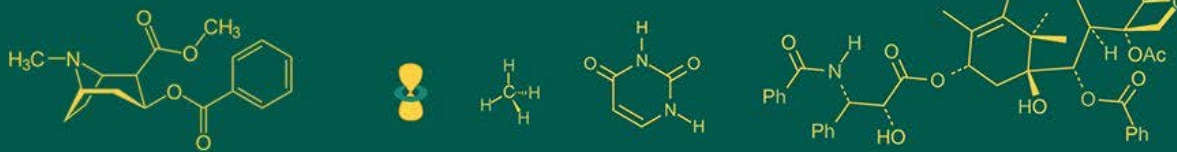


## International Journal of Advanced Biochemistry Research



ISSN Print: 2617-4693  
 ISSN Online: 2617-4707  
 IJABR 2024; 8(10): 857-866  
[www.biochemjournal.com](http://www.biochemjournal.com)  
 Received: 03-09-2024  
 Accepted: 05-10-2024

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## Management of borer complex of sugarcane (*Saccharum officinarum*)

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**DOI:** <https://doi.org/10.33545/26174693.2024.v8.i10k.2627>

**Abstract**

The field experiment was under taken to evaluate the efficacy of different seven insecticides viz. Azadirachtin 0.03% EC, *Metarhizium anisopliae* + *Beauveria bassiana* + *Lecanicillium lecanii*, *Metarhizium anisopliae* + *Bacillus thuringiensis* + *Lecanicillium lecanii*, Fipronil 40 + Imidacloprid 40, Chlorantraniliprole 18.50SC, Chlorpyrifos 20% EC Bifenthrin 8% + Clothianidin 10% SC, against borer complex of sugarcane during 2023-2024 was conducted at Regional Sugarcane Research Station, Basmath, Dist. Hingoli. The result revealed that for all borer complex Chlorantraniliprole 18.50 significantly superior over rest treatments. The next best insecticides were in order of Chlorpyrifos 20% EC @ 1.5 ml a.i./ha, Fipronil 40 + imidacloprid 40 @ 0.44 ml + 0.44 ml a.i./ ha, Bifenthrin 8% + Clothianidin 10% SC @ 1 ml + 1 ml a.i./ ha, *Metarhizium anisopliae* + *Bacillus thuringiensis* + *Lecanicillium lecanii* @ 4 ml + 2 ml a.i./ha, *Metarhizium anisopliae* + *Beauveria bassiana* + *Lecanicillium lecanii* @ 4 ml + 2 ml a.i./ha, Azadirachtin 0.03EC @ 2500 ml a.i./ha, respectively.

**Keywords:** Sugarcane, early shoot borer, top shoot borer, internode borer

**Introduction**

Cultivation of sugarcane (*Saccharum officinarum*) in India dates back to the Vedic period. Sugarcane is one of the several species of tall perennial true grass of genus *Saccharum*, tribe Andropogoneae, Native tropical to warm temperate to tropical region of south Asia and Melanesia and used for sugarcane production. (Nripesh and Gaikwad, 2017) [6]. India has been known as the original home of sugarcane and sugar.

Sugarcane, (*Saccharum officinarum*) is one of important commercial crop which contribute to the economy of the Nation significant. Sugarcane originated in New Guinea. Mainly grown in tropical country. Commercial sugarcane is a hybrid grass species accounting 86% of global sugarcane production (Daniels and Daniels, 1993) [2]. Globally sugarcane is cultivated over an area of 26.9 million hectares with total production of 1859 million tones and productivity of 81.7 tone per hectares. (FAO) 2021.

Among the major insect pest's sugarcane early shoot borer *Chilo infuscatellus*, top shoot borer, *Scirpophaga excerptalis* internode borer *S. inferens*, are damaging pests of sugarcane. Economical loss in sugarcane has been estimated to the extent of 15- 20 per cent in the cane yield in addition to a decrease in produce quality (Mujumder, 2020) [5]. Sugarcane crop mainly affected in Maharashtra region include borer complex.

Early shoot borer, *Chilo infuscatellus* damages young cane up to 8 week after planting the caterpillar that hatch out from the egg get scattered and enter into the young shoots by making hole just above the ground level and tunnels downwards. The central shoot dries up causing dead heart and also emits an offensive smell on being pulled out. Yield loss of sugarcane is estimated to be 22-23% by early shoot borer (Patil and Hapse 1981) [8].

Top shoot borer, *Scirpophaga excerptalis* Walk injurious to cane in later stage and persist till harvest (Pali 1965) [7] stated that the *Scirpophaga nivella* is major pest of sugarcane. The newly hatch caterpillars make number of small holes on leaves enter into midrib of the leaves producing galleries in the midrib. Later bore downward into the shoot from the top causing death of central shoot. Also produce bunchy top i.e. bushy appearance. (Alam *et al.*, 2006) [1], stated that yield loss by *Scirpophaga excerptalis* is up to 12.29-43.67%. Internode borer, *Sesamia inferens* Walk, infestation of this pest noticed in all stages of crop growth. The activity as an internode borer starts 3 to 4 months after planting and continuous till harvest.

The caterpillar bores at the nodal region and enter into the cane (Stem). The hole usually plugged with excreta. Duo to feeding “galleries” are formed inside the cane, the tissue turn red leading to reddish appearance and cane become hard. (Srikanth *et al.*, 2012) [9] reported that per cent of reduction in cane yield is up to 34.88% and reduction in sugar recovery 1.7 -3.07%.

### Materials and Methods

Field experiment was conducted during seasonal planting 2023-24 at Regional Sugarcane Research station, Basmath Nagar, taluka place in Hingoli, district of Marathwada region which comes under the Assured Rain fall zone (ARZ) of Maharashtra state.

**Table 1:** Details of the field experiment

Crop	Sugarcane
Design	Randomized Block Design
Treatments	Eight (8)
Replication	Three (3)
Plot size	6m x 6m x 1.2 m
Spacing	60x90 Cm
Date of sowing	Second forth night of January 2023
Date of Insecticides Spray	First spray 07 March 2023
	Second spray 12 May 2023
	Third Spray 13 September 2023
Date of harvesting	25 February 2024

**Table 2:** Details of various treatments

Sr. No	Name of treatment	Formulation	Dose/hq
1	Azadirachtin 0.03% EC	300 ppm	(2 lit.) + (2 lit.)
2	<i>Metarhizium anisopliae</i> + <i>Beauveria bassiana</i> + <i>Verticillium lecanii</i>	4 ml + 2 ml	(2 lit.) + (1 it.)
3	<i>Metarhizium anisopliae</i> + <i>Bacillus thuringiensis</i> + <i>Verticillium lecanii</i> .	4 ml + 4 ml	(2 lit.) + (2 lit.)
4	Fipronil 40 + Imidacloprid 40	0.44 ml + 0.44 ml	(2 lit.) + (2 lit.)
	Chlorantraniliprole 18.50 sc	0.37 ml	(2 lit.) + (2 lit.)
6	Chlorpyrifos 20% EC	1.5 ml	(2 lit.) + (1 lit.)
7	Bifenthrin 8% + Clothianidin 10% SC	1 ml + 1 ml	(4 lit)
8	Untreated	-----	-----

### Methods of Recording Observations

#### Efficacy of insecticides and biopesticides against borer complex

The efficacy of various insecticides against borer complex that is early shoot borer, top shoot borer, internode borer was judged on the basis of the per cent of dead heart bunchy and dead top at early stage and at maturity. The spraying was done on ETL basis. The percent of incidence was calculated as follows:

Infestation percentage were calculated by following formulae.

$$\text{Percent of Incidence} = \frac{\text{Total Number of infected cane}}{\text{Total number of cane observed}} \times 100$$

#### Statistical analysis

The data were subjected to analysis of variance (ANOVA) as prescribed for randomized block design. Data recorded on per cent damage and plant damage was subjected to square root transformation.

### Results and Discussion

#### Management of major insect pests of sugarcane

#### Effect of different insecticides and combination of biopesticides on population of early shoot borer (*C. infuscatellus*)

##### Pre count one day before spray

The data on *C. infuscatellus* population one day before spray is presented in Table 3 the result were statistically non-significant before application of insecticide indicating uniform distribution of *C. infuscatellus* population.

##### Seven days after first spray

The data are presented in table 3 there were significant difference among the treatment on seven days after spray. All the treatment were recorded significantly lower population of *C. infuscatellus* than untreated control. The population of *C. infuscatellus* in treatment Chlorantraniliprole 18.50 SC @ 0.37 ml a.i. ha was lowest

(3.23% dead heart), which was significantly superior over rest treatments.

The next best insecticides were in order of Chlorpyrifos 20% EC@ 1.5 ml i.e./ha, Fipronil 40 + imidacloprid 40@ 0.44 ml + 0.44 ml a.i./ ha, Bifenthrin 8% + Clothianidin 10% SC @ 1 ml + 1 ml a.i./ ha, *Metarhizium anisopliae* + *Bacillus thuringiensis* + *Lecanicillium lecanii* @ 4 ml + 2 ml a.i./ha, *Metarhizium anisopliae* + *Beauveria bassiana* + *Lecanicillium lecanii* @ 4 ml + 2 ml a.i./ha, *Azadirachtin* 0.03 EC @ 2500 ml i a.i./ha. The treatment Chlorantraniliprole 18.50 SC @ 0.37 ml a.i./ ha Chlorpyrifos 20% EC@ 1.5 ml a.i./ha, Fipronil 40 + imidacloprid 40 @ 0.44 ml + 0.44 ml i.e./ ha, and Bifenthrin 8% + Clothianidin 10% SC @ 1 ml + 1 ml i.e./ ha were significantly at par with each other. The highest population of *C. infuscatellus* (9.03% dead heart) was observed in untreated control.

##### Fifteen days after first spray

The result obtained are presented in table 3 there were significant difference among the treatment on fifteen days after spray. All the treatment were recorded significantly lower population of *C. infuscatellus* than untreated control. The population of *C. infuscatellus* in Chlorantraniliprole 18.50 SC @ 0.37 ml a.i./ ha was lowest (2.10% dead heart), which was significantly superior over rest treatments.

The next best insecticides were in order of Chlorpyrifos 20% EC@ 1.5 ml a.i./ha, Fipronil 40 + imidacloprid 40@ 0.44 ml + 0.44 ml a.i./ ha, Bifenthrin 8% + Clothianidin 10% SC @ 1 ml + 1 ml a.i./ ha, *Metarhizium anisopliae* + *Bacillus thuringiensis* + *Lecanicillium lecanii* @ 4 ml + 2 ml a.i./ha, *Metarhizium anisopliae* + *Beauveria basiana* + *Lecanicillium lecanii* @ 4 ml + 2 ml i.e./ha, *Azadirachtin* 0.03 EC @ 2500 ml i.e./ha. The treatments Chlorantraniliprole 18.50 SC @ 0.37 ml a.i./ ha, Chlorpyrifos 20% EC@ 1.5 ml i.e./ha, Fipronil 40 + imidacloprid 40 @ 0.44 ml + 0.44 ml a.i./ ha, and Bifenthrin 8% + Clothianidin 10% SC @ 1 ml + 1 ml a.i./ ha were

significantly at par with each other. The highest population of *C. infuscatellus* (7.01% dead heart) was observed in untreated control.

### Thirty days after first spray

The data are presented in table 3 there were significant difference among the treatment on thirty days after spray. All the treatment were recorded significantly lower population of *C. infuscatellus* than untreated control. The population of *C. infuscatellus* in Chlorantraniliprole 18.50 SC @ 0.37 ml a.i./ ha was lowest (2.15% dead heart), which was significantly superior over rest treatments.

The next best insecticides were in order of Chlorpyrifos 20% EC@ 1.5 ml a.i./ha, Fipronil 40 + imidacloprid 40@ 0.44 ml + 0.44 ml a.i./ ha, Bifenthrin 8% + Clothianidin 10% SC @ 1 ml + 1 ml a.i./ ha, *Metarhizium anisopliae* + *Bacillus thuringiensis* + *Lecanicillium lecanii* @4 ml + 2 ml a.i./ha, *Metarhizium anisopliae* + *Beauveria basiana* + *Lecanicillium lecanii* @ 4 ml + 2 ml a.i./ha, Azadirachtin 0.03EC @ 2500 ml a.i./ha. The treatment Chlorantraniliprole 18.50 SC @ 0.37 ml a.i./ ha, Chlorpyrifos 20% EC@ 1.5 ml a.i./ha, Fipronil 40 + imidacloprid 40@ 0.44 ml + 0.44 ml a.i./ ha, were significantly at par with each other. The highest population of *C. infuscatellus* (6.01% dead heart) was observed in untreated control.

### Effect of different insecticides and combination of biopesticides on population of early shoot borer (*C. infuscatellus*) with second spray

#### Seven days after second spray

The presented in table 3 there were significant difference among the treatment on seven days after second spray. All the treatment were recorded significantly lower population of *C. infuscatellus* than untreated control. The population of *C. infuscatellus* in Chlorantraniliprole 18.50 SC @ 0.37 ml a.i./ ha was lowest (2.23% dead heart), which was significantly superior over rest treatments.

The next best insecticides were in order of Chlorpyrifos 20% EC@ 1.5 ml a.i./ha, Fipronil 40 + imidacloprid 40@ 0.44 ml + 0.44 ml a.i./ ha, Bifenthrin 8% + Clothianidin 10% SC @ 1 ml + 1 ml a.i./ ha, *Metarhizium anisopliae* + *Bacillus thuringiensis* + *Lecanicillium lecanii* @4 ml + 2 ml a.i./ha, *Metarhizium anisopliae* + *Beauveria basiana* + *Lecanicillium lecanii* @4 ml + 2 ml a.i./ha, Azadirachtin 0.03 EC @ 2500 ml a.i./ha. The treatment Chlorantraniliprole 18.50 SC @ 0.37 ml a.i. ha, and Chlorpyrifos 20% EC@ 1.5 ml a.i./ha, were significantly at par with each other. The highest population of *C. infuscatellus* (10.20% dead heart) was observed in untreated control.

#### Fifteen days after second spray

The result obtained are presented in table 3 and there were significant difference among the treatment on fifteen days after second spray all the treatment were recorded significantly lower population of *C. infuscatellus* than untreated control. The population of *C. infuscatellus* in Chlorantraniliprole 18.50 SC @ 0.37 ml a.i./ ha was lowest (2.92% dead heart), which was significantly superior over rest treatments.

The next best insecticides were in order of Chlorpyrifos 20% EC @ 1.5 ml a.i./ha, Fipronil 40 + imidacloprid 40 @ 0.44 ml + 0.44 ml a.i./ ha, Bifenthrin 8% + Clothianidin

10% SC @ 1 ml + 1 ml a.i./ ha, *Metarhizium anisopliae* + *Bacillus thuringiensis* + *Lecanicillium lecanii* @4 ml + 2 ml a.i./ha, *Metarhizium anisopliae* + *Beauveria basiana* + *Lecanicillium lecanii* @ 4 ml + 2 ml a.i./ha, Azadirachtin 0.03EC @ 2500 ml a.i./ha. The treatment Chlorantraniliprole 18.50 SC @ 0.37 ml a.i. ha, Chlorpyrifos 20% EC@ 1.5 ml a.i./ha, Fipronil 40 + imidacloprid 40@ 0.44 ml + 0.44 ml a.i./ ha, and Bifenthrin 8% + Clothianidin 10% SC @ 1 ml + 1 ml a.i./ ha, *Metarhizium anisopliae* + *Bacillus thuringiensis* + *Lecanicillium lecanii* @4 ml + 2 ml a.i./ha, *Metarhizium anisopliae* + *Beauveria basiana* + *Lecanicillium lecanii* @4 ml + 2 ml a.i./ha were significantly at par with each other. The highest population of *C. infuscatellus* (9.25% dead heart) was observed in untreated control.

### Thirty days after second spray

The result obtained are presented in table 3 there was significant difference among the treatment on thirty days after second spray. All the treatment were recorded significantly lower population of *C. infuscatellus* than untreated control. The population of *C. infuscatellus* in Chlorantraniliprole 18.50 SC @ 0.37 ml a.i./ ha was lowest (4.49% dead heart), which was significantly superior over rest treatments.

The next best insecticides were in order of Chlorpyrifos 20% EC @ 1.5 ml a.i./ha, Fipronil 40 + imidacloprid 40 @ 0.44 ml + 0.44 ml a.i./ ha, Bifenthrin 8% + Clothianidin 10% SC @ 1 ml + 1 ml a.i./ ha, *Metarhizium anisopliae* + *Bacillus thuringiensis* + *Lecanicillium lecanii* @4 ml + 2 ml a.i./ha, *Metarhizium anisopliae* + *Beauveria basiana* + *Lecanicillium lecanii* @4 ml + 2 ml a.i./ha, Azadirachtin 0.03EC@ 2500 ml a.i./ha. The treatment Chlorantraniliprole 18.50 SC @ 0.37 ml a.i. ha, Chlorpyrifos 20% EC@ 1.5 ml a.i./ha, Fipronil 40 + imidacloprid 40@ 0.44 ml + 0.44 ml a.i./ ha, and Bifenthrin 8% + Clothianidin 10% SC @ 1 ml + 1 ml a.i./ ha, *Metarhizium anisopliae* + *Bacillus thuringiensis* + *Lecanicillium lecanii* @4 ml + 2 ml a.i./ha, were significantly at par with each other. The highest population of *C. infuscatellus* (9.98% dead heart) was observed in untreated control.

### Effect of different insecticides and combination of biopesticides on population of early shoot borer (*C. infuscatellus*) with third spray

#### Seven days after third spray

The result obtained are presented in table 3 there were significant difference among the treatment on seven days after third spray. All the treatment were recorded significantly lower population of *C. infuscatellus* than untreated control. The population of *C. infuscatellus* in Chlorantraniliprole 18.50 SC @ 0.37 ml a.i./ ha was lowest (3.17% dead heart), which was significantly superior over rest treatments. The next best insecticides were in order of Chlorpyrifos 20% EC@ 1.5 ml a.i./ha, Fipronil 40 + imidacloprid 40@ 0.44 ml + 0.44 ml a.i./ ha, Bifenthrin 8% + Clothianidin 10% SC @ 1 ml + 1 ml a.i./ ha, *Metarhizium anisopliae* + *Bacillus thuringiensis* + *Lecanicillium lecanii* @ 4 ml + 2 ml a.i./ha, *Metarhizium anisopliae* + *Beauveria basiana* + *Lecanicillium lecanii* @4 ml + 2 ml a.i./ha, Azadirachtin 0.03EC@ 2500 ml a.i./ha. The treatment Chlorantraniliprole 18.50 SC @ 0.37 ml a.i. ha, and Chlorpyrifos 20% EC@ 1.5 ml a.i./ha, were significantly at par with each other. The highest population of *C.*

*infuscatellus* (7.83% dead heart) was observed in untreated control.

#### **Fifteen days after third spray**

The result obtained are presented in table 3 there was significant difference among the treatment on fifteen days after third spray. All the treatment were recorded significantly lower population of *C. infuscatellus* than untreated control. The population of *C. infuscatellus* in Chlorantraniliprole 18.50 SC @ 0.37 ml a.i./ ha was lowest (3.12% dead heart), which was significantly superior over rest treatments.

The next best insecticides were in order of Chlorpyrifos 20% EC@ 1.5 ml a.i./ha, Fipronil 40 + imidacloprid 40@ 0.44 ml + 0.44 ml a.i./ ha, Bifenthrin 8% + Clothianidin 10% SC @ 1 ml + 1 ml a.i./ ha, *Metarhizium anisopliae* + *Bacillus thuringiensis* + *Lecanicillium lecanii* @4 ml + 2 ml a.i./ha, *Metarhizium anisopliae* + *Beauveria basiana* + *Lecanicillium lecanii* @4 ml + 2 ml a.i./ha, *Azadirachtin* 0.03EC@ 2500 ml a.i./ha. The treatment Chlorantraniliprole 18.50 SC @ 0.37 ml a.i. ha, Chlorpyrifos 20% EC@ 1.5 ml a.i./ha, Fipronil 40 + imidacloprid 40@ 0.44 ml + 0.44 ml a.i./ ha, and Bifenthrin 8% + Clothianidin 10% SC @ 1 ml were significantly at par with each other. The highest population of *C. infuscatellus* (7.00% dead heart) was observed in untreated control.

#### **Thirty days after third spray**

The result obtained are presented in table 3 there were significant difference among the treatment on thirty days after third spray. All the treatment were recorded significantly lower population of *C. infuscatellus* than untreated control. The population of *C. infuscatellus* in Chlorantraniliprole 18.50 SC @ 0.37 ml a.i./ ha was lowest (3.11% dead heart), which was significantly superior over rest treatments.

The next best insecticides were in order of Chlorpyrifos 20% EC@ 1.5 ml a.i./ha, Fipronil 40 + imidacloprid 40@ 0.44 ml + 0.44 ml a.i./ ha, Bifenthrin 8% + Clothianidin 10% SC @ 1 ml + 1 ml a.i./ ha, *Metarhizium anisopliae* + *Bacillus thuringiensis* + *Lecanicillium lecanii* @4 ml + 2 ml a.i./ha, *Metarhizium anisopliae* + *Beauveria basiana* + *Lecanicillium lecanii* @4 ml + 2 ml a.i./ha, *Azadirachtin* 0.03EC@ 2500 ml a.i./ha. The treatment Chlorantraniliprole 18.50 SC @ 0.37 ml a.i. ha, Chlorpyrifos 20% EC@ 1.5 ml a.i./ha, Fipronil 40 + imidacloprid 40@ 0.44 ml + 0.44 ml a.i./ ha, and Bifenthrin 8% + Clothianidin 10% SC @ 1 ml + 1 ml a.i./ ha were significantly at par with each other. The highest population of *C. infuscatellus* (7.00% dead heart) was observed in untreated control.

### **Effect of different insecticides and combination of biopesticides on population of top shoot borer (*Scirpophaga excerptalis* Walk (Nivella Fab)**

#### **Pre count one day before spray**

The data on *Scirpophaga excerptalis* population one day before spray is presented in Table 4 the result were statistically non-significant before application of insecticide indicating uniform distribution of *Scirpophaga excerptalis* population.

#### **Seven days after first spray**

The result obtained are presented in table 4 there were significant difference among the treatment on seven days after first spray. All the treatment were recorded

significantly lower population of *Scirpophaga excerptalis* than untreated control. The population of *Scirpophaga excerptalis* in Chlorantraniliprole 18.50 SC @ 0.37 ml a.i./ ha was lowest (3.24% dead heart), which was significantly superior over rest treatments.

The next best insecticides were in order of Chlorpyrifos 20% EC@ 1.5 ml a.i./ha, Fipronil 40 + imidacloprid 40@ 0.44 ml + 0.44 ml a.i./ ha, Bifenthrin 8% + Clothianidin 10% SC @ 1 ml + 1 ml a.i./ ha, *Metarhizium anisopliae* + *Bacillus thuringiensis* + *Lecanicillium lecanii* @4 ml + 2 ml a.i./ha, *Metarhizium anisopliae* + *Beauveria basiana* + *Lecanicillium lecanii* @4 ml + 2 ml a.i./ha, *Azadirachtin* 0.03EC@ 2500 ml a.i./ha. The treatment Chlorantraniliprole 18.50 SC @ 0.37 ml a.i. ha, Chlorpyrifos 20% EC@ 1.5 ml a.i./ha, Fipronil 40 + imidacloprid 40@ 0.44 ml + 0.44 ml a.i./ ha, were significantly at par with each other. The highest population of *Scirpophaga excerptalis* (9.05% dead heart) was observed in untreated control.

#### **Fifteen days after first spray**

The result obtained are presented in table 4 there were significant difference among the treatment on fifteen days after first spray. All the treatment were recorded significantly lower population of *Scirpophaga excerptalis* than untreated control. The population of *Scirpophaga excerptalis* in Chlorantraniliprole 18.50 SC @ 0.37 ml a.i./ ha was lowest (2.11% dead heart), which was significantly superior over rest treatments. The next best insecticides were in order of Chlorpyrifos 20% EC@ 1.5 ml a.i./ha, Fipronil 40 + imidacloprid 40@ 0.44 ml + 0.44 ml a.i./ ha, Bifenthrin 8% + Clothianidin 10% SC @ 1 ml + 1 ml a.i./ ha, *Metarhizium anisopliae* + *Bacillus thuringiensis* + *Lecanicillium lecanii* @4 ml + 2 ml a.i./ha, *Metarhizium anisopliae* + *Beauveria basiana* + *Lecanicillium lecanii* @4 ml + 2 ml a.i./ha, *Azadirachtin* 0.03EC@ 2500 ml a.i./ha. The treatment Chlorantraniliprole 18.50 SC @ 0.37 ml a.i. ha, Chlorpyrifos 20% EC@ 1.5 ml a.i./ha, Fipronil 40 + imidacloprid,40@ 0.44 ml + 0.44 ml a.i./ ha, and Bifenthrin 8% + Clothianidin 10% SC @ 1 ml + 1 ml a.i./ha, *Metarhizium anisopliae* + *Bacillus thuringiensis* + *Lecanicillium lecanii* @4 ml + 2 ml a.i./ha, were significantly at par with each other. The highest population of *Scirpophaga excerptalis* (7.00% dead heart) was observed in untreated control.

#### **Thirty days after first spray**

The result obtained are presented in table 4 there were significant difference among the treatment thirty days after first spray. All the treatment were recorded significantly lower population of *Scirpophaga excerptalis* than untreated control. The population of *Scirpophaga excerptalis* in Chlorantraniliprole 18.50 SC @ 0.37 ml a.i./ ha was lowest (1.56% dead heart), which was significantly superior over rest treatments.

The next best insecticides were in order of Chlorpyrifos 20% EC@ 1.5 ml a.i./ha, Fipronil 40 + imidacloprid 40@ 0.44 ml + 0.44 ml a.i./ ha, Bifenthrin 8% + Clothianidin 10% SC @ 1 ml + 1 ml a.i./ ha, *Metarhizium anisopliae* + *Bacillus thuringiensis* + *Lecanicillium lecanii* @4 ml + 2 ml a.i./ha, *Metarhizium anisopliae* + *Beauveria basiana* + *Lecanicillium lecanii* @4 ml + 2 ml a.i./ha, *Azadirachtin* 0.03 EC@ 2500 ml a.i./ha. The treatment Chlorantraniliprole 18.50 SC @ 0.37 ml a.i. ha, Chlorpyrifos 20% EC@ 1.5 ml a.i./ha, were significantly at

par with each other. The highest population of *Scirpophaga excerptalis* (6.08% dead heart) was observed in untreated control.

#### Seven days after second spray

The result obtained are presented in table 4 there were significant difference among the treatment on seven days after second spray. All the treatment were recorded significantly lower population of *Scirpophaga excerptalis* than untreated control. The population of *Scirpophaga excerptalis* in Chlorantraniliprole 18.50 SC @ 0.37 ml a.i./ha was lowest (4.08% dead heart), which was significantly superior over rest treatments. The next best insecticides were in order of Chlorpyrifos 20% EC@ 1.5 ml a.i./ha, Fipronil 40 + imidacloprid 40@ 0.44 ml + 0.44 ml a.i./ ha, Bifenthrin 8% + Clothianidin 10% SC @ 1 ml + 1 ml a.i./ ha, *Metarhizium anisopliae* + *Bacillus thuringiensis* + *Lecanicillium lecanii* @4 ml + 2 ml a.i./ha, *Metarhizium anisopliae* + *Beauveria basiana* + *Lecanicillium lecanii* @4 ml + 2 ml a.i./ha, Azadirachtin 0.03EC@ 2500 ml a.i./ha. The treatment Chlorantraniliprole 18.50 SC @ 0.37 ml a.i. ha, Chlorpyrifos 20% EC@ 1.5 ml a.i./ha and Fipronil 40 + imidacloprid 40@ 0.44 ml + 0.44 ml a.i./ ha, were significantly at par with each other. The highest population of *Scirpophaga excerptalis* (11.05% dead heart) was observed in untreated control.

#### Fifteen days after second spray

The result obtained are presented in table 4 there were significant difference among the treatment on fifteen days after second spray. All the treatment were recorded significantly lower population of *Scirpophaga excerptalis* than untreated control. The population of *Scirpophaga excerptalis* in Chlorantraniliprole 18.50 SC @ 0.37 ml a.i./ha was lowest (3.26% dead heart), which was significantly superior over rest treatments.

The next best insecticides were in order of Chlorpyrifos 20% EC@ 1.5 ml a.i./ha, Fipronil 40 + imidacloprid 40@ 0.44 ml + 0.44 ml a.i./ ha, Bifenthrin 8% + Clothianidin 10% SC @ 1 ml + 1 ml a.i./ ha, *Metarhizium anisopliae* + *Bacillus thuringiensis* + *Lecanicillium lecanii* @4 ml + 2 ml a.i./ha, *Metarhizium anisopliae* + *Beauveria basiana* + *Lecanicillium lecanii* @4 ml + 2 ml a.i./ha, Azadirachtin 0.03EC@ 2500 ml a.i./ha. The treatment Chlorantraniliprole 18.50 SC @ 0.37 ml a.i. ha and Chlorpyrifos 20% EC@ 1.5 ml a.i./ha, were significantly at par with each other. The highest population of *Scirpophaga excerptalis* (8.85% dead heart) was observed in untreated control.

#### Thirty days after second spray

The result obtained are presented in table 4 there were significant difference among the treatment on thirty days after second spray. All the treatment were recorded significantly lower population of *Scirpophaga excerptalis* than untreated control. The population of *Scirpophaga excerptalis* in Chlorantraniliprole 18.50 SC @ 0.37 ml a.i./ha was lowest (5.04% dead heart), which was significantly superior over rest treatments.

The next best insecticides were in order of Chlorpyrifos 20% EC@ 1.5 ml a.i./ha, Fipronil 40 + imidacloprid 40@ 0.44 ml + 0.44 ml a.i./ ha, Bifenthrin 8% + Clothianidin 10% SC @ 1 ml + 1 ml a.i./ ha, *Metarhizium anisopliae* + *Bacillus thuringiensis* + *Lecanicillium lecanii* @4 ml + 2 ml a.i./ha, *Metarhizium anisopliae* + *Beauveria basiana* +

*Lecanicillium lecanii* @4 ml + 2 ml a.i./ha, Azadirachtin 0.03EC@ 2500 ml a.i./ha. The treatment Chlorantraniliprole 18.50 SC @ 0.37 ml a.i. ha, Chlorpyrifos 20% EC@ 1.5 ml a.i./ha, Fipronil 40 + imidacloprid 40@ 0.44 ml + 0.44 ml a.i./ ha, and Bifenthrin 8% + Clothianidin 10% SC @ 1 ml + 1 ml a.i./ ha were significantly at par with each other. The highest population of *Scirpophaga excerptalis* (9.24% dead heart) was observed in untreated control.

#### Seven days after third spray

The data presented in table 4 there were significant difference among the treatment on seven days after third spray. All the treatment were recorded significantly lower population of *Scirpophaga excerptalis* than untreated control. The population of *Scirpophaga excerptalis* in Chlorantraniliprole 18.50 SC @ 0.37 ml a.i./ ha was lowest (4.07% dead heart), which was significantly superior over rest treatments.

The next best insecticides were in order of Chlorpyrifos 20% EC@ 1.5 ml a.i./ha, Fipronil 40 + imidacloprid 40@ 0.44 ml + 0.44 ml a.i./ ha, Bifenthrin 8% + Clothianidin 10% SC @ 1 ml + 1 ml a.i./ ha, *Metarhizium anisopliae* + *Bacillus thuringiensis* + *Lecanicillium lecanii* @4 ml + 2 ml a.i./ha, *Metarhizium anisopliae* + *Beauveria basiana* + *Lecanicillium lecanii* @4 ml + 2 ml a.i./ha, Azadirachtin 0.03EC@ 2500 ml a.i./ha. The treatment Chlorantraniliprole 18.50 SC @ 0.37 ml a.i. ha and Chlorpyrifos 20% EC@ 1.5 ml a.i./ha, were significantly at par with each other. The highest population of *Scirpophaga excerptalis* (7.83% dead heart) was observed in untreated control.

#### Fifteen days after third spray

The data presented in table 4 there were significant difference among the treatment on fifteen days after third spray. All the treatment were recorded significantly lower population of *Scirpophaga excerptalis* than untreated control. The population of *Scirpophaga excerptalis* in Chlorantraniliprole 18.50 SC @ 0.37 ml a.i./ ha was lowest (4.07% dead heart), which was significantly superior over rest treatments.

The next best insecticides were in order of Chlorpyrifos 20% EC@ 1.5 ml a.i./ha, Fipronil 40 + imidacloprid 40@ 0.44 ml + 0.44 ml a.i./ ha, Bifenthrin 8% + Clothianidin 10% SC @ 1 ml + 1 ml a.i./ ha, *Metarhizium anisopliae* + *Bacillus thuringiensis* + *Lecanicillium lecanii* @4 ml + 2 ml a.i./ha, *Metarhizium anisopliae* + *Beauveria basiana* + *Lecanicillium lecanii* @4 ml + 2 ml a.i./ha, Azadirachtin 0.03EC@ 2500 ml a.i./ha. The treatment Chlorantraniliprole 18.50 SC @ 0.37 ml a.i./ ha, Chlorpyrifos 20% EC@ 1.5 ml a.i./ha and Fipronil 40 + imidacloprid 40@ 0.44 ml + 0.44 ml a.i./ ha, were significantly at par with each other. The highest population of *Scirpophaga excerptalis* (7.43% dead heart) was observed in untreated control.

#### Thirty days after third spray

The data presented in table 4 there were significant difference among the treatment on thirty days after third spray. All the treatment were recorded significantly lower population of *Scirpophaga excerptalis* than untreated control. The population of *Scirpophaga excerptalis* in Chlorantraniliprole 18.50 SC @ 0.37 ml a.i./ ha was lowest (4.17% dead heart), which was significantly superior over rest treatments.

The next best insecticides were in order of Chlorpyrifos 20% EC@ 1.5 ml a.i./ha, Fipronil 40 + imidacloprid 40@ 0.44 ml + 0.44 ml a.i./ ha, Bifenthrin 8% + Clothianidin 10% SC @ 1 ml + 1 ml a.i./ ha, *Metarhizium anisopliae* + *Bacillus thuringiensis* + *Lecanicillium lecanii* @4 ml + 2 ml a.i./ha, *Metarhizium anisopliae* + *Beauveria basiana* + *Lecanicillium lecanii* @4 ml + 2 ml a.i./ha, Azadirachtin 0.03EC@ 2500 ml a.i./ha. The treatment Chlorantraniliprole 18.50 SC @ 0.37 ml a.i. ha, Chlorpyrifos 20% EC@ 1.5 ml a.i./ha, Fipronil 40 + imidacloprid 40@ 0.44 ml + 0.44 ml a.i./ ha, and Bifenthrin 8% + Clothianidin 10% SC @ 1 ml + 1 ml a.i./ ha and *Metarhizium anisopliae* + *Bacillus thuringiensis* + *Lecanicillium lecanii* @4 ml + 2 ml a.i./ha, were significantly at par with each other. The highest population of *Scirpophaga excerptalis* (7.20% dead heart) was observed in untreated control.

### Effect of different insecticides and combination of biopesticides on population of Internode borer *Sesamia inferens*

#### Pre count one day before spray

The data on *Sesamia inferens* population one day before spray is presented in Table 5 the result were statistically non-significant before application of insecticide indicating uniform distribution of *Sesamia inferens* population.

#### Seven days after first spray

The data presented in table 5 there were significant difference among the treatment on seven days after first spray. All the treatment were recorded significantly lower population of *Sesamia inferens* than untreated control. The population of *Sesamia inferens* in Chlorantraniliprole 18.50 SC @ 0.37 ml a.i./ ha was lowest (4.30% dead heart), which was significantly superior over rest treatments.

The next best insecticides were in order of Chlorpyrifos 20% EC@ 1.5 ml a.i./ha, Fipronil 40 + imidacloprid 40@ 0.44 ml + 0.44 ml a.i./ ha, Bifenthrin 8% + Clothianidin 10% SC @ 1 ml + 1 ml a.i./ ha, *Metarhizium anisopliae* + *Bacillus thuringiensis* + *Lecanicillium lecanii* @4 ml + 2 ml a.i./ha, *Metarhizium anisopliae* + *Beauveria basiana* + *Lecanicillium lecanii* @4 ml + 2 ml a.i./ha, Azadirachtin 0.03EC@ 2500 ml a.i./ha. The treatment Chlorantraniliprole 18.50 SC @ 0.37 ml a.i. ha, Chlorpyrifos 20% EC@ 1.5 ml a.i./ha, were significantly at par with each other. The highest population of *Sesamia inferens* (10.15% dead heart) was observed in untreated control.

#### Fifteen days after first spray

The data presented in table 5 there were significant difference among the treatment on fifteen days after first spray. All the treatment were recorded significantly lower population of *Sesamia inferens* than untreated control. The population of *Sesamia inferens* in Chlorantraniliprole 18.50 SC @ 0.37 ml a.i./ ha was lowest (3.13% dead heart), which was significantly superior over rest treatments.

The next best insecticides were in order of Chlorpyrifos 20% EC@ 1.5 ml a.i./ha, Fipronil 40 + imidacloprid 40@ 0.44 ml + 0.44 ml a.i./ ha, Bifenthrin 8% + Clothianidin 10% SC @ 1 ml + 1 ml a.i./ ha, *Metarhizium anisopliae* + *Bacillus thuringiensis* + *Lecanicillium lecanii* @4 ml + 2 ml a.i./ha, *Metarhizium anisopliae* + *Beauveria basiana* + *Lecanicillium lecanii* @4 ml + 2 ml a.i./ha, Azadirachtin 0.03EC@ 2500 ml a.i./ha. The treatment Chlorantraniliprole 18.50 SC @ 0.37 ml a.i. ha and Chlorpyrifos 20% EC@ 1.5

ml a.i./ha were significantly at par with each other. The highest population of *Sesamia inferens* (8.51% dead heart) was observed in untreated control

#### Thirty days after first spray

The data presented in table 5 there were significant difference among the treatment on thirty days after first spray. All the treatment were recorded significantly lower population of *Sesamia inferens* than untreated control. The population of *Sesamia inferens* in Chlorantraniliprole 18.50 SC @ 0.37 ml a.i./ ha was lowest (3.49% dead heart), which was significantly superior over rest treatments.

The next best insecticides were in order of Chlorpyrifos 20% EC@ 1.5 ml a.i./ha, Fipronil 40 + imidacloprid 40@ 0.44 ml + 0.44 ml a.i./ ha, Bifenthrin 8% + Clothianidin 10% SC @ 1 ml + 1 ml a.i./ ha, *Metarhizium anisopliae* + *Bacillus thuringiensis* + *Lecanicillium lecanii* @4 ml + 2 ml a.i./ha, *Metarhizium anisopliae* + *Beauveria basiana* + *Lecanicillium lecanii* @4 ml + 2 ml a.i./ha, Azadirachtin 0.03EC@ 2500 ml a.i./ha. The treatment Chlorantraniliprole 18.50 SC @ 0.37 ml a.i. ha, Chlorpyrifos 20% EC@ 1.5 ml a.i./ha and Fipronil 40 + imidacloprid 40@ 0.44 ml + 0.44 ml a.i./ ha, were significantly at par with each other. The highest population of *Sesamia inferens* (7.38% dead heart) was observed in untreated control.

#### Seven days after second spray

The data presented in table 5 there were significant difference among the treatment on seven days after second spray. All the treatment were recorded significantly lower population of *Sesamia inferens* than untreated control. The population of *Sesamia inferens* in Chlorantraniliprole 18.50 SC @ 0.37 ml a.i./ ha was lowest (0.59% dead heart), which was significantly superior over rest treatments.

The next best insecticides were in order of Chlorpyrifos 20% EC@ 1.5 ml a.i./ha, Fipronil 40 + imidacloprid 40@ 0.44 ml + 0.44 ml a.i./ ha, Bifenthrin 8% + Clothianidin 10% SC @ 1 ml + 1 ml a.i./ ha, *Metarhizium anisopliae* + *Bacillus thuringiensis* + *Lecanicillium lecanii* @4 ml + 2 ml a.i./ha, *Metarhizium anisopliae* + *Beauveria basiana* + *Lecanicillium lecanii* @4 ml + 2 ml a.i./ha, Azadirachtin 0.03EC@ 2500 ml a.i./ha. The treatment Chlorantraniliprole 18.50 SC @ 0.37 ml a.i. ha and Chlorpyrifos 20% EC@ 1.5 ml a.i./ha, were significantly at par with each other. The highest population of *Sesamia inferens* (8.33% dead heart) was observed in untreated control.

#### Fifteen days after second spray

The data presented in table 5 there were significant difference among the treatment on fifteen days after second spray. All the treatment were recorded significantly lower population of *Sesamia inferens* than untreated control. The population of *Sesamia inferens* in Chlorantraniliprole 18.50 SC @ 0.37 ml a.i./ ha was lowest (2.97% dead heart), which was significantly superior over rest treatments.

The next best insecticides were in order of Chlorpyrifos 20% EC@ 1.5 ml a.i./ha, Fipronil 40 + imidacloprid 40@ 0.44 ml + 0.44 ml a.i./ ha, Bifenthrin 8% + Clothianidin 10% SC @ 1 ml + 1 ml a.i./ ha, *Metarhizium anisopliae* + *Bacillus thuringiensis* + *Lecanicillium lecanii* @4 ml + 2 ml a.i./ha, *Metarhizium anisopliae* + *Beauveria basiana* + *Lecanicillium lecanii* @4 ml + 2 ml a.i./ha, Azadirachtin 0.03EC@ 2500 ml a.i./ha. The treatment Chlorantraniliprole 18.50 SC @ 0.37 ml a.i. ha and Chlorpyrifos 20% EC@ 1.5

ml a.i./ha were significantly at par with each other. The highest population of *Sesamia inferens* (7.60% dead heart) was observed in untreated control.

### Thirty days after second spray

The data presented in table 5 there were significant difference among the treatment on thirty days after second spray. All the treatment were recorded significantly lower population of *Sesamia inferens* than untreated control. The population of *Sesamia inferens* in Chlorantraniliprole 18.50 SC @ 0.37 ml a.i./ ha was lowest (3.07% dead heart), which was significantly superior over rest treatments.

The next best insecticides were in order of Chlorpyrifos 20% EC@ 1.5 ml a.i./ha, Fipronil 40 + imidacloprid 40@ 0.44 ml + 0.44 ml a.i./ ha, Bifenthrin 8% + Clothianidin 10% SC @ 1 ml + 1 ml a.i./ ha, *Metarhizium anisopliae* + *Bacillus thuringiensis* + *Lecanicillium lecanii* @4 ml + 2 ml a.i./ha, *Metarhizium anisopliae* + *Beauveria basiana* + *Lecanicillium lecanii* @4 ml + 2 ml a.i./ha, *Azadirachtin* 0.03EC@ 2500 ml a.i./ha. The treatment Chlorantraniliprole 18.50 SC @ 0.37 ml a.i. ha, Chlorpyrifos 20% EC@ 1.5 ml a.i./ha, Fipronil 40 + imidacloprid 40@ 0.44 ml + 0.44 ml a.i./ ha, and Bifenthrin 8% + Clothianidin 10% SC @ 1 ml + 1 ml a.i./ ha were significantly at par with each other. The highest population of *Sesamia inferens* (9.04% dead heart) was observed in untreated control.

### Seven days after third spray

The data presented in table 5 there were significant difference among the treatment on seven days after third spray. All the treatment were recorded significantly lower population of *Sesamia inferens* than untreated control. The population of *Sesamia inferens* in Chlorantraniliprole 18.50 SC @ 0.37 ml a.i./ ha was lowest (4.47% dead heart), which was significantly superior over rest treatments. The next best insecticides were in order of Chlorpyrifos 20% EC@ 1.5 ml a.i./ha, Fipronil 40 + imidacloprid 40@ 0.44 ml + 0.44 ml a.i./ ha, Bifenthrin 8% + Clothianidin 10% SC @ 1 ml + 1 ml a.i./ ha, *Metarhizium anisopliae* + *Bacillus thuringiensis* + *Lecanicillium lecanii* @4 ml + 2 ml a.i./ha, *Metarhizium anisopliae* + *Beauveria basiana* + *Lecanicillium lecanii* @ 4 ml + 2 ml a.i./ha, *Azadirachtin* 0.03EC@ 2500 ml a.i./ha. The treatment Chlorantraniliprole 18.50 SC @ 0.37 ml a.i. ha, Chlorpyrifos 20% EC@ 1.5 ml a.i./ha, Fipronil 40 + imidacloprid 40 @ 0.44 ml + 0.44 ml a.i./ ha, and Bifenthrin 8% + Clothianidin 10% SC @ 1 ml + 1 ml a.i./ ha and *Metarhizium anisopliae* + *Bacillus thuringiensis* + *Lecanicillium lecanii* @ 4 ml + 2 ml a.i./ha, were significantly at par with each other. The highest population of *Sesamia inferens* (8.43% dead heart) was observed in untreated control.

### Fifteen days after third spray

The data presented in table 5 there were significant difference among the treatment on fifteen days after third spray. All the treatment were recorded significantly lower population of *Sesamia inferens* than untreated control. The

population of *Sesamia inferens* in Chlorantraniliprole 18.50 SC @ 0.37 ml a.i./ ha was lowest (4.03% dead heart), which was significantly superior over rest treatments.

The next best insecticides were in order of Chlorpyrifos 20% EC@ 1.5 ml a.i./ha, Fipronil 40 + imidacloprid 40 @ 0.44 ml + 0.44 ml a.i./ ha, Bifenthrin 8% + Clothianidin 10% SC @ 1 ml + 1 ml a.i./ ha, *Metarhizium anisopliae* + *Bacillus thuringiensis* + *Lecanicillium lecanii* @4 ml + 2 ml a.i./ha, *Metarhizium anisopliae* + *Beauveria basiana* + *Lecanicillium lecanii* @4 ml + 2 ml a.i./ha, *Azadirachtin* 0.03EC@ 2500 ml a.i./ha. The treatment Chlorantraniliprole 18.50 SC @ 0.37 ml a.i. ha and Chlorpyrifos 20% EC@ 1.5 ml a.i./ha, were significantly at par with each other. The highest population of *Sesamia inferens* (8.20% dead heart) was observed in untreated control.

### Thirty days after third spray

The data presented in table 5 there were significant difference among the treatment on thirty days after third spray. All the treatment were recorded significantly lower population of *Sesamia inferens* than untreated control. The population of *Sesamia inferens* in Chlorantraniliprole 18.50 SC @ 0.37 ml a.i./ ha was lowest (2.97% dead heart), which was significantly superior over rest treatments.

The next best insecticides were in order of Chlorpyrifos 20% EC@ 1.5 ml a.i./ha, Fipronil 40 + imidacloprid 40@ 0.44 ml + 0.44 ml a.i./ ha, Bifenthrin 8% + Clothianidin 10% SC @ 1 ml + 1 ml a.i./ ha, *Metarhizium anisopliae* + *Bacillus thuringiensis* + *Lecanicillium lecanii* @4 ml + 2 ml a.i./ha, *Metarhizium anisopliae* + *Beauveria basiana* + *Lecanicillium lecanii* @ 4 ml + 2 ml a.i./ha, *Azadirachtin* 0.03EC@ 2500 ml a.i./ha. The treatment Chlorantraniliprole 18.50 SC @ 0.37 ml a.i. ha and Chlorpyrifos 20% EC@ 1.5 ml a.i./ha were significantly at par with each other. The highest population of *Sesamia inferens* (7.57% dead heart) was observed in untreated control.

### Yield

The data on yield of sugarcane were recorded in kg/ plot that converted into tonnes/ha and presented in table 6 the result revealed that all the insecticide treatment were significantly superior over untreated control in increasing yield. The highest yield of sugarcane was recorded in plots treated with Chlorantraniliprole 18.50 SC @ 0.37 ml i.e./ ha (112 t/ha), followed by Chlorpyrifos 20% EC @ 1.5 ml i.e./ ha (110.33 t/ha), Fipronil 40 + imidacloprid 40@ 0.44 ml + 0.44 ml i.e./ ha (108.04 t/ha), Bifenthrin 8% + Clothianidin 10% SC @ 1 ml + 1 ml a.i./ha (107.24 t/ha), *Metarhizium anisopliae* + *Beauveria basiana* + *Lecanicillium lecanii* @4 ml + 2 ml i.e./ha (106.38 t/ha), *Metarhizium anisopliae* + *Bacillus thuringiensis* + *Lecanicillium lecanii* @ 4 ml + 2 ml i.e./ha (106.19 t/ha), *Azadirachtin* 0.03EC@ 2500 ml i.e./ha (105.08 t/ha). The lowest yield obtained from untreated plot (102.00t/ha).

Similar finding were reported by Douressamy *et al.*, (2018) [3] result revealed that Chlorantraniliprole18.50 SC were effective against early shoot.

**Table 3:** Management of early shoot borer *C. infuscatellus* on Sugarcane during 2023

Sr. no	Treatments	Conc. (%)	1 <sup>st</sup> Spray				2 <sup>nd</sup> Spray			3 <sup>rd</sup> Spray			Overall Mean
			Average per cent dead heart by early shoot borer				Average per cent dead heart by early shoot borer			Average per cent dead heart by early shoot borer			
			1 DBS	7 DAS	15 DAS	30 DAS	7 DAS	15 DAS	30 DAS	7 DAS	15 DAS	30 DAS	
1	Azadirachtin 0.03% EC	300 ppm	8.97 (3.14)	6.29 (2.69)	5.42 (2.53)	4.30 (2.26)	7.36 (2.88)	6.04 (2.64)	6.29 (2.69)	6.67 (2.76)	6.21 (2.66)	6.17 (2.66)	6.32 (2.69)
2	<i>Metarhizium anisopliae</i> + <i>Beauveria bassiana</i> + <i>Lecanicillium lecanii</i> .	4 ml + 2 ml	8.07 (3.00)	6.03 (2.64)	5.02 (2.45)	4.04 (2.23)	5.46 (2.53)	4.01 (2.23)	6.00 (2.64)	5.83 (2.59)	6.17 (2.66)	6.15 (2.65)	5.71 (2.56)
3	<i>Metarhizium anisopliae</i> + <i>Bacillus thuringiensis</i> + <i>Lecanicillium lecanii</i>	4 ml + 4 ml	7.83 (2.96)	5.21 (2.48)	4.06 (2.24)	3.46 (2.06)	5.38 (2.52)	3.71 (2.16)	5.46 (2.54)	6.53 (2.72)	5.14 (2.45)	5.25 (2.47)	5.06 (2.46)
4	Fipronil 40 + Imidacloprid 40	0.44 ml + 0.44 ml	7.73 (2.92)	4.25 (2.28)	3.25 (2.05)	3.13 (1.98)	4.57 (2.35)	3.29 (2.05)	5.19 (2.48)	5.43 (2.51)	4.45 (2.29)	4.27 (2.26)	4.43 (2.31)
5	Chlorantraniliprole 18.50 SC	0.37 ml	5.60 (2.56)	3.23 (2.04)	2.10 (1.76)	2.15 (1.74)	2.23 (1.78)	2.92 (1.98)	4.49 (2.33)	3.17 (2.01)	3.12 (1.98)	3.11 (1.98)	3.20 (2.01)
6	Chlorpyrifos20% EC	1.5 ml	6.67 (2.74)	4.00 (2.23)	3.00 (1.99)	3.09 (1.98)	3.65 (2.14)	3.11 (2.01)	4.91 (2.43)	4.50 (2.31)	4.35 (2.28)	4.21 (2.25)	4.12 (2.23)
7	Bifenthrin 8% + Clothianidin 10% SC	1 ml + 1 ml	7.77 (2.95)	5.03 (2.45)	3.39 (2.06)	3.37 (2.04)	5.09 (2.45)	3.33 (2.06)	5.44 (2.53)	5.50 (2.54)	5.11 (2.44)	5.11 (2.44)	4.88 (2.39)
8	Control	-----	11.97 (3.60)	9.03 (3.16)	7.01 (2.82)	6.01 (2.64)	10.20 (3.34)	9.25 (3.19)	9.98 (3.31)	7.83 (2.95)	7.00 (2.82)	7.00 (2.82)	8.44 (3.06)
SE±			0.18	0.13	0.12	0.09	0.12	0.11	0.09	0.13	0.08	0.08	0.11
C.D.at 5%			N/S	0.40	0.39	0.27	0.38	0.35	0.30	0.40	0.26	0.25	
C.V. (%)			10.67	9.04	9.92	7.41	8.67	8.61	6.55	8.85	5.98	5.82	

\*Figures in parentheses are  $\sqrt{x + 0.5}$  transformed value DAS: Days after Spray NS: Non-Significant

**Table 4:** Management of top shoot borer *Scirpophaga excerptalis* on Sugarcane during 2023

Sr. no	Treatments	Conc. (%)	1 <sup>st</sup> Spray				2 <sup>nd</sup> Spray			3 <sup>rd</sup> Spray			Overall Mean
			Average per cent dead heart by top shoot borer				Average per cent dead heart by top shoot borer			Average per cent dead heart by top shoot borer			
			1DBS	7 DAS	15 DAS	30DAS	7 DAS	15 DAS	30DAS	7 DAS	15DAS	30 DAS	
1	Azadirachtin 0.03% EC	300 ppm	8.97 (3.14)	6.30 (2.69)	5.43 (2.53)	4.22 (2.25)	9.27 (3.20)	7.67 (2.94)	9.18 (3.18)	7.00 (2.82)	6.00 (2.64)	6.73 (2.77)	7.07 (2.81)
2	<i>Metarhizium anisopliae</i> + <i>Beauveria bassiana</i> + <i>Lecanicillium lecanii</i> .	4 ml + 2 ml	8.07 (3.00)	6.04 (2.64)	5.03 (2.45)	4.00 (2.22)	9.04 (3.16)	7.15 (2.85)	9.10 (3.17)	6.00 (2.64)	5.80 (2.60)	6.30 (2.70)	6.65 (2.74)
3	<i>Metarhizium anisopliae</i> + <i>Bacillus thuringiensis</i> + <i>Lecanicillium lecanii</i>	4 ml + 4 ml	7.83 (2.96)	5.22 (2.48)	4.07 (2.24)	3.80 (2.16)	7.07 (2.83)	5.30 (2.50)	7.11 (2.84)	5.87 (2.61)	5.57 (2.55)	5.87 (2.60)	5.77 (2.57)
4	Fipronil 40 + Imidacloprid 40	0.44 ml + 0.44 ml	7.73 (2.92)	4.26 (2.28)	3.26 (2.05)	2.73 (1.90)	6.07 (2.65)	5.04 (2.45)	6.22 (2.68)	5.37 (2.52)	5.33 (2.51)	5.03 (2.45)	5.1 (2.44)
5	Chlorantraniliprole 18.50 SC	0.37 ml	5.60 (2.56)	3.24 (2.04)	2.11 (1.76)	1.56 (1.58)	4.08 (2.24)	3.26 (2.05)	5.04 (2.45)	4.07 (2.25)	4.07 (2.25)	4.17 (2.26)	3.72 (2.14)
6	Chlorpyrifos20% EC	1.5 ml	6.67 (2.74)	4.01 (2.23)	3.01 (1.99)	2.19 (1.76)	4.96 (2.41)	4.30 (2.29)	5.18 (2.47)	4.10 (2.25)	5.03 (2.45)	4.23 (2.27)	4.36 (2.28)
7	Bifenthrin 8% + Clothianidin 10%	1 ml + 1 ml	7.77 (2.95)	5.07 (2.45)	3.30 (2.06)	3.39 (2.06)	6.26 (2.68)	5.07 (2.45)	6.30 (2.69)	5.67 (2.57)	5.37 (2.52)	5.43 (2.52)	5.36 (2.49)
8	Control		11.97 (3.60)	9.05 (3.16)	7.00 (2.82)	6.08 (2.64)	11.05 (3.46)	8.85 (3.13)	9.24 (3.19)	7.83 (2.96)	7.43 (2.90)	7.20 (2.86)	8.57 (3.07)
SE±			0.18	0.13	0.12	0.10	0.13	0.12	0.11	0.08	0.08	0.12	
C.D.at 5%			N/S	0.40	0.39	0.32	0.42	0.38	0.34	0.26	0.27	0.36	
C.V. (%)			10.67	9.04	9.92	8.91	8.38	8.45	6.84	5.82	5.97	8.12	

\*Figures in parentheses are  $\sqrt{x + 0.5}$  transformed value DAS: Days after Spray NS: Non-Significant



**Table 5:** Management of internode borer *Sesamia inferens* on Sugarcane during 2023

Sr. no	Treatments	Conc. (%)	1 <sup>st</sup> Spray				2 <sup>nd</sup> Spray			3 <sup>rd</sup> Spray			Overall Mean
			Average per cent dead heart by internode shoot borer				Average per cent dead heart by internode borer			Average per cent dead heart by internode borer			
			1 DBS	7 DAS	15 DAS	30 DAS	7 DAS	15 DAS	30 DAS	7 DAS	15 DAS	30 DAS	
1	Azadirachtin 0.03% EC	300 ppm	11.30 (3.50)	8.67 (3.10)	7.33 (3.10)	6.19 (2.66)	4.30 (2.29)	6.30 (2.69)	6.63 (2.73)	8.20 (3.03)	7.20 (2.86)	7.00 (2.82)	7.31 (2.87)
2	<i>Metarhizium anisopliae</i> + <i>Beauveria bassiana</i> + <i>Lecanicillium lecanii</i> .	4 ml + 2 ml	10.87 (3.44)	8.54 (3.08)	5.42 (3.08)	6.02 (2.64)	3.07 (2.01)	5.70 (2.58)	6.07 (2.65)	7.37 (2.87)	6.60 (2.75)	6.87 (2.79)	6.65 (2.78)
3	<i>Metarhizium anisopliae</i> + <i>Bacillus thuringiensis</i> + <i>Lecanicillium lecanii</i>	4 ml + 4 ml	9.67 (3.26)	8.32 (3.04)	5.14 (3.04)	6.00 (2.62)	2.90 (1.97)	5.40 (2.52)	5.30 (2.50)	6.50 (2.72)	6.33 (2.70)	6.34 (2.69)	6.19 (2.70)
4	Fipronil 40 + Imidacloprid 40	0.44 ml + 0.44 ml	8.76 (3.12)	6.50 (2.73)	4.35 (2.73)	4.63 (2.36)	2.37 (1.82)	4.40 (2.32)	4.31 (2.29)	5.50 (2.54)	5.70 (2.58)	4.98 (2.42)	5.15 (2.49)
5	Chlorantraniliprole 18.50 SC	0.37 ml	6.54 (2.73)	4.30 (2.29)	3.13 (2.29)	3.49 (2.11)	0.59 (1.26)	2.97 (1.95)	3.07 (2.00)	4.47 (2.33)	4.03 (2.23)	2.97 (1.94)	3.55 (2.11)
6	Chlorpyrifos 20% EC	1.5 ml	7.45 (2.90)	5.73 (2.59)	4.07 (2.59)	4.11 (2.25)	1.35 (1.53)	4.03 (2.23)	4.12 (2.25)	5.40 (2.51)	5.30 (2.50)	3.89 (2.17)	4.54 (2.35)
7	Bifenthrin 8% + Clothianidin 10%	1 ml + 1 ml	9.33 (3.14)	8.00 (2.99)	4.77 (2.99)	5.83 (2.60)	2.47 (1.85)	4.43 (2.32)	5.10 (2.46)	5.63 (2.57)	5.73 (2.58)	5.96 (2.62)	5.75 (2.61)
8	Control		12.20 (3.63)	10.15 (3.33)	8.51 (3.33)	7.38 (2.87)	8.33 (3.04)	7.60 (2.92)	9.04 (3.16)	8.43 (3.07)	8.20 (3.03)	7.57 (2.91)	8.74 (3.12)
SE±			0.19	0.11	0.11	0.12	0.10	0.11	0.15	0.14	0.11	0.08	
C.D. at 5%			N/S	0.34	0.34	0.38	0.32	0.34	0.46	0.43	0.34	0.25	
C.V. (%)			10.35	6.76	6.76	8.72	9.29	7.91	10.38	9.00	7.37	5.59	

\*Figures in parentheses are  $\sqrt{x + 0.5}$  transformed value DAS: Days after Spray NS: Non-Significant

**Table 6:** Effects of different insecticide against sugarcane yield during 2023

Sr. No	Treatment	Conc. (%)	Yield (t/hq)
1	Azadirachtin 0.03% EC	300 ppm.	105.08 (10.28)
2	<i>Metarhizium anisopliae</i> + <i>Beauveria bassiana</i> + <i>Lecanicillium lecanii</i> .	4 ml + 2 ml	106.38 (10.34)
3	<i>Metarhizium anisopliae</i> + <i>Bacillus thuringiensis</i> + <i>Lecanicillium lecanii</i>	4 ml + 4 ml	106.19 (10.34)
4	Fipronil 40 + Imidacloprid 40	0.44 ml + 0.44 ml	108.04 (10.44)
5	Chlorantraniliprole 18.50 SC	0.37 ml	112.00 (10.61)
6	Chlorpyrifos 20% EC	1.5 ml	110.33 (10.54)
7	Bifenthrin 8% + Clothianidin 10% SC	1 ml + 1 ml	107.24 (10.39)
8	Control	-----	102.00 (10.14)
SE±			0.30
C.D. at 5%			0.91
C.V. (%)			5.13

## Conclusion

### 1. Early shoot borer *C. infuscatellus*

Overall effect of different insecticides and combination of different biopesticides after 1<sup>st</sup>, 2<sup>nd</sup> and 3<sup>rd</sup> spray on *C. infuscatellus* shows that plot treated with Chlorantraniliprole 18.50 SC was most superior with average per cent of dead heart (2.01) compared to other insecticides but it was found at par with Chlorpyrifos 20% EC (2.23) followed by Fipronil 40 + imidacloprid 40 (2.31) and Bifenthrin 8% + Clothianidin 10% SC (2.39), *Metarhizium anisopliae* + *Bacillus thuringiensis* + *lecaniicillium lecanii* (2.46), *Metarhizium anisopliae* + *Beauveria bassiana* + *lecaniicillium lecanii* (2.56), Azadirachtin 0.03EC (2.69), highest per cent of dead heart found in untreated control (3.06).

### 2. Top shoot borer *Scirpophaga excerptalis*

Overall effect of different insecticides and combination of different biopesticides after 1<sup>st</sup>, 2<sup>nd</sup> and 3<sup>rd</sup> spray on *Scirpophaga excerptalis* shows that plot treated with Chlorantraniliprole 18.50 SC was most superior with

average per cent of dead heart (2.14) compared to other insecticides but it was found at par with Chlorpyrifos 20% EC (2.25) followed by Fipronil 40 + imidacloprid 40 (2.44) and Bifenthrin 8% + Clothianidin 10% SC (2.49), *Metarhizium anisopliae* + *Bacillus thuringiensis* + *lecaniicillium lecanii* (2.57), *Metarhizium anisopliae* + *Beauveria bassiana* + *lecaniicillium lecanii* (2.74), Azadirachtin 0.03EC (2.81), highest per cent of dead heart found in untreated control (3.07).

### 3. Internode borer *Sesamia inferens* Walk

Overall effect of different insecticides and combination of different biopesticides after 1<sup>st</sup>, 2<sup>nd</sup> and 3<sup>rd</sup> spray on *Scirpophaga excerptalis* shows that plot treated with Chlorantraniliprole 18.50 SC was most superior with average per cent of dead heart (2.11) compared to other insecticides but it was found at par with Chlorpyrifos 20% EC (2.35) followed by Fipronil 40 + imidacloprid 40 (2.49) and Bifenthrin 8% + Clothianidin 10% SC (2.61), *Metarhizium anisopliae* + *Bacillus thuringiensis* + *lecaniicillium lecanii* (2.70), *Metarhizium anisopliae* +

*Beauveria basiana* + *lecaniicillium lecaniii* (2.78), *Azadirachtin* 0.03EC (2.87), highest per cent of dead heart found in untreated control (3.12).

#### 4. Yield

All the insecticide treatment were significantly superior over untreated control in increasing yield the highest yield of sugarcane was recorded in plots treated with Chlorantraniliprole 18.50 SC @ 0.37 ml i.e./ ha (112 t/ha), followed by Chlorpyrifos 20% EC @ 1.5 ml i.e./ ha (110.33t/ha), Fipronil 40 + imidacloprid 40@ 0.44 ml + 0.44 ml i.e./ ha (108.04 t/ha), Bifenthrin 8% + Clothianidin 10% SC @ 1 ml + 1 ml a.i./ha (107.24 t/ha), *Metarhizium anisopliae* + *Beauveria bassiana* + *lecaniicillium lecaniii* @4 ml + 2 ml i.e./ha (106.38 t/ha), *Metarhizium anisopliae* + *Bacillus thuringiensis* + *lecaniicillium lecaniii* @ 4 ml + 2 ml i.e./ha (106.19 t/ha), *Azadirachtin* 0.03EC @ 2500 ml i.e./ha (105.08 t/ha) and the lowest yield obtained from untreated plot (102.00t/ha).

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