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Bioefficacy of insecticides and bio-pesticides against yellow stem borer, *Scirpophaga incertulus* (walk.) and their effect on spiders in rice crop

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Abstract

All the treatments tested for the management of yellow stem borer, Scirpophaga incertulus (Walk.) had the comparable lower number of dead hearts and white ears than un-treated control. Fipronil 5 SC was best with final infestation of 1.9 % and 45.83 q/ha yield followed by cartap hydrochloride 50 SP, triazophos 40 EC, cartap hydrochloride 4G, lambda cyhalothrin 5 EC, endosulfan 35 EC, Bt and neemarin which gave 44.96, 43.37, 42.49, 40.13, 39.85, 39.07 and 38.78 q/ha yield, respectively. Maximum numbers of predatory spiders were recorded in control plot and it was 3.26 / hill. Among the different treatments the maximum number of spiders was found in cartap hydrochloride 4 G followed by fipronil 5 SC as 1.66 and 1.53 / hill, respectively.

Key words: Fipronil, Scirpophaga incertulas, predators, Oryza sativa L.

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Rice (Oryza sativa L.) is one of the most important cereal crops of India and is a staple food of more than 65 % of its population. 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. Chemical insecticides are still effective method to control insect pests particularly in the rice crop. The indiscriminate use of chemical insecticides can be environmentally disruptive and can result in the accumulation of residues in the harvested produce. Dodan and Lal (1999); Kaul and Sharma (1999) and Rath (1999 & 2001). The use of conventional insecticides causes sudden decrease in the number of natural enemies also. Keeping in view the importance of rice crop, the present study was undertaken and results thus obtained are presented herein.

Material and Method

The field trial was conducted 2010 at Crop Research Centre of the S.V.P.U.A. &T., Meerut, laid in R.B.D. with nine treatments and 3 replications. The treatments were T1, triazophos 40 EC @ 0.75 lit./ha, T2, cartap hydrochloride 4G @ 18.75 kg/ha, T3, lambda-cyhalothrin 5 EC @ 0.625 lit/ha, T4, fipronil 5 EC @ 18.75 kg/ha, T5, endosulfan 35 EC @ 1.5 lit/ha., T6, cartap hydrochloride 50SP @ 1.0 kg/ha., T7, neemarin @ 1.5 lit.,/ha., T8, Bacillus thuringiensis var, kurstaki @ 1.5 kg/ha. and T9, untreated control. All the treatments were applied twice, first at the 50 days and second at 75 days after transplanting with hand operated knap-sack sprayer, only water was sprayed in untreated control plot, the spray volume used for foliar application of insecticide was 600 litre\ha. During spraying due care was taken to prevent insecticides drift and granular insecticide was applied after mixing in 10 Kg sand/acre. The observations on dead hearts and white ear formation due to yellow stem borer were taken on five randomly selected hills / plot, before 1 day and after 3, 7, 14 and 20 one days of application. The percentage of dead hearts / white ears was worked out.

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.

Results and Discussion

All the treatments were significantly effective in reducing the infestation of rice yellow stem borer (YSB) and thus, reducing the formation of dead heart and white ear significantly as compared to the control (Table 1).

Table 1. Bio-efficacy of insecticides and bio-pesticides against Scirpophaga incertulas in rice.

Treatments	Dose / ha.	% dead hearts / white ears							
		before spray	First Application				Second Application			
			3 DAA	7 DAA	14 DAA	21 DAA	3 DAA	7 DAA	14 DAA	21 DAA
T1. Triazophos 40 EC	0.75 lit.	4.96 (12.87)	2.43 (8.62)	2.96 (9.91)	3.60 (9.96)	4.23 (11.76)	1.96 (7.93)	2.46 (8.93)	2.96 (9.91)	2.99 (9.70)
T2. Cartap hydrochloride 4G	18.75 kg	4.70 (12.31)	2.80 (9.42)	3.26 (10.37)	3.96 (11.28)	4.43 (12.07)	2.36 (8.74)	2.83 (9.47)	3.73 (11.13)	4.10 (11.67)
T3. Lambda-cyhalothrin 5 EC	0.625 lit.	5.16 (12.93)	3.10 (9.92)	3.60 (10.56)	4.06 (11.17)	4.63 (12.23)	2.06 (8.17)	2.60 (8.97)	2.93 (9.64)	3.13 (10.04)
T4. Fipronil 5 SC	0.5 lit.	5.03 (12.91)	1.73 (7.54)	2.40 (8.40)	2.40 (8.90)	3.43 (10.65)	0.93 (4.52)	1.03 (4.76)	1.46 (6.94)	1.93 (7.92)
T5. Endosulfan 35 EC	1.5 lit.	5.23 (13.13)	3.30 (10.09)	3.76 (11.03)	4.10 (11.43)	4.70 (11.98)	3.26 (10.37)	3.76 (11.15)	4.26 (11.91)	4.36 (12.05)
T6. Cartap hydrochloride 50SP	1.0 kg	5.53 (13.49)	2.30 (8.05)	2.90 (9.60)	3.13 (9.79)	3.90 (11.19)	1.63 (7.33)	1.93 (7.89)	2.43 (8.88)	2.96 (9.60)
T7. B.t.	1.5 kg	5.63 (13.53)	4.03 (11.54)	4.60 (12.29)	5.00 (12.80)	5.93 (12.08)	4.13 (11.68)	4.66 (12.35)	5.13 (12.96)	5.60 (13.68)
T8. Neemarin 1500 ppm	3.0 lit	6.30 (14.42)	4.96 (12.85)	5.26 (13.23)	5.60 (13.67)	6.10 (14.28)	5.73 (13.79)	5.93 (13.93)	6.30 (14.43)	6.90 (15.17)
T9. Control		4.83 (12.55)	6.66 (14.91)	7.53 (15.92)	8.26 (16.70)	8.80 (17.24)	8.80 (17.23)	8.56 (16.99)	9.06 (17.51)	9.33 (17.78)
SEm±		NS	1.27	1.13	1.21	1.05	1.03	1.32	0.85	0.87
CD (P=0.05)			3.85	3.45	3.66	3.17	3.13	3.99	2.58	2.64

(Figures in parentheses are angular transformed values; DAA = Days after application)

Table 2. Effect of different treatments on spider's population.

Treatments	Dose/ha	Number of spiders/hill							
		before spray	First Application				Second Application			
			3 DAA	7 DAA	14 DAA	21 DAA	3 DAA	7 DAA	14 DAA	21 DAA
T1. Triazophos 40 EC	0.75 lit.	1.33 (1.53)	0.60 (1.26)	0.66 (1.29)	0.80 (1.34)	1.00 (1.41)	0.60 (1.26)	0.80 (1.34)	0.86 (1.37)	1.0 (1.41)
T2. Cartap hydrochloride 4G	18.75 kg	1.20 (1.48)	1.06 (1.43)	1.13 (1.46)	1.66 (1.63)	1.73 (1.64)	1.46 (1.57)	1.40 (1.55)	1.60 (1.61)	1.66 (1.63)
T3. Lambda-cyhalothrin 5 EC	0.625 lit.	1.13 (1.46)	0.73 (1.31)	0.80 (1.34)	0.86 (1.36)	1.06 (1.41)	0.73 (1.31)	0.80 (1.34)	0.93 (1.39)	1.06 (1.44)
T4. Fipronil 5 SC	0.5 lit.	1.06 (1.44)	1.00 (1.41)	0.93 (1.39)	1.13 (1.46)	1.66 (1.63)	1.20 (1.48)	1.33 (1.52)	1.40 (1.54)	1.53 (1.59)
T5. Endosulfan 35 EC	1.5 lit.	1.46 (1.56)	0.53 (1.23)	0.60 (1.26)	0.74 (1.31)	0.93 (1.39)	0.53 (1.24)	0.73 (1.31)	0.86 (1.37)	0.93 (1.39)
T6. Cartap hydrochloride 50SP	1.0 kg	1.00 (1.41)	0.80 (1.34)	0.86 (1.36)	0.87 (1.39)	1.13 (1.46)	0.86 (1.37)	0.93 (1.39)	1.06 (1.43)	1.20 (1.48)
T7. B. t.	1.5 kg	1.46 (1.57)	1.26 (1.50)	1.40 (1.55)	1.60 (1.61)	2.26 (1.79)	2.00 (1.73)	1.86 (1.69)	1.93 (1.71)	2.06 (1.75)
T8. Neemarin 1500 ppm	3.0 lit	1.26 (1.50)	1.33 (1.53)	1.46 (1.57)	1.66 (1.63)	2.53 (1.88)	2.26 (1.81)	2.53 (1.88)	2.60 (1.89)	2.66 (1.91)
T9. Control		1.20 (1.47)	1.93 (1.71)	2.06 (1.75)	2.73 (1.93)	2.93 (1.98)	3.13 (2.03)	3.40 (2.09)	3.33 (2.08)	3.26 (2.06)
SEm±		NS	0.04	0.05	0.06	0.07	0.05	0.05	0.06	0.06
CD (P=0.05)			0.13	0.14	0.14	0.19	0.15	0.16	0.17	0.18

(Figures in parentheses are square root transformed values; DAA = Days after application)

Table 3. Economics of different treatments in management of Scirpophaga incertulas

Treatments	Total cost of treatment / application (Rs./ha.)	Yield (q/ha.)	Yield obtained over control (q/ha.)	Value of increased yield (Rs/ha.)	Gross income (Rs/ha.)	Net income (Rs/ha.)	Cost: Benefit Ratio
T1. Triazophos 40 EC	1555.00	43.37	7.98	15162.00	82403.00	80848.00	1:9.75
T2. Cartap hydrochloride 4G	2717.00	42.49	7.10	13490.00	80731.00	78014.00	1:4.96
T3. Lambda-cyhalothrin 5 EC	1030.000	40.13	4.74	9006.00	76247.00	75217.00	1:8.74
T4. Fipronil 5 SC	1380.00	45.83	10.44	19836.00	87077.00	85897.00	1:14.4
T5. Endosulfan 35 EC	1030.00	39.85	4.46	8474.00	75715.00	74835.00	1:8.23
T6. Cartap hydrochloride 50SP	1880.00	44.96	9.57	18183.00	85424.00	83544.00	1:9.67
T7. B.t	2562.00	39.07	3.68	6992.00	74233.00	71818.00	1:2.73
T8. Neemarin 1500 ppm	25549.00	38.78	3.39	6441.00	73682.00	48133.00	1:0.25
T9. Control	-	35.39	-	-	-	-	-

Labour charges = Rs. 100/day; Rental value of sprayer = Rs. 20.00/day; Sale price of produce = Rs. 1900/quintal

In treated plots, the yellow stem borer infestation recorded as dead hearts and white ears ranged from 1.93 to 6.90 as against 9.33 % in control, after 21 days of second spray. Fipronil 5 SC @ 0.5 lit. / ha. was found most effective against YSB followed by cartap hydrochloride 50 SP @ 1.0 kg,. / ha. and triazophos 40 EC @ 0.75 lit/ha. Although, statistical analyses showed non-significant difference among various treatments but control had significantly high (9.33 %) dead hearts / white ears than in treated plots, after 21 days of second spray. It gave clear message that chemical insecticides including bio-pesticides suppressed the population of yellow stem borer in rice.

The present finding in agreement with the findings of Dhaka *et al.,* (2011), who reported fipronil 5 SC as the best treatment in reducing the infestation of insect pests in rice, Sachan *et al.,* (2006) reported cartap hydrochloride 50 SP as the second best treatment in managing the stem borer in rice, Prasad *et al.,* (2005) found fipronil 0.3 GR at 0.075 kg a.i./ha most effective in controlling yellow stem borer infestation. As regards the bio-pesticides, the neemarin was found better than the Bt though on par statistically. The percentage of dead hearts / white ears after 21 days of second spray was 5.6 and 6.9 with neemarin and Bt, respectively. These results are in conformity with the findings of Dhaka *et al.,* (2011); Kumar *et al.,* (2012) and Prasad *et al.,* (2004) who found neem products to control yellow rice stem borer. These findings do not corroborates with the findings of Singh *et al.,* (2008) who reported that Bt as second best treatment in controlling the yellow stem borer among all the treatments.

The results on the availability of spiders in different treatments (Table 2) showed that highest number of spiders, was found in the un-treated control (3.26 / hills after 21 days of second spray), which was higher than the number of spiders recorded in other treatments. The least number of the spiders were recorded in the treatment of endosulfan 35 EC. The results indicated that Bt, neemarin, fipronil 5 SC, cartap hydrochloride 50 SP, and cartap hydrochloride 4G had no adverse effect on predators. The present studies are in conformity with several workers viz. Kadam *et al.,* (2005) who reported the maximum number of spider populations in the plot treated with neem oil spray and NSKE and also with Dhaka *et al.,* (2011) who also reported fipronil 0.3 GR and cartap hydrochloride 4G a bit safer for the spiders.

Conclusion

The plots treated with fipronil 5SC (45.83 q/ha), cartap hydrochloride 50 SP (44.96 q./ha) and triazophos 40 EC (43.37 q/ha) gave higher yield among the treatments and the yield in all treatments was found significantly higher than untreated control (35.39 q/ha). The findings are in confirmation with Nayak *et al.,* (2000). In terms of economics the highest net return was also obtained with fipronil 5 SC followed by cartap hydrochloride 50 SP and triazophos 40 EC. The highest cost: benefit ratio was

also found with fipronil 5 SC (14.4) followed by triazophos 40 EC (9.75) and cartap hydrochloride 50 SP (9.67). Similar results on yield component was reported by Dhaka *et al.,* (2011). The results reveal that since the plots treated with fipronil 5 SC had the lowest dead hearts / white ears percentage and produced maximum paddy yield than other treatments and more number of predators were also found in rice field.

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