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Evaluation of different insecticides against rice yellow stem borer, *Scirpophaga incertulas* (Walker)

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Abstract
The experiment was conducted at Research cum Instructional Farm of Shaheed Gundadhoor College of Agriculture and Research Station, Kumhrawand, Jagdalpur, Bastar (C.G.) during *Kharif* 2021 to evaluate different insecticides against yellow stem borer of rice. Based on mean of three observations results showed that, T_8 (Fipronil 0.3 GR 2.5 g/m^2+ Cartap hydrocholoride 4% GR @ 1.9 g/m^2) was found to be most effective against yellow stem borer with 1.13% DH and 84.10 percent reduction over control (ROC). The highest infestation of yellow stem borer was recorded in the untreated control plots throughout the experimental periods.

Keywords: Bastar, rice, yellow stem borer, insecticide, evaluation

Introduction
Rice (*Oryza sativa* L.) is one of the cultivated graincrops in India as well as in Asia countries and a staple diet in major parts of India (Rani and Venkatesh 2018) [11]. A whole production of rice during 2020–21 was recorded 121.46 million tonnes. It was 9.01 million tonnes higher than the previous 5-year average of 112.44 million tonnes (Bidari *et al*. 2021) [2]. Rice fields are environmental buffers and they are a dynamic ecosystem. Because of these certain characteristics, at least 300 insect pests attack rice fields at different stages, although only 23 of them really cause significant damage (Kalode and Pasalu, 1986) [3]. Among them, the yellow stem borer, *Scirpophaga incertulas*, is the major culprits for huge economic crop losses of rice (Seni and Naik, 2017) [9]. Yellow stem borer is one of the most destructive pest and is widely distributed monophagous pest in the India subcontinent and has assumed the number one pest status and attacks the rice crop at all the growth stages (Morshed *at al.*, 2020) [6].
Chhattisgarh state, popularly known as the "rice bowl of India" covers around 3.51 million acres of rice cultivation. Rice is grown on an average of 3.77 million hectares in Chhattisgarh, with productivity ranging from 1.2 to 1.6 t/ha and a total production of 8.58 MT, mostly from rain fed (Pradhan *et al*. 2018) [8]. Rice is the important crop in Bastar and grown in about 4.63 lakh hectare area, which covers 70 percent of the net sown area (Netam and Gupta, 2015) [7]. In Chhattisgarh region various rice pests cause losses up to 20 percent every year to rice crop. In Chhattisgarh major pest in rice production is yellow stem borer, *Scirpophaga incertulas* Walker (Anonymous, 2009) [1]. For managing this economic important rice pest various management tactics has adopted by earlier researchers *viz.* cultural, physical, mechanical, biological, chemical and planting of resistant cultivars that have resistance to insects are employed to reduce the damage caused by this pest. Most of the insecticides are too expensive for the resource poor farmers whose main cultivable crop is rice (Mina *et al*., 2013) [5]. Among management practices mostly and repeatedly chemical practices are using by farmers. Due to the repeated use, they cause 3 Rs like resistant, resurgence and residue. So, for the alternate option is change the old molecules of insecticides. In this context, present trail was conducted to evaluate the relative efficacy of various insecticides both at nursery and tillering stage against rice yellow stem borer for effective management of the pest.

Materials and Methods
Field experiment was conducted on rice variety Swarna to evaluate the different insecticides against the incidence of yellow stem borer. The experiment was conducted in Research cum Instructional Farm of SGCARS, Jagdalpur during *Kharif* season 2021-22. The crop was transplanted with spacing 20 x 15 cm, plot size 20 m^{2}and randomized block design in three

replications. Schedules of insecticide application was: 1st application: seed treatment (9th July 2021), 2nd application: nursery treatment (5th Aug. 2021) and 3rd application: field application (6th Sep. 2021). Observations were recorded at 35, 50 and 65 DAT days after transplanting. Three sprays were applied at seed treatment, nursery and main field on rice crop. The percent incidence of yellow stem borer (*S. incertulas*) in term of dead heart and white ear head were recorded from ten hills in each plot at tillering and panicle stages respectively and incidence was recorded at weekly interval after one month of transplantation to harvesting of crop. The percent damage was calculated by using following formula:

$$\text{Percent dead heart} = \frac{\text{Number of dead hearts}}{\text{Total number of tillers}} \times 100$$

$$\text{Percent white ears} = \frac{\text{Number of white ears head}}{\text{Total productive tillers}} \times 100$$

Damage reduction percent over the control

Damage percentage of major insect pests was observed under different pest management treatments and percent change in damage was calculated according to formula:

$$\text{DROC\%} = \frac{C-T}{T} \times 100$$

Where,
T = Damage percentage from treated (protected) plot
C = Damage percentage from untreated (control) plot

Table 1: Details about the insecticidal treatments:

Crop Stage	Treatments		Dosage (g/ m^2 or ml/L)	Dose/ha
Seed Treatment	T_1	Thiamethoxam 25% WG	4 g	80 g
Nursery	T_2	Carbofuran 3% GR (Check)	3.3 g	3 kg
	T_3	Fipronil 0.3 GR	2.5 g	2.5 kg
Main field	T_4	Chlorantraniliprole 0.4 GR	1.0 g	10 kg
	T_5	Cartap hydrocholoride 4% GR	1.9 g	19 kg
	T_6	Thiamethoxam 12.6% + Lambda-cyhalothrin 9.5% ZC	0.4 ml	200 ml
Seed treatment + main filed	T_7	Thiamethoxam 70% WS + Chlorantraniliprole 0.4 GR (T_1 + T_4)	1 g	10 kg
Nursery + main field	T_8	Fipronil 0.3GR + Cartap hydrocholoride 4% GR (T_3+ T_5)	1.9 g	19 kg
Untreated control	T_9	Untreated control	-	-

Result and Discussion

Incidence of dead hearts (DH) at 35 DAT (days after transplanting)

The pooled data of impact of insecticides used against Rice yellow stem borer in term of dead hearts (DH) were recorded non-significant result and pest varied from 1.34 to 4.38 percent /hill.

Incidence of dead hearts (DH) at 50 DAT (days after transplanting)

On 50 DAT, the data of insecticidal treatments used against Rice yellow stem borer in term of dead hearts (DH) gave rise to the significant result. The minimum dead hearts incidence was recorded when applied T_8- Fipronil 0.3 GR @ 2.5 g/ m2 + Cartap hydrocholoride 4% GR @ 1.9 g/m^2 in reducing the incidence of dead hearts (0.85 DH%) which was at par with T_5- Cartap hydrocholoride 4% GR @ 1.9 g/m^2 (0.89 DH%), T_4- Chlorantraniliprole 0.4 GR @ 1.0 g/m^2 (1.00 DH%) followed by T_6- Thiamethoxam 12.6% + Lambda-cyhalothrin 9.5% ZC @ 0.4 ml/L (1.40 DH%), T_7- Thiamethoxam 25% WG @ 4 g/kg seed + Chlorantraniliprole 0.4 GR 1.0 g/m^2 (T1 + T4) 1.98 DH%, T_3- Fipronil 0.3 GR @ 2.5 g/ m^2 (2.07 DH%), T_2- Carbofuran 3% GR (Check) @ 3.3 g/ m^2 (2.51 DH%). The highest incidence of dead hearts (7.08 DH%) was received in case of untreated plot.

Incidence of dead hearts (DH) at 65 DAT (days after transplanting)

The pooled data of impact of insecticides used against Rice yellow stem borerin term of dead hearts (DH) were recorded significant result. The minimum Damage was found in term of dead hearts in the treatment T_8- Fipronil 0.3 GR @ 2.5 g/m^2 + Cartap hydrocholoride 4% GR (T3+ T5) 1.9 g/m^2 in reducing the incidence of dead hearts (1.20 DH%) which was at par with T_5- Cartap hydrocholoride 4% GR 1.9 g/m^2 (1.75 DH%), T_4- Chlorantraniliprole 0.4 GR 1.0 g/m^2 (2.00 DH%), followed by T_7- Thiamethoxam 25% WG@4 g/kg seed + Chlorantraniliprole 0.4 GR @ 1.0 g/m^2 (T1 + T4) 1.0 g/m^2 (2.35 DH%), T_6- Thiamethoxam 12.6% + Lambda-cyhalothrin 9.5% ZC @ 0.4 ml/L (2.40 DH%), T_3- Fipronil 0.3 GR @ 2.5 g/m^2 (3.83 DH%), T_2- Carbofuran 3% GR (Check) 3.3 g/m^2 (6.26 DH%). The highest incidence of dead hearts (9.87 DH%) was received in T_9 (untreated control).

Overall efficacy after three observations

Overall mean of three observation (35, 50, 65 DAT) the data pertaining to the efficacy of insecticides against rice yellow stem borer has been pooled and presented in Table 3.Among treatments, most effective treatment was T_8 -Fipronil 0.3 GR @ 2.5 g/m^2+ Cartap hydrocholoride 4% GR @ 1.9 g/m^2 (T_3+ T_5) 1.13% (Dead hearts) with 84.10 percent reduction over control (ROC) which was on par with T_5-Cartap hydrocholoride 4% GR @ 1.9 g/m^2 (1.53% DH) with 78.48% (ROC), T_4-Chlorantraniliprole 0.4 GR @ 1.0 g/m^2 (1.70% DH) with 76.09% (ROC) and T_6 -Thiamethoxam 12.6% + Lambda-cyhalothrin 9.5% ZC @ 0.4/L (1.83% DH) with 74.26% (ROC), for stem borer management (Table 2).

Previous researcher, Seni and Naik (2017) [9] who observed that the Rynaxypyr 20 SC @ 30 g a.i/ha was found most effective against YSB followed by cartap hydrochloride 50 SP @ 375 g a.i/ha, fipronil 5 SC @ 75 g a.i/ha and acephate 95 SG @ 682 g a.i /ha. Sitesh *et al.* (2015) [10] also reported that the dead heart incidence was found lowest in Chlorantraniliprole 0.4% G when applied in seedbed.

Table 2: Efficacy of insecticides against stem borer under field condition.

Crop Stage	Treatments		Dosage	Mean damage of stem borer				
				35 DAT	50 DAT	65 DAT	Overall mean	ROC%
Seed Treatment	T_1	Thiamethoxam 25% WG	4 g/kg seed	3.98 (2.19) ^{g}	2.74 (1.89) ^{h}	6.31 (2.59) ^{h}	4.34 (2.22) ^{h}	38.96
Nursery alone (15 DAS/ one week before transplanting)	T_2	Carbofuran 3% GR (Check)	3.3 g/ m2	2.70 (1.89) ^{f}	2.51 (1.82) ^{egh}	6.26 (2.64) ^{g}	3.82 (2.12) ^{g}	46.24
	T_3	Fipronil 0.3 GR	2.5 g/ m2	3.98 (2.19) ^{h}	2.07 (1.71) ^{ef}	3.83 (2.15) ^{f}	3.29 (2.02) ^{f}	53.72
Main field (20-25 DAT)	T_4	Chlorantraniliprole 0.4 GR	1.0 g/ m2	2.10 (1.69) ^{e}	1.00 (1.38) ^{abc}	2.00 (1.66) ^{abc}	1.70 (1.58) ^{bc}	76.09
	T_5	Cartap hydrocholoride 4% GR	1.9 g/ m2	1.94 (1.71) ^{d}	0.89 (1.35) ^{ab}	1.75 (1.66) ^{ab}	1.53 (1.57) ^{b}	78.48
	T_6	Thiamethoxam 12.6% + Lambda-cyhalothrin 9.5% ZC	0.4 ml/L	1.70 (1.58) ^{c}	1.40 (1.50) ^{abcd}	2.40 (1.83) ^{de}	1.83 (1.64) ^{dcd}	74.26
Seed treatment + main filed	T_7	Thiamethoxam 25% WG + Chlorantraniliprole 0.4 GR (T1 + T4)	1.0 g/ m2	1.67 (1.57) ^{b}	1.98 (1.68) ^{e}	2.35 (1.82) ^{d}	2.00 (1.69) ^{e}	71.90
Nursery+ Mainfield	T_8	Fipronil 0.3 GR + Cartap hydrocholoride 4% GR (T3+ T5)	1.9 g/ m2	1.34 (1.49) ^{a}	0.85 (1.34) ^{a}	1.20 (1.48) ^{a}	1.13 (1.44) ^{a}	84.10
Untreated control	T_9	Untreated control	-	4.38 (2.26) ^{i}	7.08 (2.84) ^{i}	9.87 (3.29) ^{i}	7.11 (2.80) ^{i}	0.00
C.D (p=0.05)				N/A	0.75	0.84	0.7	
Sem (±)				0.3	0.25	0.28	0.23	
C.V (%)				28.52	24.78	22.57	21.18	

*ROC%: reduction percent over control.

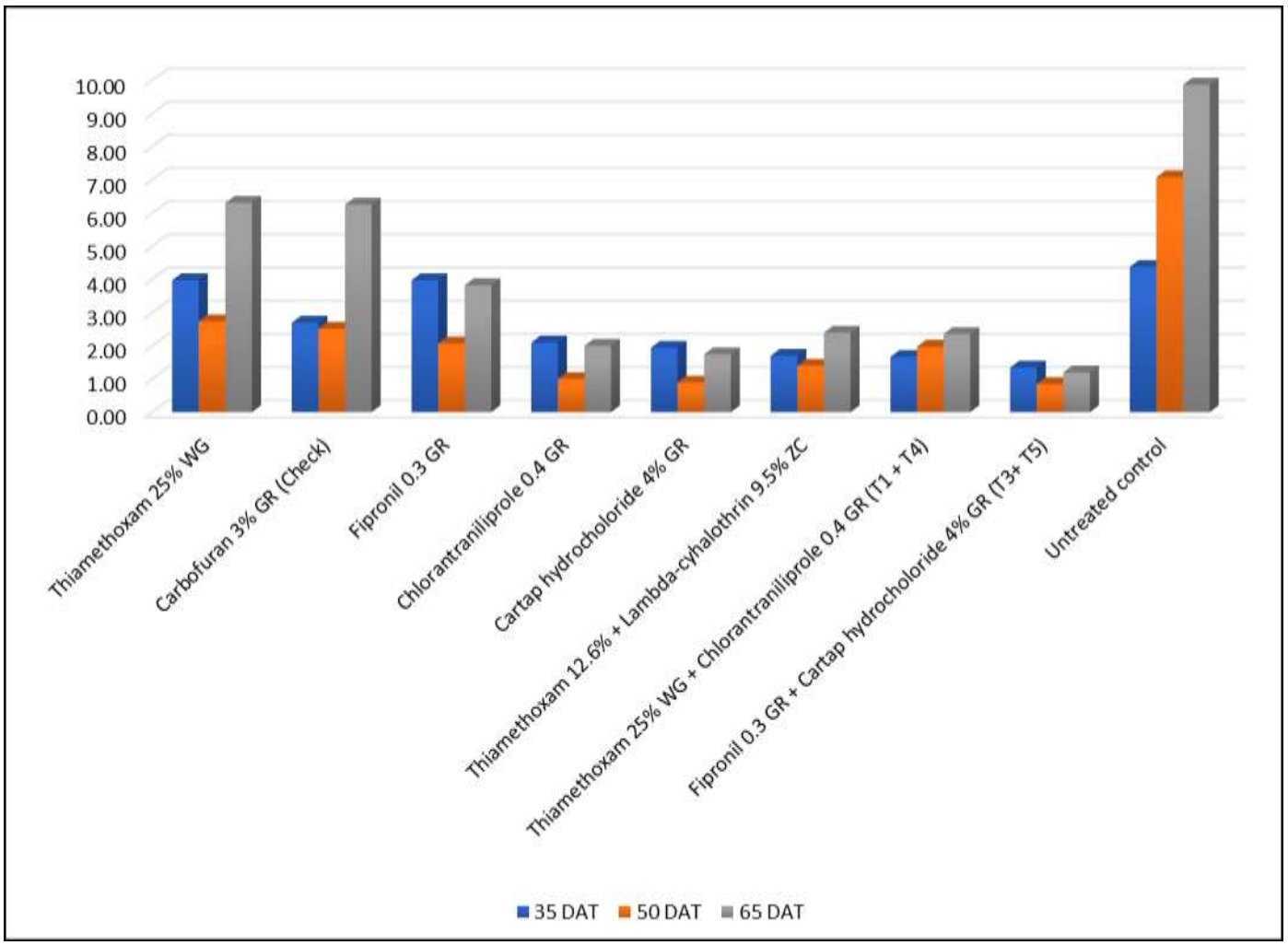

Fig 1: Efficacy of insecticides against rice stem borer

Conclusion

It may conclude that the minimum infestation of stem borer in case of application of Fipronil 0.3 GR @ 2.5 g/m^2+ Cartap hydrocholoride 4% GR @1.9 g/m^2,1.13% (Dead hearts) with 84.10 percent reduction over control (ROC) which was on par with Cartap hydrocholoride 4% GR @1.9 g/m^2 (1.53% DH) with 78.48% (ROC), Chlorantraniliprole 0.4 GR @ 1.0 g/m^2 (1.70% DH) with 76.09% (ROC) and Thiamethoxam 12.6% + Lambda-cyhalothrin 9.5% ZC @0.4/L (1.83% DH) with 74.26% (ROC), for stem borer management.

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