Journal of AgriSearch 1(1):40-44
Peer Reviewed Quarterly
ISSN : 2348-8808 (Print), 2348-8867 (Online)

On-farm Evaluation of Integrated Management of Rice Yellow Stem Borer (*Scirpophaga incertulas* Walk.) in Rice-Wheat Cropping System under Low Land Condition

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ARTICLE INFO

Received on	:	26.01.2014
Revised received on	:	21.02.2014
Accepted on	:	07.03.2014
Published online	:	27.03.2014

ABSTRACT

The experiment was conducted in Randomized Block Design with three replication to evaluate the integrated management of rice yellow stem borer (*Scirpophaga incertulas* Walk.) in rice-wheat cropping system under low land condition. All the treatments had the comparable lowest number of dead hearts, white heads, number of productive tillers and filled grain than untreated control. Among tested treatments Fipronil@ 75 gm a. i./ha was found best, because it provide minimum dead hearts, white heads and maximum productive tillers, filled grain and yield, However, Fipronil treated plots have maximum numbers of predators than other insecticides treated plots. Maximum number of different predators was found in *Trichogramma japonicum* treated plot followed by tobacco and neem extract plots.

Keywords : Yellow stem borer, *Trichogramma japonicum*, Dead hearts, White heads

INTRODUCTION

Rice(*Oryza sativa* L.) is the stable food for over half the world's population. It provides 27% of dietary energy and 20% of dietary protein in the developing countries. This crop is cultivated in at least 114, mostly developing countries and it is the primary source of income and employment for more than 100 million household in Asia (FAO,2004). Almost 90% of the rice is grown and consumed in Asia (Khush and Brar, 2002). India is a second largest rice producer in world followed by China. World wide rice is grown on about 145 million hectares with a production of 600 million tones, in India area under rice cultivation is from 38 to 43 million hectares with a productivity of 2.6 ton/ha only (Singh *et al,* 2009). Insect pests are severe constraints to rice production throughout the world. Rice is affected by more than 100 insect among which 10-12 pose an economic threat to rice cultivation. Rice stem borer occupy the major status as pest and cause considerable damage to the rice cultivation in almost in all rice growing stages. The status of stem borer incidence in 21 states of India reported that the level of pest was "severe" in seven states, "moderate" in six states and "low" in six states. From a large dataset in India obtained from 28 years of experiments, 1% dead hearts cause 2.5% yield loss, 1% white heads cause 4.0% yield loss, and 1% deadhearts and whiteheads cause 6.4% yield loss (Muralidharan and Pasalu, 2006). Rice is generally resistant to yellow stem borer(YSB) *Scirpophaga incertulas* Walk damage when very young, at mid-growth, and after panicle exsertion (Bandong and Litsenger 2005), The YSB, which infest the plant from seedling to maturity, are worldwide in distribution (Dale 1994) . Plants injured by stem borers can partially recover by producing more tillers (Bandong and Litsenger, 2005; Lv et al., 2008) Eight species of the stem borers of rice are know to be of significant importance in Asia, among these stem borer, the YSB has been found to be predominant in India. Srivastava (2003) reported that YSB is cause 1% to 19% yield loss in early planted and 38% to 80% in late transplanted rice crops. In the north India's hilly tracts, low infestation on rice occurs in early July, when larvae cause dead hearts in seedlings, severe infestations occur in

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September, with maximum whiteheads reaching upto 50 % to 60% in the field. However it caused 3 to 95% grain yield loss in India (Rodante et. al., 2011). YSB is abundant both on lowland rice and upland rice and will attack young plant even in the nursery (Litsinger et al., 1987).

Methods for controlling YSB include cultural practices, insecticides, biological, and varietal resistance. Insecticide control is the most popular method and accounts for the majority of insecticide use on rice in Asia The use of insecticides can be environmentally disruptive and can result in the accumulation of residues in the harvested produce (Chinniah *et al.* 1998, Dodan and Roshan 1999, Rath 1999 and 2001, Bora *et al.* 2004) and Prasad *et al.* (2004) found neem products effective against yellow rice stem borer. Keeping in view the importance of rice crop, the field experiment was designed to determine relative efficacy of different new insecticides, biocontrol agent and plant extract to find out the effect of these control measures on reduction of the infestation of YSB, existing number of predators in treated plots and yield attributes.

MATERIALS AND METHODS

The experiment was conducted in the farmers field during the year Kharif 2007 to 2010 for on farm trial at 30 location in Randomized Block Design (RBD), having ten treatments (T_1= Carbofuran@ 750 g a.i./ha, T_2 = Phorate @ 1250 g a.i./ha, T_3 = Fenthion@ 1000 g *a.i.*/ha, T_4 = Quinolphos @ 1000g a.i./ha, T_5 = Cartap @ 750 g a.i./ha, T_6 = Fipronil @ 75 g a.i./ha, T_7 = Released *Trichogramma japonicum* @ 100000/ha, 5 times after 15-20 days interval, T_8 = Neem leaf extract @40 ml/liter of water after 30 days of transplanting, T_9 = Tobacco leaf extract@ 40 ml/ liter of water after 30 days of transplanting, T_{10} = Control), which were repeated thrice in a net experimental area 60 m^2. Nursery of rice variety "Rajendra Kasturi" sown in the month of June and line transplanting was done after 25 days of sowing at 20 x 20 cm hill spacing. Plant extracts were prepared in following manner. Leaves and small branches of neem and tobacco 5 kg of each were cut into small pieces and mixed with 10 liter water. The mixture was boiled for 30-50 minutes and afterward was allowed to cool for about 2 hrs. and then filtered through muslin cloth.

The collection and identification of predators of YSB was started from 25 days after transplanting at 7 days interval, which was continued up to 100 days after transplanting to record the availability of predators. The predators were collected by net sweep method. The diameter of the net was 33.5 cm with 1.0 meter long handle. The collection was made in each treatment and replication for 25-30 minutes. The collected predators were kept separately and identified in the laboratory.

The pretreatment dead hearts were counted 25 days after transplanting. After 15 days of the spray, post- treatment dead hearts were counted. White heads were noted at 70 days after transplanting. The per cent damage due to ' dead heart' and 'white head ' is calculated by the following formulae (Eq. 1 to 2) (Mahapatra and Nand, 1996)

% damage due to dead heart =

$$\frac{\text{Total No. of Dead Heart}}{\text{Total No. of Tillers *}} \times 100 \qquad \text{(Eq. 1)}$$

* = (Dead hearts + Healthy tillers)

$$\% \text{ white head} = \frac{I}{NZ(M-N)Y} \times 100 \qquad \text{(Eq. 2)}$$

Where,

I = Total number of infected tillers from all infected hills

Z = Average number of tillers per hill from all infested hills

N = Total number of I infested hills

M = Total number of hills (uninfested plus infested)

Tiller count was determined from randomly selected 10 hills in each treatment and replication. Filled grain and unfilled grains were counted in laboratory on 10 selected panicles from each treatment and replication, the sterility per cent was counted by total grains minus filled grains divided(/) total grain multiply(x) 100. From each treatment and replication was harvested to obtain the yield of paddy, which was extrapolated kg ha^{-1}. The three year data were pooled, tabulated and statistically analyzed using statistical programme.

RESULTS AND DISCUSSION

Pooled data indicated that pre- treatment dead heart count showed that 7.54 to 12.98 per cent were damaged by YSB (Table 1) which witnessed the availability of YSB larvae in the experimental field. After 15 days of the application of treatments, dead heart count range from 3.0-5.98 per cent in treated plot. Although, statistical analysis showed non significant effect among treatments but control plot had significantly high dead heart per centage (16.09%) than in treated plot. This field

Table 1 : Effect of pre and post treatment dead hearts (%) and white heads (%) in rice variety Rajendra Kasturi (Pooled data from 2007-2010)

Treatments	Pre treatment dead hearts(%) after 25 days of transplanting	Post treatment dead hearts(%) after 15 days of application	White head (%) at 70 days after transplanting
Carbofuran@ 750 g a.i. /ha	10.76	3.41b	4.67b
Phorate @ 1250 g a.i. /ha,	11.87	3.90b	4.98b
Fenthion@ 1000 g a.i. /ha,	11.56	4.71b	5.01b
Quinolphos @ 1000g a.i. /ha	10.43	3.67b	4.01b
Cartap @ 750 g a.i. /ha	8.96	3.50b	4.00b
Fipronil @ 75 g a.i. /ha	7.54	3.00b	3.98b
Released Trichogramma japonicum @ 100000/ha	12.67	5.02b	4.67b
Neem extract @ 60 ml/liter	12.98	5.04b	5.11b
Tobacco extract@ 60 ml/liter	12.10	5.98b	5.21b
Control	11.12	16.09a	12.13a
LSD 0.05	1.85	0.213	0.245

study gives clear information that chemical pesticide, bio-control agent including plant extract suppressed the population of YSB. Likewise, comparable white head per cent range from 3.98 to 5.21% was recorded among the treatment i.e. chemical pesticides, bio-control agents and plant extracts, which was significantly lower than white dead per centage recorded in control plot (12.13 %). The average white heads were declined from 43.00 to 56.78 per centages in treated plots over the control (Table 1). Comparable but significantly higher number of productive tillers produced by treatment (33-39 tillers / hill) than untreated (28 tillers /hill). Field study showed that plant extracts and bio-control agent controlled YSB as efficiently as chemical pesticides (Table 2). The result also showed that more number of filled grain / panicle (163-178 grain /panicle) was obtained from treated plots than untreated control (151 grains / panicle). The results of paddy yield depicted in table 2 showed that the plots treated with insecticides, biopesticide and plant extract produced significantly higher yield (3500-4000 kg/ha) , than untreated control (2810kg/ha) . In terms of yield the order was Fipronil @ 75 g a.i. /ha (4000kg/ha) > Cartap @ 750 g a.i./ha (3900 kg/ha) > Carbofuran@ 750 g a.i./ha (3800 kg/ha) > Quinolphos @ 1000g a.i./ha (3700 kg/ha) > Tobacco extract@ 60 ml/liter (3680kg/ha), *Trichogramma japonicum* @ 100000/ha (3650kg/ha), Neem extract @ 60 ml/liter (3630 kg/ha), Phorate @ 1250 g a.i./ha (3600 kg/ha) >

Table 2 : Impact of paddy yield and yield attributing characters of rice variety Rajendra Kasturi in different treatments (Pooled analysis of 2007-2008, 2008-2009 and 2009-2010)

Treatments	Productive tillers	Filled Grain (No.)	Sterility (%)	Yield (Kg/ha)
Carbofuran@ 750 g a.i. /ha	36.0a	170	7.67	3800a
Phorate @ 1250 g a.i. /ha,	34.0a	165	7.98	3600a
Fenthion@ 1000 g a.i. /ha,	33.0a	163	8.67	3500a
Quinolphos @ 1000g a.i. /ha	35.0a	168	8.50	3700a
Cartap @ 750 g a.i. /ha	38.0a	175	6.98	3900a
Fipronil @ 75 g a.i. /ha	39.0a	178	6.90	4000a
Trichogramma japonicum @ 100000/ha	34.0a	167	8.00	3650ab
Neem extract @ 60 ml/liter	33.0a	160	8.25	3630ab
Tobacco extract@ 60 ml/liter	35.0	169	8.55	3680ab
Control	28.0b	151	16.10	2810b
LSD 0.05	1.56	5.79	0.98	116

Fenthion@ 1000 g a.i./ha (3500 kg/ha). The average increase paddy yield over the control ranged between 24.55 to 42.34 per cent in the respective treatments. The results on the availability of predators in different treatments (Table 3) showed that almost same number of predators, was found Released *Trichogramma japonicum* @ 100000/ha (50), Neem extract @ 60ml/liter (45), Tobacco extract@ 60ml/l (48) was recorded , However some predators are recorded in insecticide spray plot viz., Cartap @ 750 g a.i./ ha (25), and Fipronil @ 75 g a.i./ha (26) which was higher than the number of predators available in other chemical treated plots. The least number of predators were recorded Phorate @ 1250 g a.i. / ha(13). The results indicated that the *Trichogramma japonicum* and plant extracts had no adverse effect on predators than chemical insecticides. The preliminary results of this study reveals that the plot treated with Fipronil @ 75 g a.i./ha had the lowest dead hearts and white hearts per centage and produced maximum paddy yield than other treatments.

In respect to chemical control the same finding reported earlier by Atwal *et al.*1997 and Puri *et al.* 1999. Several workers have reported that stem borer of rice can be successfully controlled by the use of botanical and biocontrol agents (Bras *et al.* 1994, Bora et al. 2004 Chinniah *et al.* 1998, Dodan and Roshanlal 1999, Kaul and Sharma 1999, Kaur *et al.* 2000, Prasad *et al.* 2001, Prasad *et al.* 2004, and Rath 1999 and 2001).

Table 3 : Population of different predators/natural enemies in rice variety Rajendra Kashturi in different treatment (Pooled data of 2007-2008, 2008-2009 and 2009-2010)

Treatments	No. of Predators							
	Long -horned grasshopper	Cricket	Damselfiles	Bug	Lady bird	Wolf	Coccinellids	Dragon	Total
Carbofuran@ 750 g a.i. /ha	2	1	2	-	-	3	6	4	18
Phorate @ 1250 g a.i. /ha	1	2	1	2	1	1	-	5	13
Fenthion@ 1000 g a.i. /ha	1	1	3	1	-	2	5	3	16
Quinolphos @ 1000ga.i. /ha	4	2	1	2	1	4	4	6	24
Cartap @ 750 g a.i. /ha	1	-	4	1	3	5	5	6	25
Fipronil @ 75 g a.i. /ha	2	5	1	2	1	4	6	5	26
Released *Trichogramma japonicum* @ 100000/ha	3	7	10	5	4	6	7	8	50
Neem extract @ 60ml/liter	2	5	12	4	1	8	7	6	45
Tobacco extract@ 60ml/l	2	8	10	5	2	10	3	8	48
Control	5	8	11	6	4	12	8	10	64

CONCLUSION

Yellow stem borer (*Scirpophaga incertulus* Walker) is one of the most important pests in Bihar and it is responsible for substantial yield losses. The present investigation was undertaken to study of integrated management of YSB through use of new insecticides, biocontrol agent and plant extracts and their impact on dead hearts, white heads, productive tillers, yield attributes and number of predators. A on farm trails (OFT) was conducting Kharif season of 2007 to 2010 in 30 location of the farmers field in Sitamarhi district of Bihar to determine the comparative efficacy of new insecticide, biocontrol agent and plant extract for the management of YSB.

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CORRECT CITATION

Singh D, Singh AK and Kumar A. 2014. On-farm Evaluation of Integrated Management of Rice Yellow Stem Borer (*Scirpophaga incertulas* Walk.) in Rice-Wheat Cropping System under Low Land Condition. *Journal of AgriSearch* **1**(1) : 40-44.