*Original Research Article*

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

**Abstract**

The present investigation, entitled “Efficacy of Selected Chemicals and Biopesticides Against Yellow Stem Borer [Scirpophaga incertulas (Walker)] in Paddy”*,* was conducted during the *Kharif* season of 2024 at the Central Research Farm (CRF), Department of Entomology, Sam Higginbottom University of Agriculture, Technology And Sciences, Prayagraj, Uttar Pradesh. The experiment was laid out in a Randomized Block Design (RBD) with seven treatments, each 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. 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 earheads (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. This was followed by **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. *kurstaki* showed moderate efficacy (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 – 26.99%).**

***Keywords:*** Biopesticides, Chemicals, Flubendiamide, Paddy, Yellow stem borer.

# Introduction

Rice (*Oryza sativa* L.) (2n = 24) is a monocotyledonous crop, which belong to the family Gramineae is one of the most important staple food crops for more than two-thirds 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 **Timsina *et al.,* (2023).**

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 lysine as a protein. Natural brown rice provides the vitamin B-complex, particularly thiamin, riboflavin, and niacin. Zinc and iron are abundant in red and black rice **Chaudhari *et al.,* (2018)**

The two major factors responsible for poor yield are adverse weather and pest epidemics. Among the various biological constraints, insect-pest problem is one of the major constraints’ accounting 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).**

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 the central shoot which is also called ‘dead heart’ symptom and damage during the panicle initiation stage results in chaffy, unfilled grains which is also called as ‘white ear’ **(Anonymous, 2024)**.

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

# Materials and Methods

The field experiment was carried out during the *Kharif* season of 2024 at the Central 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 Hydrochloride 50 SP (T4), *Bacillus thuringiensis* var. *kurstaki* (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 before 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 earheads (WEH) at the panicle initiation stage **Kinjale *et al.,* (2021).** Five randomly chosen and tagged plants from each plot had their yellow stem borer damage symptoms noted. The percentage of dead hearts and white ears were then computed using the formula below **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 at 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. *kurstaki* (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 per cent of infestation of yellow stem borer at 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. *kurstaki* (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 higher infestation 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. *kurstaki* 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 during *Kharif* season of 2024 after first spray

**Treatments**

|  |  |
| --- | --- |
| **Treatments** | **Per cent 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. *kurstaki*** | 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. Effect of different treatments on infestation of yellow stem borer [*Scirpophaga incertulas* (Walker)] on paddy during *Kharif* season of 2024 after first spray

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

**Per cent white earheads infestation (%)**

|  |  |
| --- | --- |
| **Treatments** | **Per cent White earheads 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. *kurstaki*** | 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. Effect of different treatments on infestation of yellow stem borer [*Scirpophaga incertulas* (Walker)] on paddy during *Kharif* season of 2024 after second spray

**Conclusion**

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

Disclaimer (Artificial intelligence)

Option 1:

Author(s) hereby declare that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc.) and text-to-image generators have been used during the writing or editing of this manuscript.

Option 2:

Author(s) hereby declare that generative AI technologies such as Large Language Models, etc. have been used during the writing or editing of manuscripts. This explanation will include the name, version, model, and source of the generative AI technology and as well as all input prompts provided to the generative AI technology

Details of the AI usage are given below:

**References**

1. Anonymous. (2024) The Central Research Institute for Dryland Agriculture or CRIDA. Indian Council of Agricultural Research. <http://www.icar-crida.res.in:8080/naip/ysb.jsp>
2. Chatterjee, S. and Mondal, P. (2014). Management of rice yellow stem borer, *Scirpophaga incertulas* Walker using some biorational insecticides. *Journal of Biopesticides*, 7: 143-147.
3. Chaudhari, P. R., Tamrakar, N., Singh, L., Tandon, A. and Sharma, D. (2018) Rice nutritional and medicinal properties: A review article. *Journal of Pharmacognosy and Phytochemistry*, 7(2): 150-156.
4. **Gomez, K. A., Kaur, A.** and **Singh, G. (2012).** Field efficacy of Bacillus thuringiensis against rice yellow stem borer. International Journal of Pest Management, **58(3):** 231–236.
5. **Karthikeyan, K., Raguraman, S.** and **Chinniah, C. (2018)**. Evaluation of insecticides against yellow stem borer in rice under field conditions. Pest Management in Horticultural Ecosystems, **24**(1): 65–69.
6. Kinjale, R. S., Jalgaonkar, V. N., Naik, K. V., Hatwar, N. K. and Lad, S. S. (2021) Evaluation of the efficacy of some insecticides against rice yellow stem borer, *Scirpophaga incertulas* (Walker). *Journal of Entomology and Zoology Studies*, *9*(1): 123-125.
7. Madhu, B., Warghat, A. N. and Tayde, A. R. (2020) Comparative effect of bio pesticides and neem commercial products on rice yellow stem borer, *Scirpophaga incertulas* (Walker). *Journal of Entomology and Zoology Studies*, *8*(1): 758-760.
8. **Mandal, S. K., Biswas, G. C.** and **Samanta, A. (2013).** Performance of neonicotinoid insecticides in managing stem borers in rice. Oryza, **50(4):** 391–395.
9. Patel, S. and Singh, C. P. (2017). Seasonal incidence of rice stem borer, *Scirpophaga incertulas* (Walker) on different varieties of rice in relation to weather parameters. *Journal of Entomology and Zoology Studies*, *5*(3): 80-83.
10. **Prasad, C. S., Rajendran, R.** and **Senthilkumar, R. (2020)**. Role of biopesticides in managing rice insect pests. Indian Journal of Entomology, **82**(2): 346–349.
11. **Rahman, M. M., Hossain, M. A.** and **Ahmed, M. S. (2016)**. Comparative efficacy of some insecticides against rice stem borers. Bangladesh Journal of Agricultural Research, **41**(1): 55–64.
12. **Ramesh, B., Kumar, A. N.** and **Sheeba, A. (2021)**. Efficacy of novel insecticides against yellow stem borer (Scirpophaga incertulas) in rice. Journal of Entomological Research, **45**(2): 213–218.
13. **Srinivasan, R.** and **Gunasekaran, K. (2017)**. Comparative performance of diamide insecticides against rice stem borers. Madras Agricultural Journal, **104**(10–12): 320–324.
14. **Subramanian, S., Kavitha, P.** and **Selvaraj, T. (2014).** Field evaluation of insecticides against rice yellow stem borer. Indian Journal of Plant Protection, **42(2)**: 180–183.
15. Thorat, S. S., Gangwar, R. K., Parmar, M. B., Patel, S. G. and Kacha, D. J. (2023). Bio-efficacy of insecticides against rice yellow stemborer and leaf folder. *Agricultural Research Journal*, *60*(5): 699-705.
16. Timsina, S., Katel, S. and Adhikari, N. (2023) Efficacy of commercially available insecticides against yellow stem borer (*Scirpophaga incertulas* Walker.). *Journal of agriculture and applied biology*, 4(1): 39 – 47.
17. **Yadav, R. S., Kumar, R.** and **Singh, S. (2015)**. Evaluation of neem-based products against insect pests of rice. Environment and Ecology, **33**(3A): 1086–1090.