



Bio-efficacy of Imidacloprid 17.8%, a Novel Insecticide Against Rice Planthoppers (BPH & WBPH) and its Natural Enemies

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ABSTRACT

Imidacloprid 17.8%SL, a novel insecticide formulation at five concentrations viz., 10g.a.i/ha, 15g.a.i/ha, 20g.a.i/ha, 25g.a.i/ha and 30g.a.i/ha in comparison with monocrotophos 36SC were field evaluated against mixed population of planthoppers viz., brown planthopper (*Nilaparvata lugens* Stal.) and white-backed planthopper (*Sogatella furcifera* Horvath) in rice under irrigated conditions. The results indicated that the test product, imidacloprid 17.8%SL at four concentrations viz., @15, 20, 25 and 30g.a.i/ha were more effective and significantly superior in efficacy as compared to the check insecticide, monocrotophos 36SL @ 500g.a.i/ha. It also indicates that imidacloprid 17.8%SL is specific to target pest and eco-friendly to natural enemies viz., spiders and mirid bugs. The present studies conclude that the management of rice planthoppers through imidacloprid 17.8 %SL @ 20g.a.i /ha can be recommended as economical as well as eco-friendly.

Key words : Bioefficacy, Mirid Bugs, Rice Planthoppers (BPH/WBPH), Spiders

Rice is the most important host plant of brown planthopper (*Nilaparvata lugens* Stal.) and white-backed planthopper (*Sogatella furcifera* Horvath) rose from the status of a secondary pest to major field constraint beginning in the 1960s. In India, losses due to planthoppers in 1976-77 were estimated at 365,000 metric tonnes of milled rice equivalent to the annual consumption of 3 million people (Dyck and Thomas, 1979). In Krishna-Godavari delta system, widespread planting of high yielding varieties, increased use of nitrogen containing fertilizers, increased use of insecticides, rapid expansion of irrigation systems and inadequate weed control are major factors known to contribute to the outbreaks of planthoppers. Farming community without sufficient knowledge, indiscriminately applying many insecticides at sub-lethal rates, which cause planthopper resurgence. Although many attempts were made to evaluate insecticides against rice insect pests (Krishnaiah and Kalode, 1986; Reddy *et al.*, 1987; Krishnaiah and Kalode 1993), efforts should be continued to generate information on the efficacy of newer insecticides against the insect pest complex in rice under field conditions, have wider choice of insecticides to rice farmers. At present, the focus on insecticides evaluation has been shifted from traditional Organo-phosphates and Carbamates to new groups of insecticides like neonicotinoids and phenyl -pyrazoles, which are more pests specific and better suited as components of integrated pest

management. Taking into consideration the economic importance of rice crop, a systemic insecticide formulation, Imidacloprid 17.8% produced by M/s Cheminova India Limited, Mumbai was evaluated for its bio-efficacy against planthoppers (BPH and WBPH) and safety towards natural enemies in irrigated rice ecosystem.

MATERIAL AND METHODS

A field experiment was laid out in randomised block design at Agricultural Research Station, Maruteru during *kharif* and *rabi* seasons, 2000-2001 to evaluate the efficacy of imidacloprid 17.8% at different concentrations (10g.a.i/ha, 15g.a.i/ha, 20g.a.i/ha, 25g.a.i/ha and 30g.a.i/ha) in comparison with the standard check, monocrotophos 36SL@ 500g.a.i/ha for the management of mixed population of planthoppers (BPH/WBPH) and safety to natural enemies in irrigated rice ecosystem. The paddy crop was raised by following all the normal agronomic practices and the net plot size was 4.5 X 3.6 m² with a spacing of 20 X 15 cm and 15 X 15cm during *kharif* and *rabi* seasons, respectively. Based on ETL's of pest population, two sprayings were given. The observations on the incidence of planthoppers as well as natural enemies (spiders/mirid bugs) were recorded from 40 randomly selected hills per plot at 70 DAT and 85 DAT as per stratified random sampling method. The data on grain yield from each plot were also recorded. The data of two seasons were statistically analysed after suitable

transformations and presented in Table 1, 2 and 3. The per cent mortality of planthoppers was arrived from the mean population of BPH and WBPH in comparison to untreated control and presented in Table 1 and Fig 2. Mean populations of natural enemies viz., spiders and mirid bugs are presented in Table 2 and Fig 1. Pest-defender ratio at different dosages of test was calculated and presented in Table 3.

RESULTS AND DISCUSSION

Mixed population of planthoppers (BPH/WBPH)

Perusal of data presented in Table 1 revealed that imidacloprid 17.8%SL @ 15, 20, 25 and 30 g.a.i/ha (T2-T5) were more effective and significantly superior in efficacy over other treatments in checking the mixed population of planthoppers (Fig 1). In efficacy and effectiveness, imidacloprid 17.8%SL @ 15g.a.i/ha (T2) to 30g.a.i/ha (T5) were statistically on par with each other treatment. On an average a mortality of 84.5%, 87%, 89% and 90.5% were recorded in T2, T3, T4 and T5 respectively, as against 35.45% of mortality in standard check, monocrotophos 36SL (Fig 2). From economic point of view, imidacloprid 17.8%SL @ 20 g.a.i/ha can be recommended for all practical purposes. High degree of efficacy of imidacloprid against planthoppers was observed in Peoples Republic of China (Mao Lixin and Liang Tianxi, 1995). Similar trends regarding the efficacy of imidacloprid against rice planthoppers were also observed in All India Coordinated Trials (Anonymous, 1998, 1999 and 2001). Krishnaiah *et al*, 2003 reported that imidacloprid @ 25 g a.i./ha exhibited high degree of efficacy against brown planthoppers without hampering the predatory efficiency of mirid bugs under practical field situations by showing favourable pest predator ratios comparable to untreated control.

Natural enemies

Spiders

Mean population of spiders presented in Table 2 revealed that lowest population recorded in imidacloprid 17.8% SL@ 25g.a.i/ha (73.63/40hills) followed by imidacloprid 17.8%SL @ 20g.ai/ha (75.13/40hills), imidacloprid 17.8% SL @ 15g.ai/ha (78.25/40hills) and imidacloprid 17.8%SL @ 30g.ai/ha (79.75/40 hills) as compared to monocrotophos 36SL (85.87/40 hills) and untreated control (115.38 /40 hills). Data in Table 3 indicated that lack of sufficient BPH and WBPH populations in imidacloprid treated plots might have affected spider populations

rather than the direct toxicity of the insecticide to spiders (Fig 1). Taking into cognizance the ratio between planthoppers and spiders showed high Pest-defender ratio in T5 (1:1.46), T4 (1:1.12) and T3 (1:1.10) treatments as against untreated control (1:0.159) (Fig 1).

Mirid bugs

Mean population of mirid bugs presented in Table 2 revealed that lowest population recorded in imidacloprid 17.8% SL@ 30g.a.i/ha treated plots (57.88/40hills) followed by imidacloprid 17.8%SL @ 25g.ai/ha (59.63/40 hills), imidacloprid 17.8%SL @ 20g.a.i/ha (61.50/40 hills) and imidacloprid 17.8%SL @ 15g.ai/ha (70.25/40 hills) as compared to monocrotophos 36SL (109.5/40 hills) and untreated control (193.5/40 hills). These results are in conformity with the results of All India Coordinated trials (Anonymous, 1998 and 1999) which stated that mirid bug is only passive dependent on BPH and WBPH population and not an active predator having the capacity to check planthopper populations under practical field conditions. Relatively more toxicity of imidacloprid to green mirid bug has already been reported under green house conditions (Jhansilaxmi *et al* 2001a and b). Whereas the ratio between planthoppers and mirid bugs (Pest-defender ratio) showed more population of mirid bugs in imidacloprid 17.8%SL @ 30g.ai/ha (1:1.06) followed by 1:0.91 in imidacloprid 17.8%SL @ 25g.ai/ha and 1:0.82 in imidacloprid 17.8%SL @ 20g.ai/ha as against 1:0.27 in untreated control (Table 3). However imidacloprid showed favourable pest defender ratio (P: D) comparable to untreated control. This implies that the insecticide did not hamper the predatory efficiency of mirid bugs under practical situation (Fig 1). The present findings are in agreement with Krishnaiah *et al*, 2003 and RamGopal Varma *et al.*, 2003.

As the dosage increases, the population of spiders and mirid bugs were on increasing note based on P: D ratios (Table 3). In other words, imidacloprid 17.8%SL at all dosages of test was more or less safer to natural enemies. It also indicates that imidacloprid 17.8%SL is specific to target pest and eco-friendly to natural enemies.

Phytotoxicity

Imidacloprid 17.8SL at the doses of 10g.a.i/ha (T1) to 30g.a.i/ha (T5) did not exhibit any visual symptoms of phytotoxicity of what so ever on the foliage of rice crop during the crop growth.

Table 1. Bioefficacy of 'Imidacloprid 17.8%' against planthoppers (pooled data)

Sno	Treatments	Rate g.a.i/ha	Planthoppers/40hills*		Mean population of Planthoppers/ 40hills	% Mortality		Mean %mortality	Grain yield (kg/ha)
			70 DAT	8 DAT		70 DAT	85 DAT		
T ₁	IMIDACLOPRID 17.8% SL	10	112.75(10.43)	183.25(13.41)	148.00	71	83	77.00	4194
T ₂	IMIDACLOPRID 17.8% SL	15	88.00(9.31)	84.00(9.03)	86.00	77	92	84.50	4380
T ₃	IMIDACLOPRID 17.8% SL	20	73.25(8.51)	76.50(8.72)	74.88	81	93	87.00	4387
T ₄	IMIDACLOPRID 17.8% SL	25	60.00(7.57)	71.25(8.29)	65.63	85	93	89.00	4544
T ₅	IMIDACLOPRID 17.8% SL	30	56.25(7.37)	52.50(7.21)	54.38	86	95	90.50	4603
T ₆	IMIDACLOPRID 17.8% SL	500	382.25(19.04)	286.75(16.57)	334.5	2	73	37.56	4219
T ₇	UNTREATED CONTROL	-	390.50(19.26)	1054.25(31.17)	722.38	-	-	-	2861
	F' test		Sig	Sig					Sig
	CD at 5% level		8.84	4.45					742

* Square root transformations Figures in parentheses are transformed values Sig = Significant

Table 2. Effect of 'IMIDACLOPRID 17.8%SL' against natural enemies in irrigated rice ecosystem (pooled data)

Sno	Treatments	Rate g.a.i/ha	Natural enemies/40hills*					
			Spiders/40hills		Mean	Mirid bugs/40 hills		Mean %Mortality
			70 DAT	85 DAT		70 DAT	85 DAT	
T ₁	IMIDACLOPRID 17.8% SL	10	57.50 (7.54)	117.75 (10.81)	87.63	42.50 (6.45)	131.00 (11.37)	86.75
T ₂	IMIDACLOPRID 17.8% SL	15	56.50 (7.52)	100.00 (9.94)	78.25	30.25 (5.34)	110.25 (10.47)	70.25
T ₃	IMIDACLOPRID 17.8% SL	20	51.25 (7.12)	99.00 (9.88)	75.13	21.75 (4.27)	101.25 (9.87)	61.50
T ₄	IMIDACLOPRID 17.8% SL	25	53.75 (7.17)	93.50 (9.42)	73.63	20.25 (4.45)	99.00 (9.79)	59.63
T ₅	IMIDACLOPRID 17.8% SL	30	58.25 (7.59)	101.25 (10.06)	79.75	20.25 (4.24)	95.50 (9.77)	57.88
T ₆	IMIDACLOPRID 17.8% SL	500	64.24 (7.98)	107.50 (10.26)	85.87	50.00 (7.09)	169.00 (12.86)	109.50
T ₇	UNTREATED CONTROL	-	84.25 (9.10)	146.50 (12.08)	115.38	51.75 (7.21)	335.25 (17.93)	193.50
	F' test		Sig	sig		sig	sig	
	CD at 5% level		1.42	1.27		1.88	2.39	

* Square root transformations Figures in parentheses are transformed values Sig = Significant

Table 3. Effect of Imidacloprid 17.8% SL on planthoppers vis-a-vis Natural Enemies

Treatments	Rate g.a.i/ha	Mean population of planthoppers / 40 Hills	Mean population of natural enemies/ 40 hills		Pest-defender ratio(P:D)	
			Spiders	Mirid bugs	PH:Spiders	PH:Mirid bugs
IMIDACLOPRID 17.8% SL	10	148.00	87.63	86.75	1:0.59	1:0.59
IMIDACLOPRID 17.8% SL	15	86.00	78.25	70.25	1:0.91	1:0.82
IMIDACLOPRID 17.8% SL	20	75.13	75.13	61.50	1:1.00	1:0.52
IMIDACLOPRID 17.8% SL	25	65.63	73.63	59.63	1:1.12	1:0.91
IMIDACLOPRID 17.8% SL	30	54.38	79.75	57.88	1:1.46	1:1.06
IMIDACLOPRID 17.8% SL	500	642.75	85.87	109.50	1:0.25	1:0.32
UNTREATED CONTROL	-	722.38	115.38	193.50	1:0.15	1:0.27

PH: Planthoppers

Fig 1. Efficacy of Imidacloprid 17.8 SL against planthoppers *vis-a-vis* natural enemies in rice.

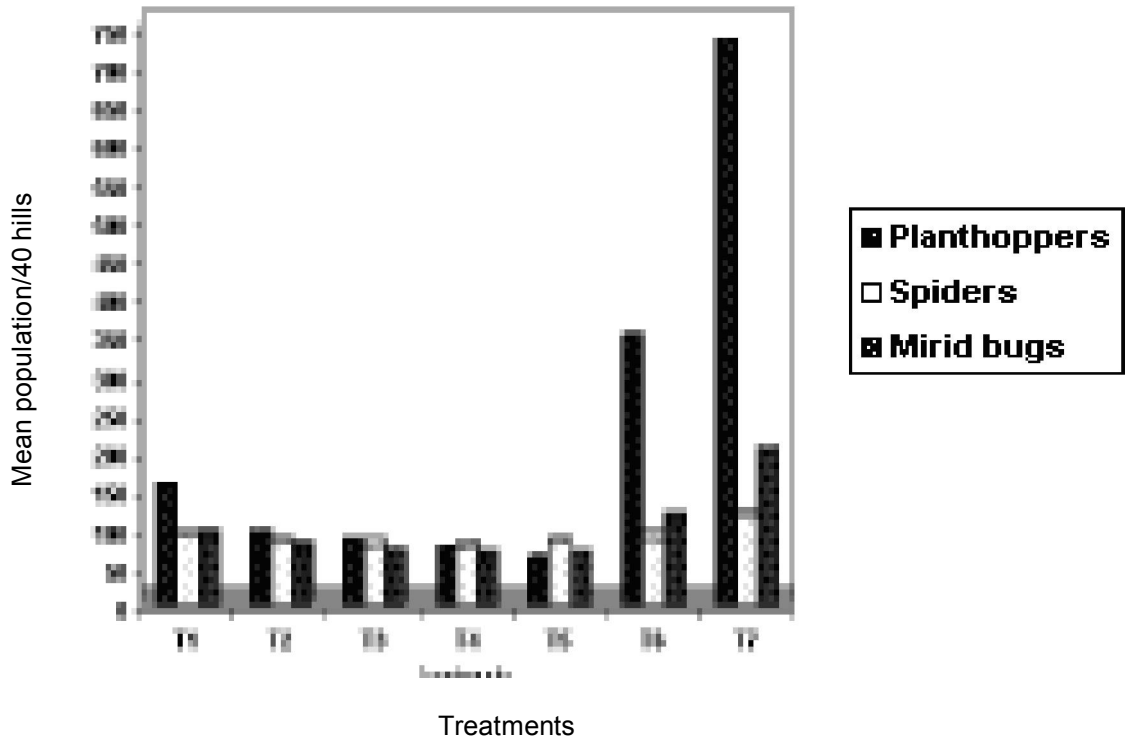
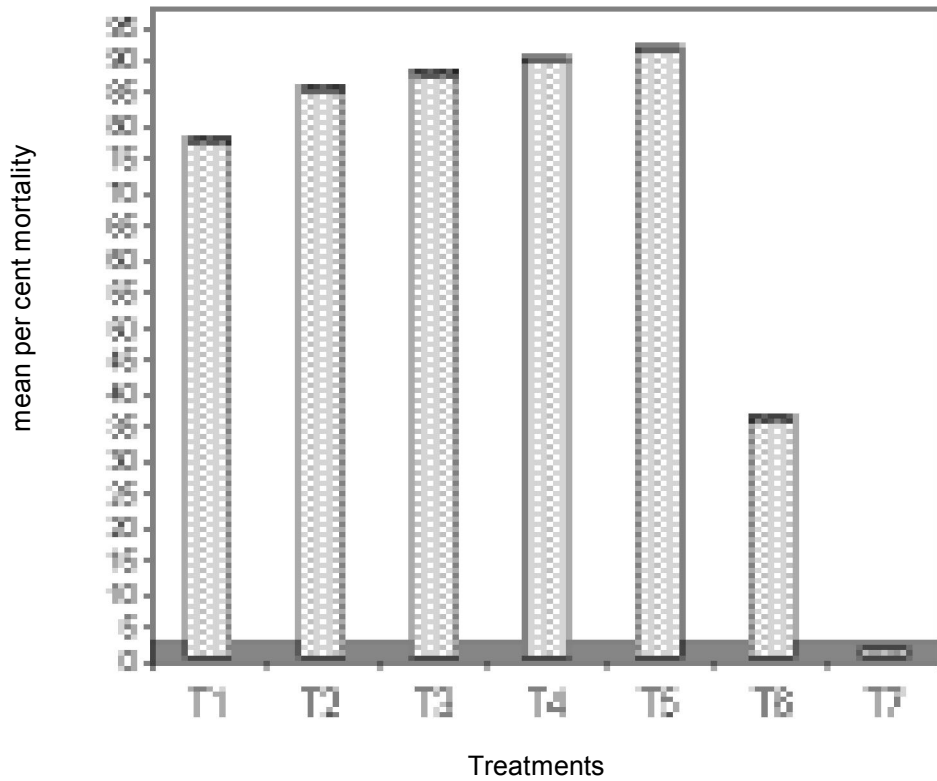


Fig 2. Efficacy of Imidacloprid 17.8 SL on mean per cent mortality of planthoppers in rice.



Grain yield

The data presented in Table 1 revealed that highest mean grain yield of 4603kg/ha was recorded in imidacloprid 17.8%SL 30g.a.i/ha (T5) as against 2861kg/ha recorded in untreated control (T7). A mean grain yields of 4194kg/ha to 4603 kg/ha was recorded in different treatments (T2-T5), which were statistically on par and significantly differ from the untreated control.

Imidacloprid 17.8%SL @15,20,25 and 30g.a.i/ha were more effective and significantly superior in efficacy in suppressing the mixed population of planthoppers (both BPH and WBPH). Imidacloprid 17.8%SL at all dosages of test was more or less safe to natural enemies viz., spiders and mirid bugs. A grain yield of 4194kg/ha to 4603kg/ha was recorded in different dosages of imidacloprid 17.8SL @10g.a.i/ha to 30g.a.i/ha (T1-T5), which were statistically on par and significantly differ from the untreated control (2861kg/ha). Considering the safety, environmental friendly nature of insecticide, per cent mortality of planthoppers and grain yield, imidacloprid 17.8SL @ 20g.a.i/ha can be recommended for the economic and ecofriendly management of planthoppers in rice.

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