Studies on Seasonal Incidence and Management of Early Shoot Borer and Top Shoot Borers using New Insecticides in Sugarcane (*Saccharum officinarum L.*)

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Received:- 08 September 2022/ Revised:- 25 September 2022/ Accepted:- 01 October 2022/ Published: 31-10-2022

Abstract— *The present investigation was carried out to Studies on seasonal incidence and management of early shoot borer and top shoot borers using new insecticides in sugarcane (Saccharum officinarum L.), at Institute of Agricultural Sciences, BHU, Varanasi, UP, India to assess the chemical control of sugarcane pest Chilo infuscatellus (Snellen) and Scirpophaga excerptalis (walker) with seven insecticide viz. Novaluron 10 EC @ 100 g a.i. ha-1, Fipronil 5 SC @ 150 g a.i. ha-1, Lambda-cyhalothrin 5 EC @ 25 g a.i. ha-1, Rynaxypyr 20 SC @ 40 g a.i. ha-1, Acetamiprid 20 SC@ 10 g a.i. ha-1, Spinosad 45 SC @ 100 g a.i. ha-1 and Emamactin benzoate 5 SG @ 10 g a.i. ha-1 and compared with untreated control using randomized block design with three replications and observations of dead heart per 10 hills recorded 1 day before spray and 7th, 15th, 30th days after spray. It was observed that infestation both early shoot borer and top shoot borer started from 23rd standard week with 2.45 and 1.23% dead heart per 10 hills respectively with the corresponding maximum, minimum and rainfall was 36.120C, 27.520C and 0.00 mm while the morning and evening RH 71% - 52%. The studies on efficacy of newer insecticide molecules on early shoot borer revealed that the Rynaxypyr 20 SC recorded lowest post treatment mean of (13.85% - 7.13%) over the other insecticidal treatments. On top shoot borer Rynaxypyr 20 SC showed lowest damage of (5.77% - 5.50%) over the other insecticidal treatments. yield of plot treated with Rynaxypyr 20 SC was higher (61.68 t/ha) than that of any other treatments.*

Keywords— Sugarcane, Seasonal incidence, Early shoot borer and Top shoot borer, Efficacy of newer insecticides.

I. INTRODUCTION

Sugarcane (Saccharum officinarum L.) is a tropical plant belonging to the family gramineae. Sugarcane originated in New Guinea, where the cultivated canes were of two main groups: (a) thin, hardy north Indian types Saccharum barberi and the Chinese Saccharum sinenses and (b) thick, juicy noble canes S. officinarum. S. officinarum is highly prized cane. The origin of S. officinarum is Indo-Myanmar China border with New Guinea as the main centre of diversity. The S.officinarum are called the "noble canes' due to thick, juicy, low-fibred canes of high sucrose content. The origin of Saccharum robustum is New Guinea. The origin of Saccharum spontaneum is subtropical India. For cultivation of sugarcane, loam soil of 10 - 15 percent moisture content is suitable. If the moisture content in soil is low, proper moisture should be maintained. Till deep by disc harrow followed by 2 - 3 light plough and levelling. Generally the distance between row to row is kept at 90 cm and setts of three buds are used, 37.5 thousand setts or according to thickness 60 - 65 quintal setts per hectare is used. Before sowing, soak

the setts of 2 or 3 buds in water and then treat with mercury chemical (Ariton 6 percent or Anglol 3 percent) of 0.25 percent solution. For seed processing, Bavistin 0.1 percent solution can be used.

Byproducts like molasses is the main raw material for alcohol and alcohol based industries, paper industry, fuel purposes and green tops are used as cattle feed. About two percent of the sugarcane is used as raw and juice (beverage) purpose. Sugarcane contains about 65 percent juice and juice contains 77.88 percent water, 8 - 12 percent sucrose, 0.3 to 3.0 percent reducing sugar, 0.5 - 1.0 percent organic substance and 0.2 - 1.0 percent ash (Sundra, 2001). Theoretically sugarcane gives a yield of 450 t ha-1 per year (Moore 1998) but the average yield of the country is only around 70 t ha-1. The average yield is higher (80 t ha-1) in tropical region than the sub-tropical 55 t ha-1. The low production and the productivity are the end results of various factors. Among the factors responsible, the insect pests problems are prominent (Purbeyet al, 2000). The production and productivity of the sugarcane is affected by many factors viz, soil type, selections of variety, fertilizer management, irrigation management and damaged caused by pests. Sugarcane is attacked by insects however 15 pests are reported to cause considerable loss in yield. The early shoot borer, top shoot borer, Internode borer, white grub, sugarcane pyrilla, white wooly aphid, scale insect and termites these are major pest of sugarcane but the early shoot borer are worst pest responsible for severe damage in early growth stage and yield loss.

Sugarcane by virtue of its long duration is infested by a large number of pests. Many pests start infesting the cane right from the very first day when setts are planted in the soil, and till the crop is harvested. The crop is attacked by a large number of insect pests (David 1990) and among them Lepidopteron tissue borers are considered to be the most destructive. Out of about a dozen tissue borers, damaging sugarcane crop in India, top borer Scirpophaga excerptalis (Walker & Plassey), Chilotumidiscostalis are the most injurious particularly in Bihar (Purbeyet al., 2000) and shoot borer, Chiloinfuscatelhis in Uttar Pradesh and Assam. Among different borers, shoot borer causes 22 - 33 percent in yield loss (Patil & Hapse, 1981), top borer causes 86 percent in yield loss, stalk borer causes 6.11 - 10.61 percent in yield loss (Jena &Patnaik, 1996), and root borer causes upto 34.20 percent in yield loss (Pandey et al., 1996). In sucking insects pests Pyrillacauses 28.10 percent in yield loss and 1.60 units of sucrose in juice (Agarwal, 1969), white fly causes a loss of 23.40 percent in yield & 2.90 units of sucrose in juice (Khanna, 1948). Mealybug causes a decrease in sucrose content by 24.10 while the reduction in brix is 16.20 percent (Kalra& Sidhu 1964) and the thrips cause a loss of 30.77 percent on central leaves of 90 days old crop (Gupta 1996). The damage and loss caused by top borer, (Scirpophaga excerptalis walker) are due to the mortality of shoots and canes and also due to the arrest in growth of the later. The mortality of young shoots may go even upto 100 percent as observed in Punjab and Bihar (Anon., 1939; Agarwala and Prasad, 1956). In Tamilnadu, due to low incidence of the pest, 10 percent of the shoots die, while in 3-4 percent further growth is suppressed (Doss, 1954). As the crop grows, the percent mortality of shoots/canes due to borer infestation decreases (Anon., 1939; Agarwala and Prasad, 1956; Agarwal and Siddiqui, 1964). Most of the insecticides used on agricultural crop belong to any one of the following chemical group viz. organophosphate, carbamates and pyrethroids. The wide spread use of structurally similar preparation which have same mode of action carries the risk resistance development. To overcome this, discovery of newer classes of insecticide molecules which belongs to formulation technology, active at low doses and least exposure to an environment and their incorporation in integrated pest management system is gaining importance. Increasing the area under sugarcane crop at one hand and relative paucity of the information regarding new molecules on other hand, the present investigation were therefore undertaken to evaluate the new generation, low dose ecofriendly pesticides viz., Novaluron, Lambda-cyhalothrin, Rynaxypyr, Fipronil, Spinosad, Emamectin benzoate and Acetamiprid with following objectives.

Objective of research:

1) To study these Seasonal incidence of early shoot borer and top shoot borer.
2) To study the efficacy of new insecticide against Early shoot borer, Chilloinfuscatellus (Snellen) and Top shoot borer, Scirpophaga excerptalis (walker).

3) To study the impact of insecticidal treatments on sugarcane yield.

II. MATERIALS AND METHODS

The field experiment on the topic entitled "Studies on seasonal incidence and management of early shoot borer and top shoot borers using new insecticides in sugarcane (Saccharum officinarum L.)"were conducted at the Agricultural Research Farm of Institute of Agricultural Sciences, B.H.U, Varanasi during Kharif 2018 - 2019.

2.1 Experimental site

Varanasi lies between 240 56' N to 250 35' N Latitude and 820 14' E to 830 24' E Longitude and the elevation is 141.3 m above the mean sea level, almost in the center of Indo-gangeticbelt. It possesses sub-tropical climate and experiences annual mean precipitation ranging 75 to 100 cm (approx.), most of which is received during kharif season. Mean maximum temperature experienced during the experiment was 41.00C during 2nd week of June and the mean minimum temperature was 4.70C during 3rd week of January. The maximum rainfall experienced was 154.8 mm during 3rd week of August.

TABLE 1
DETAILS OF THE FIELD EXPERIMENT

Crop	Sugarcane
Variety	Co 0239
Design	Randomized Block Design (RBD)
Treatments	8
Replication	3
Plot size	6x3 m^2
Total No. of Plots	24
Number of rows per plot	4
Row to row distance	90cm
Planting material	3 budded setts, 4 setts/meter
Date of sowing	10 April 2018
Date of Insecticides spray	First spray 25 June 2019
	Second spray 22 August 2019
Date of harvesting	12 April 2019

Fertilizer application: The fertilizers were applied at the rate of 120:80:60 kg ha-1 N, P2O5 and K2O in the form of urea, single super phosphate and murate of potash. Full dose of phosphorous and potash and half dose of nitrogen should be applied at the time of planting and rest of the nitrogen after 80- 90 days of planting.

Field trial was conducted to determine the appropriate phenological stage of sugarcane for applying insecticides in order to achieve most effective chemical to control sugarcane early shoot borer and top shoot borer during crops seasons of 2018 - 2019 at experimental site of Agricultural Research Farm, Institute of Agricultural Science, Banaras Hindu University. The experiment consists of eight treatments including control and was laid out in randomized block design (RBD) with 3 replications for evaluating their comparative efficacy against sugarcane early shoot borer and top borer. The sugarcane variety Co 0239, a recommended early was planted on 9th April during 2018. The plot size was kept 6 x 3 m2 with row to row spacing at 0.9 m. The path between replication and subplots were maintained 1.5 m and 1m, respectively. Three budded cane setts were planted eye to eye keeping 4 sets in each row. The uniform agronomical practices were followed as per the recommendation for the crop in this area. The treatment details are as follows:

TABLE 2
DETAILS OF VARIOUS INSECTICIDAL TREATMENTS FOR FIELD EXPERIMENT ON SUGARCANE.

Treatments	Technical name	Formulation (percent)	Dose (g a. i./ha)
1	Novaluron	10 EC	100
2	Fipronil	5 SC	150
3	Lambda-cyhalothrin	5 EC	25
4	Rynaxypyr	20 SC	40
5	Acetamiprid	20 SP	10
6	Spinosad	45 SC	100
7	Emamectin benzoate	5 SG	10
8	Untreated Control	-	-

2.2 Method of application of treatments

The required quantity of spray solution was calibrated by spraying the control plot with water alone. Spraying solution of insecticides per plot of different concentrations were worked out at the time of spraying and mixed in clean water. The spraying of insecticides was carried out during morning hours by electric operated knapsack sprayer. All the three plots of treatment in three replications were treated at a time. The care was taken to cover all the plant parts thoroughly. The spray pump was thoroughly washed with water while switching on one insecticide to another.

2.3 Methods of recording observations

2.3.1 Observations of Meteorological Data

Daily meteorological observation with regards to the temperature (°C) i.e., maximum and minimum, relative humidity (percent) at 07:00 am and 14:00 pm and precipitation (mm) prevailing at Agricultural Research Farm, Institute of Agricultural Sciences, BHU, Varanasi were recorded during the course of investigation i.e., 2018 - 2019. Data so obtained were finally merged together to obtain the average of weather parameters viz.; temperature (°C) and relative humidity (percent) and rainfall (mm) on monthly basis from January to December. Correlated with the occurrence of the pest population. A correlation coefficient method was adopted to work out the relationship between the occurrence of the pest and the weather parameters

2.3.2 Bioefficacy of new insecticide molecules against early shoot borer, C. infuscatellus.

The efficacy of various insecticides against early shoot borer was judged on the basis of the percent dead heart at vegetative stage. The spraying was done on ETL basis. The granular application was done in endemic area on ETL basis. The percent incidence (dead heart) was calculated as follows:

$$\text{Incidence (percent)} = \frac{\text{No. of infested plants (dead hearts)}}{\text{Total number of cane observed}} \times 100$$

Simultaneously, the meteorological parameters viz; ambient temperature in °C (maximum and minimum), relative humidity percent, at 07:00 a.m. and 14:00 p.m. and rainfall (mm) were also recorded during the investigation from the observatory of Agricultural experimental farm of Banaras Hindu University. Finally correlation between pest incidence and weather parameters were worked out.

2.3.3 Record of yield

Harvesting was done on 12th April 2019 plot wise. The yield per plot subjected to respective treatments was extrapolated to tones per hectare. The yield data in each treatment was recorded separately and subjected to statistical analysis to test the significance of mean yield variation in different treatments. The percent increase in yield over control in various treatments was calculated by using the following formula.

2.3.4 Statistical analysis

The ANOVA of data recorded during the experiment was made for the insect pests under study and the calculated ‘F’ was compared with tabulated 'F' at 5 percent level of significance. The significance of difference between treatments was judged by CD at 5 percent level of significance.

TABLE 3
EFFECT OF INSECTICIDAL TREATMENTS ON CHILLO INFUSCATELLUS (SNELLEN) AFTER FIRST INSECTICIDAL SPRAY.

S.N.	Treatments	Dosage (g a.i./ha)	Average per cent dead hearts by early shoot borer				Post treatment mean
			1 DBS	7 DAS	15 DAS	30 DAS	
1	Novaluron 10 EC	100	23.10* (4.91)**	20.20 (4.60)	16.20 (4.15)	13.50 (3.81)	16.69
2	Fipronil 5 SC	150	22.10 (4.80)	17.40 (4.29)	14.20 (3.90)	10.90 (3.45)	14.22
3	Lambda-cyhalothrin 5 EC	25	23.20 (4.91)	18.10 (4.37)	15.40 (4.05)	11.90 (3.60)	15.20
4	Rynaxypyr 20 SC	40	23.30 (4.93)	17.10 (4.26)	13.30 (3.79)	11.00 (3.46)	13.85
5	Acetamiprid 20 SP	10	23.70 (4.96)	21.50 (4.75)	20.20 (4.60)	15.60 (4.07)	19.13
6	Spinosad 45 SC	100	24.10 (5.01)	21.10 (4.70)	16.30 (4.16)	13.60 (3.82)	17.06
7	Emamectin benzoate 5 SG	10	23.60 (4.95)	19.80 (4.56)	20.60 (4.64)	15.30 (4.04)	18.60
8	Untreated Control		25.10 (5.10)	23.40 (4.94)	23.30 (4.93)	22.10 (4.81)	23.01
C.D. at 5%			N/A	0.148	0.210	0.193	
S.Em. ±			0.06	0.049	0.069	0.064	

Mean of three replication, ** Figures in parentheses are square root transformed values, DBS- Days before spray, DAS- Days after spray.

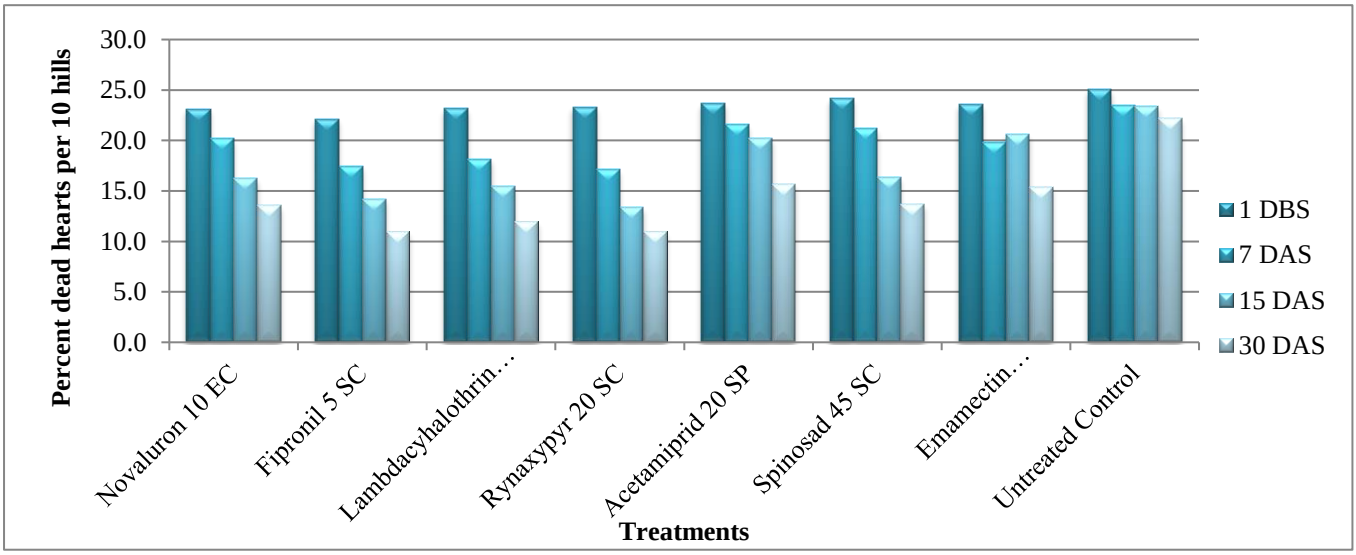

FIGURE 1: Response of insecticidal treatments against *Chilo infuscatellus* snellen after first spray
DBS - Days before spray, DAS - Days after spray

TABLE 4

EFFECT OF INSECTICIDAL TREATMENTS ON *CHILLO INFUSCATELLUS* (SNELLEN) AFTER SECOND INSECTICIDAL SPRAY

Sl.No.	Treatments	Dosage (g a.i./ha)	Average per cent dead hearts by early shoot borer				Post treatment mean
			1 DBS	7 DAS	15 DAS	30 DAS	
1	Novaluron 10 EC	100	24.40* (5.03)**	14.60 (3.94)	10.10 (3.33)	8.30 (3.05)	11.03
2	Fipronil 5 SC	150	23.20 (4.92)	8.80 (3.13)	8.00 (3.01)	7.50 (2.91)	8.14
3	Lambda-cyhalothrin 5 EC	25	23.40 (4.93)	7.40 (2.90)	7.70 (2.95)	6.40 (2.72)	7.22
4	Rynaxypyr 20 SC	40	24.50 (5.04)	7.50 (2.91)	7.50 (2.91)	6.30 (2.71)	7.13
5	Acetamiprid 20 SP	10	24.70 (5.07)	13.50 (3.81)	12.70 (3.72)	13.10 (3.76)	13.14
6	Spinosad 45 SC	100	25.70 (5.16)	15.40 (4.06)	9.90 (3.30)	8.90 (3.15)	11.46
7	Emamectin benzoate 5 SG	10	23.60 (4.95)	15.20 (4.02)	11.40 (3.52)	10.90 (3.45)	12.54
8	Untreated Control		27.20 (5.31)	23.18 (4.91)	19.90 (4.58)	16.30 (4.16)	19.85
C.D. at 5%			0.134	0.156	0.156	0.156	
S.Em. ±			0.044	0.052	0.052	0.052	

Mean of three replication, ** Figures in parentheses are square root transformed values, DBS- Days before spray, DAS- Days after spray.

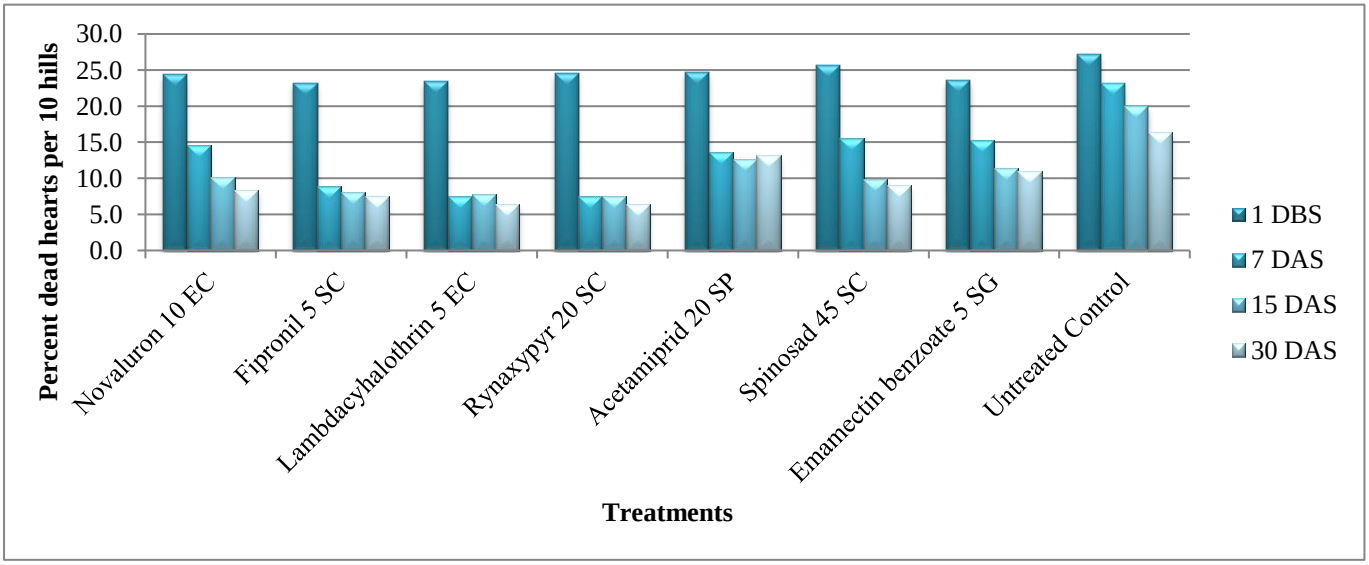

FIGURE 2: Response of insecticidal treatments against *Chilo infuscatellus* snellen after second spray

TABLE 5
INFLUENCE OF ABIOTIC FACTORS ON SEASONAL INCIDENCE OF EARLY SHOOT BORER (*CHILLO INFUSCATELLUS SNELLEN*) OF SUGARCANE

Standared week no.	Rainfall (mm)	Temperature (^{0}C)		Relative humidity (%)		Early shoot borer infestation (%)
		Max.	Min.	Morn.	Even.	
22	0.00	36.15	26.35	69	50	0.00
23	0.00	36.12	27.52	71	52	2.45
24	2.42	41.24	27.33	60	36	5.82
25	0.00	40.42	28.36	63	36	9.62
26	33.30	33.95	26.75	80	61	14.52
27	8.00	35.54	27.94	77	57	10.21
28	11.65	35.59	26.23	83	58	13.54
29	78.43	33.38	25.45	86	66	12.34
30	91.45	28.46	23.62	88	87	10.24
31	86.84	28.17	22.86	93	88	8.37
32	26.64	31.85	24.73	92	77	5.38
33	20.44	33.36	25.34	88	70	3.24
34	154.87	31.11	24.31	91	81	1.42
35	118.48	32.21	24.32	93	77	0.00

TABLE 6
CORRELATION BETWEEN WEATHER PARAMETERS AND EARLY SHOOT BORER (*CHILO INFUSCATELLUS SNELLEN*) INFESTATION

Insect pest	Weather parameters				
	Rain fall (mm)	Relative humidity		Temperature	
		Morning	Evening	Maximum	Minimum
Early shoot borer (%DH)	-0.17666	-0.02310*	-0.07366	0.01698**	0.17091

DH - Dead hearts
***** correlation is significant at the 0.01 level.***
**** correlation is significant at the 0.05 level.***

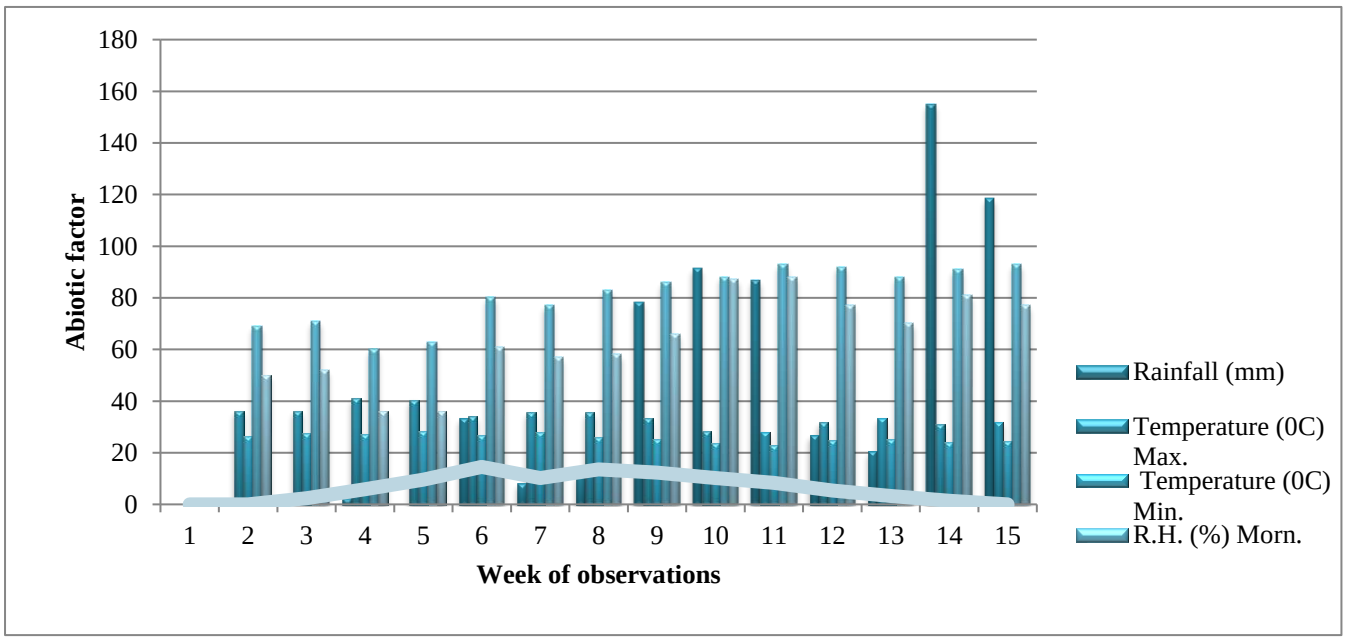

FIGURE 3: Influence of abiotic factor on the infestation of sugarcane *Chilo infuscatellus* snellen

TABLE 7
EFFECT OF INSECTICIDAL TREATMENTS ON *SCIRPOPHAGA EXCERPTALIS* AFTER FIRST INSECTICIDAL SPRAY

S.N.	Treatments	Dosage (g a.i. / ha)	Pre count (%)	Average per cent dead hearts by top shoot borer			Post treatment mean
			1 DBS	7 DAS	15 DAS	30 DAS	
1	Novaluron 10 EC	100	9.56* (3.24)**	8.42 (3.06)	8.66 (3.06)	7.42 (3.10)	8.17
2	Fipronil 5 SC	150	8.58 (3.09)	7.49 (3.08)	6.18 (2.90)	6.36 (2.67)	6.68
3	Lambda-cyhalothrin 5 EC	25	8.44 (3.07)	7.64 (3.05)	7.52 (2.93)	7.45 (2.91)	7.54
4	Rynaxypyr 20 SC	40	8.33 (3.05)	6.42 (3.05)	5.47 (2.71)	5.43 (2.53)	5.77
5	Acetamiprid 20 SP	10	8.85 (3.13)	8.49 (2.89)	7.95 (3.07)	6.60 (2.99)	7.68
6	Spinosad 45 SC	100	9.37 (3.21)	8.52 (3.23)	8.41 (3.08)	8.45 (3.06)	8.46
7	Emamectin benzoate 5 SG	10	9.53 (3.24)	8.42 (3.26)	8.72 (3.06)	8.78 (3.11)	8.64
8	Untreated Control		10.02 (3.31)	11.32 (3.39)	11.47 (3.50)	12.50 (3.53)	11.76
C.D. at 5%			N/A	0.261	0.307	0.212	
S.Em. ±			0.07	0.085	0.1	0.069	

Mean of three replication, ** Figures in parentheses are square root transformed values, DBS- Days before spray, DAS- Days after spray.

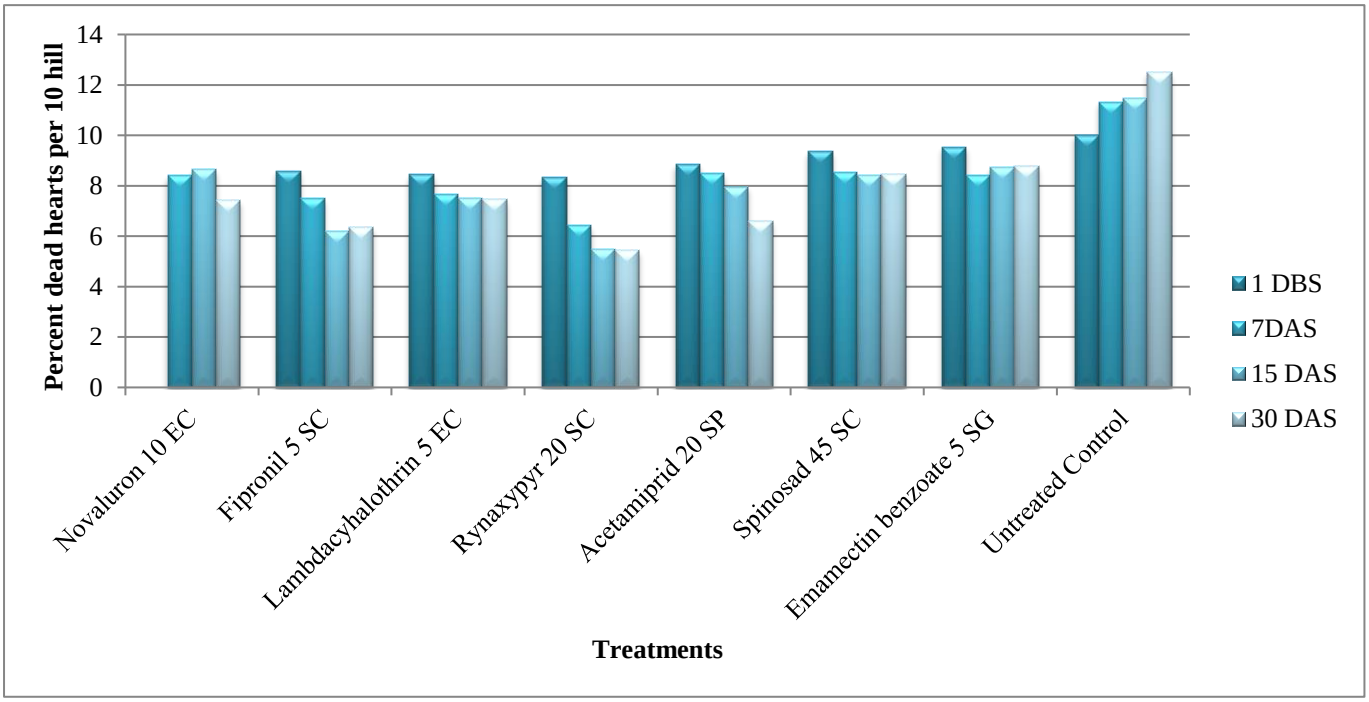

FIGURE 4: Response of insecticidal treatments against *Scirpophaga excerptalis* (Walker) first spray
DBS - Days before spray, DAS - Days after spray

TABLE 8

EFFECT OF INSECTICIDAL TREATMENTS ON *SCIRPOPHAGA EXCERPTALIS* AFTER SECOND INSECTICIDAL SPRAY

S.N.	Treatments	Dosage (g a.i./ha.)	Pre count (%)	Average per cent dead hearts by top shoot borer			Post treatment mean
			1 DBS	7 DAS	15 DAS	30 DAS	
1	Novaluron 10 EC	100	8.65* (2.76)**	6.46 (2.95)	5.34 (2.72)	4.31 (3.05)	6.25
2	Fipronil 5 SC	150	6.89 (2.80)	5.45 (2.97)	4.56 (3.07)	6.44 (2.92)	5.83
3	Lambda-cyhalothrin 5 EC	25	7.62 (2.93)	6.42 (2.90)	5.65 (2.71)	4.66 (3.17)	6.15
4	Rynaxypyr 20 SC	40	6.78 (2.78)	5.33 (2.75)	5.63 (2.51)	4.14 (2.56)	5.50
5	Acetamiprid 20 SP	10	8.07 (3.01)	7.80 (2.90)	7.44 (2.96)	7.01 (2.90)	7.67
6	Spinosad 45 SC	100	7.70 (2.94)	6.10 (2.89)	6.01 (2.66)	5.43 (2.64)	6.33
7	Emamectin benzoate 5 SG	10	8.52 (3.08)	7.54 (2.89)	6.69 (2.91)	6.49 (2.77)	7.38
8	Untreated Control		9.24 (3.28)	9.54 (3.19)	9.66 (3.23)	9.80 (3.26)	9.66
C.D. at 5%			0.22	0.202	0.297	0.255	
S.Em. ±			0.072	0.066	0.097	0.083	

**** Mean of three replication,** Figures in parentheses are square root transformed values, DBS- Days before spray, DAS- Days after spray.***

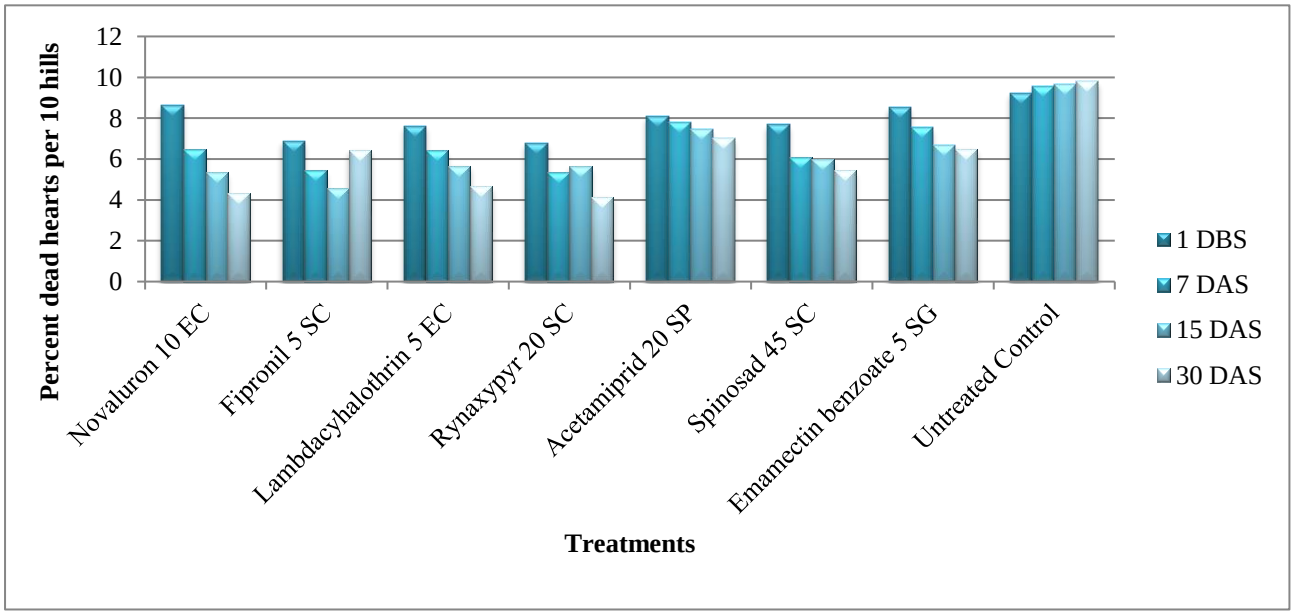

FIGURE 5: Response of insecticidal treatments against *Scirpophaga excerptalis* (Walker) second spray

DBS - Days before spray, DAS - Days after spray.

TABLE 9

INFLUENCE OF ABIOTIC FACTORS ON SEASONAL INCIDENCE OF TOP BORER (SCIRPOPHAGA EXCERPTALIS) OF SUGARCANE

Standard week No.	Rainfall (mm)	Temperature (^{0}C)		R.H. (%)		Top borer infestation (%)
		Max.	Min.	Morn.	Even.	
22	0.00	36.15	26.35	69	50	0.00
23	0.00	36.12	27.52	71	52	1.23
24	2.42	41.24	27.33	60	36	3.56
25	0.00	40.42	28.36	63	36	4.34
26	33.30	33.95	26.75	80	61	3.69
27	8.00	35.54	27.94	77	57	5.85
28	11.65	35.59	26.23	83	58	6.02
29	78.43	33.38	25.45	86	66	12.34
30	91.45	28.46	23.62	88	87	9.24
31	86.84	28.17	22.86	93	88	8.96
32	26.64	31.85	24.73	92	77	10.24
33	20.44	33.36	25.34	88	70	9.23
34	154.87	31.11	24.31	91	81	6.56
35	118.48	32.21	24.32	93	77	5.62
36	94.67	30.65	23.63	91	79	4.37
37	0.00	32.42	23.68	88	68	2.84
38	53.42	32.53	22.86	88	65	1.66
39	0.00	33.44	25.95	88	63	1.13
40	0.00	34.25	20.87	83	51	1.09
41	0.00	31.64	20.34	89	61	1.20
42	0.00	33.43	16.56	84	40	0.00

TABLE 10

CORRELATION BETWEEN WEATHER PARAMETERS AND TOP BORER (*SCIRPOPHAGA EXCERPTALIS*) INFESTATION

Insect pest	Weather parameters				
	Rain fall (mm)	Relative humidity		Temperature	
		Morning	Evening	Maximum	Minimum
Top borer (%) DH	-0.51872	-0.35426*	-0.58808	0.33343**	0.23221

DH - Dead hearts

***** correlation is significant at the 0.01 level.***

**** correlation is significant at the 0.05 level.***

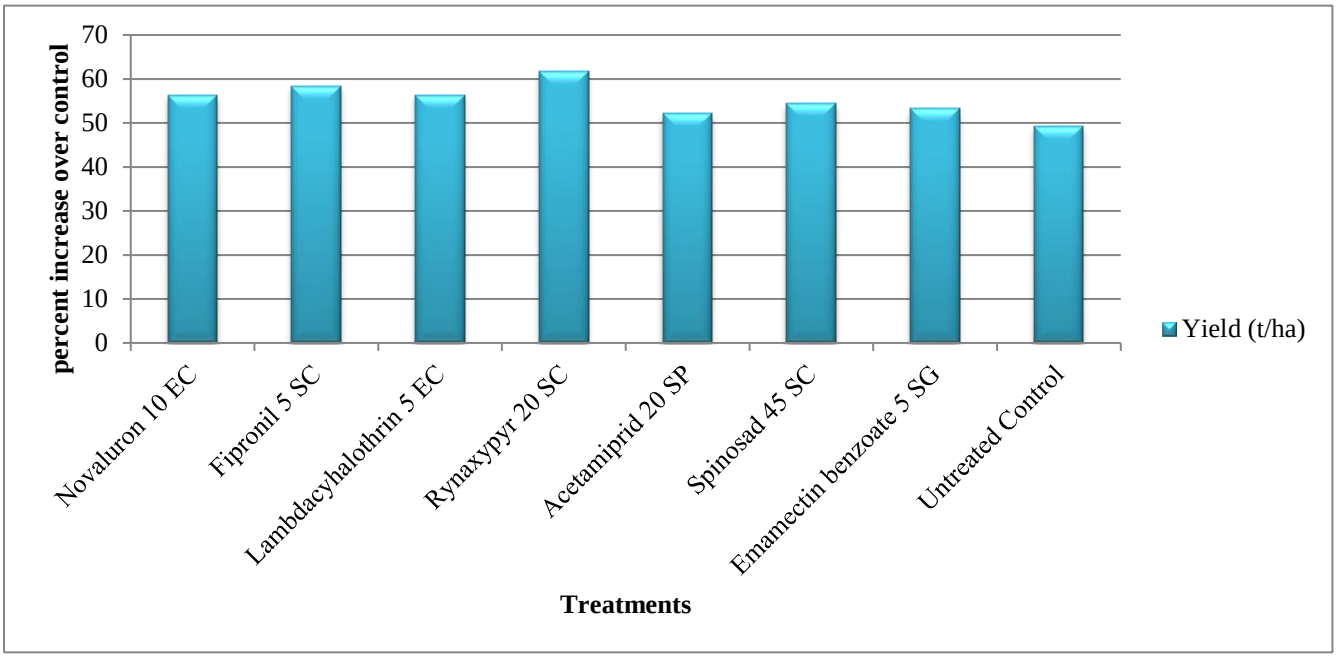

FIGURE 7: Impact of insecticidal treatments on Sugarcane yield

III. SUMMARY AND CONCLUSION

Seasonal incidence of insect pests on sugarcane was studied on a separate bulk plot in the same field having isolation distance. Weather data was also recorded simultaneously from the meteorological observatory available at the Agricultural Research farm work out the relationship between the occurrence of insect pests and weather parameters. To study the bio efficacy, two sprays of test insecticides viz., Rynaxypyr 20 SC, Fipronil 5 SC, Lambda-cyhalothrin 5 EC, Novaluron 10 EC, Spinosad 45 SC, Emamectin benzoate 5 SG and Acetamiprid 20 SP. were assessed against the major insect pests and the data thus obtained have been subjected to suitable transformation before being statistically analyzed. Studies on the incidence of C. infuscatellus revealed that the percent dead hearts were observed to be highest 26 th standard week (14.52 percent infestation) and S. excerptalis its peak population during 29 th standard week (12.43 percent infestation).

The correlation studies between the incidence of C. infuscatellus and weather parameter revealed that percent dead hearts had showed a significant positive correlation with maximum temperature (r=0.01698) and minimum temperature (r=0.17091). A non- significant negative correlation with morning RH (r=-0.02310), evening RH (r=-0.07366) and rainfall (r=-0.17666). The correlation studies between the population's buildup of S. excerptalis and weather parameter revealed a significant positive correlation with maximum temperature (r=0.33343) and minimum temperature (r=0.23221). A non-significant negative correlation with rainfall (r=-0.51872) and evening RH (r=-0.58808). A significant negative correlation with morning RH (r=-0.35426). Regarding the efficacy of insecticides it was observed the Rynaxypyr 20 SC was found to be effective against the insect pests under study viz., C. infuscatellus (13.85 percent and 7.13 percent post treatment mean) and S. excerptalis (5.77 percent and 5.77 percent post treatment mean). It is the only insecticidal treatment among all the treatments assessed which proved to be most effective against both pests in sugarcane. The insecticides Fipronil 5 SC were found to be effective next to Lambda-cyhalothrin 5 EC. Among all insecticidal treatments, application of Acetamiprid 20 SP recorded a low efficacy compared with other insecticides but significantly superior over control.

The yield was found to be highest in Rynaxypyr 20 SC treated plot (61.68 t ha -1) and was followed by Fipronil (58.36 t ha -1) and Lambda-cyhalothrin 5 EC (56.25 t ha -1) treated plot. Among all the insecticides a low yield was recorded in plots treated with Acetamiprid 20 SP (52.14 t ha -1) but the yield was significantly higher than the mean yield recorded in untreated control plots. From the above observations, it could be concluded that; High incidence of C. infuscatellus were observed (14.52 percent infestation) during fourth week of June (standard week no. 26) whereas, in case S. excerptalis peak population was observed (12.34 percent infestation) during third week of July (standard week no. 29) and the population dynamic were high during the vegetative phase of crop growth. Bio-efficacy of insecticidal treatment against major insect pest of sugarcane showed that Rynaxypyr 20 SC was first best insecticidal treatment against the pest's viz., early shoot borer (13.85 percent and 7.13 percent post treatment mean) and top shoot borer (5.77 percent and 5.5 percent post treatment mean). Besides Fipronil 5 SC, the next best insecticidal treatments were Lambda-cyhalothrin 5 EC, Novaluron 10 EC and Spinosad 45 SC.

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