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Efficacy of insecticides on yellow stem borer, *Scirpophaga incertulas* in rice crop

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Abstract
An experiment was conducting during *kharif*, 2013 at Main Experimental Station of Narendra Deva University of Agriculture and Technology, Kumarganj, Faizabad-224 229 (U.P.) to evaluate the efficacy of some insecticides at different doses against the yellow stem borer *scirpophaga incertulas* (Walker) in rice ecosystem. The application of insecticides was done after transplanting, when the pest population reached at their ETL (Economic threshold level). The result shows that among all the insecticides (treatments), profenofos 40 + cypermethrin 4 (44 EC) 880 gm a.i. was most effective against the yellow stem borer, *scirpophaga incertulas* (Walker) (1.25 per cent) followed by profenofos 40 + cypermethrin 4 (44 EC) 440 gm a.i. (1.75 per cent) and conversely protected the crop. The least efficacy of treatment was found in lambda cyhalothrin 5 EC (3.75 per cent) treated plots. All the treatments were found effective and significantly superior over the control.

Keywords: transplanting, pest, population, ETL, efficacy, insecticides, *scirpophaga incertulas*, profenofos, lambda cyhalothrin

1. Introduction
Rice (*Oryza sativa* L.) is one of the most important staple food crop of Asia and a primary stable diet of over half of the world population relying on rice as the major daily source of calories and protein [4]. Asia accounts for about 90% of the world's rice area and production. Among the rice growing countries, India has the largest area under rice in the world (about 44.6 mha) i.e. 28% of the world's area of production, and ranks second next to China. The share of India to the world's production is near about 22.1 percent [2]. Uttar Pradesh contributes 56.57 lakh ha area and 119.92 lakh ton production with productivity of 2.12 t/ha in comparison to Punjab with maximum productivity (3.82 t/ha) of rice in India [1]. Rice yield in south and south-east Asia fluctuate yearly and adverse only about 2 tonnes/ha or less. The two major factors responsible for poor yield are adverse weather (flood, drought, typhoons etc.) and pest epidemic. Present investigation on yellow stem borer *scirpophaga incertulas* (Walker) of paddy was conducted during *kharif*, 2013 at the main Experimental Station of Narendra Deva University of Agriculture and Technology, Kumarganj, Faizabad-224 229 (U.P.) to estimate the effectiveness of insecticides against yellow stem borer. The rice plant is subjected to attack by more than 100 species of insects, 20 of them can cause economic damage. Together they infest all parts of the plant at all growth stages, and a few transmit viral diseases [5]. Rice yellow stem borer (YSB), *Scirpophaga incertulas* (Walker) of national importance as their incidence has significant impact on rice yields across the diverse rice ecosystems.

2. Materials and Methods
The experiment was conducted during the kharif of 2013, at Main Experimental Station of Narendra Deva University of Agriculture and Technology, Kumarganj, Faizabad-224 229 (U.P.) in a Randomized Block Design (RBD) with eight treatments and four replications in plot size measuring 11 x 5 sqm. The treatments were *viz.*, Profenofos 40%+ Cypermethrin4% (44) EC @ 220 (g./ha.), Profenofos 40%+ Cypermethrin4% (44) EC @ 330 (g./ha.), Profenofos 40%+ Cypermethrin4% (44) EC @ 440 (g./ha.), Profenofos 40%+ Cypermethrin4% (44) EC @ 880 (g./ha.), Profenofos 50 EC, Cypermethrin 10EC and Lamda cyhalothrin 5 EC including an untreated or control against yellow stem borer *Scirpophaga incertulas* (Walker). The insecticides were applied as and when the pest population reached at their ETL (Economic threshold level) with their respective doses as mentioned in Table-1.

The insecticides were sprayed in their respective doses by diluting in sufficient amount of water (based on crop stage) with the help of Knapsack sprayer fitted with hollow cone nozzle. The incidence of insects was recorded one day before of spray as pre-treatment observation and post treatment observations were taken at 7and 15 after spraying different times depending on infestation by insects. The total number of tillers/panicles and total damaged tillers (DH /WE) were counted on 10 randomly selected hills in each plot for calculating the damaged per cent with following formula.

$$\text{Damage per cent} = \frac{\text{Total numbre of dead hearts/hills}}{\text{Total no. of tillers/hills}} \text{x} 100$$

The yield per plot was recorded and computed on hectare basis.

Table 1: Relative efficacy of insecticides against rice yellow stem borer on rice during *kharif*, 2013.

Sl. No	Treat-ment No.	Insecticides	Doses (g. ai/ha	Mean per cent damage by stem borer		
				Pre-treatment	7DAS	15DAS
1	T1	Profenofos + Cypermethrin 44 EC	220	5.46 (2.44)	4 (2.12)	3.5 (2.00)
2	T2	Profenofos + Cypermethrin 44 EC	330	5.50 (2.45)	3.5 (2.00)	2.5 (1.73)
3	T3	Profenofos + Cypermethrin 44 EC	440	4.74 (2.28)	3 (1.87)	1.75 (1.50)
4	T4	Profenofos + Cypermethrin 44 EC	880	4.47 (2.22)	2.75 (1.80)	1.25 (1.32)
5	T5	Profenofos 50 EC	500	5.75 (2.50)	3.75 (2.06)	2.75 (1.80)
6	T6	Cypermethrin 10 EC	50	6.00 (2.55)	4.25 (2.18)	3.75 (2.06)
7	T7	Lambda cyhalothrin 5 EC	12.5	4.75 (2.29)	4.25 (2.18)	3.75 (2.06)
8	T8	Untreated	0	5.75 (2.50)	9.5 (3.16)	12 (3.53)
SEm±				0.086	0.049	0.056
CD				NS	0.15	0.17

3. Result and Discussion

The stem borer infestation was observed at 15 days after transplanting. The pre count of population of yellow stem borer, *Scirpophaga incertulas* (Walker) was non-significant showing the even distribution (which ranged from 4.74 to 5.75 per cent dead hearts, Table-1). At seven days after treatment of insecticide, the borer infestation varied from 2.75 to 9.50 per cent, all the treatments were found effective and significantly superior over the control. The minimum dead heart (2.75 per cent) was recorded in profenofos 40 + cypermethrin 4 (44 EC) 880 gma.i.treated plot which was significantly superior over profenofos 40 + cypermethrin 4 (44 EC) 440 g. a.i.(3.00 per cent) followed by profenofos 40 + cypermethrin 4 (44 EC) 330 g. a.i.(3.50 per cent), profenofos 50 EC (3.75 %) treated plot as compared with untreated (9.5 %) control.

The infestation done by yellow stem borer in rice was also recorded at 15 DAT ranged from 1.25 to 12.00 per cent. The minimum incidence of dead hearts (1.25 %) was observed in profenofos 40 + cypermethrin 4 (44 EC) 880 g. a.i. treated plot followed by profenofos 40 + cypermethrin 4 (44 EC) 440 g. a.i.(1.75%), profenofos 40 + cypermethrin 4 (44 EC) 330 g. a.i.(2.50%), profenofos 50 EC (2.75 %), profenofos 40 + cypermethrin 4 (44 EC) 220 g. a.i.(3.50%), cypermethrin 10 EC(3.75) and lambda cyhalothrin 5 EC (3.75). The cypermethrin 10 EC and lambda cyhalothrin 5 EC treated plot were found at par with each other, but differed significantly from the rest of the treatments (Table-1). These results contradict the findings of [3], who reported that numerically least damage was noted for imidacloprid 17.8 SL (100 ml/ha), followed by carbofuran 3G (30 kg/ha), fipronil 0.3G (750 ml/ha), monocrotophos 36 WSC (1125 ml/ha), propenphos 50 EC (500 ml/ha), bifenthrin 10 EC (500 ml/ha) and chlopyriphos 20EC (1875 ml/ha) [6] support the present findings to confirm that nuvacron (monocrotophos 36 WSC) was observed as the most effective chemical with minimum stem borer infestation (0.50% DH & 0.27% WEH) and maximum grain yield of 6.30 t/ha. Confidor (imidacloprid 17.8 EC) and roket (profenophos 40% + cypermethrin 4%) was comparable with nuvacron in terms of reduction in stem borer infestation and yield. It can be concluded that insecticide mixture formulation containing pesticide like propenphos can be used in combination with cypermethrin as an important component of pest management programme for suitable management of yellow stem borer in rice.

3.1 Effect of treatments on rice grain yield

The effectiveness of treatments determined on the basis of grain yield obtained in different treatments during the *Kharif*, 2013 have been presented in (Table-2).

During *Kharif* 2013, the data on grain yield in all treatments were found significantly superior over check (untreated or control). Profenofos 40 + cypermethrin 4 (44 EC) 880 g. a.i ha^{-1} treated plots gave a maximum grain yield (46.14 q ha^{-1}), which differed significantly based on grain yield, the effective treatments in order of their superiorities were Profenofos 40 + cypermethrin 4 (44 EC) 440 g. a.i (41.82 q ha^{-1}) > Profenofos 40 + cypermethrin 4 (44 EC) 330 g. a.i (38.86 q ha^{-1}) > Profenofos 50EC (39.55q ha^{-1}) > Profenofos 40 + cypermethrin 4 (44 EC) 220 g. a.i (q ha^{-1}) > cypermethrin 10 EC(q ha^{-1}) > lambda cyhalothrin 5 EC > and untreated control (q ha^{-1}).

Table 2: Effect of treatments on grain yield of paddy during *Kharif*, 2013.

Sr. No.	Treatments	Yield per Plot (Kg./Plot)	Yield per Hectare (Quintal/ Hectare)
1	Profenofos 40 + Cypermethrin 4 (44 EC (220 gm a.i.)	20.13	36.59
2	Profenofos 40 + Cypermethrin 4 (44 EC) (330 gm a.i.)	21.38	38.86
3	Profenofos 40 + Cypermethrin 4 44 EC (440 gm a.i.)	23.00	41.82
4	Profenofos 40 + Cypermethrin 4 (44 EC) (880 gm a.i.)	25.38	46.14
5	Profenofos 50 EC	21.75	39.55
6	Cypermethrin 10EC	19.13	34.77
7	Lambda cyhalothrin 5 EC	18.38	33.41
8	Control	15.63	28.41

CD – 1.753 (For Yield / Plot)
CD – 3.187 (For Quintal / Hectare)
SEm ± -0.596 (For Yield / Plot)
SEm± -1.084 (For Yield / Quintal)

3.2 Economics of treatments

The economics of the treatments was determined in term of cost:benefit ratio. The cost:benefit ratios of treatments during *Kharif*, 2013 have been presented in Table-3. The maximum Cost: Benefit ratio was obtained in plot treated with profenofos +cypermethrin 44% EC @ 440g.a.i./ha (1:8.1) followed by profenofos +cypermethrin 44% EC @ 330g.a.i./ha (1:7.8). The maximum net income of Rs 37049.00`/ha was obtained in profenofos +cypermethrin 44 EC @ 880g.a.i./ha treated plot followed by profenofos +cypermethrin 44 EC @ 440g.a.i./ha (34137.00`/ha). The cost: benefit ratio of other treatments observed in descending order were profenofos 50 EC (1:7.1), profenofos +Cypermethrin 44 EC @ 880 g.a.i./ha (1:6.9), profenofos + cypermethrin 44 EC @ 220 g.a.i./ha (1:6.8), cypermethrin 10 EC (1:6.1) and lambda cyhalothrin 5 EC (1:5.2) and net income (`/ha) of other treatments observed in descending order were profenofos + cypermethrin 44% EC @ 330g.a.i./ha (Rs 32397.00`/ha), profenofos 50 EC (Rs 31781.00/ha), profenofos +Cypermethrin 44% EC @ 220g.a.i./ha (Rs 30071.00 `/ha), cypermethrin 10 EC (Rs 28695.00`/ha) and lambda cyhalothrin 5 EC (Rs 27573.00`/ha).

Table 3: Economics of management practices of insect-pests during *kharif*, 2013.

Treatment No.	Quantity of required lit./ha/ treatment	Cost of insect-cides ₹/ha	Total cost of prote-ction ₹/ha	Yield q/ha	Yield saved over control q/ha	Value of saved yield ₹/ha	Gross income ₹/ha	Net income ₹/ha	Cost Benefit Ratio
Profenofos 40% + Cypermethrin 4% (44%) EC (220 gm a.i.)	0.5	760	1030	36.59	8.18	6953	31101	30071	1:675
Profenofos 40% + Cypermethrin 4% (44%) EC (330 gm a.i.)	0.75	760	1220	39.55	11.14	9469	33617	32397	1:7.76
Profenofos 40% + Cypermethrin 4% (44%) EC (440 gm a.i.)	1	760	1410	41.82	13.41	11398	35547	34137	1:8.08
Profenofos 40% + Cypermethrin 4% (44%) EC (880 gm a.i.)	2	760	2170	46.14	17.73	15070	39219	37049	1:6.9
Profenofos 50 EC	1	600	1250	38.86	10.45	8882	33031	31781	1:7.1
Cpermethrin 10 EC	0.5	450	875	34.77	6.36	5406	29554	28695	1:6.1
Lambda cyhalothrin 5% EC	0.25	700	825	33.41	5	4250	28398	27573	1:5.15
Untreated	-	-	-	28.41	-	-	-		

Cost of treatment= cost of insecticide+ cost of labour charge+ cost of sprayer
Labour charge= ₹ 150x4=600
Rent of sprayer= ₹ 50
Price of product = ₹ 850/q

4. Conclusion

It can be concluded that out of Profenofos 40 + cypermethrin 4 (44 EC) 880 g. a.i ha^{-1} treated plots gave a maximum grain yield (46.14 q ha^{-1}), which differed significantly based on grain yield, the effective treatments in order of their superiorities were Profenofos 40 + cypermethrin 4 (44 EC) 440 g. a.i (41.82 q ha^{-1}) > Profenofos 40 + cypermethrin 4 (44 EC) 330 g. a.i (38.86 q ha^{-1}) > Profenofos 50EC (39.55q ha^{-1}) > Profenofos 40 + cypermethrin 4 (44 EC) 220 g. a.i (q ha^{-1}) > cypermethrin 10 EC(q ha^{-1}) > lambda cyhalothrin 5 EC > and untreated control (q ha^{-1}).

The maximum Cost: Benefit ratio was obtained in plot treated with profenofos +cypermethrin 44% EC @ 440g.a.i./ha (1:8.1) followed by profenofos +cypermethrin 44% EC @ 330g.a.i./ha (1:7.8).

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