The Bioscan 12(1): 313-316, 2017 (Supplement on Agronomy)
www.thebioscan.com

EFFICACY OF CERTAIN NEWER INSECTICIDES AGAINST YELLOW STEM BORER, *SCIRPOPHAGA INCERTULAS* (WALKER) IN PADDY

PINJARI FAKRUDDIN[1], ARDHENDU CHAKRABORTY[2]* AND SAMIK CHOWDHURY[3]
[1]International Crops Research Institute for the Semi-Arid Tropics, Patancheru, Telangana - 502 324
[2]Krishi Vigyan Kendra, Khowai, Chebri, Tripura - 799 207
[3]Indian Council of Agricultural Research, North Eastern Hill Region, Kolashib, Mizoram - 796 081
e-mail: imardhendu@gmail.com

KEYWORDS
Bioefficacy
Yellow stem borer
Insecticides

Received on :
05.11.2016

Accepted on :
04.02.2017

***Corresponding author**

ABSTRACT
A supervised field experiment was conducted to evaluate the impact of newer insecticides against yellow stem borer in paddy. All the treatments tested in this experiment had the comparable lower number of dead hearts and white ears than un-treated control. It was found that cartap hydrochloride 4 G at 700g a.i./ha recorded a low overall mean (6.86% dead heart and 6.85% white ear) and was the best treatment followed by indoxacarb 15.8 EC at 60g a.i./ha (7.00% dead heart and 6.98% white ear) compared to the untreated check (11.43% and 12.51%). The order of efficacy was cartap hydrochloride 4 G at 700g a.i./ha ≥ indoxacarb 15.8 EC at 60g a.i./ha > carbosulfan 25 EC at 350g a.i./ha > cartap hydrochloride 50 SP at 50g a.i./ha > fipronil 5 SC at 50g a.i./ha > phosphamidon 40 SL at 500g a.i./ha > flubendiamide 20 WG at 125g a.i./ha > emamectin benzoate 5 SG at 11g a.i./ha > buprofezin 25 SC at 200g a.i./ha. The grain yield (5625.22 kg/ha) and benefit cost ratio (1: 2.34) were higher in the treatment with cartap hydrochloride 4 G at 700g a.i./ha compared to the untreated check (3428.56 kg/ha).

INTRODUCTION

Rice (*Oryza sativa* L.) is the world's second most important crop and is consumed by more than 60 per cent of the world population. It is grown on over 145 million hectares in more than 110 countries. India is the largest rice growing country, it accounts for more than 40 per cent of food grain production (Sekh *et al.*, 2007). The rice crop is subjected to sustain a considerable damage by a number of insect pests, among them yellow stem borer, *Scirpophaga incerulas* (Walk.) is the principle devastators, which is responsible for economic crop losses under local conditions (Kumar *et al.*, 2012). This insect attacks the crop from the seedling stage to the harvesting stage and thus causes complete loss of affected tillers. Dead hearts are produced when the insect attacks at vegetative stage while white heads occur when the stem borer attack at time of heading.

Management of the stem borer in rice involved application of pesticides, varietal resistance and use of natural enemies (Khan *et al.*, 2010). While, agriculture uses 52 per cent of total insecticides in India, rice crop alone accounts for 17 per cent of it. About 50 per cent of Indian rice farmers use old group of insecticides ranging from one to six applications per crop against stem borers, brown planthoppers, white backed planthoppers and leaf folder (Shepard *et al.*, 1993). Indiscriminate use of conventional insecticides have resulted in a number of undesirable side effects such as the emergence of resistance species of insects, environmental pollution and hazards to farmers (Hassall, 1990).

In the advent of newer group of insecticides, newer insecticides with novel mode of action are used to control the yellow stem borer, *S. incertulas* and achieved successful control. Keeping in view the importance of rice crop and the management of yellow stem borer with certain newer insecticides, the present study was undertaken and results thus obtained are presented herein.

MATERIALS AND METHODS

A field trial was conducted to study the impact of newer insecticides against the yellow stem borer *S. incertulas* during *Rabi* 2013 at the Eastern farm of PAJANCOA and RI, Karaikal. The experiment was laid out in a Randomized Block Design (RBD) with ten treatments replicated thrice. The treatments were T1 Cartap hydrochloride 4G @ 700 g a.i./ha, T2 Carbosulfan 25 EC @ 350 g a.i./ha, T3 Fipronil 5 SC @ 50 g a.i./ha, T4 Flubendiamide 20 WG @ 125 g a.i./ha, T5 Cartap hydrochloride 50 SP @ 50 g a.i./ha, T6 Indoxacarb 15.8 EC @ 60 g a.i./ha, T7 Emamectin benzoate 5 SG @ 11 g a.i./ha, T8 Buprofezin 25 SC @ 200 g a.i./ha, T9 Phosphamidon 40 SL @ 500 g a.i./ha, T10 Untreated check. The ruling rice variety ADT 39 was transplanted in 7 × 3 square meter plots with a spacing of 20 × 15 cm.

The recommended dose of fertilizer of 120:40:40 kg / ha as N: P_2O_5: K_2O, respectively was applied. About 25 per cent N and K_2O, 100 per cent, P_2O_5 was applied as basal and remaining amount of N and K_2O was applied in three equal split doses at tillering, panicle initiation and flowering stages.

The observations on dead heart and white ear were recorded from 40 DAS and continued up to 60 DAS. Two foliar applications were given with high volume sprayer after the pest reached ETL.

Observations on pest occurrence were recorded prior to the treatment and after imposing the treatment. Post treatment observations were recorded at 1, 3, 5, 7, 10, 12 and 14 days after spraying.

Assessment of the yellow stem borer, S. incertulas

Assessment of dead heart and white ears damage symptom caused by the yellow stem borer, *S. incertulas* was made on ten randomly selected plants per plot and the damage was worked out as below:

$$\text{Percent dead hearts} = \frac{\text{Number of damaged tillers}}{\text{Total nuber of tillers}} \times 100$$

$$\text{Percent white ears} = \frac{\text{Number of damaged productive tillers}}{\text{Total number of productive tillers}} \times 100$$

(Heinrichs *et al.*, 1985)

To assess the performance of treatments per cent reduction over control was worked out with the following formula.

$$\text{Percent reduction over control} = \frac{\text{Untreated check - Treatment}}{\text{Untreated check}} \times 100$$

Grain yield/plot was also recorded at harvest and it was converted in to quintal / ha. for analysis and comparison. The economics of each treatment was also worked out on the basis of cost benefit ratio.

The data obtained from the field experiments were analysed in a Randomized Block Design by 'F' test for significance as described by Panse and Sukhatme (1958). Critical difference values were calculated at 5% probability level and the treatment mean values of the experiment were compared using Duncan's Multiple Range Test (DMRT) (Gomez and Gomez, 1984).

RESULTS

Management of stem borer

The results on the effect of newer insecticides against the yellow stem borer, *S. incertulas* on the rice variety, ADT 39 during *Rabi* 2013 are presented in Table 1. The damage by the yellow stem borer, *S. incertulas* was observed from 40 days after sowing (DAS) and continued up to 95 DAS. Before the first foliar and soil application, the dead heart damage ranged from 10.35 to 11.74 per cent/hill and there was no significant difference among the treatments.

At 1 day after treatment (DAT), the dead heart damage ranged from 6.58 to 10.91 per cent/hill. Among the treatments, cartap hydrochloride 4 G at 700 g a.i./ha recorded the lowest dead heart damage of 6.58 per cent/hill and was on par with indoxacarb 15.8 EC (6.74 %), followed by carbosulfan 25 EC at 350 g a.i./ha (7.41%) compared to the untreated check which recorded the highest per cent damage of 10.91 per cent. It was found that all the insecticidal treatments were superior than the untreated check. Similar trend was observed upto 5 DAT. A decline in dead heart damage was observed from 1 DAT and continued upto 7 DAT.

At 7 DAT, there was a decrease in dead heart damage which ranged from 4.61 to 11.52 per cent irrespective of the treatments. The minimum dead heart damage was recorded in cartap hydrochloride 4 G at 700 g a.i./ha, (4.61%) that was on par with indoxacarb 15.8 EC at 60 g a.i./ha (4.73%),followed by carbosulfan 25 EC at 350 g a.i./ha (5.19 %) compared to the untreated check (11.52%). Similar trend was observed up to 14 DAT.

Before the second foliar and soil application, the per cent white ear damage ranged from 10.03 to 11.93 per cent/hill (Table 2). At 1 DAT, the white ear damage ranged from 7.04 to 12.06 per cent/hill. Among the treatments, cartap hydrochloride 4 G at 700 g a.i./ha, recorded the lowest white ear damage of 7.04 per cent/hill and was on par with indoxacarb 15.8 EC at 60 g a.i./ha (7.20%), followed by carbosulfan 25 EC at 350 g a.i./ha (8.05%) compared to the untreated check (12.06%). A decline in white ear symptoms was observed from 1 DAT and continued up to 7 DAT.

The white ear symptom was in an increasing trend from 10 DAT and continued up to 14 DAT. At 10 DAT, the white ear damage ranged from 6.65 to 12.83 per cent/hill irrespective of the treatments. The minimum white ear damage was recorded in cartap hydrochloride 4 G at 700 g a.i./ha, (6.65%) that was on par with indoxacarb 15.8 EC at 60 g a.i./ha (6.83%) followed by carbosulfan 25 EC at 350 g a.i./ha (7.61%) compared to the untreated check that registered the highest white ear damage of 12.83 per cent/hill. Similar trend was also observed up to 12 DAT.

At 14 DAT, the per cent white ear damage ranged from 7.61 to 13.04 per cent/hill irrespective of the treatments. It was found that after the second foliar and soil application, the per cent white ear damage was minimum in cartap hydrochloride 4 G at 700 g a.i./ha (7.04 to 7.61%) that was on par with indoxacarb 15.8 EC at 60 g a.i./ha (7.20 to 7.79%) compared to the untreated check which recorded the highest damage ranging from 12.06 to 13.04 per cent/hill.

The overall mean values exhibited that stem borer damage ranged from 6.85 to 11.97 per cent/hill. The stem borer damage was lowest (6.85%) in cartap hydrochloride 4 G at 700 g a.i./ha that was comparable with indoxacarb 15.8 EC at 60 g a.i./ha (6.99 %) followed by carbosulfan 25 EC at 350 g a.i./ha (7.60 %) compared to the untreated check (11.97%). It was found that cartap hydrochloride 4 G at 700 g a.i./ha was superior than the other treatments. It was found that cartap hydrochloride 4 G at 700 g a.i./ha was superior among the treatments with a per cent reduction of 42.77 compared to the untreated check.

The order of efficacy was cartap hydrochloride 4 G at 700 g a.i./ha≥ indoxacarb 15.8 EC at 60 g a.i./ha > carbosulfan 25 EC at 350 g a.i./ha > cartap hydrochloride 50 SP at 50 g a.i./ha > fipronil 5 SC at 50 g a.i./ha > phosphamidon 40 SL at 500 g a.i./ha > flubendiamide 20 WG at 125 g a.i./ha > emamectin benzoate 5 SG at 11 g a.i./ha > buprofezin 25 SC at 200 g a.i./ha.

Yield and BCR

The effect of newer insecticides on the yield of the rice variety ADT 39 is presented in the Table 3. The grain yield ranged from 3428.56 to 5625.22 kg/ha. The highest yield was recorded in cartap hydrochloride 4 G at 700 g a.i./ha (5625.22

Table 1: Bioefficacy of newer insecticides against the yellow stem borer, *S. incertulas* during *Rabi* 2013 on dead heart after first foliar and soil application

Treatments	Per cent damage #I Foliar and soil application										
	Dose (g a.i/ha)	Pre treatment count (40 DAS)	1 DAT	3 DAT	5 DAT	7 DAT	10 DAT	12 DAT	14 DAT	Overall mean	Per cent reduction over control
Cartap hydrochloride 4G	700 (soil application)	10.35	6.58^{a}	5.60^{a}	4.94^{a}	4.61^{a}	6.22^{a}	6.53^{a}	10.03^{a}	6.86	37. 98
Carbosulfan 25 EC	350	10.94	7.41^{b}	6.30^{b}	5.56^{b}	5.19^{b}	7.01^{b}	7.35^{b}	10.30^{b}	7.51	34.29
Fipronil 5 SC	50	11.74	8.39^{e}	7.14^{e}	6.30^{e}	5.88^{e}	7.93^{cd}	8.32^{cd}	10.83^{c}	8.32	27.20
Flubendiamide 20 WG	125	10.63	8.29^{e}	7.05^{e}	6.22^{e}	5.81^{e}	7.84^{c}	8.23^{c}	10.55^{c}	8.08	29.30
Cartap hydrochloride 50 SP	50	11.70	7.49^{b}	6.38^{b}	5.62^{b}	5.25^{b}	7.08^{b}	7.43^{b}	10.32^{b}	7.66	32.98
Indoxacarb 15.8 EC	60	10.54	6.74^{a}	5.74^{a}	5.07^{a}	4.73^{a}	6.38^{a}	6.70^{a}	10.07^{a}	7.00	38.75
Emamectin benzoate 5 SG	11	11.05	8.91^{d}	7.58^{d}	6.69^{d}	6.24^{d}	8.43^{de}	8.85^{de}	10.79^{d}	8.37	25.02
Buprofezin 25 SC	200	10.68	9.49^{e}	8.07^{e}	7.12^{e}	6.65^{e}	8.97^{e}	9.35^{e}	11.04^{e}	8.92	21.95
Phosphamidon 40 SL	500	11.22	7.60^{b}	6.46^{b}	5.70^{b}	5.32^{b}	6.93^{b}	7.27^{b}	10.16^{a,b}	7.58	33.68
Untreated check	-	10.87	10.91^{f}	11.29^{f}	11.36^{f}	11.52^{f}	11.73^{f}	11.86^{f}	11.93^{f}	11.43	-
SE. d	2.07	0.19	0.18	0.16	0.16	0.28	0.29	0.09	-	-	
CD(P = 0.05)	NS	0.41**	0.38**	0.34**	0.34**	0.60**	0.62**	0.20**			
C.V(%)	14.59	1.45	1.47	1.40	1.44	2.17	2.19	0.65			

In a column mean followed by a common letter are not significantly different by LSD (P = 0.01); ** - Significant at 1 % level ; # - Mean of three replications ; NS - Non significant, * - Significant at 5 % level; DAS - Days after sowing ; DAT - Days after treatment

Table 2: Bioefficacy of newer insecticides against the yellow stem borer, *S. incertulas* during *Rabi* 2013 on white ear basis after second foliar and soil application

Treatments	Per cent damage #II Foliar and soil application										
	Dose (g a.i/ha)	Pretreatment count (60 DAS)	1 DAT	3 DAT	5 DAT	7 DAT	10 DAT	12 DAT	14DAT	Overall mean	Percent reduction over control
Cartap hydrochloride 4G	700(soil application)	10.03	7.04^{a}	5.98^{a}	5.28^{a}	4.93^{a}	6.65^{a}	7.28^{a}	7.61^{a}	6.85	45.24
Carbosulfan 25 EC	350	10.30	8.05^{b}	6.85^{b}	6.04^{b}	5.64^{b}	7.61^{b}	7.99^{b}	8.38^{b}	7.60	39.24
Fipronil 5 SC	50	10.83	8.82^{d}	7.50^{d}	6.62^{d}	6.18^{d}	8.34^{d}	8.75^{d}	9.19^{d}	8.27	33.89
Flubendiamide 20 WG	125	10.55	9.39^{f}	7.98^{f}	6.04^{f}	6.58^{f}	8.87^{f}	9.31^{f}	9.77^{f}	8.56	31.57
Cartap hydrochloride 50SP	50	10.32	8.33^{c}	7.07^{c}	6.25^{c}	5.84^{c}	7.88^{c}	8.21^{c}	8.62^{c}	7.81	37.56
Indoxacarb 15.8 EC	60	10.07	7.20^{a}	6.09^{a}	5.43^{a}	5.01^{a}	6.83^{a}	7.42^{a}	7.79^{a}	6.98	44.20
Emamectin benzoate 5 SG	11	10.79	9.67^{g}	8.22^{g}	7.25^{g}	6.77^{g}	9.14^{g}	9.59^{g}	10.07^{g}	8.93	28.61
Buprofezin 25 SC	200	11.04	9.86^{h}	8.38^{h}	7.45^{h}	6.90^{h}	9.43^{h}	9.78^{h}	10.32^{h}	9.14	26.93
Phosphamidon 40 SL	500	10.16	9.12^{e}	7.76^{e}	6.85^{e}	6.39^{e}	8.62^{e}	9.05^{e}	9.49^{e}	8.43	32.61
Untreated check	-	11.93	12.06^{i}	12.26^{i}	12.39^{i}	12.62^{i}	12.83^{i}	12.96^{i}	13.04^{i}	12.51	-
SE. d	0.09	0.08	0.06	0.09	0.05	0.10	0.07	0.09	-	-	
CD(P =0.05)	0.20**	0.18**	0.14**	0.20**	0.12**	0.21**	0.16**	0.20**			
C.V (%)	0.65	0.62	0.52	0.78	0.49	0.75	0.56	0.68			

In a column mean followed by a common letter are not significantly different by LSD (P = 0.01); ** - Significant at 1 % level ; # - Mean of three replications; NS - Non significant; * - Significant at 5 % level; DAS - Days after sowing; DAT - Days after treatment

Table 3: Yield of rice and BCR on the different treatments of newer insecticides in the rice

Treatments	Dose(g a.i/ha)	YieldKg/ha	BCR
Cartap hydrochloride 4G	700 (soilapplication)	5625.22^{a}	1: 2.34
Carbosulfan 25 EC	350	4965.87^{bc}	1: 2.11
Fipronil 5 SC	50	4496.5^{cde}	1: 1.90
Flubendiamide 20 WG	125	4187.88^{ef}	1: 1.79
Cartap hydrochloride 50 SP	50	4789.56^{bcd}	1: 2.02
Indoxacarb 15.8 EC	60	5340.73^{ab}	1: 2.24
Emamectin benzoate 5 SG	11	3968.24^{efg}	1: 1.71
Buprofezin 25 SC	200	3746.44^{fg}	1: 1.60
Phosphamidon 40 SL	500	4278.64^{def}	1: 1.80
Untreated check	-	3428.56^{g}	- -
SE. d	2.07		
CD(P =0.05)	4.35**		
C.V(%)	3.80		

Mean of 3 replications;In a column mean followed by a common letter are not significantly different by LSD;** - Significant at P = 0.01

kg/ha), that was comparable with indoxacarb 15.8 EC at 60 g a.i./ha (5340.73 kg/ha) followed by carbosulfan 25 EC at 350 g a.i./ha (4965.87 kg/ha). It was found that cartap hydrochloride 4 G at 700 g a.i./ha was superior than the other treatments. All the treatments were found to be superior than the untreated check (3428.56 kg/ha).

The BCR for the evaluation of newer insecticides are presented in Table 3. It was found that cartap hydrochloride 4 G at 700 g a.i./ha recorded the maximum benefit cost ratio of 1:2.34 and was comparable with indoxacarb 15.8 EC at 60 g a.i./ha (1:2.24) followed by carbosulfan 25 EC at 350 g a.i./ha (1: 2.11) compared to the untreated check.

The declining order of benefit cost ratio was arranged as cartap hydrochloride 4 G at 700 g a.i./ha ≥ indoxacarb 15.8 EC at 60 g a.i./ha > carbosulfan 25 EC at 350 g a.i./ha > cartap hydrochloride 50 SP at 50 g a.i./ha > fipronil 5 SC at 50 g a.i./ha > phosphamidon 40 SL at 500 g a.i./ha > flubendiamide 20 WG at 125 g a.i./ha > emamectin benzoate 5 SG at 11 g a.i./ha > buprofezin 25 SC at 200 g a.i./ha.

DISCUSSION

Tanveer *et al.* (2012) reported that minimum yellow stem borer infestation of 6.0 per cent was recorded in the treatment with cartap hydrochloride 4 G at 750 g a.i./ha. Earlier studies by Kulagod *et al.* (2011) and Yadav and Raghuraman (2014) also evidenced that cartap hydrochloride 4 G was significantly superior than other treatments in the trial and maintained low infestation of yellow stem borer. Pathak and Tiwari (2005) reported that cartap hydrochloride 4 G at 750 g a.i./ha recorded the dead heart damage from 3.83 to 5.36 per cent and was superior than carbofuran 3 G at 750 g a.i./ha and Neemzal T/S 1 per cent at 9 g a.i./ha. Prasad *et al.* (2007) and Balakrishna and Satyanarayana (2013) also reported that cartap hydrochloride 4 G at 0.60 kg a.i./ha was effective in controlling the rice stem borers followed by chlorpyriphos 20 EC at 500 g a.i./ha and fipronil 4.95 EC at 50 g a.i./ha.

Pathak and Tiwari (2005) reported that cartap hydrochloride 4 G at 750 g a.i./ha had maximum increased grain yield of 54.7 per cent compared to the untreated check. Tanveer *et al.* (2012) stated that cartap hydrochloride 4 G at 750 g a.i./ha recorded the highest grain yield of 41.93 q/ha followed by fipronil 0.3 G at 75 g a.i./ha (39.93q/ha) and carbofuran 3 G at 1000 g a.i./ha (38.26 q/ha). All the earlier findings are in conformity with the present findings.

REFERENCES

Balakrishna, B. and Satyanarayana, P. V. 2013. Genetics of brown planthopper (*Nilaparvata lugens* Stal.) resistance in elite donors of rice (*Oryza sativa* L.).*The Bioscan.* **8:** 1413-1416.

Gomez, K. A. and Gomez, A. A. 1984. *Statistical procedures for Agricultural Research. John Wiley and Sons,* New York, p.680.

Hassall, K. A. 1990. Biochemistry and use of pesticides. Macmillan press LTD., Hound mills, Basing stoke, Hampshire and Loandon. 536. pp. 121-246.

Heinrichs, E. A., Medrano, F. G. and Rapusas, H. 1985. Genetic evaluation for insect resistance in Rice. *IRRI,* Los Banos, Philippines. pp. 103-279.

Khan, R. A., Khan, J. A., Jamil, F. F. and Hameed, M. 2010. Resistance of different basmati rice varieties to stem borers under different controlled tactics of IPM and evaluation of yield. *Pak. J. Bot.* **37(2):** 319–324.

Kulagod, S. D., Hedge, M., Nayak, G. V., Vastrad, A. S., Hugar, P. S. and Basavagouda, K. 2011. Evaluation of insecticides bio rational against yellow stem borers and leaf folders on rice crops. *Karnataka J. Agric. Sci.* **24(2):** 224-246.

Kumar Amit, Lal, M. N., Singh, A. K. and Prasad, C. S. 2012. Eco-friendly management of *Scirpophaga incertulus* (Walk.). *Ann Plant Protect Sci.* **20(2):** 211-212.

Panse, V. G. and Sukhatme, P. V. 1958. Statistical methods for agricultural works. *Indian Council of Agricultural Research,* New Delhi, p. 327.

Pathak, H. P and Tiwari, S. N. 2005. Comparative efficacy of different formulations of carbofuran, cartap hydrochloride and sex pheromone against insect pests of rice. *Pestology.* **29(1):** 17-23.

Prasad, S. S., Gupta, P. K. and Kanaujia, B. L. 2007. Effect of seed treatments and nursery application of certain insecticides against yellow stem borer on semi deep water rice. *Proc, natl. Acad. Sci., India, Section B, Biol. Sci.* **77:** 73-76.

Sekh, K., Nair, N., Chakraborty, S. and Somchoudhury, A. K. 2007. Efficacy of fipronil 80% against stem borer and leaf folder. *Pestology,* **31(1):** 39-41.

Shepard, B. M., Khan, Z. R., Pathak, M. D. and Heinrichs, E. A. 1993. Management of insect pests of rice in Asia. *In:* Pimental, D and A. A. Hanson (Eds). CRC Hand book of pest management, Vol. III. CBS Publishers and Distributors, New Delhi. PP. 255-278.

Tanveer, H., Arvind, K., Madke, P. K. and Singh, H. 2012. Impact of insecticides against yellow stem borer (*Scirpophaga incertulas*) on paddy grain yield. *Trends in Biosciences.* **5(4):** 310-311.

Yadav, A. and Raghuraman, M. 2014. Bioefficacy of certain newer insecticides against fruit and shoot borer, *Leucinodes orbonalis* (Guen.), whitefly, *Bemisia tabaci* (Genn.), and jassid, *Amrasca devastans* Distant in brinjal. *The Ecoscan.* **6:** 85-89