*Biological Forum – An International Journal* **15(9): 969-974(2023)**

**ISSN No. (Print): 0975-1130**
**ISSN No. (Online): 2249-3239**

# Eco-friendly Management with respect to Yellow Stem Borer (*Scirpophaga incertulas* Walker) on Rice

***Batta G.B.*, K.L. Paikra, G.P. Paikra, P.K. Bhagat, Sachin Kumar Jaiswal and Priti Singh***
*Department of Entomology,*
*IGKV, Raj Mohini Devi College Agriculture and Research Station, Ambikapur (Chhattisgarh), India.*

*(Corresponding author: Batta G.B.*)*
*(Received: 07 July 2023; Revised: 05 August 2023; Accepted: 03 September 2023; Published: 15 September 2023)*
*(Published by Research Trend)*

**ABSTRACT: Farmers highly rely on synthetic insecticides against destructive pests, the excessive use of which in the field results in severe adverse effects on the agroecosystem, human health and wildlife. So, research was conducted at Agriculture Research Farm of Raj Mohini Devi College of Agriculture and Research Station Ambikapur, (C.G.) during Kharif 2022 to manage yellow stem borer of rice in an environmentally responsible manner. The research followed RBD with 4 replications and 5 treatments using variety MTU-1010. The treatments are $T_1$ Botanical-insecticides (Neemazal 1% EC + Eucalyptus oil + Cartap hydrochloride 50% SC), $T_2$ Botanical – insecticides (Neemazal 1% EC + Neem oil + Triflumezopyrim 10% SC), $T_3$ All botanicals (Neemazal 1% EC + Eucalyptus oil + Neem oil), $T_4$ All insecticides (Chlorantraniliprole 0.4G + Cartap hydrochloride 50% SC + Triflumezopyrim10% SC) and untreated control. The results shown that $T_4$ All insecticides (Chlorantraniliprole 0.4G + Cartap hydrochloride 50%SC + Triflumezopyrim10% SC) recorded with lowest per cent of dead heart and white ear head (3.7% DH and 2.0% WE, respectively) followed by $T_3$ All botanicals (Neemazal 1% EC + Eucalyptus oil + Neem oil) with 3.75% DH and 2.4% WE while untreated plot recorded with highest 6.9% DH and 6.1%, WE, respectively. Similarly, the highest yield and net returns recorded from treatment $T_4$ All insecticides (Chlorantraniliprole 0.4G + Cartap hydrochloride 50% SC + Triflumezopyrim 10% SC) i.e., 42 q $ha^{-1}$ and Rs. 54796 $ha^{-1}$, respectively followed by $T_3$ All botanicals (Neemazal 1% EC +Eucalyptus oil + Neem oil) with 39.5 q $ha^{-1}$ and Rs.54714 $ha^{-1}$, respectively while the lowest yield and net returns recorded from untreated plot with 33 q $ha^{-1}$ and Rs. 39795 $ha^{-1}$, respectively. Whereas due to low cost of treatment, $T_3$ All botanicals (Neemazal 1% EC + Eucalyptus oil + Neem oil) recorded with highest Cost to Benefit ratio i.e., (1:1.74) followed by $T_4$ All insecticides (Chlorantraniliprole 0.4G + Cartap hydrochloride 50% SC + Triflumezopyrim10% SC) with (C: B -1:1.49).**

**Keywords:** Eco-friendly management, rice yellow stem borer, yield.

## INTRODUCTION

Rice (*Oryza sativa* L.), belonging to the Poaceae family, Sub-family Oryzoideae, tribe Oryzae with chromosome number 24 i.e., 2n= 24, is the staple food crop for more than 60% of the world population and is particularly important in Southeast Asian countries. Rice is the only cereal crop that can be grown submerged in water and requires more water than any other crop (Food and Agriculture Organization, 2004). The global land area for rice cultivation is about 164.19 million hectares (Roy Choudhury *et al.*, 2021). India is first in terms of area under rice cultivation with 45 million hectares and second in terms of rice production with 124.37 million tonnes after China, accounting for 21.7 per cent of global rice production with an average productivity of 28.01 q $ha^{-1}$. (Anonymous, 2021). Grown for more than 6000 years, rice is economically, socially and culturally important to a large number of people across the globe (Pathak *et al.*, 2018). Over 1400 insect's species attack standing and stored rice in the world (Grist and Lever 1969), while Kalode and Pasalu (1986) reported that over 100 species of insect pests attack rice crop at various stages of its growth. Out of which, 20 are of major economic importance (Pathak and Dhaliwal 1981). The yellow stem borer (*Scripophaga incertulas*) is oneof the major pests of rice. Stemborer larvae feed on the leaf sheath for a few days before boring into the stem. When feeding occurs during the vegetative stage of plant development, the affected tillers wither and die, a condition known as a dead heart (Pathak and Khan 1994). When feeding occurs at reproductive stages of plant development, injury prevents panicle development. Panicles may emerge, but remain straight, are whitish, and do not produce grains, a condition known as a whitehead (Pathak and Khan 1994). Yield loss estimate across India varied from 11.2to 40.1% due to dead hearts and 27.6 to 71.7% due to white ears, respectively (Krishnaiah and Varma 2012). Thus, the

average loss of yield in rice accounted for 30 per cent due to stem borers, in India (Lastuka, 2009; Rahman *et al.*, 2014).

In Chhattisgarh, rice is mainly grown under rainfed ecosystem during Kharif season and it is completely dependent on monsoon. Rice occupies an area of 3.7 million ha of total 6.53 million ha cultivated area with production and productivity of 7.16 Mt and 1889 Kg ha$^{-1}$. However, the production and productivity of rice per unit area is very low compared to other statedue to high pest and disease infestation, poor fertility availability in soil, poor adaptation of improved crop production technology, poor prevailing organization and promotional supporting agencies for modernizing agriculture etc (Pandey *et al.* 2009).

The injudicious and unselective use of insecticides can cause insecticide resistance (Khan and Khaliq 1989), pest resurgence (Kushwaha, 1995), secondary pest outbreak (Heinrichs, 1994; Satpathi *et al.*, 2005), environment pollution (Kushwaha, 1995), persistent residual toxicity (Wakil *et al.*, 2001), and reduce the populations of beneficial insects (Guan Soon, 1990; Phillips *et al.*, 1990; Debach and Rosen 1991; Way and Heong 1994). Because of severe crop loss caused by YSB, effective measures to manage the pest are on strong demand in India. Many conventionalinsecticides though have been evaluated against the pest, yet, most of the chemicals have failed to protect environmental crises due to excessive application of insecticides and to provide adequate pest control. Plant extracts are becoming increasingly important as a result of the dangers posed by chemical pesticides. The use of indigenous botanicals has been appreciated (Gurung & Azad 2013). Numerous plants, spices, and their extracts are known to have insecticidal properties. Contrary to conventional pesticides based on a single active ingredient, plant bioactive components are a complex array of novel compounds with a variety of behavioural and physiological impacts on insects. Products that have been treated with plant extracts repel and discourage insects from feeding. Therefore, it is important to encourage the use of fundamental plant derivative formulations, such as oils and extracts. These pesticides are excellent for usage since they are harmless to nontarget species such as predators and parasites (Gurung and Azad 2013).

## MATERIALS AND METHOD

The present experiment was conducted at Agricultural Research Farm of R.M.D College of Agriculture and Research Station, Ambikapur (C.G.) during kharif season 2022. The trials werelaid in Randomized Block Design (RBD) with five treatments and four replications. Treatment details are presented in Table 1. The crop variety MTU1010 was transplanted in the main field having 5 × 4 m$^2$, plot size with 20 cm × 15 cm (P × R). The data was recorded from randomly selected 10 hills per plot at before 30 DAT and after application of insecticide (i.e., 30,50 and 65DAT) and before harvesting for white ear head. The effectiveness of treatments against yellow stem borer of rice was assessed on the basis of total number of dead hearts and white ears.

**Table 1: Details of the insecticides used for the experiment.**

| Sr. No. | Treatment | Details of treatments | Dosage/ha |
|---|---|---|---|
| 1. | Botanical-insecticides | Neemazal 1% EC 25-30 DAT | 2.5 lit/ha |
| | | Eucalyptus oil 45-50 DAT | 1 lit/ha |
| | | Cartap hydrochloride 50% SC 60-65 DAT | 1Kg /ha |
| 2. | Botanical-insecticides | Neemazal 1%EC 25-30 DAT | 2.5 lit/ha |
| | | Neem oil 45-50 DAT | 2 lit/ha |
| | | Triflumezopyrim 10% SC 60-65 DAT | 25 Kg/ha |
| 3. | All botanicals | Neemazal 1% EC 25-30 DAT | 2.5 lit/ha |
| | | Eucalyptus oil 45-50 DAT | 1 lit/ha |
| | | Neem oil 60-65 DAT | 2 lit/ha |
| 4. | All insecticides | Chlorantraniliprole 0.4G 25-30 DAT | 10 Kg/ha |
| | | Cartap hydrochloride 50% EC 45-50 DAT | 1 Kg/ha |
| | | Triflumezopyrim 10% SC 60-65 DAT | 25 Kg/ha |
| 5. | Untreated control | Only water | Water spray |

**Percent damage caused by yellow stem borer was subsequently worked out as % DH &WE:**

$$\text{Dead heart (\%)} = \frac{\text{Total no. of dead heart}}{\text{Total no. of tiller}} \times 100$$

$$\text{White ear head (\%)} = \frac{\text{No. of white ears}}{\text{No. of productive tillers}}$$

The grain yield of each plot was recorded separately at harvesting time and converted into q ha$^{-1}$before statistical analysis. The percent increase in yield over control in various treatments and the economics of each treatment was also worked out on the basis of expenditure in differenttreatment.

% increase in yield in treatment over control

$$= \frac{\text{Yield in treatment} - \text{Yield in control}}{\text{Yield in control}} \times 100$$

$$\text{C : B ratio} = \frac{\text{Net returns (Rs. ha}^{-1})}{\text{Cost of treatment (Rs. ha}^{-1})}$$

## RESULTS AND DISCUSSIONS

The efficacy of bio-friendly insecticides *i.e.* T1 Botanical – insecticides (Neemazal 1%EC + Eucalyptus oil + Cartap hydrochloride 50% SC), T2 Botanical – insecticides (Neemazal 1% EC+ Neem oil + Triflumezopyrim10% SC), T3 All botanicals (Neemazal 1% EC + Eucalyptus oil + Neem oil), T4 All

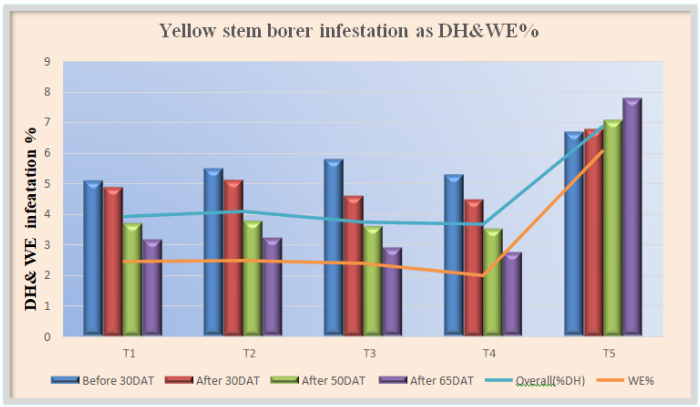
insecticides (Chlorantraniliprole 0.4G + Cartap hydrochloride 50% SC + Triflumezopyrim10% SC) and T5 Untreated control were evaluated in order to provide better protection to rice against yellow stem borer infestation during Kharif -2022.

**Yellow stem borer infestation as percent dead heart at before application of insecticide (i.e., before 30 DAT).** A day prior observation was recorded for assessing whether the stem damage by the pest was uniformly distributed over all the treatments. Among the treatments the dead heart infestation per cent was observed from the ranged of 5.1 to 6.7. No significant difference was observed in the mean dead heart symptoms before the application of different treatments, which were presented in Table 2 and depicted in Fig. 1.

**Table 2: Evaluation of eco-friendly insecticides against yellow stem borer infestation as per cent dead heart/white ear head in rice during Kharif -2022.**

| T. No. | Treatment | Names | Dosage | Yield stem borer infestation as per cent dead heart (DH%) | | | | | Per cent DH reduction over control | White ear head infestation (WE%) | White ear head reduction over control |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Before 30 DAT | After 30 DAT | After 50 DAT | After 65 DAT | Overall (%DH) | | | |
| T1 | Botanical - insecticides | Neemazal 1% EC | 2.5lt/ha | 5.1 (13.1) | 4.9 (12.8) | 3.7 (11.1) | 3.2 (10.2) | 3.9 (11.4) | 43.0 | 2.5 (9.0) | 58.5 |
| | | Eucalyptus oil | 1l/ha | | | | | | | | |
| | | Cartap hydrochloride 50% SC | 1kg/ha | | | | | | | | |
| T2 | Botanical-insecticides | Neemazal 1% | 2.5lt/ha | 5.5 (13.6) | 5.1 (13.1) | 3.8 (11.4) | 3.2 (10.3) | 4.1 (11.7) | 40.6 | 2.5 (9.0) | 59.1 |
| | | Neem oil | 2lt/ha | | | | | | | | |
| | | Triflumezopyrim 10% SC | 25kg/ha | | | | | | | | |
| T3 | All botanicals | Neemazal 1% EC | 2.5lt/ha | 5.8 (13.9) | 4.6 (12.4) | 3.6 (11.0) | 2.9 (9.9) | 3.75 (11.2) | 44.9 | 2.4 (8.9) | 60.7 |
| | | Eucalyptus oil | 1l/ha | | | | | | | | |
| | | Neem oil | 2l/ha | | | | | | | | |
| T4 | All insecticides | Chlorantraniliprole 0.4G | 10kg/ha | 5.3 (13.3) | 4.5 (12.4) | 3.5 (10.9) | 2.8 (9.6) | 3.7 (11.1) | 46.4 | 2.0 (8.1) | 67.2 |
| | | Cartap hydrochloride 50% SC | 1kg/ha | | | | | | | | |
| | | Triflumezopyrim 10% SC | 25kg/ha | | | | | | | | |
| T5 | Untreated control | Only water | water spray | 6.7 (15.0) | 6.8 (15.1) | 7.1 (15.5) | 7.8 (16.2) | 6.9 (15.2) | 0.0 | 6.1 (14.3) | 0 |
| C.D at 5% | | | | N/A | 0.662 | 0.762 | 0.884 | 0.574 | | 1.254 | |
| S.E(m) ± | | | | 0.34 | 0.213 | 0.245 | 0.283 | 0.184 | | 0.403 | |

Figure in Parenthesis are arcsine transformed values X'=arcsine √x; CD at 5% level of significance, DAT- Days after transplanting; DH-Dead Heart; WE-White Ear




T1- (Neemazal 1% EC+ Eucalyptus oil+ Cartap hydrochloride 50% EC), T2-(Neemazal 1% EC+ Neem oil+ Triflumezopyrim 10% SC), T3-(Neemazal 1% EC+ Eucalyptus oil+ Neem oil), T4-(Chlorantraniliprole 0.4 G+Cartap hydrochloride 50% SC+Triflumezopyrim 10% SC), T5-Only water.

**Fig. 1.** Effect of insecticides against yellow stem borer infestation as percent dead heart & white ear head in rice during Kharif -2022.

**Yellow stem borer infestation percent dead heart after application of insecticide (i.e., at 30 DAT).** The observation on the pest infestation after 30 DAT revealed that all the treatment registered significantly lower infestation per cent as compared to untreated control. Among all the treatments, the treatment T4 including All insecticides (i.e. Chlorantraniliprole 0.4 G + Cartap hydrochloride 50% SC + Triflumezopyrim 10% SC) was superior of all the treatments as it recorded lowest level of infestation i.e., 4.5% DH, followed by T3 All botanicals (Neemazal 1% EC + Eucalyptus oil + Neem oil), T1 Botanical – insecticides (Neemazal 1% EC + Eucalyptus oil + Cartap hydrochloride 50% SC) and T2 Botanical – insecticides (Neemazal 1% EC + Neem oil + Triflumezopyrim 10% SC) with dead heart incidence of 4.6, 4.9 and 5.1%, respectively. However, the highest infestation 6.8% DH was recorded from untreated control.

**Yellow stem borer infestation as percent dead heart at 50 DAT.** The observations of the dead heart was recorded at 50 DAT and found that there was significant practical difference among the treatments, however there was less incidence of dead heart found in T4 All insecticides (Chlorantraniliprole 0.4 G + Cartap hydrochloride 50% SC + Triflumezopyrim 10% SC) i.e., 3.5% DH followed by T3 All botanicals (Neemazal 1% EC + Eucalyptus oil + Neem oil), T1 Botanical – insecticides (Neemazal 1% EC + Eucalyptus oil + Cartap hydrochloride 50% SC) and T2 Botanical – insecticides (Neemazal 1% EC + Neem oil + Triflumezopyrim 10% SC) with dead heart incidence of 3.6, 3.7 and 3.8%, respectively. However, the highest infestation 7.1% DH was recorded from untreated control.

**Yellow stem borer infestation as percent dead heart at 65 DAT.** Among all the treatments at 65 DAT, the treatment T4 All insecticides (Chlorantraniliprole 0.4G+Cartap hydrochloride 50% SC+Triflumezopyrim 10% SC) is superior of all the treatments as it recorded lowest level of infestation i.e.,2.8% DH, followed by T3 All botanicals ( Neemazal1% EC + Eucalyptus oil + Neem oil),T1 Botanical-insecticides (Neemazal 1% EC + Eucalyptus oil + Cartap hydrochloride 50% SC) and T2 Botanical – insecticides (Neemazal 1%EC + Neem oil+ Triflumezopyrim10% SC) with the dead heart incidence of 2.9,3.2 and 3.2% respectively. However, the infestation was recorded highest (7.8% DH) in the untreated control plot.

**Overall mean yellow stem borer infestation as percent dead heart.** The perusal of overall mean data revealed that all the treatments showed significantly effective minimum infestation of dead heart over control. Among them, T4 all insecticides (Chlorantraniliprole 0.4G+ Cartaphydrochloride 50% SC + Triflumezopyrim10% SC) which showed significantly superior over all the treatments with overall (%DH) 3.7, but closely followed by T3 All botanicals ( Neemazal 1% EC + Eucalyptus oil + Neem oil),T1Botanical- insecticides (Neemazal 1% EC + Eucalyptus oil + Cartap hydrochloride 50% SC) and T2 Botanical – insecticides ( Neemazal 1%EC + Neem oil+ Triflumezopyrim10% SC) with the dead heart incidence of 3.75,3.9 and 4.1% respectively. However, the highest infestation 6.9 % DH was recorded from untreated control.

**Yellow stem borer infestation as percent white ear head in rice during Kharif-2022.** The observation regarding white ear head infestation caused by yellow stem borer were recorded before harvesting of the crop and the data showed significance difference among different insecticidal treatments. The result of per cent white ear head infestation by yellow stem borer on rice was observed the minimum for T4 All insecticides (Chlorantraniliprole 0.4 G + Cartap hydrochloride 50% SC + Triflumezopyrim 10% SC) i.e., 2.0% WE infestation. There is no significant difference between T3 All botanicals (Neemazal 1% EC + Eucalyptus oil + Neem oil),T1 Botanical-insecticides (Neemazal 1% EC + Eucalyptus oil + Cartap hydrochloride 50% SC) andT2 Botanical – insecticides (Neemazal 1% EC + Neem oil + Triflumezopyrim 10% SC) and as they recorded 2.4, 2.5 and 2.5% WE infestation respectively. However, the highest infestation 6.1% WE were recorded from T5 untreated control.

**Overall mean yellow stem borer infestation as percent dead heart reduction over control.** The result of overall mean percent of dead heart reduction over control was highest in T4 All insecticides (Chlorantraniliprole 0.4G+Cartap hydrochloride 50% SC+ Triflumezopyrim 10%SC) as 46.4% is closely related by T3 All botanicals (Neemazal 1% EC+Eucalyptus+Neemoil),T1Botanical-insecticides (Neemazal 1% EC + Eucalyptus oil + Cartap hydrochloride 50% SC) and T2 Botanical-insecticides (Neemazal 1% EC + Neem oil+ Triflumezopyrim 10% SC) which gave the per cent dead heart reduction of 44.9%,43.04% and 40.6%, respectively which is presented in Table 2.

**Overall mean yellow stem borer infestation as percent white ear head over control.** The per cent white ear head reduction over control was calculated and result revealed that the highest white ear head reduction was recorded in T4 All insecticides (Chlorantraniliprole 0.4G+Cartap hydrochloride 50%SC +Triflumezopyrim10% SC) with 67.2% followed by T3 All botanicals (Neemazal 1% EC + Eucalyptus oil + Neem oil) with 60.7%. T1 Botanical-insecticides (Neemazal 1% EC + Eucalyptus oil + Cartap hydrochloride 50% SC) and T2 Botanical – insecticides (Neemazal 1%EC + Neem oil+ Triflumezopyrim10% SC) with 58.5%. and with 59.1%, respectively.

**Evaluation of yield loss caused by yellow stem borer on rice Grain yield (q.ha$^{1}$).** A perusal of results represented in Table 3 and Fig. 2 revealed that all the treatments recorded higher grain yield of rice over untreated control. The highest yield (42 q ha$^{-1}$) was obtained from T4 All insecticides (Chlorantraniliprole 0.4 G + Cartap hydrochloride 50% SC + Triflumezopyrim 10% SC) followed by T3 All botanicals (Neemazal 1% EC + Eucalyptus oil + Neem oil) and T1 Botanical-insecticides (Neemazal 1% EC + Eucalyptus oil + Cartap hydrochloride 50% SC) and which gave 39.5 and 39.1q ha$^{-1}$ yield, respectively. Further analysis of data showed that these treatments were significantly superior over rest of the treatments. The lowest grain yield was recorded from untreated control (33.0 q ha$^{-1}$ yield).

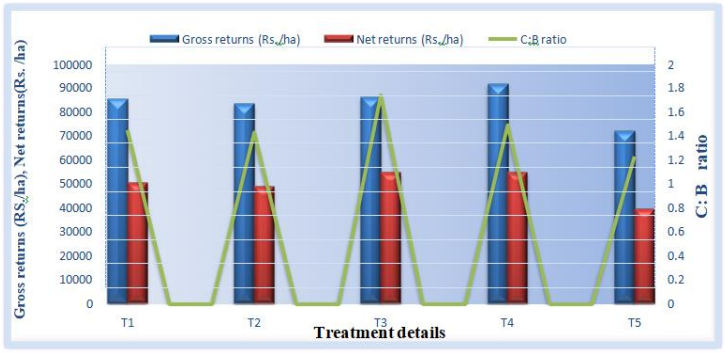
**Net returns (Rs. ha$^{-1}$).** Various insecticides bring about significant effect in net return. It is evident from data that T4 All insecticides (Chlorantraniliprole 0.4G + Cartap hydrochloride 50% SC + Triflumezopyrim 10% SC) recorded higher net return (Rs. 54796 ha$^{-1}$), found at par with T3 All botanicals (Neemazal 1% EC + Eucalyptus oil + Neem oil) and T1 Botanical-insecticides (Neemazal 1% EC + Eucalyptus oil + Cartap hydrochloride 50% SC) with (Rs.54714 and Rs.50487 ha$^{-1}$), respectively but significantly

superior over other remaining treatments. Further analysis of data also revealed that untreated control found significantly the lowest net return (Rs.39795 ha$^{-1}$).

**Cost Benefit (C: B) ratio.** Amongst different insecticidal treatments, the treatment T3 All botanicals (Neemazal 1% EC + Eucalyptus oil + Neem oil) proved best as maximum C:B ratio (1:1.74) followed by T4 All insecticides (Chlorantraniliprole 0.4G + Cartap hydrochloride 50% SC + Triflumezopyrim 10%SC) and T1 Botanical-insecticides (Neemazal 1% EC + Eucalyptus oil + Cartap hydrochloride 50% SC) with (1:1.49) and with (1:1.45) which was significantly superior over all of the treatments. Further analysis of data also revealed that untreated control was the inferior regarding C:B ratio (1:1.23). The practical utility of any pest management practices can be best judged because of net return and cost benefit ratio. Treatments of yellow stem borer in rice in term of management strategies showed significant direct yield advantage over untreated control and maximizing net return as well as C:B ratio. This was because of more net returns than the money spent in crop production with these insecticides and their combinations.

**Table 3: Economics of the treatments against yellow stem borer infestation (%) in rice during Kharif -2022.**

| T. No. | Treatment | Names | Dosage | Yield / Economics | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Yield (q haa$^{-1}$) | Yield increased over control (q ha$^{-1}$) | Cost (Rs. ha$^{-1}$) | Gross returns (Rs. ha$^{-1}$) | Value of increased yield (Rs. ha$^{-1}$) | Net returns (Rs. ha$^{-1}$) | C:B ratio |
| T1 | Botanical - insecticides | Neemazal 1% EC | 2.5lt/ha | 39.1 | 6.1 | 34868 | 85355 | 13316 | 50487 | 1:1.45 |
| | | Eucalyptus oil | 1l/ha | | | | | | | |
| | | Cartap hydrochloride 50% SC | 1kg/ha | | | | | | | |
| T2 | Botanical-insecticides | Neemazal 1% | 2.5lt/ha | 38.2 | 5.2 | 34315 | 83390 | 11351 | 49075 | 1:1.43 |
| | | Neemoil | 2lt/ha | | | | | | | |
| | | Triflumezopyrim 10% SC | 25kg/ha | | | | | | | |
| T3 | All Botanicals | Neemazal 1% EC | 2.5lt/ha | 39.5 | 6.5 | 31514 | 86288 | 14189 | 54714 | 1:1.74 |
| | | Eucalyptus oil | 1l/ha | | | | | | | |
| | | Neem oil | 2l/ha | | | | | | | |
| T4 | All Insecticides | Chlorantraniliprole 0.4G | 10kg/ha | 42 | 9.0 | 36890 | 91686 | 19647 | 54796 | 1:1.49 |
| | | Cartap hydrochloride 50% SC | 1kg/ha | | | | | | | |
| | | Triflumezopyrim 10% SC | 25kg/ha | | | | | | | |
| T5 | Untreated control | Only water | waterspray | 33 | 0 | 32244 | 72039 | 0 | 39795 | 1:1.23 |
| C.D at 5% | | | | 5.31 | | | 11355.04 | | 10444.14 | 0.319 |
| S.E(m±) | | | | 1.72 | | | 3685.14 | | 3389.51 | 0.104 |




T1- (Neemazal 1% EC+ Eucalyptus oil+ Cartap hydrochloride 50% EC), T2-(Neemazal 1% EC+ Neem oil+ Triflumezopyrim 10% SC), T3- (Neemazal 1% EC+ Eucalyptus oil + Neem oil), T4-(Chlorantraniliprole 0.4 G+Cartap hydrochloride 50% SC+Triflumezopyrim 10% SC), T5- Only water.

**Fig. 2.** Gross and net return & C:B ratio of rice influenced by insecticides against yellow stem borer (% dead heart/white ear).

## CONCLUSIONS

The efficacy of some eco-friendly insecticides was also evaluated in order to provide better protection to rice against yellow stem borer infestation and also to protect the environment from excessive usage of insecticides. The results revealed that treatment T4 All insecticides (Chlorantraniliprole 0.4G + Cartap hydrochloride 50% SC + Triflumezopyrim 10% SC) was found to be most effective treatment with lower per cent of dead heart and white earhead (3.7 and 2.0 %, respectively) followed by treatment T3 All botanicals (Neemazal 1% EC + Eucalyptus oil + Neem oil) with (3.75% DH and 2.4% WE, respectively) and T1 Botanical-insecticides (Neemazal 1% EC + Eucalyptus oil + Cartap hydrochloride 50% SC) with (3.9% DH and 2.5%WE, respectively). Whereas untreated plot recorded with maximum number of dead heart (6.9%) and white earhead infestation (6.1%).

Taking into account economics of treatments against yellow stem borer in rice, clearly revealed that all the treatments recorded good yield and net return over

untreated control. The maximum yield and net return were obtained from T4 All insecticides (i.e., Chlorantraniliprole 0.4G + Cartap hydrochloride 50% SC + Triflumezopyrim 10% SC) with (42 q $ha^{-1}$and Rs.54796 $ha^{-1}$) followed by T3 All botanicals (i.e., Neemazal 1% EC + Eucalyptus oil + Neem oil) (39.5 q $ha^{-1}$and Rs. 54714 $ha^{-1}$) respectively.

Considering cost of pesticides, T3 All botanicals (i.e., Neemazal 1% EC + Eucalyptus oil + Neem oil) proved best with maximum C:B ratio (1:1.74) followed by T4 All insecticides (i.e., Chlorantraniliprole 0.4G + Cartap hydrochloride 50% SC + Triflumezopyrim 10% SC) (1:1.49) and T1 Botanical-insecticides (i.e., Neemazal 1% EC + Eucalyptus oil + Cartap hydrochloride 50% SC) (1:1.45) which were significantly superior over all the treatments. Further analysis of data also revealed that untreated control was inferior regarding C:B ratio (1: 1.23). The current findings were in support with Kulagod *et al.* (2011) recorded that there was significant dead heart difference among the treatments at 5 days after spray. Cartap hydrochloride 50%SP @1g/l recorded significantly lowest per cent dead heart. Justin and Preetha (2014) revealed that chlorantraniliprole 0.4 GR was proved to be the best among all the tested insecticides with reduced stem borer infestation and recorded higher grain yield. While Neem oil exerted minimumreduction percentage of stem borer.

Based on the present studies, it is proven that treatment T3 All botanicals (i.e., Neemazal 1% EC + Eucalyptus oil + Neem oil) is best with maximum C:B ratio, net returns and less environmental impact, so it can be recommended for farmers based on results of further investigation.

## FUTURE SCOPE

All the treatments were found significant to each other and its eco-friendly management with respect to yellow stem borer which is safer for environment.

## REFERENCES


Anonymous (2021). Annual Report 2021-2022, Directorate of Economics and Statistics. Department of Agriculture and Cooperation, Ministry of Agriculture, Government of India.

Debach, P. and Rosen, S. (1991). Biological Control of Natural Enemies. UK: Cambridge University Press: 13.

Food and Agriculture Organization (2004). International Year of Rice. FAO Factsheet, 1–2.

Grist, D. H. and Lever, R. J. A. W. (1969). Pests of Rice. Longmans, Green and Co., London, U.K.

Guan-Soon, L. (1990). Overview of vegetables IPM in Asia. *FAO Plant Prot Bull., 38*(2), 73–78.

Gurung, T. R. and Azad, A. K. (2013). Extent and potential use of bio-pesticides for cropprotection in SAARC Countries. SAARC Agriculture Centre.

Heinrichs, E. A. (1994). Biology and Management of Rice Insects. London: Willey Eastern Ltd. 591.

Justin, C.G.L. and Preetha, G. (2014). Survey on the occurrence, distribution pattern and management of stem borers on rice. *Journal of Entomology and Zoological Studies, 2*(6), 86-90.

Kalode, M. B. and Pasalu, I. C. (1986). Pest management in rice. *Indian Farming, 9*(1), 31-34.

Khan, I. and Khaliq, A. (1989). Field evaluation of some granular insecticides for the control of rice stems borers. *Pak. J. Sci. Ind. Res., 32*(12), 824.

Krishnaiah, K. and Varma, N. R. G. (2012). Status paper on "Changing insect pest scenario in therice ecosystem- a national perspective.

Kulagod, S.D., Hegde, M., Nayak, G. V., Vastrad, A. S., Hugar, P. S. and Basavanagoud, K. (2011). Evaluation of insecticides and bio-rationals against yellow stem borer. *Journal of Agricultural Sciences, 24*(2), 244-246.

Kushwaha, K.S. 1995. Chemical control of rice stem borer, *Scirpophaga incertulas* (Walker) and leaf folder *Cnaphalocrocis medinalis* Guenee on Basmati. *J. Insect Sci., 8*(2), 225– 226.

Lastuvka, Z. (2009). Climate change and its possible influence on the occurrence and importanceof insect pests. *Plant Protection Science, 45*(1), 53-62.

Pandey, M. P., Verulkar, S. B. and Sarawgi, A. K. (2009). Status paper on rice for Chhattisgarh. Rice Knowledge Management Portal (RKMP). Directorate of Rice Research, Hyderabad.

Pathak, H., Nayak, A. K., Jena, M., Singh, O. N., Samal, P. and Sharma, S. G. (2018). Rice Research for Enhancing Productivity, Profitability and Climate Resilience, ICAR- National Rice Research for Institute, 1–527.

Pathak, M. D. and Dhaliwal, G. S. (1981). Trends and strategies for rice insect problems in tropical Asia. In: IRRI Research paper series No. 64. International Rice ResearchInstitute, Los Banos, Philippines.

Pathak, M. D. and Khan, Z. R. (1994). Insect Pests of Rice. International Rice Research Institute, Los Banos (The Phillipines), Manila, 1-17.

Phillips, J. R., Graues, J. P. and Luttecl, R. G. (1990). Insecticides resistance management. *Pak. J. Agric. Sci., 38*(1), 3–4.

Rahaman, M. M., Islam, K. S., Jahan, M. and Mamun, M. A. A. (2014). Relative abundance of stemborer species and natural enemies in rice ecosystem at Madhupur, Tangail, Bangladesh. *Journal of Bangladesh Agricultural University, 12*(2), 267-272.

Roy Choudhury, A. (2021). Rice Research for Quality Improvement: Genomics and Genetic Engineering, Springer.

Satpathi, C. R., Mukhopadhyay, A. K., Katti, G., Pasalu, I. C. and Venkateswarlu, B. (2005). Quantification of the role of natural biological control in farmers' rice field in West Bengal. *Ind. J. Entomol, 67*(3), 211–213.

Wakil, W., Hasan, M., Akbar, R. and Gulzar, A. (2001). Evaluation of different insecticides against rice stem borer and rice leaf folder. *Pak. J. Agric. Sci., 31*(1), 49–50.

Way, M. J. and Heong, K. L. (1994). The role of biodiversity in the dynamics and management of insect-pests of tropical irrigated rice: A review. *Bull. Entomol. Res., 84*(4), 567–587.



**How to cite this article:** Ganga Bhavani Batta, K.L. Paikra, G.P. Paikra, P.K. Bhagat, Sachin Kumar Jaiswal and Priti Singh (2023). Eco-friendly Management with respect to Yellow Stem Borer (*Scirpophaga incertulas* Walker) on Rice. *Biological Forum – An International Journal, 15*(9): 969-974.