On Farm and Multi Location Performance of Indigenous Sex Pheromone Lure against Rice Yellow Stem Borer

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Abstract

A series of supervisory male annihilation on-farm and multi locations field trials conducted with YSB lure having 3 mg of (Z)-11-hexadecenal and (Z)-9-hexadecenal at 3:1 ratio loaded in PVC dispensers installed @ 20 traps/ha clearly indicated that the indigenous YSB lure as an effective tool for the management of YSB problem in rice. Reduction in insect pest incidence was also reflected with increase yield and C: B ratio.

Key words: Indigenous, lure, sex pheromone, trap, YSB

Rice is the major staple food crop in India with annual production of 106.29 million tones during 2013-14 (www.oryza.com). Among different crop pests, the Yellow Stem Borer (YSB), *Scripophaga incertulas* (Walker) (Pyralidae: Lepidoptera) with country wide distribution is the most dominant and destructive. It causes yield loss up to 38 to 80 per cent (Dale, 1994). Since stem borer problem extends up to maturity phase of the crop, over dependence on insecticide is considered as undesirable. In the absence of resistant rice varieties against stem borer, there is a need for eco-friendly alternatives for stem borer management.

Insect sex pheromone is a promising tool for the management of YSB because of their natural occurrence, lack of toxicity, high bioactivity, species specificity, long potency and compatibility with other IPM components. Though the use of sex pheromone is a well established technique in rice IPM for monitoring and mass trapping of the insect, so far there has been out sourcing of knowledge and skill that leads to dependence on foreign expertise in molecule synthesis and formulation development. Absence of indigenous formulation has also adds to higher price and non availability of quality lures in sufficient quantity especially in pest out break situation.

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Considering the above issues in view, the present studies were undertaken to develop and demonstrate cost effective indigenous pheromone lure for the management of YSB in rice, so that the technique can be made available in the public system for use against rice stem borer in the country.

Materials and Methods

Designing indigenous pheromone blend for the management of local geographic population of YSB was achieved through different steps which involved synthesis of molecules, screening for biological activity, designing of dispenser and trap, quality control and bio efficacy. The indigenous lure was also aimed at cost effectiveness and timely availability of quality lure in sufficient quantity for the ultimate adoption by the farmers.

The sex pheromone molecule for YSB, (Z)-11-hexadecenal and (Z)-9-hexadecenal were synthesized using the expertise of pheromone laboratory, IICT, Hyderabad. Based on bioactive studies the blend combination having (Z)-11-hexadecenal and (Z)-9-hexadecenal at 3:1 ratio was designed as indigenous YSB lure and was loaded to the pre treated PVC dispenser @ 3mg/lure. The lures were placed in to the polythene sleeve trap and deployed in the field.

Performance of indigenous YSB lure was evaluated for their efficacy in monitoring and mass trapping (male annihilation) of the target pest. The bio efficacy experiments were conducted as, on farm trial during *Kharif* 2009 at farmer's field in Kabisthalam village of Kumbakonam, Tamilnadu. The lure were also tested across different location in the state through Multi Location Trial (MLT) which includes Rice Research Station, Tirur (TIR), Agriculture Research Station, Thirupathisaram (TPS), Plant Breeding Station, Coimbatore (CBE), Anbil Dharmalingam Agricultural College and Research Institute (ADAC&RI), Trichy (TRY) and TRRI, Aduthurai (ADT). In all the trials, for monitoring the lures were used @ 8 traps/ha. The traps were installed at 10 DAT with an inter trap distance of 60 m in a triangular pattern. Trap height was maintained at 0.5 m above the crop canopy. The trap catch threshold of 8 moths/trap/day recommended by Krishnaiah *et al.* (2004) was used for deploying mass trapping. The mass trapping has been done by increasing the number to 20 traps/ha with 20 m x 25 m spacing. Lures were changed at every 21 days till crop harvest. In all the field trials,

care was taken not to use any insecticides. The trap catches were recorded at weekly interval and analyzed statistically. Further, the stem borer damage in terms of Dead Heart (DH) was assessed at 30 and 45 DAT from 100 randomly selected tillers in 1 x1m micro plot. For White Ear (WE) damage, the samples were drawn at 15 days after flowering synchronizing with milk filling and dough stage of the crop. Yield estimation was also made in three 5x5m micro plot in each treatment and reported as kg ha^{-1}. The efficacy of the treatment was assessed by comparing the crop damage, pheromone trap catches and grain yield with untreated control. By adopting partial budgeting procedures the cost benefit ratio was also worked out.

Results and Discussion

On farm performance of indigenous YSB lure

The performance of indigenous YSB lure at the farmer field at Kabisthalam in *kharif* 2009 season revealed low incidence of dead heart in pheromone intercepted plot. Incidence of dead heart at 30 and 45 DAT was 3.20 and 1.70 per cent. In the plot without any pest control, a much higher damage of 8.43 and 7.00 per cent DH was observed at 45 and 30 DAT (Table 1). White ear incidence of 3.90 per cent was observed in pheromone trap installed plot against 10.20 per cent in the control. The highest grain yield of 4567 kg ha^{-1} was recorded in the pheromone trap installed than control plot of 3240 kg ha^{-1}. Returns per additional cost involved in mass trapping were 14 fold and the yield gain was 1327 kg ha^{-1} in pheromone intercepted field.

Performance of indigenous YSB lure under multi location

The mean trap catches in the interception period in the tested multi locations ranged from 19.8 moths/trap in Thirupathisaram (TPS) to a maximum of 34.5 moths/ trap in Coimbatore (CBE) (Table 2). In tillering stage, reduction in dead heart observed was 32.80 per cent in Tirur (TIR) followed 22.40 per cent in Coimbatore. In Thirupathisaram, Aduthurai (ADT) and Trichy (TRY) reduction in dead heart percentage due to indigenous lure installation was 18.60, 4.62 and 14.80 per cent respectively over the untreated control. In Aduthurai at reproductive stage of the crop up to 80.52 per cent reduction in white ear damage was observed. In terms of yield gains, maximum yield of 225 kg ha^{-1} was realized. Following two time mass trapping a yield gain of 208

kg ha^{-1} was realized in Coimbatore and 252 kg ha^{-1} was realized in Trichy (Table 2).

The results of the field trials conducted in on-farm and multi locations trials clearly indicated that the indigenous YSB lure as an effective tool for the management of YSB problem in rice. Reduction in insect pest incidence was also reflected in increase in yield and C:B ratio. The above said findings were in line with the findings of Varma *et al.* (2000), Krishnaiah *et al.* (2004), Tiwary (2004), and Ravi *et al*. (2008) who employed male annihilation technique for the management of YSB in rice.

Conclusions

It was concluded from the study that YSB lure with 3 mg of (Z)-11-hexadecenal and (Z)-9- hexadecenal @ 3:1 impregnated in PVC dispensers recommended @ 20 traps/ha can be used for mass trapping of *S. incertulas*. The technique can reduce the damage level and there by dependence on chemical spray may either be avoided or reduced.

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Table 1: On farm performance of indigenous YSB lure

Treatment	Dead Heart (%)		WhiteEar (%)	Yield (Kg ha^{-1})	CB ratio
	30 DAT	45 DAT			
Pheromone trap installed plot (20 traps ha^{-1})	3.20 (11.09)	1.70^{a} (8.53)	3.90 (12.11)	4567	2.04
Control plot (without any plant protection)	7.00 (15.79)	8.43^{b} (17.46)	10.20 (19.00)	3240	1.51
CD (P= 0.05)	NS	0.55	NS	NS	

Figures in parentheses are transformed values

Table 2: On station multi location performance of indigenous YSB lure

Trap Efficacy Parameters	Locations				
	ADT	TRY	CBE	TPS	TIR
Mean trap catches in the interception period	22.67 (3-32)	22.67 (1-26)	34.50 (0- 32)	19.80 (0- 42)	24.00 (2-26)
Per cent reduction in Dead Heart	14.80	4.62	22.40	18.60	32.80
Per cent reduction in White ear	80.52	25.68	44.50	22.80	44.50
No. of lure replacement (interception at 25,46,57 DAT)	Three	Two	Two	Three	Three
Cost of interception ha^{-1} (@Trap Rs 20; lure Rs 6)	760	640	520	760	760
Yield gain kg ha^{-1}	225	252	208	124	241

Figures in parentheses indicates range in catches (minimum - maximum)