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# Efficacy of different chemicals and biopesticides against yellow stem borer [*Scirpophaga incertulas* (Walker)] on rice (*Oryza sativa* L.)

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**Abstract**
A field trial was conducted at Naini, Prayagraj during the *kharif* season 2022 at Central Research Farm, Sam Higginbottom University of Agriculture, Technology and Sciences, Prayagraj, (U.P.). Eight treatment including untreated control were evaluated against *Scirpophaga incertulas* (Walker) i.e., ($T_1$) Fipronil 5% SC @ 0.1 ml/lit., ($T_2$) Chlorantraniliprole 0.4 G @ 20 gm/lit., ($T_3$) Flubendiamide 480 SC @ 0.1 ml/lit., ($T_4$) Spinosad 45% SC @ 0.1 ml/lit., ($T_5$) Nisco sixer plus @ 1 ml/lit., ($T_6$) *Metarhizium anisopliae* WP @ 2 gm/lit., ($T_7$) Azadirachtin 10000 ppm @ 1 ml/lit and untreated control. The data on the yellow stem borer infestation percent per hill of after spray revealed that all the treatments were significantly superior over untreated control. Among all the treatments lowest yellow stem borer infestation per hill was recorded in Chlorantraniliprole 0.4 G (3.08) after first and second insecticidal spray respectively, which is followed by Spinosad 45% SC (4.04), Fipronil 5% SC (4.16), Flubendiamide 480 SC (4.47), *Metarhizium anisopliae* WP (4.84), Nisco sixer plus (5.13) and (5.67) as compared to untreated control. Among the entire treatment highest yield was recorded in Chlorantraniliprole 0.4 G (49.1 q/ha) followed by Spinosad 45% SC (44.1 q/ha), Fipronil 5% SC (44.8q/ha), Flubendiamide 480 SC (43.2 q/ha), *Metarhizium anisopliae* WP (36.1 q/ha), Nisco sixer plus (35.8q/ha), Azadirachtin 10000 ppm (34.4 q/ha) as compared to untreated control (21.7 q/ha). The best and most economical treatment was Chlorantraniliprole 0.4 G (1:2.55) followed by Spinosad 45%SC (1:2.50), Fipronil 5% SC (1:2.39), Flubendiamide 480 SC (1:2.27), *Metarhizium anisopliae* WP (1:2.23), Nisco sixer plus (1:2.14), Azadirachtin 10000 ppm (1:2.12) as compared to untreated control (1:1.41).

**Keywords:** Bio-pesticides, chlorantraniliprole, efficacy, insecticides, yellow stem borer

## Introduction
Rice (*Oryza sativa* L.) is the main source of food for more than half the world's population and its cultivation secures a livelihood for more than two billion people. About 90 percent of the rice produced is consumed within the country. (Balasubramamiam and Kumar, 2019) [1].
Rice is belong to family Poaceae or Gramineae, the rice is life and princess among the cereals, the staple food of 65% of the total population in India. It constitutes about 52% of the total food grain production and 55% of total cereal production. In India, paddy is grown in 44.06million ha constituting 34.4% of the total cultivable area. About 70% of our farmers are cultivating paddy and the production is about 105.31 million tonnes and productivity being 2178t/ha. (Sharanappa *et al.*, 2017) [15].
Rice is the staple food crop in India and stood first among the various other food crop cultivated in India and on rice grains are rich in (per 100 g dry weight) Nutrients like Protein (8.1 2 g), Fat (0.8 g), Carbohydrates (91 g), Minerals like Calcium (32 mg), Magnesium (28 mg), Sodium (6 mg), Vitamins Like Thiamin ($B_1$) (0.08 mg), Niacin ($B_3$) (1.82 mg) and Fats (0.60 g). (Singh and Singh, 2017) [17].
About 300 species of insects have been reported to attack rice crop in India, out of which 20 have been found to be the major pests. Among the insect pests, yellow stem borer (*Scirpophaga incertulas* WIk.), brown plant hopper (*Nilaparvata lugens* Stal.), green leafhopper (*Nephotettix* spp.), ear head bug (*Leptocorisa oratorius* Fabricius), leaf folder (*Cnaphalocrocis medinalis* Gn.) and case worm (*Nymphula depunctalis* Guenee). The average yield loss in rice have been accounted for 30% loss in stem borers, while plant hoppers 20%, gall midge 15%, leaf folder 10% and other pests 25% respectively. (Parasappa, 2017) [12].
In rice major yield losses occur due to insect pests and diseases. Among the insect pests, yellow stem borer (YSB), *Scirpophaga incertulas* (Walker) is the most important and

devastating insect pest of rice ecosystem and causing yield losses up to 27-34% every year. The damage is caused by caterpillars, which bore into the stem and destroy the growing tips by feeding the internal contents. This in turn disrupts the flow of water and nourishment to the plant, thereby causing dead heart during vegetative stage. When the infestation occurs at the flowering stage, the ear heads become chaffy. The economic threshold level for YSB has been determined to be in between 5- 10% larval infestation levels. **(**Omprakash *et al.*, 2017) [11].

## Material and Methods

The present study was conducted at the Central Research Farm, Sam Higginbottom University of Agriculture, Technology and Sciences, Prayagraj during *kharif* season 2022-23.

The experiment was laid out in Randomized Block Design (R BD) with three replications and eight treatments including an untreated check with a plot size of 2m x 1m each and the treatment was assigned randomly.

The seedlings of rice variety Rupali was sown in nursery by dry bed method. A seed bed of 5 x 8 m size was prepared in dry condition. On sowing date, the beds were flooded with water and puddle. Sprout seed was sown and then beds keep saturate initially up to a week and then submerge with a thin layer of water throughout. The nursery beds was irrigate one day before seedling uprooting to make the soil soft and about 28 days old seedlings was uproot by holding at the base and pulling them up one by one and their roots was wash to remove the soil. Transplanting was done manually keeping two seedlings per hill with spacing 20 cm x 10 cm (row x plant).

The treatments were given at 53 and 67 days after transplanting and the observations on the number of rice yellow stem borer pest were recorded from the five randomly selected and tagged plants from each plot. The observations were recorded a day before followed by 3rd, 7th and 14th days after spraying. Dead hearts due to rice yellow stem borer pest was recorded from each net plot and the population was worked out per plant.

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

(Ingle and Raghuraman, 2019) [9]

Benefit over the control for each spray treatment was obtain by subtracting the income of the control treatment from that of each sprayed treatment. To find out net returns and cost benefit ratio by following formula:

$$\text{BCR} = \frac{\text{Gross return}}{\text{Total cost of cultivation}}$$

Where,

BCR= Benefit cost ratio

(Thuppukonda and Kumar, 2022) [18]

## Results and Discussion

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. Chlorantraniliprole 0.4 G (3.08%) was found significantly superior in reducing the population of yellow stem borer as well as increasing yield supported by Omprakash *et al.,* (2017) [11] similar findings were also reported by Chatterjee *et al.*, (2019) [5], Sachan *et al.*, (2018) [14], Singh and Singh (2017) [17] followed by Spinosad 45% SC (4.04%) these findings are supported by Buduru *et al.*, (2019) [3] and Chatterjee and Mondal (2014) [4]. The treatment Fipronil 5% SC (4.16%) similar findings were also obtained by Girish *et al.,* (2016) [8], Chormule *et al.*, (2014) [6]. Flubendiamide 480 SC (4.47%) similar findings also reported by Prasad and Sountharya (2022) [13] the next best treatment is *Metarhizium anisopliae* WP (4.84%) supported by Singh ad Chatterjee (2021) [16]. The least effective treatment was Azadirachtin 10000 ppm (5.67%) supported by Bhojane *et al*., (2020) [2], Choudhary *et al.,* (2017) [7].

The highest yields among the treatment were significant. The highest yield and benefit cost ratio was recorded in Chlorantraniliprole 0.4 G (49.1 q/ha) followed by Spinosad 45% SC (44.1 q/ha), Fipronil 5% SC (44.8 q/ha), Flubendiamide 480 SC (43.2q/ha), *Metarhizium anisopliae* WP (36.1 q/ha), Nisco sixer plus (35.8 q/ha), respectively, while the lowest grain yield of 34.4 q/ha was observed in plot treated with Azadirachtin 10000 ppm and the untreated control plot resulted least grain yield 21.7q/ha in comparison to plots treated with different insecticides. The results on the economics of certain selected insecticides in rice revealed that the highest cost benefit was achieved. Among the treatment studied, the best and most economical treatment was Chlorantraniliprole 0.4 G (1:2.55), which was followed by Spinosad 45% SC (1:2.50), Fipronil 5% SC (1:2.39), Flubendiamide 480 SC (1:2.27), *Metarhizium anisopliae* WP (1:2.23), Nisco sixer plus (1:2.14), Azadirachtin 10000 ppm (1:2.12) as compared to Control (1:1.41).

Maximum cost benefit ratio (1:2.55) was obtained in Chlorantraniliprole 0.4 G which was supported by Omprakash *et al.,* (2017) [11] who reported that the Chlorantraniliprole 0.4 G recorded the high yield. Spinosad 45% SC which also reported a profitable yield of these findings is supported by Chatterjee and Mondal (2014) [4]. The cost benefit ratio of Fipronil (1:2.50) these results were to the findings reported by Jaiswal *et al.*, (2017) [10]. The cost benefit ratio obtained in the treatment Flubendiamide 480 SC (1:2.39) was supported by Omprakash *et al*., (2017) [11]. The cost benefit ratio of *Metarhizium anisopliae* WP (1:2.23) and Azadirachtin 10000 (1:2.12) was supported by Chatterjee and Mondal (2017) [4].

**Table 1:** Infestation percent of yellow stem borer due to insecticides (1st spray)

| Tr. No. | Treatments | Infestation percent | | | | |
|---|---|---|---|---|---|---|
| | | 1 DBS | After spray | | | |
| | | | 3 DAS | 7 DAS | 14 DAS | Mean |
| $T_1$ | Fipronil 5% SC | 5.61 (13.67) * | 4.87 (12.74) | 3.91 (11.39) | 4.50 (12.25) | 4.42 (12.13) |
| $T_2$ | Chlorantraniliprole 0.4 G | 5.70 (13.78) | 4.07 (11.61) | 2.91 (9.78) | 3.35 (10.55) | 3.44 (10.66) |
| $T_3$ | Flubendiamide 480 SC | 5.68 (13.78) | 5.12 (13.06) | 4.04 (11.57) | 4.53 (12.28) | 4.56 (12.32) |
| $T_4$ | Spinosad 45% SC | 5.96 (14.10) | 4.67 (12.46) | 3.88 (11.34) | 4.34 (12.05) | 4.29 (11.95) |
| $T_5$ | Nisco Sixer Plus | 5.72 (13.84) | 5.63 (13.73) | 4.79 (12.62) | 5.19 (13.16) | 5.20 (13.17) |
| $T_6$ | *Metarhizium anisopliae* WP | 6.00 (14.17) | 5.45 (13.36) | 4.47 (12.21) | 5.09 (13.03) | 5.00 (12.72) |
| $T_7$ | Azadirachtin 10000 ppm | 6.54 (14.79) | 6.25 (14.46) | 5.14 (13.09) | 5.81 (13.93) | 5.73 (13.84) |
| $T_8$ | Control | 6.06 (14.23) | 7.26 (15.49) | 8.35 (16.79) | 10.10 (18.53) | 8.57 (16.98) |
| F test | | NS | S | S | S | S |
| S.Ed (±) | | 0.30 | 0.99 | 1.62 | 2.04 | 1.54 |
| CD (0.05%) | | - | 0.97 | 0.97 | 0.67 | 1.45 |

*Figures in the parenthesis are arc sine transformed value DBS= Day before spray DAS=Day after spray

**Table 2:** Infestation percent of yellow stem borer due to insecticides (2nd spray)

| Tr. No. | Treatments | Infestation percent | | | |
|---|---|---|---|---|---|
| | | After spray | | | |
| | | 3 DAS | 7 DAS | 14 DAS | Mean |
| $T_1$ | Fipronil 5% SC | 4.36 (12.05)* | 3.82 (11.27) | 3.56 (10.88) | 3.91 (11.40) |
| $T_2$ | Chlorantraniliprole 0.4 G | 3.21 (10.32) | 2.60 (9.26) | 2.35 (8.81) | 2.72 (9.47) |
| $T_3$ | Flubendiamide 480 SC | 4.44 (12.16) | 4.39 (12.10) | 4.33 (12.00) | 4.38 (12.09) |
| $T_4$ | Spinosad 45% SC | 4.25 (11.90) | 3.71 (11.10) | 3.41 (10.65) | 3.79 (11.21) |
| $T_5$ | Nisco Sixer Plus | 5.12 (13.06) | 5.06 (12.99) | 5.00 (12.91) | 5.06 (12.99) |
| $T_6$ | *Metarhizium anisopliae* WP | 4.96 (12.86) | 4.61 (12.40) | 4.47 (12.21) | 4.68 (12.49) |
| $T_7$ | Azadirachtin 10000 ppm | 5.72 (13.83) | 5.66 (13.76) | 5.40 (13.08) | 5.61 (13.67) |
| $T_8$ | Control | 11.97 (20.24) | 12.82 (20.94) | 13.46 (21.51) | 12.73 (20.62) |
| F test | | S | S | S | S |
| S.Ed (±) | | 2.71 | 3.14 | 3.45 | 3.10 |
| CD (0.05%) | | 0.76 | 0.83 | 0.50 | 0.94 |

*Figures in the parenthesis are arc sine transformed value DBS= Day before spray DAS=Day after spray

**Table 3:** Economics of cultivation

| Tr. No. | Treatments | Yield q/ha. | Cost of yield ₹./q | Total cost of yield (₹.) | Common cost (₹.) | Treatment cost (₹.) | Total cost (₹.) | C:B ratio |
|---|---|---|---|---|---|---|---|---|
| $T_1$ | Fipronil 5% SC | 43.80 | 1,700 | 74460 | 26,125 | 5000 | 31125 | 1:2.39 |
| $T_2$ | Chlorantraniliprole 0.4 G | 49.10 | 1,700 | 83470 | 26,125 | 6550 | 32675 | 1:2.55 |
| $T_3$ | Flubendiamide 480 SC | 43.20 | 1,700 | 73440 | 26,125 | 6200 | 32325 | 1:2.27 |
| $T_4$ | Spinosad 45% SC | 44.10 | 1,700 | 74970 | 26,125 | 3770 | 29895 | 1: 2.50 |
| $T_5$ | Nisco Sixer Plus | 35.80 | 1,700 | 60860 | 26,125 | 2300 | 28425 | 1:2.14 |
| $T_6$ | *Metarhizium anisopliae* WP | 36.10 | 1,700 | 61370 | 26,125 | 1280 | 27405 | 1:2.23 |
| $T_7$ | Azadirachtin 10000 ppm | 34.40 | 1,700 | 68480 | 26,125 | 1400 | 27525 | 1:2.12 |
| $T_8$ | Control | 21.70 | 1,700 | 36890 | 26,125 | - | 26,125 | 1:1.41 |

## Conclusion

Results showed that Chlorantraniliprole 0.4 G is the most effective treatment against yellow stem borer and produces maximum yield and recorded highest Cost-Benefit ratio compared to other treatments. While, and Spinosad 45% SC was found to be more effective than other treatments. Followed by Fipronil 5% SC, Flubendiamide 480 SC, *Metarhizium anisopliae* WP, Nisco sixer plus, Azadirachtin 10000 ppm.

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