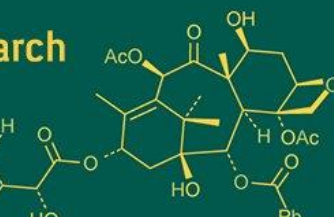
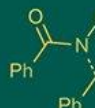


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Bio-efficacy of novel insecticides against yellow stem borer, *Scirpophaga incertulas* (Walker), in basmati rice

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Abstract

A field experiment was conducted during the *Kharif* 2025 season at the Crop Research Centre (CRC), Sardar Vallabhbhai Patel University of Agriculture and Technology (SVPUAT), Modipuram, Meerut, Uttar Pradesh, to evaluate the bio-efficacy of novel insecticides against the yellow stem borer, *Scirpophaga incertulas* (Walker), in basmati rice under natural infestation conditions. Seven treatments, namely Flubendiamide 39.35% WG, Chlorantraniliprole 18.5% SC, Chlorantraniliprole 0.4% GR, Cartap Hydrochloride 4% GR, Virtako (Thiamethoxam 1% + Chlorantraniliprole 0.5%), Fipronil 0.3% GR and an untreated control, were evaluated. The observations on dead heart and white ear head were recorded before and at 7, 15 and 21 days after each spray. Among the treatments, Chlorantraniliprole 18.5% SC proved to be the most effective, recording the lowest mean infestation (7.61% after the first spray and 6.93% after the second spray) with the highest mean reduction in infestation over untreated control (39.65% and 52.72%, respectively). Flubendiamide 39.35% WG was the second most effective treatment, followed by Virtako. Chlorantraniliprole 0.4% GR, Cartap Hydrochloride 4% GR and Fipronil 0.3% GR showed comparatively lower efficacy, while the untreated control recorded the highest infestation throughout the experiment. The study demonstrated that Chlorantraniliprole 18.5% SC was the most effective insecticide for managing yellow stem borer in basmati rice and may be considered as an effective insecticide component in IPM programmes under the agro-climatic conditions of western Uttar Pradesh.

Keywords: *Scirpophaga incertulas*, yellow stem borer, rice, Chlorantraniliprole, Flubendiamide, bio-efficacy, insecticide management

Introduction

Rice (*Oryza sativa* L.) is the most important staple cereal crop in Asia, providing food security and sustaining the livelihoods of millions of people. It plays a crucial role in the agricultural economy of many Asian countries. However, rice production is significantly affected by a wide range of insect pests, among which stem borers are considered one of the most destructive due to the severe yield losses they cause (Badari *et al.*, 2023; Tagliapietra *et al.*, 2024) ^[1, 7]. Among the stem borer complex, the yellow stem borer, *Scirpophaga incertulas* (Walker) (Lepidoptera: Crambidae), is recognized as the most economically important species in irrigated and rainfed lowland rice ecosystems of South and Southeast Asia (Newton & Dixon, 1990) ^[5]. The larval stage causes damage by boring into rice stems and feeding internally on the growing tissues. This concealed feeding habit protects the larvae from natural enemies and reduces the effectiveness of contact insecticides, making the pest difficult to control. During the vegetative stage, larval feeding results in the formation of "dead hearts," whereas infestation during the reproductive stage causes "white ears" or "white heads," characterized by unfilled panicles. These symptoms substantially reduce productive tillers and grain yield, often without obvious external signs during the early stages of infestation (Dale, 1994; Savary *et al.*, 2000) ^[3, 6]. The incidence and severity of yellow stem borer have increased with the adoption of high-yielding rice varieties, intensive nitrogen fertilization and continuous rice cultivation throughout the year (Heong *et al.*, 2015) ^[4].

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Excessive nitrogen application enhances larval survival, while asynchronous planting and overlapping cropping seasons ensure continuous host availability. In addition, changing climatic conditions, particularly higher temperatures and humidity, have been associated with increased survival, faster development and more generations of the pest, thereby aggravating crop damage. Chemical insecticides have long been the principal method for managing yellow stem borer. However, their indiscriminate and repeated use has led to several challenges, including insecticide resistance, pest resurgence, ecological imbalance and adverse effects on beneficial organisms (Heong *et al.*, 2015) [4]. Consequently, Integrated Pest Management (IPM) has emerged as a sustainable strategy that combines cultural practices, resistant cultivars, biological control agents and the need-based application of selective insecticides. Furthermore, recent advances in pheromone-based monitoring, parasitoid conservation and molecular studies on the biology and ecology of *S. incertulas* have provided new opportunities for developing environmentally safe and economically viable management strategies. Therefore, a comprehensive understanding of the pest's biology, ecology, damage symptoms and management approaches is essential for designing effective and sustainable control measures against the yellow stem borer in rice (Dale, 1994) [3].

Materials and Methods

Experimental Site

A field experiment was conducted during the *Kharif* 2025 season at the Crop Research Centre (CRC), Sardar Vallabhbhai Patel University of Agriculture and Technology (SVPUAT), Modipuram, Meerut, Uttar Pradesh, India. The experimental site is situated at 29°01' N latitude and 77°45' E longitude, with an elevation of 237 m above mean sea level, representing the Western Plain Zone of Uttar Pradesh. The study was carried out under field conditions in an untreated rice crop, where yellow stem borer infestation occurred naturally, to evaluate the performance of insecticidal treatments under prevailing pest pressure.

Crop Establishment

The experiment was conducted using the basmati rice variety Pusa Basmati-1509. Twenty-one-day-old seedlings were transplanted during the fourth week of July 2025 (transplanting date: 28 July 2025) at a spacing of 20 × 15 cm. The crop was raised following the recommended agronomic practices of SVPUAT, Meerut. A fertilizer dose of 120:60:40 kg N:P₂O₅: K₂O ha⁻¹ was applied according to the recommended agronomic practices of SVPUAT. Insecticidal treatments were applied throughout the crop season to permit natural infestation of yellow stem borer.

Sampling Method and Recording of Yellow Stem Borer Dead heart and white ear infestation

Each treatment in the form of spraying was applied twice during the crop season. Observation on infestation of yellow stem borer as 'Dead Heart' and 'White Ear Head' were recorded on 5 randomly selected hill from three central rows at one day before, 7, 14 and 21 days after each spray / spread application.

The percentage infestation was calculated using the following formulae:

$$\text{Dead hearts (\%)} = \frac{\text{Number of dead hearts}}{\text{Total number of tillers observed}} \times 100$$

$$\text{White ear heads (\%)} = \frac{\text{Number of white ear heads}}{\text{Total number of productive tillers observed}} \times 100$$

Meteorological Observations

Weekly meteorological data, including maximum temperature (°C), minimum temperature (°C), mean temperature (°C), morning relative humidity (%), evening relative humidity (%), mean relative humidity (%) and rainfall (mm), were obtained from the Agro-meteorological Observatory, Department of Soil Science, SVPUAT, Modipuram, Meerut. Weather data corresponding to each Standard Meteorological Week were used to study their relationship with yellow stem borer incidence.

Statistical Analysis

The relationship between yellow stem borer efficacy of insecticide was analysed using ANOVA TABLE. Weekly pest efficacy data were correlated with the corresponding meteorological variables to determine the influence of abiotic factors on management of yellow stem borer. Statistical analyses were performed using OPSTAT statistical software (Version 16.0, CCS Haryana Agricultural University, Hisar, India) and the significance of correlation coefficients was tested at the 5% probability level ($P \leq 0.05$).

Result

The efficacy of different novel insecticides against yellow stem borer was evaluated based on the incidence of dead heart and white ear head following two insecticidal sprays during *Kharif* 2025. Significant differences among the treatments were observed at all post-treatment observation intervals.

Effect of insecticides after the first spray

Before the first spray, yellow stem borer infestation (dead heart/white ear head) was uniform across treatments, ranging from 9.90 to 11.70%. All insecticidal treatments significantly reduced pest infestation compared with the untreated control. Chlorantraniliprole 18.5% SC was the most effective treatment, recording the lowest mean infestation (7.61%) and the highest mean reduction over control (39.65%), followed by Flubendiamide 39.35% WG (8.41%; 33.30%) and Virtako (8.81%; 30.13%). Chlorantraniliprole 0.4% GR, Cartap Hydrochloride 4% GR and Fipronil 0.3% GR showed comparatively lower efficacy, with mean infestations of 8.95%, 9.80% and 9.87%, respectively. The untreated control recorded the highest mean infestation (12.61%), indicating the superior effectiveness of Chlorantraniliprole 18.5% SC in managing yellow stem borer after the first spray.

Effect of insecticides after the second spray

Before the second spray, yellow stem borer infestation ranged from 7.55 to 13.65%. All insecticidal treatments further reduced dead heart and white ear head incidence after the second application. Chlorantraniliprole 18.5% SC remained the most effective treatment, recording the lowest mean infestation (6.93%) and the highest mean reduction over control (52.72%), followed by Flubendiamide 39.35% WG (7.88%; 46.24%) and Virtako (8.49%; 42.08%). Chlorantraniliprole 0.4% GR, Cartap Hydrochloride 4% GR and Fipronil 0.3% GR were comparatively less effective, with mean infestations of 9.09%, 9.65% and 10.26%,

respectively. The untreated control recorded the highest mean infestation (14.66%), confirming the superior efficacy of Chlorantraniliprole 18.5% SC in suppressing yellow stem borer after the second spray.

Overall, the results clearly demonstrated that Chlorantraniliprole 18.5% SC was the most effective insecticide for suppressing yellow stem borer infestation in basmati rice throughout the experimental period. Flubendiamide 39.35% WG ranked second in efficacy, while Virtako also provided satisfactory control. The remaining insecticides were comparatively less effective but still performed significantly better than the untreated control.

Discussion

The present study demonstrated that all the tested insecticides significantly reduced yellow stem borer infestation compared with the untreated control, with Chlorantraniliprole 18.5% SC proving to be the most

effective treatment, followed by Flubendiamide 39.35% WG and Virtako. The superior performance of Chlorantraniliprole may be attributed to its translaminar activity and its unique mode of action on insect ryanodine receptors, resulting in rapid feeding cessation and effective control of concealed stem-boring larvae (Lahm *et al.*, 2009) [9]. Flubendiamide also exhibited excellent efficacy due to its prolonged residual activity and effectiveness against lepidopteran borers (Tohnishi *et al.*, 2005) [12]. Similar findings have been reported by Singh *et al.* (2017) [11], Prasad *et al.* (2019) [10] and Chinnadurai *et al.* (2021) [8], who observed that diamide insecticides provided superior control of *Scirpophaga incertulas* and significantly reduced dead heart and white ear incidence compared with conventional insecticides. Therefore, Chlorantraniliprole 18.5% SC may be recommended as an effective component of integrated pest management (IPM) programmes for sustainable management of yellow stem borer in basmati rice.

Table 1: Percent dead heart and white ear head of yellow stem borer after 1st spray during 2025

Treatments No.	Treatment Name	Dose/ha	DH/WEH (%)					MRC %
			1 DBS*	7 DAS*	15 DAS*	21 DAS*	Mean	
T ₁	Flubendiamide 39.35% WG	50 ml/ha	11.5 (19.79)	7.05 (15.36)	6.65 (14.91)	8.45 (16.86)	8.41 (16.73)	33.30
T ₂	Chlorantraniliprole 18.5% SC	150 ml/ha	10.75 (19.11)	6.38 (14.56)	5.75 (13.82)	7.55 (15.88)	7.61 (15.84)	39.65
T ₃	Chlorantraniliprole 0.4% GR	10 kg/ha	9.9 (18.30)	8.40 (16.79)	7.80 (16.14)	9.70 (18.11)	8.95 (17.33)	29.02
T ₄	Cartap Hydrochloride 4%GR	18 kg/ha	11.6 (19.87)	8.95 (17.35)	8.38 (16.74)	10.25 (18.64)	9.80 (18.15)	22.28
T ₅	Virtako (Thiamethoxam1%+ Chlorantraniliprole 0.5%)	6 kg/ha	11.15 (19.48)	7.85 (16.23)	7.25 (15.56)	9.00 (17.43)	8.81 (17.17)	30.13
T ₆	Fipronil 0.3%GR	15 kg/ha	10.25 (18.63)	9.48 (17.89)	8.90 (17.31)	10.85 (19.20)	9.87 (18.25)	21.72
T ₇	Untreated control	-----	11.7 (19.96)	12.18 (20.37)	12.90 (21.03)	13.65 (21.66)	12.61 (20.75)	
C.D. at 5%			N/A	2.595	2.869	2.114		
SE(m)			0.778	0.833	0.921	0.679		
SE(d)			1.1	1.178	1.303	0.96		
C.V			6.974	8.515	9.665	6.438		

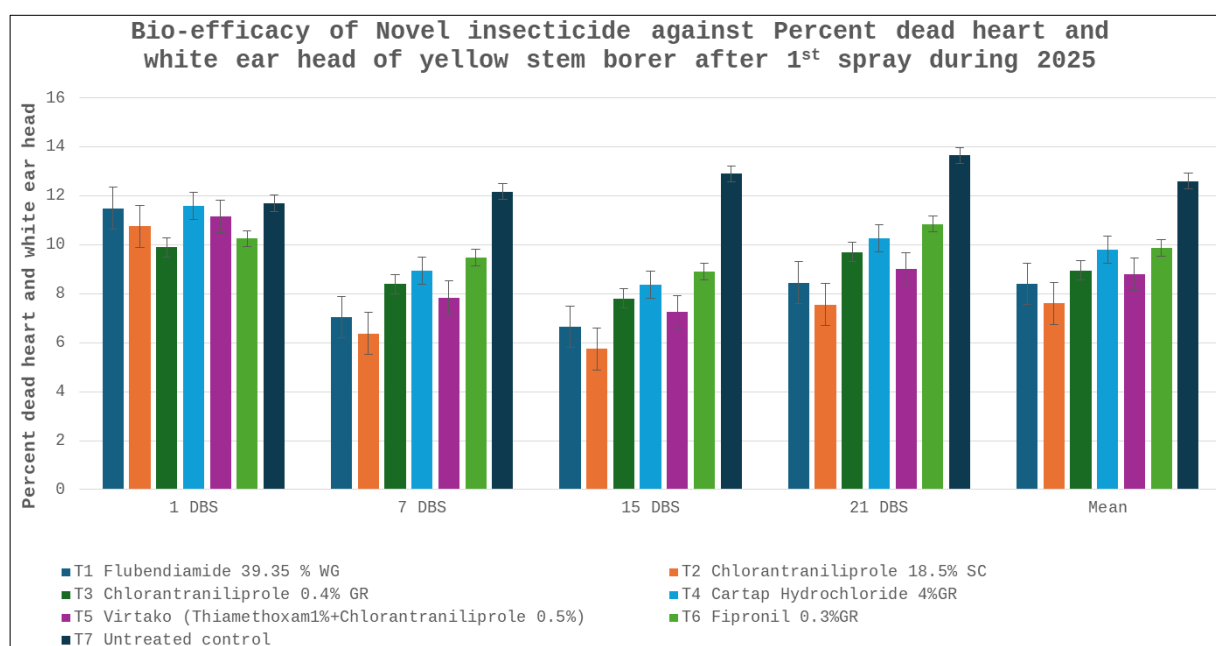
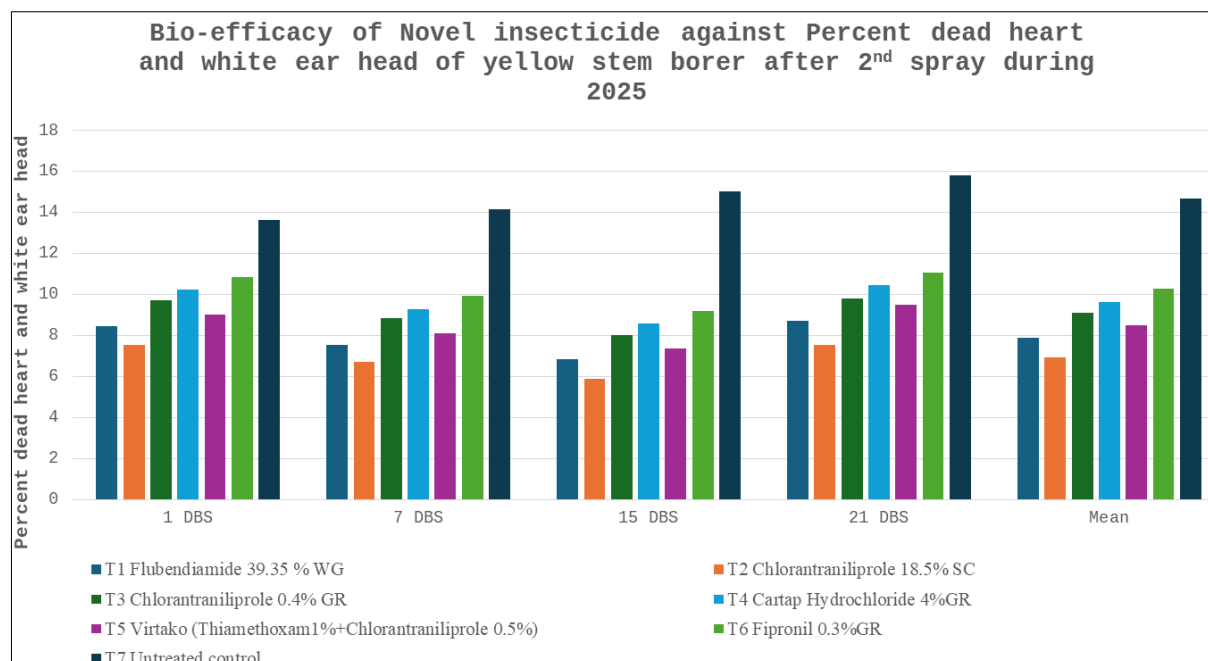


Table 2: Percent dead heart and white ear head of yellow stem borer after 2nd spray during 2025

Treatments No.	Treatment Name	Dose/ha	DH/WEH (%)					MRC %
			1 DBSS*	7 DASS*	15 DASS*	21 DASS*	Mean	
T ₁	Flubendiamide 39.35% WG	50 ml/ha	8.45 (16.86)	7.52 (15.85)	6.85 (15.13)	8.70 (17.13)	7.88 (16.24)	46.24
T ₂	Chlorantraniliprole 18.5% SC	150 ml/ha	7.55 (15.88)	6.70 (14.97)	5.90 (14.03)	7.55 (15.92)	6.93 (15.20)	52.72
T ₃	Chlorantraniliprole 0.4% GR	10 kg/ha	9.70 (18.11)	8.85 (17.28)	8.00 (16.40)	9.80 (18.22)	9.09 (17.50)	37.99
T ₄	Cartap Hydrochloride 4%GR	18 kg/ha	10.25 (18.64)	9.30 (17.73)	8.60 (17.02)	10.45 (18.83)	9.65 (18.05)	34.17
T ₅	Virtako (Thiamethoxam1%+ Chlorantraniliprole 0.5%)	6 kg/ha	9.00 (17.43)	8.10 (16.51)	7.35 (15.71)	9.50 (17.92)	8.49 (16.89)	42.08
T ₆	Fipronil 0.3%GR	15 kg/ha	10.85 (19.20)	9.95 (18.36)	9.20 (17.62)	11.05 (19.39)	10.26 (18.64)	30.01
T ₇	Untreated control	-----	13.65 (21.66)	14.15 (22.07)	15.05 (22.81)	15.80 (23.40)	14.66 (22.48)	
C.D. at 5%			2.114	2.101	1.854	1.875		
SE(m)			0.679	0.674	0.595	0.602		
SE(d)			0.96	0.954	0.841	0.851		
C.V			6.438	6.66	6.075	5.576		



Conclusion

The present study demonstrated that all the evaluated insecticides significantly reduced yellow stem borer infestation in basmati rice compared with the untreated control. Among the tested treatments, Chlorantraniliprole 18.5% SC proved to be the most effective, recording the lowest dead heart and white ear head incidence after both insecticidal sprays, followed by Flubendiamide 39.35% WG and Virtako (Thiamethoxam 1% + Chlorantraniliprole 0.5%). These findings indicate that among the insecticides evaluated under the present experimental conditions of *Scirpophaga incertulas* due to their high efficacy against concealed larval stages and prolonged residual activity. The study suggests that Chlorantraniliprole 18.5% SC can be effectively incorporated into integrated pest management (IPM) programmes for sustainable management of yellow stem borer in basmati rice. Adoption of this insecticide in combination with appropriate cultural and biological control practices will help minimize yield losses, reduce dependence on repeated insecticide applications and

promote environmentally sustainable rice production under the agro-climatic conditions of western Uttar Pradesh.

References

1. Badari Prasad PR, Sreenivas AG, Guruprasad GS, Divan JR, Harischandra Naik R, Veeranagouda M, *et al.* Management of yellow stem borer in a paddy ecosystem using SPLAT mating disruption techniques. *Cereal Res Commun.* 2023;51(2):495-508. doi:10.1007/s42976-022-00304-y.
2. Chintalapati P, Rathod S, Repalle N, Varma NRG, Karthikeyan K, Sharma S, *et al.* Insect pest incidence with the system of rice intensification: results of a multi-location study and a meta-analysis. *Agronomy.* 2023;13(4):1100. doi:10.3390/agronomy13041100.
3. Dale D. Insect pests of the rice plant: their biology and ecology. In: Heinrichs EA, editor. *Biology and management of rice insects.* Wiley Eastern; 1994. p. 363-485.

4. Heong KL, Cheng JA, Escalada MM. Rice pest management: issues and opportunities. In: Heong KL, Cheng JA, Escalada MM, editors. Rice planthoppers: ecology, management, socio economics and policy. Springer; 2015. p. 1-20. doi:10.1007/978-94-017-9535-7_1.
5. Newton C, Dixon AFG. Pattern of growth in weight of alate and apterous nymphs of the English grain aphid, *Sitobion avenae*. Entomol Exp Appl. 1990;55(3):231-238. doi:10.1111/j.1570-7458.1990.tb01367.x.
6. Savary S, Willocquet L, Elazegui FA, Castilla NP, Teng PS. Rice pest constraints in tropical Asia: quantification of yield losses due to rice pests in a range of production situations. Plant Dis. 2000;84(3):357-369. doi:10.1094/PDIS.2000.84.3.357.
7. Tagliapietra BL, Soares CF, Clerici MTPS. Rice (*Oryza sativa* L.) and its products for human consumption: general characteristics, nutritional properties and types of processing. Food Sci Technol. 2024;44. doi:10.5327/fst.00292.
8. Chinnadurai D, Ramesh V, Kumar A. Evaluation of newer insecticides against yellow stem borer, *Scirpophaga incertulas* (Walker), in rice. J Entomol Zool Stud. 2021;9(3):1119-1123.
9. Lahm GP, *et al.* The discovery of chlorantraniliprole: a new anthranilic diamide insecticide acting as a ryanodine receptor activator. Bioorg Med Chem Lett. 2009;19:6274-6279.
10. Prasad D, Singh R, Kumar S. Bio-efficacy of novel insecticides against yellow stem borer in rice. Indian J Entomol. 2019;81(4):839-843.
11. Singh B, Kumar M, Singh R. Field evaluation of new insecticides against yellow stem borer, *Scirpophaga incertulas* (Walker), in rice. J Entomol Res. 2017;41(4):413-418.
12. Tohnishi M, Nakao H, Furuya T, *et al.* Flubendiamide, a novel insecticide highly active against lepidopterous insect pests. J Pestic Sci. 2005;30(4):354-360.

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