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Field efficacy of certain insecticide molecules against yellow stem borer, *Scirpophaga incertulas* (Walker) in rice at Prayagraj U.P

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Abstract
A field experiment was conducted at Crop Research Farm, Dept of Entomology, NAI, SHUATS, Prayagraj in 2019-20 *Kharif* season to assess the "Field efficacy of certain insecticide molecules against Stem Borer *Scirpophaga incertulas* (Walker) in rice at Prayagraj U.P". The experiment was laid out in Randomized Block Design, replicated thrice and consisted of 8 treatments. The results revealed that some certain insecticide molecules applied in field for Stem borer has significant effect on Mean% Dead hearts of several spray, yield and also in economics of Basmati rice over control plot. Treatment T_5 (Chlorpyriphos @ 2.0 ml/L) performed significantly lower than the other treatments with Mean% Dead hearts after first spray (10.68) and Treatment T_4 (Monocrotophos @2ml/L) and Treatment T_6 (Spinosad @ 0.3ml/L)(11.26 and 11.84 respectively) are statistically at par with Treatment T_5 (Chlorpyriphos @ 2.0 ml/L). Treatment T_4 (Monocrotophos @2ml/L) performed significantly lower than the other treatments with Mean% White ears after second spray (9.23) and Treatment T_5 (Chlorpyriphos @ 2.0 ml/L) is statistically at par (9.77) with Treatment T_4 (Monocrotophos @2ml/L). Treatment T_4 (Monocrotophos @2ml/L) performed significantly lower than the other treatments with Mean Percentage Damage reduction of Dead hearts and White ears after (59.76%) and Treatment T_5 (Chlorpyriphos @ 2.0 ml/L) is statistically at par (59.63%) with Treatment T_4 (Monocrotophos @2ml/L) . After that Treatment T_4 (Monocrotophos @2ml/L) also performed significantly higher in yield (21.75 q/ha) and in economic (1:4.71 B:C ratio). This research depicts that use of Monocrotophos will be the best for suppressing the rice stem borer and increasing productivity of Basmati rice.

Keywords: *Scirpophaga incertulas* (Walker), dead heart, white ear, basmati rice, efficacy, productivity

Introduction
Asian rice, *Oryza sativa*; today one of the most widely grown and productive of world crops, which had its origins in southern and eastern Asia. In world the total production of rice is 463.3 million tonnes **.** India is world's second largest rice producer and consumer next to China. Total area under rice in India is 45.4 million hectare with annual production of 99.2 million tonnes and productivity is 2.18 tonnes/ha. (Anonymous, 2011) [1]. India occupied a total area of 43.79 million hectares in rice production with annual productivity of 112.91 tonnes and yield of 2578 kg/hectare during 2017-2018. (Agricultural statistics at a glance, 2018) [2]. The rice variety *Oryza sativa* is attacked by Yellow stem borer (*Scirpophaga incertulas*) causing dead hearts in younger plants (Patel and Singh 2017) [3]. Larva enters in the stem by boring it, feeds there, matures and subsequently pupates (Sarwar, 2012) [4]. If stem borer infestation occurs during vegetative growth stage, then it results in formation of dead hearts. And if the infestation occurs in reproductive stage of the crop, then it causes the damage of the growing panicle resulting in white ear head symptoms. Yellow stem borer, *Scirpophaga incertulas* (Walker) can cause 25-30 percent damage to the crop as "dead hearts" in vegetative stage and white ears with chaffy grains during heading stage (Rath, 2011 and Sachan *et al.*, 2006) [5, 6]. Fipronil disrupts nerve influx transmission (e.g., passage of chloride ions) by targeting the GABA-gated (γ- aminobutyric acid) chloride channel and at sufficient doses leading to excessive neural excitation, severe paralysis, and insect death (Aajoud *et al.*, 2003; Bobe *et al.*, 1998; Gant *et al.*, 1998) [7-9]. Phorate is an organophosphorus work by tying up or inhibiting cholinesterase (ChE). Cartap has been recognized as an analog of nereistoxin which is a neurotoxic substance initially isolated from the annelid *Lumbriconereis heteropoda*. Its primary action was earlier considered to be by direct action on and inhibition of the postsynaptic nicotinic acetylcholine receptor (AChR) ion channels.

Monocrotophos is a direct acting cholinesterase inhibitor capable of penetration through the skin. Cholinesterase inhibiting activity causes nervous system effects. (Extension Toxicology Network).
Chlorpyriphos is a broad-spectrum insecticide which kills insects upon contact by affecting the normal function of the nervous system. Chlorpyriphos affects the nervous system by inhibiting the breakdown of acetylcholine (ACh), a neurotransmitter. Spinosyns are a class of insecticides with a broad range of action against many insect pests belonging to different orders. They act as allosteric activators of nicotinic acetylcholine receptors (Bacci *et al.*, 2016) [10]. Profenofos is a neurotoxin acting as a cholonesterase inhibitor in insect nervous system.

Materials and Methods
The experiment was conducted during the kharif season 2019 at Sam Higginbottom University of Agriculture Technology And Sciences Rewa road Prayagraj UP, Central research field, Prayagraj, is situated at 25.4358° North latitude, 81.8463° East longitude and at an altitude of 98mts above sea level.

Preparation of Insecticidal Treatments
A measured quantity of insecticidal solution or powder was mixed with a little quantity of water and stirred well, after which the remaining quantity of water was added to obtain the required concentration of spray fluid. Sprayings were given by using a hand compression sprayer during evening hours. The plot in each treatment was sprayed with respective insecticides ensuring uniform coverage of insecticide. The sprayer and the accessories were thoroughly washed before changing the insecticides and also rinsed with the spray fluid of the chemical to be applied next.
The spray solution of desired concentration will be prepared by adopting the following formula,

$$V = \frac{C \times A}{\%\ a.i.}$$

Where,
V = Volume of a formulated pesticide required. C = Concentration required.
A = Volume of solution to be prepared.
% a.i. = Percentage active ingredient

Methodology
The observations on the number of rice yellow stem borer pest were recorded from the ten randomly selected and tagged plants from each plot. The observations were recorded a day before followed by 3rd, 7th, 14th days after spraying. Dead hearts and White ears due to rice yellow stem borer pest was recorded from each net plot and the population was worked out per plant.

The percent dead hearts and white ears calculated by using given formula.

- $$\text{Percent of Dead hearts} = \frac{\text{Total number of dead hearts}}{\text{Total number of tillers}} \times 100$$ [11] Om Prakash *et al.* (2017)
- $$\text{Percent of White ears} = \frac{\text{Total number of white ears}}{\text{Total number of tillers}} \times 100$$ [11] Om Prakash *et al.* (2017)

% Dead heart/ White-ear head reduction over control using Abbott's formula

- $$\text{Corrected\% dead –heart/ white-ear head Damage reduction} = \frac{[1 - \text{n in T after treatment}]}{\text{n in Co after treatments}}$$

Where,
n= no. of Dead-heart/ White-ear head: T = Treated: Co = Control

Statistical analysis
Experimental data collected was subjected to statistical analysis by adapting fisher's method of analysis of variance (ANOVA) as outlined by (Gomez and Gomez, 1984) [12]. Critical Differences (CD) were calculated with F-test was found significant at 5% level.

Results and Discussion
Mean of three, seven and fourteen days after 1st spray
All the insecticides were found to be significantly superior over control in reducing the infestation percent of stem borer which were the mean of three, seventh and fourteen days after insecticidal application. T_5 Chlorpyriphos was found significantly superior (10.68%) and these findings are supported by the Sawant *et al.* (2019) [13]. Monocrotophos was found to be the best next. The results of Monocrotophos were supported by Sharanappa *et al.* (2017) [14]. The next best treatment was Spinosad. The results were supported by Chatterjee *et al.* (2014) [15]. Profenophos is the next best treatment and was supported by Patidar *et al.* (2018) [16] and Devendra *et al.* (2018) [17]. Cartap is the next best treatment similar to the findings of Fakruddin *et al*, (2017) [18]. The treatment Fipronil was found next best and similar results were recorded by Hedge *et al*, (2017) [19]. Phorate is the least best treatment and is similar to the findings of Om Prakash *et al.*, (2017) [11].

Mean of three, seven and fourteen days after 2nd spray
All the insecticides were found to be significantly superior over control in reducing the infestation percent of stem borer which were the mean of three, seven and fourteen DASS after insecticidal application. Monocrotophos was found significantly superior (9.23%), The results of monocrotophos were supported by Sharanappa *et al*. (2017) [14]. Chlorpyriphos was found to be next best treatments. These findings are supported by the Sawant *et al*. (2019) [13]. Cartap is the next

best treatment similar to the findings of Fakruddin *et al.* (2017) [18]. The next best treatment was spinosad. The results were supported by Chatterjee *et al.* (2014) [15]. Profenophos is the next best treatment and was supported by Patidar *et al.* (2018) [16] and Devendra *et al.* (2018) [17]. The treatment Fipronil was found next best and similar results were recorded by Hedge *et al.* (2016) [19]. Phorate is the least best treatment and is similar to the findings of Om Prakash *et al.*, (2017) [11].

% damage reduction after 1st spray at dead heart

The data on percent damage reduction of Yellow stem borer *Scirpophaga incertulas* over control after 3, 7 and 14 days after spraying revealed that all the treatments were significantly superior over control. Among all the treatments T_5 Chlorpyriphos recorded highest reduction of *Scirpophaga incertulas* damage i.e., (60.24%) which was significantly superior over control followed by T_4 Monocrotophos (58.32), T_6 Spinosad (55.96), T_7 Profenophos (47.85), T_3 Cartap (47.17), T_1 Fipronil (46.42) and T_2 Phorate (32.1) was least effective among all the treatment.

% damage reduction after 2nd spray at white ear head

The data on percent damage reduction of Yellow stem borer *Scirpophaga incertulas* over control after 3, 7 and 14 days after second spraying revealed that all the treatments were significantly superior over control. Among all the treatments T4 Monocrotophos recorded highest reduction of *Scirpophaga incertulas* damage i.e.,(61.2) which was significantly superior over control followed by T5 Chlorpyriphos (59.03), T3 Cartap (57), T6 Spinosad (54.57), T7 Profenophos (52.55), T1 Fipronil (37.27) and T2 Phorate (33.98) was least effective among all the treatments.

Economics

The best and most economical treatment was Monocrotophos (1:4.76), followed by Chlorpyriphos (1:4.71),Cartap (1:4.3), Profenophos (1:4.3), Spinosad (1:4.24), fipronil (1:3.90) and Phorate (1:3.30) as compared to control (1:2.51) .The above mentioned cost benefit ratios are similar to [14] Sharanappa *et al.*, (2017), Monocrotophos and chlorpyriphos shows highest cost benefit ratio having (1:3.24) and (1:3.18)

Table 1: Effect of certain insecticide molecules on Percent infestation, damage reduction, yield and economics of Yellow Stem Borer, *Scirpophaga incertulas* (Walker) in rice

Serial No.	Treatments	Mean% dead hearts	Mean% white ears	% dead hearts damage reduction	% white ears damage reduction	% mean damage reduction	Yield (q/ha)	B:C Ratio
1	Fipronil	14.38	14.99	46.42	37.27	41.84	36.50	1:3.90
2	Phorate	18.26	15.75	32.10	33.98	33.04	30.75	1:3.30
3	Cartap	14.35	10.25	47.17	57.00	52.08	41.75	1:4.30
4	Monocrotophos	11.26	9.23	58.32	61.20	59.76	44.00	1:4.76
5	Chlorpyriphos	10.68	9.77	60.24	59.03	59.63	43.25	1:4.71
6	Spinosad	11.84	10.81	55.96	54.57	55.26	40.75	1:4.24
7	Profenophos	14.07	11.27	47.85	52.55	50.20	39.75	1:4.30
8	Control	26.89	23.93	00.00	00.00	00.00	22.25	1:2.51
	F-test	S	S	S	S	S	-	-
	CV	9.660	4.1079	11.5628	3.8186	8.3140	-	-
	CD (5%)	2.57	0.9515	10.2286	3.4516	10.2250	-	-

Conclusion

It could be concluded that for the management of Rice yellow stem borer *(Scirpophaga incertulas)* on Rice crop, recommended insecticidal schedule of Monocrotophos proved to be most effective and economical. The use of treatments such as Chlorpyriphos, Cartap hydrochloride, Spinosad, Profenophos, Fipronil for the management is also effective. However, the application Phorate, could not exert encouraging role for Rice yellow Stem borer management.

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