DOI: 10.15740/HAS/AU/12.TECHSEAR(4)2017/978-982 Agriculture Update
Volume 12 | TECHSEAR-4 | 2017 | 978-982
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RESEARCH ARTICLE :

Efficacy of acetamiprid against brown plant hoppers (*Nilaparvata lugens* Stal) in rice

■ RAJU K. PANSE, A.P. BHANDARKAR, S.K. RAJAK AND RISHIKESH MANDLOI

ARTICLE CHRONICLE :
Received :
11.07.2017;
Accepted :
26.07.2017

SUMMARY : The field experiments were conducted for evaluation of acetamiprid, a neonicotinoid insecticide, against brown planthopper (BPH) at experimental field, college of Agriculture, RARS,Murjhad Farm, Waraseoni, Balaghat M.P. during *Kharif*, 2015 with seven treatments replicated thrice following Randomized Block Design. Results revealed that acetamiprid performed very good spectrum of action throughout the seasons against BPH population than the imidacloprid. Acetamiprid 20% SP was found quite effective against BPH at 20 g a.i./ha and was also very safe to the important predators recorded to be present in rice field. Highest rice yield and B;C ratio were recorded with the treatment of acetamiprid at 20 g a.i./ha.The results obtained indicate that no phyto-toxicity was observed even at 4X dose of acetamiprid.

KEY WORDS :
Neonicotinoid,
Brown planthopper,
Acetamiprid

How to cite this article : Panse, Raju K., Bhandarkar, A.P., Rajak, S.K. and Mandloi, Rishikesh (2017). Efficacy of acetamiprid against brown plant hoppers (*Nilaparvata lugens* Stal) in rice. *Agric. Update*, **12** (TECHSEAR-4): 978-982; **DOI: 10.15740/HAS/AU/12.TECHSEAR (4)2017/978-982.**

Author for correspondence :
RAJU K. PANSE
Department of Entomology, JNKVV-College of Agriculture, WARASEONI (M.P.) INDIA
Email:rkpanseento@gmail.com
See end of the article for authors' affiliations

BACKGROUND AND OBJECTIVES

Rice (*Oryza sativa* L.) is the 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 (Saxena and Singh, 2003). The insect pests are a major constraint in rice production. Yield loss due to insect pests of rice ranges from 25 to 51 per cent (Panda and Rath, 2003). Pathak and Dhaliwal (1981) considered 20 species of major significance out of 100 species damaging rice. Of pests, the brown planthopper, *Nilaparvata lugens* (Stål) (Homoptera: Delphacidae), is an economically important insect of rice in Asia (Heinrich and Mochida, 1984). *N. lugens* damages growing plants by sucking sap directly and the affected plants become chlorotic and the leaves dry up gradually, resulting in the death of plants. This feeding damage is commonly referred as 'hopper burn', which begins in patches, but spreads rapidly as the hoppers move from dying plants to adjacent plants. In addition to direct feeding damage, *N. lugens* also serves as the vector of rice grassy stunt virus and rice ragged stunt virus (Ling, 1977). Outbreak of this pest often leads to total loss of the rice crop, if no effective control measures were taken up. Currently, chemical control is still a major method for suppressing *N. lugens* (Endo *et al.*, 1988). Since the introduction of DDT, *N. lugens* has developed resistance to almost every insecticide introduced for *N. lugens* control. Each newly introduced chemical provided effective control of *N. lugens* at first, then became less effective years later. New chemicals have frequent chemical control failures (Kilin *et al.*, 1981; Chung and Sun, 1983 and Hirai, 1993). Neonicotinoid insecticides, including imidacloprid, thiomethoxam, dinotefuran, nitenpyram, Acetamiprid, thiacloprid, and imidaclothiz, are a well-established group of insecticides (Jeschke and Nauen, 2005). Many of these chemicals are still highly effective against most field populations of *N. lugens* (Tang *et al.*, 2006). Acetamiprid was registered for controlling *N. lugens* on rice in the early 1990s. It quickly became the primary insecticide in many rice-growing areas in India because of its systemic nature and high efficacy against sucking insects (Sun *et al.*, 1996). The application dose has had to be increased from 15 g a.i./ ha in the 1990s to 60–120 g a.i./ha in 2005 in order to maintain effective control. Therefore, the present study was conducted to assess the relative toxicity of Acetamiprid under different doses againstbrown plant hopper population.

RESOURCES AND METHODS

Field experiment on the evaluation of Acetamiprid 20% SP for BPH was conducted at experimental field, college of Agriculture, RARS,Murjhad Farm, Waraseoni, Balaghat,M.P. during *Kharif*, 2015 with seven treatments replicated thrice following Randomized Block Design. Seven treatments contained fivedifferent doses of Acetamiprid 20% SP at 10, 20, 30, 40 and 80 g ai./ha, imidacloprid 17.85 SL25 mla.i./ha along with an untreated check. The crop was raised in plots (60 m^2) following recommended package of practices and maintaining a spacing of 20 × 15 cm which was left for natural infestation of desired pest. Two successive sprays of selected insecticides were conducted with pneumatic knapsack sprayer at 15 days interval. Spray volume was used at the rate of 500 L/ha. Visual sampling method was found to be most fitting for counting the brown planthopper population in the experiment. Five hills across the plot were randomly selected and hit several times with hands to take the count of nymphs and adults that fall on the standing water. Observation was taken at one day before and on one, five, seven and 15 days after each spray. The various natural enemies found to be associated with BPH in the field condition among, the wolf spider, *Pardosa pseudoannulata* was noted to be predominant in the plots. Mean population of spiders per hill up to 15 days was recorded after each spray and number of brown planthopper/spider was calculated due to the greater potentiality of spider to suppress the population of BPH in the field condition. Population of spider was observed to vary with the population of BPH. An observation for phytotoxicity parameters like chlorosis, necrosis, wilting, scorching, hyponasty and epinasty was taken 1, 3, 5, 7 and 10 days after first application only. For phytotoxicity parameters noted by using 0-10 scale *i.e.* 0= no phytotoxicity, 1= 1-10%, 2=11-20%, 3=21-30%, 4=31-40%, 5=41-50%, 6=51-60%, 7=61-70%, 8=71-80%, 9=81-90% and 10=91-100%. Necessary statistical transformation and calculation has been followed accordingly.

OBSERVATIONS AND ANALYSIS

Insecticides were tested under field condition on thebasis of number of BPH per hill, changes in the population of natural enemies and finally the yield. It is clear from the result (Table 1) that the, brown planthopper population did not vary significantly among the treatments before the application of insecticides. At 1 day after spraying the acetamiprid 20% SPat 20a.i./ha recorded lowest number of BPH per hill followed by acetamiprid 20% SP at 30a.i./ha. Upto 15 days after 1st spray acetamiprid at 20 g ai./ha maintained the population of brown planthopper under normal limit. Same trend was noticed after 2nd spray also. Population of brown planthopper considerably reduced after 1 day of spraying and continued even after 7 days. Further next better treatments were observed as acetamiprid at Lowest population was recorded in acetamiprid at 40 and 80 g a.i./ha which are statistically at par throughout the observation. Acetamipridat 20 and 30 g a.i./ha were recorded as the best treatments over other doses of acetamiprid and imidacloprid.

Effect of insecticides on spider associated with brown planthopper :

Population of natural enemies was found to be moderate to good in both seasons. Wolf spider was more abundant. Population of wolf spider was found to be highly dependent on the availability of brown planthopper for preying. This is known as the density dependent nature of Wolf spider. Number of Wolf spider was higher with more availability of panthopper and *vice-versa* in untreated plots.

It is evident from the Table 2 that mean number of Wolf spider per hill after 15 days of first spray was comparatively low in all insecticide treated plots than the untreated control. A predator favorable low BPH and

Table 1 : Relative efficacy of different treatment of acetamiprid 20% SP against BPH

Treatments	Formulation (ml or g/ha)	ADBS (BPH/hill)	Number of BPH/hill								Over all mean BPH/hill	Per cent reduction over control
			1^{st} Spray				2^{nd} Spray					
			1 DAS	5 DAS	7 DAS	15DAS	1 DAS	5 DAS	7 DAS	15 DAS		
T_1- ACETAMIPRID	10	14.30	9.93	3.33	4.73	10.26	3.50	1.72	4.21	5.38	5.38	61.56
20% SP		(3.84)	(3.22)	(1.95)	(2.29)	(3.28)	(2.00)	(1.49)	(2.17)	(2.42)	(2.42)	
T_2- ACETAMIPRID	20	11.10	8.33	3.13	4.40	7.55	2.33	1.23	2.12	4.37	4.18	74.98
20% SP		(3.40)	(2.97)	(1.90)	(2.21)	(2.84)	(1.68)	(1.32)	(1.62)	(2.21)	(2.16)	
T_3- ACETAMIPRID	30	12.57	10.53	4.70	5.40	10.27	4.03	2.00	4.54	8.12	6.19	71.54
20% SP		(3.61)	(3.32)	(2.28)	(2.43)	(3.28)	(2.13)	(1.58)	(2.24)	(2.94)	(2.59)	
T_4- ACETAMIPRID	40	14.10	10.13	3.63	5.23	9.15	3.90	2.33	2.82	7.25	5.55	69.60
20% SP		(3.82)	(3.26)	(2.03)	(2.39)	(3.11)	(2.10)	(1.68)	(1.82)	(2.78)	(2.46)	
T_5-ACETAMIPRID	80	11.83	11.03	4.97	6.10	11.42	4.53	2.80	5.21	9.01	6.88	68.71
20% SP		(3.51)	(3.39)	(2.33)	(2.57)	(3.45)	(2.24)	(1.82)	(2.39)	(3.08)	(2.72)	
T_6-MIDACLOPRID	25	12.00	12.23	6.30	7.87	11.65	7.70	4.83	7.70	8.19	8.30	55.51
17.8 SL		(3.53)	(3.56)	(2.60)	(2.89)	(3.49)	(2.86)	(2.31)	(2.86)	(2.95)	(2.97)	
T_7-Control	-	12.17	14.55	14.87	15.01	18.14	18.50	20.53	19.48	23.15	18.02	-
		(3.55)	(3.87)	(3.92)	(3.94)	(4.32)	(4.36)	(4.59)	(4.47)	(4.86)	(4.30)	
C.D. (P=0.05)		NS	0.85	1.17	1.14	0.98	1.44	1.86	1.34	1.51	1.17	-

ADBS= A day before spray, BPH= Brown plant hopper, *Data in parentheses are square root x+0.5 transformed values.*

Table 2: Effect of insecticides on natural enemies associated with *Nilaparvata lugens*

Treatments	Dose a.i. ml or g/ha	Pretreatment		15 days after 1^{st} spray		15 days after 1^{st} spray	
		BPH/hill	Spider/hill	BPH/hill	Spider/hill	BPH/hill	Spider/hill
T_1- ACETAMIPRID 20% SP	10	14.30 (3.84)	3.81 (1.95)	10.26 (3.28)	3.00 (1.87)	5.38 (2.42)	3.33 (1.96)
T_2- ACETAMIPRID 20% SP	20	11.10 (3.40)	3.90 (1.97)	7.55 (2.84)	3.00 (1.87)	4.37 (2.21)	3.00 (1.87)
T_3- ACETAMIPRID 20% SP	30	12.57 (3.61)	3.68 (1.92)	10.27 (3.28)	2.67 (1.78)	8.12 (2.94)	3.00 (1.87)
T_4- ACETAMIPRID 20% SP	40	14.10 (3.82)	3.46 (1.86)	9.15 (3.11)	2.67 (1.78)	7.25 (2.78)	2.67 (1.78)
T_5ACETAMIPRID 20% SP	80	11.83 (3.51)	3.61 (1.90)	11.42 (3.45)	3.67 (2.04)	9.01 (3.08)	3.00 (1.87)
T_6-IMIDACLOPRID 17.8 SL	25	12.00 (3.53)	3.54 (1.98)	11.65 (3.49)	4.00 (2.12)	8.19 (2.95)	3.67 (2.04)
T_7-Control	-	12.17 (3.55)	4.35 (2.09)	18.14 (4.32)	4.00 (2.12)	23.15 (4.86)	3.67 (2.04)

Table 3 : Yield and economics under different doses of acetamiprid

Treatments	Dose a.i./ha (g/ml)	Yield (q/ha)	% increase in yield over control	B:C ratio
T_1- ACETAMIPRID 20% SP	10	34.02	58.23	1:2.23
T_2- ACETAMIPRID 20% SP	20	37.42	74.04	1:4.26
T_3- ACETAMIPRID 20% SP	30	36.58	70.13	1:3.98
T_4- ACETAMIPRID 20% SP	40	34.89	62.27	1:2.82
T_5ACETAMIPRID 20% SP	80	33.00	53.48	1:1.01
T_6-IMIDACLOPRID 17.8 SL	25	34.20	59.06	1:2.16
T_7-Control	-	32.15	49.53	1:0.89

Wolf spider ratio was maintained in case of acetamiprid treated plots that implied its safety to Wolf spider. Same trend was noticed after 2nd spray also.

In our overall findings, we found that acetamiprid performed very good spectrum of action throughout the seasons against BPH population than the imidacloprid. Acetamiprid showed quick knock down in action and restrained to build up the population of BPH upto harvesting stage. Neonicotinoid insecticides belong to a new insecticide class which act as competitive inhibitor of nicotinic acetylcholine receptors in the central nervous system. Their systemic property and long residual activity make them ideal insecticides against sucking pests. In the present study, acetamiprid was found to be quite safe to Wolf spider. In all observations favourable ratio of BPH and Wolf spider was noted after acetamiprid treatments which indicated that these insecticides were safe to the population of Wolf spider. Spider population did not exhibit appreciable differences among the treatments in the experiment, corroborated by Krishnaiah *et al.* (2003) and Vijayaraghavan and Regupathy (2006).

Acetamiprid 20% SP at 20 and 30 g a.i./ harecorded the highest yields of 37.42 and 36.58 q/ ha, respectively and were on par with each other (Table 3). These results are in agreement with Varma *et al.* (2003). Bhavani and Rao (2005) reported thetreatments which also recorded higher yields wereThiomethoxam (0.025 kg a.i./ha) (4.98 t/ha), Thiacloprid (0.12kg a.i./ha) (4.75 t/ha), Acetamiprid (0.020 kg a.i./ha) (4.52 t/ha)and Clothianidin (0.015 kg a.i./ha) (4.48 t/ha).Selective, need based applications with these newer insecticides molecules would accrue economicand sustainable rice yields to the farmers. The increased yields over control were found to be 74.04 and 70.13% in acetamiprid at 20 and 30 g a.i./ha, respectively. The maximum incremental cost benefit ratio of 1: 4.26 was achieved in acetamiprid at 20 g a.i./ha treatment. This was followed by acetamiprid at 30 g a.i./ha.

Phyto-toxicity:

Acetamiprid 20% SP was evaluated for its phyto-toxicty to rice plants by employing at 20 g a.i./ha (X), 40 g a.i./ha (2X) and 80 g a.i./ha (4X) dose levels diluting in 500 litre water per hectare. The results obtained indicate that no phyto-toxicity was observed even at 4X dose. Thus, the product has been found to safe to the rice crop.

Acknowledgement:

The authors are grateful to Beijing lucky star chemicals (India)private limited, Baroda, Gujarat for financial support.

Authors' affiliations :

A.P. BHANDARKAR, S.K. RAJAK AND RISHIKESH MANDLOI, Department of Entomology, JNKVV-College of Agriculture, WARASEONI (M.P.) INDIA

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