0.2 g l^{-1} recorded 27.00, 27.29, 31.58, 31.71, 35.51 and 39.62 percent mortality over precount.

3.2 Spiders

The population of spiders ranged from 7.67 to 11.07 per ten plants before treatment during first spray and 5.60 to 6.26 per ten plants before treatment during second spray (Table 2). After first spray thiamethoxam 25 WG @ 0.2 g l^{-1} recorded the highest mean population of spiders 0.2 g l^{-1} (9.28/10 hills) followed by and sulfoxaflor 25 SC @ 0.75 ml l^{-1} (8.97/10 hills) and untreated control (8.92/10 hills). Percent population reduction over precount indicated that sulfoxaflor 25 SC @ 0.75 ml l^{-1} reduced the population up to 10.30 percent and was on par with pymetrozine 50 WG @ 0.5 g l^{-1} and thiamethoxam 25 WG @ 0.2 g l^{-1} which recorded 15.22 and 16.17 percent reduction over precount, respectively.

During second spray the pooled mean population after spray indicated that there was no significant differences between the treatments at all observations made at before, three days and five days after second spray. Though the data was non significant but the lowest mortality was recorded in sulfoxaflor treated plots *i.e.,* 25.59 percent mortality over precount. After two rounds of spray the sulfoxaflor treated plots recorded with the lowest mortality of 20.40 percent followed by pymetrozine 50 WG @ 0.5 g l^{-1} (23.89%). The other insecticides buprofezin 25 SC @ 1.6 ml l^{-1}, monocrotophos + dichlorvos 36 SL + 76 EC @ 2.2 ml l^{-1} + 1 ml l^{-1}, thiamethoxam 25 WG @ 0.2 g l^{-1}, dinotefuran 20 SG @ 0.4 g l^{-1} acetamiprid 20 SP @ 0.2 g l^{-1} and imidacloprid 17.8 SL @ 0.25 ml l^{-1} recorded with 25.92, 26.41, 26.90, 27.42, 29.18 and 32.06 percent mortality over precount (Table 3).

Results of the present findings are also experimentally corroborated by earlier workers. In former studies pymetrozine @ 125 g a.i. ha^{-1} exhibited higher toxicity to BPH and WBPH but at the same time relatively less toxic to mirid bugs [6]. Pymetrozine @ 400 g a.i. ha^{-1} has lesser adverse effects on mirid bug [7]. The next safest insecticide was buprofezin 20 SP @ 1.6 ml l^{-1} recorded 25.13 percent mortality over precount. The safety report was in accordance with previous studies which reported that significantly higher mirid bug population was recorded in buprofezin treated plots and was safer to *C. lividipennis* [3, 4]. Similar findings on safety of insecticides on spiders were in accordance with DRR reports in which it was mentioned that newer molecule sulfoxaflor does not have any impact on spider populations in the field. It was moderately safer to the green mirid bugs [1].

Table 1: Effect of new insecticide molecules on green mirid bugs after two sprays during *kharif* 2015

Particulars of the insecticides	Number of green mirid bugs per hill									
	First Spray					Second spray				
	Precount	3 DAS *	5 DAS *	Mean *	Percent reduction over precount **	Pre count	3 DAS	5 DAS	Mean	Percent reduction over precount **
Imidacloprid 17.8 SL @ 0.25 ml l^{-1}	7.63 (2.76)	3.80 (1.95)^{c}	4.20 (2.05)^{bc}	4.00 (2.00)	47.58 (39.02)^{d}	6.10 (2.44)	5.57 (2.36)^{a}	3.77 (1.93)^{bc}	4.67 (2.16)	23.44 (27.38)^{cde}
Thiamethoxam 25 WG @ 0.2 g l^{-1}	8.13 (2.85)	5.16 (2.27)^{ab}	5.00 (2.24)^{ab}	5.08 (2.25)	37.45 (34.61)^{bcd}	5.93 (2.43)	5.73 (2.39)^{a}	4.10 (2.02)^{abc}	4.92 (2.22)	17.12 (23.39)^{bc}
Acetamiprid 20 SP @ 0.2 g l^{-1}	8.16 (2.86)	4.80 (2.19)^{bc}	4.83 (2.20)^{ab}	4.82 (2.19)	40.99 (36.21)^{bcd}	5.96 (3.14)	4.33 (2.08)^{b}	3.03 (1.74)^{c}	3.68 (1.92)	38.26 (34.98)^{f}
Sulfoxaflor 25 SC @ 0.75 ml l^{-1}	7.63 (2.76)	5.20 (2.28)^{ab}	3.10 (1.76)^{c}	4.15 (2.04)	45.61 (38.20)^{cd}	6.10 (2.44)	5.20 (2.28)^{ab}	4.86 (2.20)^{ab}	5.03 (2.24)	17.54 (23.68)^{bcd}
Dinotefuran 20 SG @ 0.4 g l^{-1}	7.87 (2.81)	5.70 (2.39)^{ab}	5.63 (2.37)^{ab}	5.67 (2.38)	27.83 (29.83)^{ab}	6.23 (2.49)	5.70 (2.39)^{a}	3.50 (1.87)^{c}	4.60 (2.14)	26.16 (28.92)^{de}
Pymetrozine 50 WG @ 0.5 g l^{-1}	7.53 (2.74)	6.57 (2.56)^{a}	5.23 (2.29)^{ab}	5.90 (2.43)	21.65 (26.30)^{a}	6.23 (2.49)	6.23 (2.50)^{a}	4.87 (2.20)^{ab}	5.47 (2.34)	12.28 (19.81)^{b}
Buprofezin 25 SC @ 1.6 ml l^{-1}	8.00 (2.83)	6.00 (2.45)^{ab}	5.00 (2.24)^{ab}	5.50 (2.35)	31.25 (31.61)^{abc}	6.50 (2.54)	6.07 (2.46)^{b}	3.03 (1.74)^{c}	5.27 (2.29)	19.00 (24.64)^{ef}
Moncrotophos+Dichlorvos 36 SL + 76 EC @ 2.2 ml l^{-1} + 1 ml l^{-1}	9.90 (3.15)	5.43 (2.33)^{ab}	5.83 (2.41)^{ab}	5.63 (2.37)	43.28 (37.21)^{cd}	5.86 (2.42)	5.03 (2.24)^{ab}	4.33 (2.08)^{abc}	4.68 (2.16)	20.14 (25.37)^{cde}
Untreated control	8.5 (2.92)	6.36 (2.52)^{a}	6.03 (2.46)^{a}	6.20 (2.49)	27.06 (29.41)^{a}	5.96 (2.44)	5.83 (2.42)^{a}	5.37 (2.31)^{a}	5.60 (2.37)	6.04 (13.89)^{a}
SEm±	0.186	0.103	0.130	0.097	2.334	0.143	0.079	0.107	0.076	1.795

Fcal	NS	Sig	Sig	Sig	Sig	NS	Sig	Sig	Sig	Sig
CD (0.05)	-	0.31	0.41	0.29	6.9	-	0.24	0.32	0.23	5.4
CV(%)	11.50	7.71	10.20	7.39	12.07	10.1	5.86	9.30	6.03	12.28

Sig – Significant NS – Non Sgnificant * 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

Table 2: Effect of new insecticide molecules on spiders after two sprays during *kharif* 2015

Particulars of the insecticides	Number of spiders per ten hills									
	First Spray					Second spray				
	Precount	3 DAS *	5 DAS *	Mean *	Percent reduction over precount **	Precount	3 DAS	5 DAS	Mean	Percent reduction over precount **
Imidacloprid 17.8 SL @ 0.25 ml l^{-1}	8.67	6.03 (2.46)^{c}	6.23 (2.50)^{c}	6.13 (2.48)	29.30 (30.60)^{c}	6.26	3.30	4.86	4.08	34.82
Thiamethoxam 25 WG @ 0.2 g l^{-1}	11.07	10.03 (3.17)^{a}	8.53 (2.92)^{ab}	9.28 (3.05)	16.17 (22.72)^{abc}	6.06	3.03	4.53	3.78	37.63
Acetamiprid 20 SP @ 0.2 g l^{-1}	9.07	6.90 (2.63)^{bc}	6.60 (2.57)^{bc}	6.75 (2.60)	25.58 (28.60)^{c}	5.60	2.93	4.60	3.77	32.77
Sulfoxaflor 25 SC @ 0.75 ml l^{-1}	10.00	8.91 (2.98)^{ab}	9.03 (3.00)^{a}	8.97 (2.91)	10.30 (18.14)^{ab}	5.70	3.06	4.63	3.85	25.59
Dinotefuran 20 SG @ 0.4 g l^{-1}	8.90	6.53 (2.56)^{bc}	7.00 (2.65)^{abc}	6.77 (2.60)	23.99 (27.69)^{bc}	5.90	3.13	5.03	4.08	30.85
Pymetrozine 50 WG @ 0.5 g l^{-1}	8.77	7.80 (2.79)^{abc}	7.07 (2.66)^{abc}	7.43 (2.73)	15.22 (22.06)^{abc}	6.00	3.93	5.00	4.47	32.55
Buprofezin 25 SC @ 1.6 ml l^{-1}	7.67	5.73 (2.39)^{c}	6.30 (2.51)^{c}	6.02 (2.45)	21.58 (26.23)^{bc}	5.80	3.73	4.36	4.05	30.26
Moncrotophos+ Dichlorvos 36 SL + 76 EC @ 2.2 ml l^{-1} + 1 ml l^{-1}	10.26	8.30 (2.88)^{abc}	8.83 (2.97)^{a}	8.57 (2.93)	16.60 (23.03)^{bc}	6.07	3.50	4.23	3.87	36.22
Untreated control	9.50	8.97 (2.99)^{ab}	8.87 (2.98)^{a}	8.92 (2.99)	6.11 (13.97)^{a}	6.20	5.03	5.86	5.45	12.75
SEm±	0.216	0.164	0.127	0.133	2.900	-	0.126	0.130	0.08	2.875
Fcal	NS	Sig	Sig	Sig	Sig	-	NS	NS	NS	NS
CD (0.05)	-	0.5	0.3	0.40	8.7	-	-	-	-	-
CV(%)	12.40	10.29	8.00	8.37	21.64	9.10	11.6	10.5	7.22	15.79

Sig – Significant NS – Non Sgnificant * 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

Table 3: Cumulative effect of new insecticide molecules on spiders and green miridbugs after two sprays during *kharif* 2015

T. No	Particulars of insecticides	Percent population reduction of spiders			Percent population reduction of green mirid bugs		
		First Spray	Second spray	Mean	First Spray	Second spray	Mean
1	Imidacloprid 17.8 SL @ 0.25 ml l^{-1}	29.30 (30.60)^{c}	34.82	32.06 (32.02)^{c}	47.58 (39.02)^{d}	23.44 (27.38)^{cde}	35.51 (33.70)^{bc}
2	Thiamethoxam 25 WG @ 0.2 g l^{-1}	16.17 (22.72)^{abc}	37.63	26.90 (29.33)^{bc}	37.45 (34.61)^{bcd}	17.12 (23.39)^{bc}	27.29 (29.54)^{b}
3	Acetamiprid 20 SP @ 0.2 g l^{-1}	25.58 (28.60)^{c}	32.77	29.18 (30.55)^{bc}	40.99 (36.21)^{bcd}	38.26 (34.98)^{f}	39.62 (35.60)^{c}
4	Sulfoxaflor 25 SC @ 0.75 ml l^{-1}	10.30 (18.14)^{ab}	25.59	20.40 (17.94)^{ab}	45.61 (38.20)^{cd}	17.54 (23.68)^{bcd}	31.58 (34.17)^{c}
5	Dinotefuran 20 SG @ 0.4 g l^{-1}	23.99 (27.69)^{bc}	30.85	27.42 (29.61)^{c}	27.83 (29.83)^{ab}	26.16 (28.92)^{de}	27.00 (29.38)^{b}
6	Pymetrozine 50 WG @ 0.5 g l^{-1}	15.22 (22.06)^{abc}	32.55	23.89 (27.63)^{bc}	21.65 (26.30)^{a}	12.28 (19.81)^{b}	16.96 (23.28)^{a}
7	Buprofezin 25 SC @ 1.6 ml l^{-1}	21.58 (26.23)^{bc}	30.26	25.92 (28.79)^{bc}	31.25 (31.61)^{abc}	19.00 (24.64)^{ef}	25.13 (28.34)^{b}
8	Moncrotophos+Dichlorvos 36 SL + 76 EC @ 2.2 ml l^{-1} + 1 ml l^{-1}	16.60 (23.03)^{bc}	36.22	26.41 (29.06)^{bc}	43.28 (37.21)^{cd}	20.14 (25.37)^{bcde}	31.71 (34.25)^{c}
9	Untreated control	6.11 (13.97)^{a}	12.75	9.14 (17.36)^{a}	27.06 (29.41)^{a}	6.04 (13.89)^{a}	16.55 (23.00)^{a}
	SEm±	2.900	2.875	1.708	2.334	1.795	1.456
	Fcal	Sig	NS	Sig	Sig	Sig	Sig
	CD (0.05)	8.7	-	5.1	6.9	5.4	4.4
	CV (%)	21.64	15.79	10.62	12.07	12.28	8.43

4. Conclusions

In present experiment, all the insecticide treatments exhibited their influence on spiders and mirids. All the insecticide treatments recorded less than 50 percent mortality and proved moderately safer to the natural enemies. So, the selection of insecticides that are highly selective to pests and exert little impact on predators is vital. Employing those new insecticides which are relatively harmless to the natural enemies reduces the pest population and increases the effectiveness of natural predation.

5. Acknowledgment

The authors are grateful to Acharya NG Ranga Agricultural University and Department of Entomology, Agricultural college, Bapatla, Andhrapradesh, India for provividing facilities and financial assistance to conduct the experiment

6. References

1. DRR Progress Report. All India Coordinated Rice Improvement Programme. Entomology and Pathology. Directorate of Rice Research. Hyderabad, India 2012; 2:2.27-2.28.
2. Duncan DB. A significance test for differences between ranked treatment means in an analysis of variance. The Virginia Journal of Science. 1951; 2:171-189.
3. Hegde M, Nidagundi JP. Effect of newer chemicals on planthoppers and the mirid predators in rice. *Karanataka* Journal of Agricultural Sciences. 2009; 22(3):511-513.
4. Heinrichs EA, Basilio RP, Valencia SL. Buprofezin, a selective insecticide for the management of rice planthoppers (Homoptera: Delphacidae) and leafhoppers (Homoptera: Cicadellidae). Environmental Entomology. 1984; 13(2):515-521.
5. Khush GS. What it will take to feed five billion rice consumers by 2030. Plant Molecular Biology. 2005; 59:1-6.
6. Lakshmi VJ, Krishnaiah NV, Katti G, Pasalu IC, Chirutkar PM. Screening of insecticides for toxicity to rice hoppers and their predators Oryza. 2010; 47(4):295-301.
7. Murali BRK, Suresh K, Rajavel DS, Palanisamy N. Field efficacy of pymetrozine 50 WG against rice brown planthopper, *Nilaparvata lugens* (Homoptera: Delphacidae) Pestology. 2009; 33(5):20-21.
8. Park DS, Song MY, Park SK, Lee SK, Lee JH. Molecular tagging of the *Bph* 1 locus for resistance to brown planthopper (*Nilaparvata lugens* Stal.) through representational divergence analysis. *Molecular Genetics and Genomics.* 2008; 280:163-172.
9. Pasalu IC, Krishnaiah NV, Katti G, Varma NRG. IPM in Rice. IPM Mitra. 2002; 45-55.
10. Yarasi B, Sadumpati V, Immanni CP, Vudem DR, Khareedu VR. Transgenic rice expressing *Allium sativum* leaf agglutinin (ASAL) exhibits high- level resistance against major sap-sucking pests. *BMC Plant Biology.* 2008; 8:102-115.