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Efficacy of some insecticides and biopesticides for the management of white stem borer, *Scirpophaga fusciflua* Hampson in paddy

Vikas Tandon* and Ajai Srivastava

Department of Entomology,
Chaudhary Sarwan Kumar Himachal Pradesh Krishi Vishvavidyaalaya, Palampur-176 062, Himachal Pradesh, India.
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ABSTRACT

The field experiment was conducted on paddy at farmer's field in the Kangra district, to find out the effectiveness and economically viable control measures for the management of white stem borer. Application of various insecticides *viz*. flubendiamide 48% SC @ 50 ml ha^{-1}, rynaxypyr 20 SC @ 150 ml ha^{-1}, dinotefuran 20 SG @ 200 g ha^{-1} , monocrotophos 36 SL @ 850 ml ha^{-1} and two biopesticides *viz*. melia 5% @ 2.5 L ha^{-1} and eupatorium 5% @ 2.5 L ha^{-1}, were tested along with untreated control. All the insecticidal treatments were found significantly superior to untreated control. Flubendiamide 48% SC @ 50 ml ha^{-1} and rynaxypyr 20 SC @ 150 ml ha^{-1} were found most promising with minimum dead heart and white ears. The data on dead heart, white ear incidence and grain yield showed that all the insecticides were found to have effective control against stem borer on paddy. Considering the efficacy data with very low dose of flubendiamide 48% SC proved to be better and economically viable option for management of stem borer.

Key words: Dead hearts, *Kharif*, Paddy, White ears, White stem borer.

INTRODUCTION

Rice (*Oryza sativa* L.), is the most important cereal crop of the world. More than 90 per cent of the world's rice is grown and consumed in Asia, where 60 per cent of the earth's people live. India is the largest rice growing country of the world.

Insect-pests are the major constraints in enhancing the rice productivity, besides diseases and weeds (Behura *et al*., 2011). More than 100 species of insects are known as pests of this crop out of which 20 are of major economic significance. Stem borers are key group of insect pests of rice. This insect attacks the crop from the seedling stage to the harvesting stage and thus causes complete loss of affected tillers. The yield losses caused by insect pests in rice have been reported to the tune of 25 per cent (Dhaliwal *et al*., 2010). The larvae of rice stem borers, after hatching, bore into the stem of rice plant and cut out the food supply to the upper part of the affected stem. Dead hearts are found when the insect attacks at vegetative stage while white ears occur when the stem borer attack at reproductive stage (Chatterjee and Mondal, 2014).

The indiscriminate use of chemical insecticides can be environmentally disruptive and can result in the accumulation of residues in the harvested produce (Rath, 2001). The use of conventional insecticides causes sudden decrease in the number of natural enemies also. This study was conducted to evaluate the effect of insecticides and biopesticides on the dead hearts and white ears by rice stem borer.

MATERIALS AND METHODS

Field experiment was conducted in randomized block design with three replications and seven treatments (6+1 untreated check) on paddy at farmer's field in the Kangra district, during *kharif* 2015 and 2016. Plot size was of 9.6 m^2 with row to row and plant to plant spacing of 20cm and 15cm, respectively.

The treatments were applied at 30 days after transplanting and were repeated at 15 days interval. Two consecutive applications were made. For recording the data with regard to the incidence, ten hills were marked in each plot and observation on white stem borer incidence was recorded one day before and thereafter seven and fifteen days after spray. The per cent plant damage was calculated by counting number of dead hearts or white ears on 10 randomly selected hills/plot by using formula.

At vegetative stage:

$$\text{Infestation}(\%) = \frac{\text{Total number of dead hearts}}{\text{Total number of tillers}} \times 100$$

At booting stage

$$\text{infestation}(\%) = \frac{\text{Total number of white ears}}{\text{Total panicle bearing tillers}} \times 100$$

*Corresponding author's e-mail: tandonvikas8763@gmail.com

Table 1: List of the insecticides and biopesticides.

Treatments		Dosage (per ha)
T_1	Flubendiamide 48 % SC	50 ml
T_2	Rynaxypyr 20 SC	150 ml
T_3	Dinotefuran 20 % SG	200 g
T_4	Monocrotophos 36 % SL (standard check)	850 ml
T_5	Melia 5 %	1.5-2.5 L
T_6	Eupatorium 5 %	1.5-2.5 L
T_7	Untreated check	-

The grain yield per plot was recorded. The economics of different insecticidal treatments was worked out on the basis of prevailing market price of insecticides and application cost and finally the benefit-cost-ratio was also worked out. The data was analyzed statistically in RBD (Singh *et al.,* 1991).

RESULTS AND DISCUSSION

A perusal of data on per cent dead hearts infestation due to white stem borer revealed that there were no significant differences in different treatments and infestation varied from 7.92 to 9.04 per cent (Table 2).

First spray: In all the treatments, there was a significant reduction in plant infestation as compared to the untreated control at seven days after first spray(DAFS) schedule. The treatment dinotefuran at 7 DAFS was found to be the most effective for the control of white stem borer with 8.54 per cent infestation as compared to untreated control with 12.05 per cent infestation. The next best treatments in descending order were flubendiamide> monocrotophos > rynaxypyr > melia > eupatorium, being at par with each other and also with dinotefuran. Fifteen days after first spray, rynaxypyr treated plots recorded 10.00 per cent infestation as compared to 16.42 per cent in untreated control plots and was significantly superior to other tested insecticides and biopesticides. This was followed by dinotefuran, flubendiamide and monocrotophos with respective dead hearts infestation of 10.27, 10.47 and 11.33 per cent being at par with each other as well as with dinotefuran. Among biopesticides, eupatorium treated plots showed minimum infestation (12.78%) and was at par with insecticide treatment monocrotophos. It was further at par with melia.

Second spray: The observations at 7 DASS (Table 2) revealed almost a similar trend as obtained after first spray. Flubendiamide recorded 10.56 per cent infestation which was significantly more effective as compared to untreated control (18.68 per cent) and over other biopesticides treatments. This was followed by rynaxypyr (11.33 per cent), dinotefuran (11.99 per cent) and monocrotophos (13.61 per cent). Eupatorium (14.99 per cent) was least effective followed by melia 15.49 per cent infestation, being statistically at par. After fifteen days of second spray, all the treatments gave significant reduction in white ears infestation as compared to untreated control that recorded 14.95 per cent infestation. Flubendiamide treated plots with 2.74 per cent infestation continued to be the most superior and was significantly superior to the biopesticides. Among biopesticides, eupatorium recorded minimum of 9.56 per cent and melia recorded 10.85 per cent of white ears infestation were least effective among all the treatments and more effective compare to the control.

Benefit-cost-analysis: Data obtained on the benefit-cost analysis of various treatments (pooled data) revealed that Monocrotophos (10.32: 1) and flubendiamide (10.31: 1) were the most economically viable treatments on the basis of benefit-cost-ratio (Table 3). This was followed by dinotefuran (6.69:1) and rynaxypyr (6.03:1). Among the biopesticides, eupatorium (4.19:1) was showed comparatively higher Benefit-cost ratio as compared to melia (3.69: 1).

The present findings are supported by the result of Sekh *et al*., (2007) who reported that Flubendiamide 480 SC @ 24 and 30g a.i ha^{-1} effectively control the yellow stem borer.

Anonymous, (2006) has reported the damage suppression efficacy of rynaxypyr 0.4G @ 40 and 50 g *a.i./* could effectively control stem borer complex and increasing grain yield. Gowda, (2005) reported that flubendiamide 20 WDG at 25 and 50 g a.i ha^{-1} recorded low incidence of dead hearts (0.81 and 0.53 %) and white ears (1.26 and 1.20%) compared to other treatments. Thilagam, (2006) reported

Table 2: Efficacy of insecticides and biopesticides against white stem borer during *kharif* 2015 and 2016 at farmer's field (Kohala).

Treatments	Prior to spray	First spray		Second spray	
	DH%	DH%		DH%	WE%
		7 DAFS	15 DAFS	7 DASS	15 DASS
T_1	8.98 (17.38)	9.19 (17.56)	10.47 (18.75)	10.56 (18.84)	2.74 (9.52)
T_2	9.04 (17.40)	9.32 (17.67)	10.00 (18.31)	11.33 (19.52)	3.58 (10.90)
T_3	8.23 (16.60)	8.54 (16.90)	10.27 (18.53)	11.99 (20.19)	5.52 (13.57)
T_4	8.74 (17.15)	9.21 (17.63)	11.33 (19.62)	13.61 (21.62)	6.73 (15.03)
T_5	7.92 (16.29)	9.67 (18.07)	13.58 (21.55)	15.49 (23.11)	10.85 (19.22)
T_6	8.13 (16.42)	9.80 (18.14)	12.78 (20.83)	14.99 (22.68)	9.56 (17.99)
T_7	8.75 (17.16)	12.05 (20.28)	16.42 (23.84)	18.68 (25.54)	14.95 (22.74)
CD (0.05)	**(NS)**	**(1.61)**	**(1.58)**	**(1.48)**	**(0.66)**

Note: Figures in the parentheses are the arc sin transformed values
DAFS: Days after first spray and DASS: Days after second spray
DH= dead hearts, WE= white ears

Table 3: Benefit-cost-analysis for the management of rice white stem borer

Treatments	Dose (/ha)	Cost of spray (Rs)	Yield (q/ha)	Value of additional grain yield (Rs)	BCR
Flubendiamide 48% SC	50 ml	950	41.83	20924	10.31: 1
Rynaxypyr 20 SC	150 ml	2100	40.62	19169	6.03: 1
Dinotefuran 20SG	200 g	1300	38.38	15921	6.69: 1
Monocrotophos 36 SL	850 ml	364	37.68	14906	10.32: 1
Melia 5 %	2.5 L	1500	33.96	9512	3.69: 1
Eupatorium 5 %	2.5 L	1500	34.86	10817	4.19: 1
Control	-	-	27.4	-	

that flubendiamide 480 SC at 30 g a.i ha^{-1} was effective against stem borer in rice and also found to be safe to the spiders and coccinellids in the rice ecosystem. Dinotefuron 20% @ 200 ml/ha and Monocrotophos (Monocrown) 36 % @ 1390ml/ha were effective against rice stem borer Rath, (2012). Sandhu and Dhaliwal (2016) found Fame 480 SC @ 50 ml/ha was most promising with minimum dead heart and white ears. Rana and Singh (2017) found chlorantraniliprole 18.5 SC was most effective and minimum infestation of *S. incertulas* with 2.73 per cent (DH) and 2.06 per cent (WE) after first and second spray, respectively. Considering the efficacy of low doses Fame 480 SC proved to be better and economically viable option for the management of rice white stem borer.

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