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Management of rice yellow stem borer, *Scirpophaga incertulas* Walker using some biorational insecticides

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ABSTRACT

The experiments were carried out to study the performance of some biorational insecticides against yellow stem borer, *Scirpophaga incertulas* Walker in *Boro* rice at Rice Research Station, Chinsurah, Hooghly, West Bengal during the year 2009-10, 2010-11 and 2011-12. Nine treatments viz. *Beauveria bassiana* (Panther BB) @ 4 g/l, *Beauveria bassiana* (Myco- Jaal) @ 4 ml/l, *Metarhizium anisopliae* (Nodule Testing Laboratory, BCKV) @ 2 g/l, *Bacillus thuringiensis*(Panther BT) @ 1.5 g/l, *Bacillus thuringiensis*(Nodule Testing Laboratory, BCKV) @ 1.5 g/l, Azadirachtin 10,000 ppm @ 1 ml/l, Spinosad 45%SC @ 2 ml/15 l, Phosphamidon 40% EC @ 1.5ml/l of water and untreated control (Water Spray) were laid out in randomized block design with three replications. The observations on per cent of dead heart and white ear head along with yield of the crop in different treatments were recorded. Spinosad 45%SC proved most effective in managing the insect population as lowest DH% and WE% were observed in all the crop growing seasons. Result on pooled analyses revealed that 80.27% and 67.10% reduction of dead heart and white ear head were achieved over the control by two sprayings of Spinosad 45%SC which resulted in 69.96% increase of yield over the control. Apart from Spinosad 45%SC, Phosphamidon 40% EC also proved better in reducing the dead heart and white ear head as well as in per cent increase of yield over the control.

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Key words: Biorational insecticides, yellow stem borer, *Scirpophaga incertulas*.

INTRODUCTION

Rice *(Oryza sativa* L.), is one of the important staple food of more than half of the world population. Production and consumption of rice is concentrated mainly in Asian countries. India, being the largest rice growing country, covers an area of about 44.6 million hectares and produces around 87.8 million tonnes of rice with yield level still low at around 2.85 tonnes per hectare (Anonymous, 2005). A critical analysis of the gap between the potential and actual rice yield across the nation would reveal that several factors act as yield constraints. Among these factors, insect-pests contribute substantially to yield loss in rice production and productivity. In India, approximately 100 insect species feed on rice and 20 of these are considered to be major pests (Cramer, 1967) of which yellow stem borer, *Scirpopagha incertulas* Walker is the dominant and most destructive pest occurring throughout the country causing yield loss of about 10-60 per cent (Panda, *et al.*, 1976; Pasalu, *et al.*, 2005). The insect causes "Dead hearts" at tillering stage and "White ear head" at reproductive stage. The farmers highly rely on synthetic insecticide as a tool of choice in the battle against this noxious pest because of broad-spectrum activity, relatively low cost and rapid killing attributes. However, like all tools, insecticides have limitations. The excessive and indiscriminate use of insecticides resulted in severe adverse effect on agro-ecosystem, human health and wild life. Now-a-days, to overcome this crisis emphasize has been given on less disruptive control measures with judicial use of pesticides as a last resort. Hence, an attempt has been made to manage this borer insect using some biorational insecticides having selective toxicity and different modes of action as compared to commonly used neurotoxic insecticides.

MATERIAL AND METHODS

The field experiment was conducted in *boro* season during 2009-10, 2010-11 and 2011-12 to study the efficacy of some biorational insecticides against yellow stem borer, *S. incertulas* at Rice Research

Table 1. Incidence of 'dead heart' in *boro* rice in different treatments during 2009-10, 2010-11 and 2011-12

Treatments	%DH at 30 DAT (Pre-treatment)			%DH at 50 DAT (Post-treatment)			%DH (Pooled of 3 yr)	% Reduction over control
	1st yr	2nd yr	3rd yr	1st yr	2nd yr	3rd yr		
T_1	3.63	4.42	5.16	7.24	9.60	9.33	8.61	34.48
T_2	3.71	4.54	5.71	6.78	8.41	8.81	7.78	40.83
T_3	3.51	4.50	4.96	4.53	5.08	5.41	4.94	62.38
T_4	3.42 (10.65)	4.46 (12.19)	5.42	4.82	5.76	6.71	5.59 (13.64)	57.47
T_5	3.47 (10.73)	4.58 (12.35)	6.04	7.19	7.61	8.60	7.30 (15.61)	44.44
T_6	3.43 (10.67)	4.43 (12.15)	5.09 (13.03)	5.66	5.94	6.09	5.61	57.30
T_7	3.55 (10.86)	4.56 (12.33)	5.73 (13.84)	2.20 (8.50)	2.38 (8.79)	3.54	2.59 (9.21)	80.27
T_8	3.39 (10.61)	4.72 (12.54)	5.43 (13.47)	3.36	4.16	4.84 (12.30	4.03 (11.56)	69.36
T_9	3.54 (10.84)	4.76	5.63	10.64	14.61	14.93	13.14	-
SEm (±)	0.83	0.56	0.69	0.19	0.18	0.22	0.48	-
p<0.05	N.S.	N.S.	N.S.	0.56	0.54	0.64	1.44	-

T_1 : *B. bassiana* (Panther BB), T_2 : *B. bassiana* (Myco- Jaal), T_3 : *M. anisopliae*, T_4 : *B. thuringiensis* (Panther BT), T_5 : *B. thuringiensis* (Nodule Testing Laboratory, BCKV), T_6 : Azadirachtin 10,000 ppm, T_7 : Spinosad 45 SC, T_8 : Phosphamidon 40 EC, T_9 : Control

Station, Chinsurah, West Bengal situated at $88^0 24^/$ E longitude and $22^0 52^/$ N latitude with an altitude of 8.62 m above mean sea level. Nine treatments viz *Beauveria bassiana* (Panther BB) @ 4 g/l, *B. bassiana* (Myco- Jaal) @ 4 ml/l, *Metarhizium anisopliae* (Nodule Testing Laboratory, BCKV) @ 2 g/l, *Bacillus thuringiensis* (Panther BT) @ 1.5 g/l, *B. thuringiensis*(Nodule Testing Laboratory, BCKV) @ 1.5 g/l, Azadirachtin 10,000 ppm @ 1 ml/l, Spinosad 45 SC @ 2 ml/15 l, Phosphamidon 40 EC @ 1.5ml/l of water and untreated control (water spray) were laid out in randomized block design with three replications having plot size of 5x5 sqm. Two sprayings at an interval of 10 days were performed where first spraying was done on 31 days after transplanting (DAT). The observation on dead heart (DH) was recorded one day before first spraying i.e. 30 DAT and at 50 DAT while white ear head (WH) was recorded just before harvesting of the crop. Three quadrates each of having 1 sq m of size were randomly selected in each replication to record the incidence of DH or WH. Per cent DH and WH were calculated using the following formula:

$$\% \text{ DH or } \% \text{ WH} = \frac{\text{Number of DH or WH}}{\text{Total number of tillers / Hill}} \times 100$$

The yield was recorded from the samples after harvesting and was converted to kg/hectare. The data thus obtained were subjected to statistical analysis. Appropriate transformation was taken wherever necessary.

Table 2. Incidence of 'white ear head' in *boro* rice in different treatments during 2009-10, 2010-11 and 2011-12

Treatments	% WH (Pre-harvest)			WH% (3 yr Pooled)	% Reduction over control
	1st yr	2nd yr	3rd yr		
T_1 : *B. bassiana* (Panther BB)	18.70	21.97	36.46	25.71	37.54
T_2 : *B. bassiana* (Myco- Jaal)	17.75	16.81	35.00	23.19	43.67
T_3 : *M. anisopliae*	17.29	21.74	33.85	24.29	40.98
T_4 : *B. thuringiensis* (Panther BT)	13.64	16.33	29.24	19.74	52.05
T_5 : *B. thuringiensis*	20.44	24.52	38.65	27.87	32.29
T_6 : Azadirachtin 10,000ppm	17.38	18.42	24.25	20.02	51.37
T_7 : Spinosad 45 SC	9.86	12.16	18.61	13.54	67.10
T_8 : Phosphamidon 40 EC	11.17	12.43	21.11	14.90	63.79
T_9 : Control (Water)	27.85	37.27	58.36	41.16	-
SEm (±)	0.39	1.15	0.86	1.17	-
p<0.05	1.18	3.47	2.59	3.52	-

RESULTS AND DISCUSSION

Dead heart

Damage caused by rice yellow stem borer was assessed and injury level was recorded at 30 DAT, 50 DAT and just before harvesting. The experimental results revealed no significant differences in injury level among the different treatments before imposing any management practices. However, observation showed that two spraying at 10 days interval in different treatments registered superior result in reducing DH as compared to control (water spray) in every cropping season.

During 2009-10, lowest % DH was recorded in Spinosad 45 SC treated plot followed by T_8 i.e. Phosphamidon 40 EC. Moderate level of efficacy was recorded with *M. anisopliae* and *B. thuringiensis* against the borer insect as 4.53% and 4.82% DH was estimated in each treatment, respectively. Azadirachtin 10000 ppm though superior to *B. bassiana* and *B. thuringiensis* proved less effective than other treatments. More or less, similar performance was recorded in different treatments during 2010-11. Spinosad 45 SC again proved most efficacious followed by Phosphamidon 40 EC. In the third year i.e. during 2011-12, slight variation in the efficacy of different treatments was recorded. However, Spinosad 45 SC and Phosphamidon 40 EC again proved better than others (Table 1).

Results on pooled analysis exhibited superior performance of different treatments as compared to control. Spinosad 45 SC proved most effective which resuled in 80.27% reduction of DH over the control. Phosphamidon 40 EC registered as second best treatment as 69.36% reduction of DH was recorded. Based on efficacy, other treatments fell into two groups, such as *M. anisopliae* (T_3), *B. thuringiensis* (T_4) and Azadirachtin (T_6) in first group while *B. thuringiensis* (T_5), *B. bassiana* (T_2) and *B. bassiana* (T_1) in second group where 57.30-62.38% and 34.48-44.44% reduction of DH was recorded, respectively (Table 1).

Table 3. Yield of *boro* rice different treatments during 2009-10, 2010-11 and 2011-12

Treatments	Yield (kg/ha)			Mean Yield (kg/ha)	% Yield increase over control
	1st yr	2nd yr	3rd yr		
T_1 : *B. bassiana* (Panther BB)	2944	3000	2500	2815	46.04
T_2 : *B. bassiana* (Myco- Jaal)	3222	3111	2778	3037	49.98
T_3 : *M. anisopliae*	3833	3500	3167	3500	56.60
T_4 : *B. thuringiensis* (Panther BT)	3389	3167	2667	3074	50.59
T_5 : *B. thuringiensis*	3500	3000	2722	3074	50.59
T_6 : Azadirachtin 10,000 ppm	3944	3611	3500	3685	58.78
T_7 : Spinosad 45 SC	5500	5111	4556	5056	69.96
T_8 : Phosphamidon 40 EC	4722	4056	4000	4259	64.33
T_9 : Control (Water)	1833	1444	1278	1519	-
SEm (±)	120.33	58.61	109.34	77.44	-
p<0.05	363.86	177.24	330.61	234.15	-

These findings followed the results of Karthikeyan *et al.* (2008) who reported that Spinosad 45 SC was the most effective among other treatments in reducing as high as 63% DH.

White ear head

Observation also recorded on white ear head at pre-harvest stage over consecutive three seasons. All the treatments proved superior over control. Lowest %WH was recorded on Spinosad 45 SC in all three years but failed to show any significant difference with Phosphamidon 40 EC. Besides this, *B. thuringiensis* (T_4) also proved effective as 13.64%, 16.33% and 29.24% WH were observed. Results on pooled analysis revealed almost similar results as recorded during 2009-10, 2010-11 and 2011-12. Highest reduction over control was exerted by Spinosad 45 SC (67.10% WH) followed by Phosphamodon 40EC, *B. thuringiensis,* Azadirachtin 10,000 ppm, *B. bassiana, M. anisopliae*, *B. bassiana* (T_1) and *B. thuringiensis* (T_5) (Table 2). This finding was supported by Karthikeyan *et al.* (2008) who recorded 49% reduction of WH.

Observation on yield

Efficacy of Spinosad 45 SC also reflected in the yield in different cropping seasons. Highest yield (kg/ha) was obtained over the three consecutive cropping seasons from this treatment. Three years pooled of grain yield indicated maximum of 5056 kg/ha from Spinosad treated plots which resulted in 69.96% increase of yield over the control. Karthikeyan *et al.* (2008) also recorded increase (almost 14%) in rice yield using

Spinosad 45 SC. Next to, this treatment Phosphamidon 40 EC also produced a constant higher yield (4259 kg/ha and 64.33% increase over control) as compared to other treatments which produced variant yield in different years. However, results on mean yield showed that biorational insecticide like Azadirachtin 10000 ppm registered quite a higher yield (58.78% increase over control) followed by *M. anisopliae*, *B. thuringiensis*, Azadirachtin 10,000 ppm, *B. bassiana* (T_2), *B. bassiana* (T_1) and *B. thuringiensis* (T_5) (Table 3).

Therefore, it can be concluded that Spinosad 45 SC is a very good alternative to conventional synthetic organic insecticides for the control of *S. incertulas*. Besides this, other biopesticides like *M. anisopliae*, *B. thuringiensis*, Azadirachtin and *B. bassiana*
though not suitable as a sole control measure but may be incorporated in IPM programme.

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REFERENCES

Anonymous, 2005. Rice production in India. *Financial Express.* December 28, 2005.

Cramer, H. H. 1967. Plant Protection and World Cup Protection. *Pflanzeschutz Nachar*. **20**: 524.

Karthikeyan, K., Sosamma, J., Purushothman, S.M. and Smitha, R. 2008. Effect of spinosad against major insect pests and natural enemies in rice ecosystem. *Journal of Biological Control.* **22**: 315-320.

Panda, N., Samalo, A.P., Patro, N. C. and Reddy, T.G. 1976. Relative abundance of Lepidopteran stalk borer of rice in Bhubneswa; *Indian Journal of Entomology*. **3**: 301-304.

Pasalu, I.C., Katti, G., Krishnamurthy, P., Subbarao, L.V., Reddy, C.S., Subaih, S.V., Krishnaih, N.V. and Prasad, J.S. 2005. Integrated pest management in rice In: *Technical Bulletin*, No. 15, Directorate of Rice Research, Hyderabad. **P**. 53.

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