*Original Research Article*

“**Efficacy of selected chemicals and biopesticides against yellow stem borer [*Scirpophaga incertulas* (Walker)] on paddy rice”**

**Abstract**

The present investigation, entitled “Efficacy of Selected Chemicals and Biopesticides against Yellow Stem Borer [Scirpophaga incertulas (Walker)] in Paddy”*,* was conducted during the fall season of 2024 at the Central Research Farm (CRF), Department of Entomology, Sam Higginbottom University of Agriculture, Technology and Sciences, Prayagraj, Uttar Pradesh, India. The experiment was laid out in a randomized block design (RBD) with seven treatments, each was replicated three times, along with an untreated control plot. The study aimed to evaluate the effectiveness of various chemical insecticides and biopesticides in managing yellow stem borer infestation in paddy rice. Damage symptoms caused by S. incertulas were assessed one day before spraying and subsequently on the 7th and 14th day after insecticide application. Observations focused on typical damage indicators as dead hearts (DH) during the vegetative stage and white ear heads (WEH) during the panicle initiation stage. All treatments were found to be significantly more effective than the untreated control. Among the treatments, **T6 – Flubendiamide 20 WG 7.81%** recorded the lowest infestation and proved to be the most effective , followed by each of **T2 – Chlorantraniliprole 18.5 SC 8.88%,** **T4 – Cartap Hydrochloride 50 SP 9.94%,** and **T7 – Thiamethoxam 25 WG 12.04%.** The biopesticide **T5 –** *Bacillus thuringiensis* var. *krustaki* showed moderate efficacy as 13.00%, while **T1 – Neem oil 16.38%** and **T3 –** Beauveria bassiana **1×108 CFU/gm)** were less effective. The highest infestation was observed in the untreated control plot **T0 as 26.99%.**

***Keywords:*** Efficacy, Chemicals, Biopesticides, yellow stem borer*.*

# Introduction

Rice (*Oryza sativa* L.) (2n = 24) is a monocotyledonous crop, which belonging to the family Gramineae is one of the most important staple food crops for more than two-third of the world population **Kinjale *et al.*(2021).** Rice, derived from paddy grain, is a staple food across East, South, and Southeast Asia. Often referred to as the "grain of life," rice holds deep cultural and nutritional significance and is virtually synonymous with food in many Asian communities. There are about 23 species of rice, but only two are widely domesticated and commercially valuable which are *Oryzae sativa* (Asian rice) and *Oryza glaberrima* (African rice) **Timsina *et al.* (2023).**

Asian rice, Oryza sativa is broadly classified into two major subspecies: indica and japonica. It is believed that indica rice was first domesticated in the foothills of the Himalayas in eastern India, while japonica originated in southern China. Over time, indica rice spread across the tropical and subtropical regions from India, while japonica moved northward, adapting to temperate climates, and also spread southward into Southeast Asia. From there, it eventually reached regions like West Africa and Brazil **(Khush, 1997).**

Nutritionally, rice is composed of approximately 80% carbohydrates, 7–8% protein, 3% fat, and 3% fiber. Beyond its role as a staple food, rice is deeply embedded in the cultural, religious, and social fabric of almost all Asian societies. It also holds medicinal value, making it not just a dietary staple but a symbol of life, tradition, and health. Rice has no fat, no cholesterol and is sodium free. Rice bran oil can have up to 80% unsaturated fatty acids (oleic acid and linoleic acid). Rice has a lysine as protein. The vitamin B-complex, especially thiamin, riboflavin and niacin offered by natural brown rice. Red and black rice are rich in iron and zinc. **Chaudhari *et al.* (2018).**

Rice crop is attacked by several insect pests from nursery to harvest, which cause severe yield loss. The most important and widely distributed pest species are stem borers, *Scirpophaga incertulas*, leaf folders, *Cnaphalocrocis medinalis*, Plant hoppers, and gall midge, *Orseolia oryzae*. Stem borers are persistent pests in rice cultivation, commonly present in fields across all seasons, though typically in low numbers. Among them, Scirpophaga incertulas (Walker), commonly known as the yellow stem borer, is a monophagous and highly destructive pest, infesting rice crops across almost all regions of India **(Patel and Singh, 2017**). In Asia, Scirpophaga incertulas and Chilo suppressalis together are responsible for an estimated 5–10% yield loss in rice production **(Timsina *et al.,* 2023).**

The yellow stem borer is a major pest of rice throughout tropical South and Southeast Asia. Its infestation is especially severe in tropical lowland and deep-water rice ecosystems, where its presence can significantly affect crop health and productivity. The pest attacks all stages of the crop. Larval damage to tillers during the vegetative stage results in drying up of central shoot which is also called as ‘dead heart’ symptom and damage during the panicle initiation stage results in chaffy, unfilled grains which is also called as ‘white ear’ **(Anonymous, 2024)**. The two major factors responsible for poor yield are adverse weather and pest epidemic. Among the various biological constraints, insect-pest problem is one of the major constraints accountings for 50% damage at vegetative, 30% at reproductive and 20% at ripening stage of rice. Due to insect-pests attack the average yield reduction in rice is 40%. About 21 per cent of the global production of is lost to insect pests. **Thorat** ***et al.* (2023).**

Hence, the present study was undertaken to evaluate the efficacy of selected chemical insecticides and biopesticides against the yellow stem borer, *Scirpophaga incertulas* (Walker), in order to identify effective management strategies for minimizing yield losses in paddy rice.

# Materials and Methods

The field experiment was carried out during the fall season of 2024 at the Crop Research Farm, Naini, Prayagraj, Uttar Pradesh, India. A randomized block design (RBD) was employed, consisting of eight treatments, each replicated three times. The rice variety PB 1121 was sown in plots measuring 3 m × 2 m, with a spacing of 25 cm × 15 cm. All recommended agronomic practices were followed, except for plant protection measures. Eight different treatments used viz., application of Neem oil (T1), chlorantraniliprole18.5 SC (T2), *Beauveria bassiana* 1×108 **CFU**/gm (T3), Cartap Hydrochoride50 SP (T4), *Bacillus thuringiensis* var. *krustaki* (T5), Flubendiamide 20 WG (T6), Thiamethoxam 25WG (T7) and untreated control (T0) were tested to compare the efficacy against *Scirpophaga incertulas* and their influences on yield of paddy.

**Method of Recording Observation**

The treatments were applied at 50 and 70 days after transplanting. Observations on yellow stem borer infestation were taken one day prior to spraying, followed by assessments on the 7th and 14th days after treatment. Infestation levels were measured by recording the typical damage symptoms caused by the pest—specifically, the number of dead hearts (DH) during the vegetative growth stage and white ear heads (WEH) at the panicle initiation stage **Kinjale *et al.* (2021).** The damage symptoms by yellow stem borer were recorded on 5 randomly selected and tagged plants from each plot and then per cent dead hearts and per cent white ears was calculated with following formula **Madhu *et al.* (2020).**

$ Dead hearts =\frac{Total nomber of dead hearts}{Total number of tillers}×100$

 **[Chatterjee and Mondal, (2014)]**

$ White ears =\frac{Total nomber of white ears}{Total number of tillers with panicle}×100$

 **[Chatterjee and Mondal, (2014)]**

1. **Results and Discussion**

The data on the per cent of infestation of yellow stem borer on 7th and 14th day after first spray revealed that all the treatments were significantly superior over control. Among all the treatments, the plot treated with T6 Flubendiamide 20 WG (7.27) was found to be the most effective treatment, followed by T2 Chlorantraniliprole 18.5 SC **(**8.70**),** T4Cartap Hydrochloride 50 SP **(**9.84**),** T7 Thiamethoxam 25 WG (12.62**),** T5 *Bacillus thuringiensis* var. *krustaki* (13.78**)**, T1 Neem oil (17.36**)**, T3 *Beauveria bassiana* 1×108 CFU/gm (19.71**),** which wasleast effective among all the treatments but higher infestation in control plot T0 (26.14).

The data on the infestation percentages of yellow stem borer on 7th and 14th day after second spray revealed that all the treatments were significantly superior over control. Among all the treatments, the plot treated with T6 Flubendiamide 20 WG (8.35%) was found to be the most effective treatment, followed by T2 Chlorantraniliprole 18.5 SC **(**9.07%**),** T4Cartap Hydrochloride 50 SP **(**10.05%**),** T7 Thiamethoxam 25 WG (11.47%**),** T5 *Bacillus thuringiensis* var. *krustaki* (12.21%**)**, T1 Neem oil (15.41%**)**, T3 *Beauveria bassiana* 1×108 CFU/gm (16.44%**),** recording the least effective among all the treatments but the highest infestation was observed in control plot T0 (27.83%).

Similar findings were reported by **Ramesh *et al*. (2021)** and **Karthikeyan *et al*. (2018)** who documented a substantial reduction in dead heart and white ear symptoms in paddy with Flubendiamide 20 WG application. Chlorantraniliprole 18.5 SCwas found the next effective treatment in in managing per cent infestation of yellow stem borer. The results align with those of **Srinivasan and Gunasekaran (2017)** and **Subramanian *et al*. (2014)**, who found Chlorantraniliprole effective under both nursery and main field conditions. Where the observations of first and second spray were 8.70 and 9.07 respectively. The efficacies of Cartap Hydrochloride 50 SP on yellow stem borer in first and second spray were 9.84 and 10.05 respectively. These results are as per the findings of **Rahman *et al*. (2016)** and **Mandal *et al*. (2013)**.The next best treatment was found to be Thiamethoxam 25 WG in which the efficacy values of first and second spray were 12.62 and 11.47 respectively to the similar findings of **Rahman *et al*. (2016)** and **Mandal *et al*. (2013)**. The next best treatment was found to be *Bacillus thuringiensis* var. *krustaki* in which the efficacy values of first and second spray were 13.78 and 12.21 respectively. The efficacy of *Bacillus thuringiensis* was supported by **Prasad *et al*. (2020)** and **Gomez *et al*. (2012)**, who emphasized its role in integrated pest management (IPM) for rice ecosystems. The next best treatment was found to be Neem oil in which the efficacy values of first and second spray were 17.36 and 15.41 respectively. The efficacy of Neem oil can be attributed to its rapid degradation under field conditions and lower systemic action (**Yadav *et al*., 2015**). The least effective treatment was found to be *Beauveria bassiana* 1×108 CFU/gm in which the efficacy values of first and second spray were 19.71and 16.44 respectively.

Table 1. Efficacy of different treatments on infestation of yellow stem borer [*Scirpophaga incertulas* (Walker)] on paddy duringfallseason of 2024 after first spray

|  |  |
| --- | --- |
| **Treatments** | **Dead hearts infestation %** |
| **1DBS** | **7DAS** | **14DAS** | **Mean** |
| **T0** | **Control** | 7.46 | 24.94 | 27.35 | 26.14 |
| **T1** | **Neem oil** | 7.72 | 16.89 | 17.82 | 17.36 |
| **T2** | **Chlorantraniliprole 18.5 SC** | 7.15 | 8.33 | 9.07 | 8.70 |
| **T3** | ***Beauveria bassiana* 1×108** CFU**/gm** | 7.30 | 19.26 | 20.16 | 19.71 |
| **T4** | **Cartap Hydrochloride 50 SP** | 7.97 | 9.51 | 10.17 | 9.84 |
| **T5** | ***Bacillus thuringiensis* var. *krustaki*** | 7.38 | 13.24 | 14.32 | 13.78 |
| **T6** | **Flubendiamide 20 WG** | 7.02 | 7.18 | 7.36 | 7.27 |
| **T7** | **Thiamethoxam 25 WG** | 7.68 | 12.19 | 13.04 | 12.62 |
| **F-test** | NS | S | S | S |
| **C.V.** | 10.82 | 7.33 | 9.26 | 3.15 |
| **CD (5%)** | 1.41 | 1.79 | 2.42 | 1.07 |

Fig.1. Efficacy of different treatments on infestation % of yellow stem borer, *Scirpophaga incertulas* on paddy duringfall season of 2024 after first spray

Table 2. Efficacy of different treatments on infestation of yellow stem borer [*Scirpophaga incertulas* (Walker)] on paddy duringfall season of 2024 after second spray

|  |  |
| --- | --- |
| **Treatments** | **White ear heads infestation%**  |
| **1DBS** | **7DAS** | **14DAS** | **Mean** |
| **T0** | **Control** | 7.58 | 27.68 | 27.97 | 27.83 |
| **T1** | **Neem oil** | 6.48 | 14.42 | 16.41 | 15.41 |
| **T2** | **Chlorantraniliprole 18.5 SC** | 7.42 | 8.59 | 9.54 | 9.07 |
| **T3** | ***Beauveria bassiana* 1×108** CFU**/gm** | 5.10 | 15.49 | 17.38 | 16.44 |
| **T4** | **Cartap Hydrochloride 50 SP** | 6.80 | 9.62 | 10.48 | 10.05 |
| **T5** | ***Bacillus thuringiensis* var. *krustaki*** | 7.20 | 11.87 | 12.55 | 12.21 |
| **T6** | **Flubendiamide 20 WG** | 6.99 | 8.02 | 8.68 | 8.35 |
| **T7** | **Thiamethoxam 25 WG** | 7.69 | 10.90 | 12.03 | 11.47 |
| **F-test** | NS | S | S | S |
| **C.V.** | 15.74 | 7.97 | 6.79 | 3.06 |
| **CD (5%)** | 1.90 | 1.86 | 1.71 | 1.00 |

Fig.2. Efficacy of different treatments on infestation % of yellow stem borer [*Scirpophaga**incertulas* (Walker)] on paddy duringfall season of 2024 after second spray

**White ear heads infestation %**

**Conclusion**

This study concluded that all tested chemical and biopesticide compounds significantly reduced yellow stem borer infestation compared to the control. Flubendiamide 20 WG compound recorded the most effective, followed by Chlorantraniliprole 18.5 SC and Cartap Hydrochloride 50 SP. Among biopesticides, *Bacillus thuringiensis* showed the highest efficacy. Thus,it could be recommend that Flubendiamide can be used for effective chemical control, while *Bacillus thuringiensis* holds promise as a key biopesticide in integrated pest management (IPM) strategies for sustainable rice cultivation.

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