

**ALL INDIA CO-ORDINATED RESEARCH PROJECT  
ON  
SUGARCANE**



**ANNUAL REPORT  
SUGARCANE ENTOMOLOGY  
2016-17**

**PUNJAB AGRICULTURAL UNIVERSITY, REGIONAL RESEARCH  
STATION, KAPURTHALA - 144 601**

**ANNUAL REPORT [ENTOMOLOGY]**  
**ALL INDIA CO-ORDINATED RESEARCH PROJECT ON SUGARCANE**  
**PUNJAB AGRICULTURAL UNIVERSITY, REGIONAL RESEARCH STATION,**  
**KAPURTHALA (2016-17)**

**1. Evaluation of varieties for their reaction against major insect pests.**

<b>Project No.</b>	<b>E. 4.1</b>
Location	Punjab Agricultural University, Regional Research Station, Kapurthala.
Title	Evaluation of zonal varieties for their reaction against major insect pests.
Objectives	To grade the entries in the zonal varietal trials for their behavior towards damage by key pests in the area.
Year of start	1985-86
Technical program	Early and mid-late genotypes/varieties to be evaluated against major insect pests without any insecticidal application. Observations to be recorded on the incidence of shoot borer in April to July, top borer in July to September and stalk borer at harvest.
Technical program	To continue with the new entries.
<b>Technical Report:</b>	
Genotypes	Zonal Varietal Trials, 42 entries
Design	RBD
Replications	Three
Plot size	27 sq. m.
Date of planting	15-3-2016

Forty two genotypes comprising of seventeen early maturing (nine under IVT E, four under AVT E I plant and four under AVT E II plant) and twenty five mid-late maturing (thirteen under IVT ML, six under AVT ML I plant and six under AVT ML II plant) with respective group standards were evaluated against early shoot borer, (*Chilo infuscatellus* Snellen), top borer (*Scirpophaga excerptalis* Walker) and stalk borer (*Chilo auricilius* Dudgeon) of

sugarcane at Punjab Agricultural University, Regional Research Station, Kapurthala. Early shoot borer incidence was found to be low in all the tested genotypes (except seven genotype) viz. Co 13033, Co 13034, CoLk 13201, CoLk 13203, CoPant 13221, CoPb 13181, CoS 13231, Co 12026, Co 12027, CoLk 12203, CoPant 12221, CoH 11262, CoLk 11201, CoLk 11202, CoLk 11203, Co 13035, Co 13036, CoH 13262, CoH 13263, CoLk 13204, CoLk 13205, CoPant 13223, CoPant 13224, CoPb 13182, CoPb 13183, Co 12029, CoH 12263, CoLk 12205, CoPant 12226, CoPb 12211, CoH 11263, CoLk 11204, CoLk 11206, CoPb 11214 and CoS 11232. Only seven genotype viz. CoLk 13202 and CoPant 13222 (IVT E), CoH 13261, CoS 13232 and CoS 13233 (IVT ML), CoS 12232 (AVT ML I) and Co 11027 (AVT ML II) showed moderately susceptible to early shoot borer and its incidence were above fifteen percent (Table1).

The cumulative incidence of top borer was recorded less susceptible to moderate susceptible. However, it ranged from 4.82 per cent in Co 13036 (IVT ML) to 14.14 per cent in CoPant 13222 (IVT E) in all the genotypes evaluated which exhibited low to moderately susceptible reaction against top borer. The per cent incidence of stalk borer ranged from 6.67 per cent in CoPb 13181 (IVT E) to 17.33 per cent in CoH 13261(IVT ML). However, the genotypes under six different group showed less susceptible reaction to stalk borer (0.09- 0.21 infestation index) (Table1).

**Summary:** Early shoot borer incidence was found to be less to moderately susceptible in all the tested genotypes under six different groups. The cumulative incidence of top borer was recorded as less to moderate ranging from 4.82 to 14.14 per cent. The genotypes tested also showed less than two per cent infestation index reaction to the stalk borer.

## 2. Survey and Surveillance of insect pests of Sugarcane

<b>Project No.</b>	<b>E. 28</b>
Location	Sugarcane fields nearby sugar factories of Punjab
Title	Survey and surveillance of insect pests of Sugarcane
Objectives	To identify key insect pests of sugarcane in the area
Year of start	2003-04
Technical program	Roving survey of sugarcane fields at 5-8 Km distance be recorded
Technical program	To continue for the next year

Sugarcane fields nearby sugar factories of Punjab were surveyed for insect pests in the area. Incidence of termite ranged between 1-2 per cent in popular varieties of sugarcane viz., CoH 89003, CoJ 64 and Co 238 around sugar factories at Mukerian, Dasuya, Gurdaspur and Fazilka. The incidence of early shoot borer, top borer, stalk borer and root borer ranged between 4-5, 3-4, 6-7 and 4-5 per cent, respectively, in different varieties of sugarcane viz., Co 238, CoJ 85, Co 89003, CoJ 88 at different cane growing areas of Punjab. The incidence of pyrilla, mite and black bug were found 7-8, 5-6 and 7-8 per cent, respectively on different varieties viz. CoJ 85, Co 238, Co 89003, CoJ 64 and CoJ 88 in cane growing area of Dasuya, Mukerian, Phagwara, Batala, Gurdaspur, Ajnala, Nakodar, Dhuri, Amloh, Fazilka, Mukatsar, Faridkot, Budhewal, Ludhiana and Morinda. The incidence of whitefly was found in traces. (Table 2).

**Summary:** Most of the sugar mill areas surveyed exhibited low insect pest incidence. Stalk borer, pyrilla and black bug were recorded as major insects, while other, termite, early shoot borer, top borer, whitefly, mite & root borer were recorded as minor insect pests in sugarcane.

### 3. Monitoring of insect pests and bioagents in sugarcane agro-ecosystem

<b>Project No.</b>	<b>E. 30</b>
Location	Punjab Agricultural University, Regional Research Station, Kapurthala
Title	Monitoring of insect pests and bioagents in sugarcane agro-ecosystem
Objectives	To monitor key insect pests and natural enemies in the area
Year of start	2006-07
Technical program	1. Planting of sugarcane variety recommended for the region in 0.2 ha area. 2. All recommended practices to be followed except application of insecticide.
Technical program	To continue for the next year
Date of planting	12.03.16
Variety	CoJ 88
Area	0.2 ha

Sugarcane variety CoJ 88 was planted in 0.2 ha area and the incidence of insect pests and their natural enemies were recorded. The early shoot borer incidence started from 2<sup>nd</sup> week of April and reached its peak level of 12.6 per cent in 2<sup>nd</sup> week of May which thereafter, declined to 1.8 per cent in the 2<sup>nd</sup> week of July. The parasitoid viz., *Trichogramma* sp. and *Stenobracon* sp. were recorded as 2.0 and 3.6 per cent, respectively in the month of April and 4.0 and 4.9 per cent respectively, in the month of May. The top borer incidence started from month of May and reached to its peak level of 13.0 per cent in 2<sup>nd</sup> week of July. Thereafter, top borer incidence decreased to 1.0 per cent in the 1<sup>st</sup> fortnight of September. The bio-agents viz., *Rhaconotus* sp., *Isotima javensis* and *Stenobracon* sp. were recorded as 3.6, 3.1 and 5.0 per cent in the month of June, respectively, 5.5, 4.2 and 6.0 per cent in the month of July, respectively and 2.0, 2.1 and 3.1 per cent in the month of August, respectively. The stalk borer incidence started from 2<sup>nd</sup> week of September and reached to its peak level of 11.0 per cent in the month of November and thereafter, stalk borer incidence declined. Parasitization by bio-agents viz., *Sturmiopsis inference* and *Cotesia flavipes* were observed 2.0 and 1.0 percent in the month of September, respectively and again *Sturmiopsis inference* and *Cotesia flavipes* were observed 3.5 and 2.0 percent in the month of October and 5.0 and 3.5 per cent in the month of November, respectively. The activity of pyrilla on sugarcane initiated from 2<sup>nd</sup> week of July and continued up to first fortnight of October. Activity of bio-agent viz., *Epiricania melanoleuca* 4.8 per cent parasitization was observed in the month of August, 6.0 per cent was observed in the month of September and 3.5 per cent observed in month of October (Table 3).

**Summary:** The incidence of early shoot borer incidence varied from April to July. The activities of different parasitoid were observed against early shoot borer from 2<sup>nd</sup> week of April to July. The top borer incidence started from month of May to September. The bio-agents viz., *Rhaconotus* sp., *Isotima javensis* and *Stenobracon* sp. were observed for suppress the population of top borer. The stalk borer incidence started from September to January. Parasitization by bio-agents viz., *Sturmiopsis inference* and *Cotesia flavipes* were observed. The activity of pyrilla on sugarcane initiated from first week of July to October. Activity of bio-agent viz., *Epiricania melanoleuca* parasitization was observed in the month of August to October.

#### 4. Management of borer complex of sugarcane through lures

<b>Project:</b>	<b>E.36</b>
<b>Location:</b>	Punjab Agricultural University, Regional Research Station, Kapurthala.
<b>Title:</b>	Management of borer complex of sugarcane through lures.
<b>Objective:</b>	To manage sugarcane borers (early shoot borer, top borer and stalk borer) through pheromone traps
<b>Year of start:</b>	2008-09
<b>Variety:</b>	CoJ 88
<b>Date of planting:</b>	15.03.2016
<b>Area:</b>	1 acre

The management of borer complex (early shoot borer, top borer and stalk borer) of sugarcane through lures was conducted at Punjab Agricultural University, Regional Research Station, Kapurthala. For this purpose, three pheromone traps for each borer were installed during first week of April till the harvest of crop. Observation on number of moth catches was recorded at weekly intervals. The activity of early shoot borer started from 17<sup>th</sup> MW (Monthly Week) (Last week of April) to 33<sup>th</sup> MW (Third week of August). Thereafter, it was found to be nil up to 9<sup>th</sup> MW (last week of February 2017). The highest number of early shoot borer catches (10 moths/trap) trapped in 20<sup>th</sup> MW (Third week of May) when maximum and minimum temperature was 42.3 and 23.4<sup>o</sup>C, respectively. The early shoot borer moth catches were positively ( $r = 0.54$  and  $0.52$ ) correlated with maximum and minimum temperature, respectively, while it was negatively correlated with morning relative humidity ( $r = -0.72$ ), evening relative humidity ( $r = -0.24$ ) and rainfall ( $r = -0.08$ ) (Table 4 and 5). Incidence of early shoot borer in treatment and control plots was 7.45 and 12.33 per cent, respectively, Thus there was reduction of 39.58 per cent in the incidence of early shoot borer by lure alone (Table 6). Activity of top borer started from 20<sup>th</sup> MW (Third week of May) to 39<sup>th</sup> MW (last week of September) and thereafter, it was found to be nil up to the harvest of crop. The highest number of top borer catches (13 moths/trap) trapped during 28<sup>th</sup> MW (second week of July) when maximum and minimum temperature was 37.4 and 27.4 <sup>o</sup>C, respectively. The top borer moth catches were positively ( $r = 0.40$ ,  $0.74$  and  $0.46$ ) correlated with maximum, minimum

temperature and evening relative humidity, respectively and negatively correlated with morning relative humidity and rain fall  $r = -0.18$  and  $-0.03$  respectively, Incidence of top borer in treatment and control plots was 8.84 and 13.75 per cent, respectively. Thus there was reduction of 35.70 per cent in the incidence of top borer by lure. The activity of stalk borer started from 37<sup>th</sup> MW (second week of September) to 5<sup>th</sup> MW (last week of January, 2017), thereafter, it was found to be nil up to the harvest of crop. The highest number of stalk borer catches (11 moths/trap) were trapped in 44<sup>th</sup> MW (last week of November) when maximum and minimum temperature were 31.3 and 12.4 °C, respectively. The stalk borer moth catches were positively correlated with ( $r = 0.18$ ) with maximum temperature and morning relative humidity ( $r = 0.42$ ) while it was negatively correlated with ( $r = -0.40$ ) with minimum temperature and evening relative humidity ( $r = -0.18$ ) and rainfall ( $r = -0.19$ ) (Table 4 and 5). Incidence of stalk borer in treatment and control plots was 5.78 and 9.67 per cent, respectively, Thus there was reduction of 40.22 per cent in the incidence of stalk borer by pheromone (Table 6).

**Summary :** The activity of early shoot borer started from last week of April to third week of August. The highest numbers of early shoot borer were trapped in third week of May. Incidence of early shoot borer in treatment and control plots was 7.45 and 12.33 per cent, respectively, Thus there was reduction of 39.58 per cent in the early shoot borer by lure. The activity of top borer was started from third week of May to last week of September. The highest numbers of top borer were trapped in second week of July. Incidence of top borer in treatment and control plots was 8.84 and 13.75 per cent, respectively, Thus there was reduction of 35.70 per cent in the incidence of top borer by lure. The activity of stalk borer started from second week of September to last week of January. The highest numbers of stalk were trapped in last week of November. Incidence of stalk borer in treatment and control plots was 5.78 and 9.67 per cent, respectively, Thus there was reduction of 40.22 per cent in the incidence of stalk borer.

## 5. Bioefficacy of new insecticides for the control of sugarcane early shoot borer

<b>Project:</b>	<b>E.37.</b>
<b>Location:</b>	Punjab Agricultural University, Regional Research Station, Kapurthala.
<b>Title:</b>	Bioefficacy of new insecticides for the control of sugarcane early shoot borer.
<b>Objective:</b>	To find out effective strategy for the management of sugarcane early shoot borer
<b>Year of start:</b>	2013-14
<b>Variety:</b>	CoJ 88
<b>Date of planting:</b>	19.03.2016
<b>Area:</b>	1000 sq m

An experiment was conducted to test the efficacy of different insecticidal treatments against sugarcane early shoot borer (*Chilo infuscatellus* Snellen) at Punjab Agricultural University, Regional Research Station, Kapurthala during spring 2016-17. The cumulative percent incidence of early shoot borer was observed at 30, 60, 90 and 120 days after planting. Different treatments were given viz. Fipronil 0.3 G@ 25 kg/ha, Chlorantraniliprole 0.4 G @ 22.5 kg/ha, Phorate 10 G @ 15 kg/ha, Carbofuron 3 G @ 33 kg/ha as a soil application at 60 days after planting and Chlorantraniliprole 18.5 SC @ 375 ml/ha, Spinosad 45 SC @ 90 ml/ha, Flubendiamide 39.35 SC @ 125 ml/ha, spray at 30 and 60 days after planting and control plot. Analysis of variance revealed significant differences for the control of early shoot borer (Table 7). Out of the insecticides tested Chlorantraniliprole 18.5 SC @ 375 ml/ha was found to be significantly superior and recorded minimum percent incidence of early shoot borer (0.68%). Its application also resulted in significant increase for cane yield (89.52 t/ha), total cane height (283.17 cm), sucrose percent in juice (17.51%) and Commercial Cane Sugar (CCS) (12.23%). This was followed by Chlorantraniliprole 0.4G @ 22.5 kg/ha treatment having percent incidence of early shoot borer (1.00%) and thereby increased other parameters significantly viz. cane yield (88.68 t/ha), total cane height (282.00 cm), sucrose percent in juice (17.48%) and CCS (12.21%) (Table7). The corresponding values for incidence of ESB and other parameters in control treatment were percent incidence of early shoot borer highest (12.31%) and cane yield (70.16t/ha), total cane height (254.93 cm), sucrose percent in juice



(16.16%) and CCS (11.24%), respectively. The rest of the treatments were also comparable to control with varying levels.

**Summary:** The efficacy of different insecticidal treatments tested against sugarcane early shoot borer revealed that cumulative percent incidence of early shoot borer observed at 30, 60, 90 and 120 days after planting was least for the treatment Chlorantraniliprole 18.5 SC @ 375 ml/ha thereby resulting in increase in other economic parameters like cane yield, total cane height, sucrose (% in juice) and CCS (%) closely followed by the insecticides, Chlorantraniliprole 0.4G @ 22.5 kg, Flubendiamide 39.35 SC @ 125 ml/ha, Spinosad 45 SC @ 90 ml/ha, Fipronil 0.3 G@ 25 kg, Carbofuron 3G @ 33 kg/ha and Phorate 10 G @ 15 kg/ha as compared to control for management of early shoot borer in sugarcane.

## HIGHLIGHTS

1. Early shoot borer incidence was found to be less to moderately susceptible in all the tested genotypes under six different groups. The cumulative incidence of top borer was recorded as less to moderate ranging from 4.82 to 14.14 per cent. The genotypes tested also showed less than two per cent infestation index reaction to the stalk borer.
2. Most of the sugar mill areas surveyed exhibited low insect pest incidence. Stalk borer, pyrilla and black bug were recorded as major insects, while other, termite, early shoot borer, top borer, whitefly, mite & root borer were recorded as minor insect pests in sugarcane.
3. The incidence of early shoot borer incidence varied from April to July. The activities of different parasitoid were observed against early shoot borer from 2<sup>nd</sup> week of April to July. The top borer incidence started from month of May to September. The bio-agents *viz.*, *Rhaconotus* sp., *Isotima javensis* and *Stenobracon* sp. were observed for suppress the population of top borer. The stalk borer incidence started from September to January. Parasitization by bio-agents *viz.*, *Sturmiopsis inference* and *Cotesia flavipes* were observed. The activity of pyrilla on sugarcane initiated from first week of July to October. Activity of bio-agent *viz.*, *Epiricania melanoleuca* parasitization was observed in the month of August to October.
4. The activity of early shoot borer started from last week of April to third week of August. The highest numbers of early shoot borer were trapped in third week of May. Incidence of early shoot borer in treatment and control plots was 7.45 and 12.33 per cent, respectively, Thus there was reduction of 39.58 per cent in the early shoot borer by lure. The activity of top borer was started from third week of May to last week of September. The highest numbers of top borer were trapped in second week of July. Incidence of top borer in treatment and control plots was 8.84 and 13.75 per cent, respectively, Thus there was reduction of 35.70 per cent in the incidence of top borer by lure. The activity of stalk borer started from second week of September to last week of January. The highest numbers of stalk were trapped in last week of November. Incidence of stalk borer in treatment and control plots was 5.78 and 9.67 per cent, respectively, Thus there was reduction of 40.22 per cent in the incidence of stalk borer.
5. The efficacy of different insecticidal treatments tested against sugarcane early shoot borer revealed that cumulative percent incidence of early shoot borer observed at 30, 60, 90 and

120 days after planting was least for the treatment Chlorantraniliprole 18.5 SC @ 375 ml/ha thereby resulting in increase in other economic parameters like cane yield, total cane height, sucrose (% in juice) and CCS (%) closely followed by the insecticides, Chlorantraniliprole 0.4G @ 22.5 kg, Flubendiamide 39.35 SC @ 125 ml/ha, Spinosad 45 SC @ 90 ml/ha, Fipronil 0.3 G@ 25 kg, Carbofuron 3G @ 33 kg/ha and Phorate 10 G @ 15 kg/ha as compared to control for management of early shoot borer in sugarcane.

**Table 1. Screening of varieties for resistance to insect pests (2016-17)**

Sr. No	Genotype	Shoot borer	Top borer incidence (%)			Stalk borer		
		Cumulative percent Incidence	III Brood	IV Brood	Cumulative	Incidence (%)	Intensity (%)	Infestation index
<b>IVT Varietal Trial (Early)</b>								
1	Co 13033	12.59	5.26	4.85	10.12	10.67	1.22	0.13
2	Co 13034	7.44	3.67	4.71	8.38	8.00	0.98	0.08
3	CoLk 13201	11.78	4.35	3.26	7.61	13.33	1.19	0.16
4	CoLk 13202	15.36	8.75	2.35	11.10	14.67	1.42	0.21
5	CoLk 13203	10.06	9.64	1.20	10.84	10.67	1.33	0.14
6	CoPant 13221	11.22	4.44	5.26	9.71	9.33	1.42	0.13
7	CoPant 13222	20.35	8.64	5.49	14.14	14.67	1.50	0.22
8	CoPb 13181	4.15	5.81	0.00	5.81	6.67	1.42	0.09
9	CoS 13231	9.80	4.94	2.47	7.41	9.33	1.17	0.11
CK	Co 64	11.84	6.25	5.43	11.68	13.33	1.42	0.19
	CoPant 84211	9.79	6.12	1.05	7.18	12.00	1.25	0.15
	Co 238	10.58	9.47	8.42	17.89	10.67	1.17	0.12
CD (0.05)		2.1	1.1	1.3	1.8	1.3	0.3	0.1
<b>AVT Varietal Trial (Early I Plant )</b>								
1	Co 12026	9.87	4.88	4.49	9.37	13.33	1.17	0.16
2	Co 12027	5.90	5.13	3.70	8.83	10.67	0.83	0.09
3	CoLk 12203	10.06	7.50	3.95	11.45	14.67	1.08	0.16
4	CoPant 12221	8.10	6.25	3.37	9.62	16.00	1.08	0.17
CK	CoJ 64	11.30	4.90	4.12	9.03	12.00	1.33	0.16
	CoPant 84211	10.73	4.88	6.10	10.98	10.67	1.33	0.14
	Co 238	9.42	10.34	5.26	15.61	12.00	1.17	0.14
CD (0.05)		1.4	1.5	0.7	1.8	1.5	0.2	0.1
<b>AVT Varietal Trial (Early II Plant )</b>								
1	CoH 11262	10.33	4.44	5.56	10.00	14.67	1.42	0.21
2	CoLk 11201	11.42	5.75	3.45	9.20	13.33	1.17	0.16
3	CoLk 11202	9.76	10.00	2.38	12.38	12.00	1.17	0.14
4	CoLk 11203	8.05	6.67	2.38	9.05	13.33	0.92	0.12
CK	CoJ 64	10.67	4.60	4.44	9.04	16.00	1.33	0.21
	CoPant 84211	10.75	5.75	5.00	10.75	12.00	1.00	0.12
	Co 238	11.29	10.00	8.64	18.64	13.33	1.17	0.16
CD (0.05)		0.9	1.8	1.6	2.6	1.1	0.1	0.1
<b>IVT Varietal Trail (Mid Late)</b>								
1	Co 13035	10.07	6.90	2.33	9.22	10.67	1.08	0.12
2	Co 13036	11.19	3.61	1.20	4.82	14.67	0.92	0.13
3	CoH 13261	15.19	5.06	3.37	8.43	17.33	1.33	0.23
4	CoH 13262	10.03	5.26	4.71	9.97	9.33	0.75	0.07
5	CoH 13263	5.94	5.41	2.78	8.18	6.67	0.58	0.04
6	CoLk 13204	7.89	3.41	3.66	7.07	9.33	0.75	0.07
7	CoLk 13205	12.63	5.88	4.26	10.14	16.00	1.17	0.19

8	CoPant 13223	10.41	6.02	6.02	12.05	13.33	0.92	0.12
9	CoPant 13224	9.58	7.78	3.33	11.11	12.00	1.25	0.15
10	CoPb 13182	9.09	5.26	3.16	8.42	8.00	1.42	0.11
11	CoPb 13183	13.10	5.88	3.41	9.29	17.33	1.42	0.25
12	CoS 13232	16.51	8.33	1.05	9.39	17.33	1.17	0.20
13	CoS 13233	15.26	5.75	6.12	11.87	17.33	1.25	0.22
CK	CoS 767	10.24	3.66	6.85	10.51	13.33	1.17	0.16
	CoS 8436	9.84	6.38	3.57	9.95	12.00	0.92	0.11
	CoPant 97222	10.36	5.21	5.21	10.42	12.00	1.00	0.12
CD (0.05)		1.2	0.9	0.7	1.5	1.5	0.3	0.2
<b>AVT Varietal Trial (Mid Late I Plant)</b>								
1	Co 12029	7.28	4.26	3.57	7.83	10.67	0.75	0.08
2	CoH 12263	10.03	5.68	2.38	8.06	17.33	1.25	0.22
3	CoLk 12205	9.40	5.19	1.19	6.39	13.33	0.58	0.08
4	CoPant 12226	10.97	6.67	3.57	10.24	6.67	0.67	0.04
5	CoPb 12211	13.25	4.44	3.57	8.02	14.67	1.08	0.16
6	CoS 12232	15.31	4.76	5.95	10.71	17.33	0.92	0.16
CK	CoS 767	9.46	4.26	5.06	9.32	12.00	1.17	0.14
	CoS 8436	8.67	5.21	3.53	8.74	12.00	1.00	0.12
	CoPant 97222	9.15	7.07	2.17	9.24	10.67	1.08	0.12
CD (0.05)		1.5	0.6	0.9	0.8	2.1	0.1	0.1
<b>AVT Varietal Trial (Mid Late II Plant)</b>								
1	Co 11027	15.46	4.55	1.14	5.68	10.67	1.33	0.14
2	CoH 11263	12.17	7.79	3.33	11.13	13.33	1.25	0.17
3	CoLk 11204	12.26	6.86	3.23	10.09	9.33	1.17	0.11
4	CoLk 11206	9.58	5.68	4.55	10.23	8.00	1.17	0.05
5	CoPb 11214	7.50	5.19	2.60	7.79	6.67	0.83	0.06
6	CoS 11232	4.78	5.19	2.60	7.79	9.33	0.92	0.09
CK	CoS 767	9.83	4.90	3.70	8.61	12.00	1.00	0.12
	CoS 8436	8.92	5.68	3.49	9.17	16.00	0.83	0.13
	CoPant 97222	7.97	5.19	4.82	10.01	13.33	1.25	0.17
CD (0.05)		1.9	0.5	0.7	1.0	1.8	0.1	0.1

<b>Grade</b>			
<b>Pest</b>	<b>LS</b>	<b>MS</b>	<b>HS</b>
Early shoot borer (%)	Below 15.0	15.1-30.0	Above 30.0
Top borer (%)	Below 10.0	10.1-20.0	Above 20.0
Root borer	Below 15.0	15.1-30.0	Above 30.0
Stalk borer (infestation index)	Below 2.0	2.1-5.0	Above 5.0
Pyrilla (nymph + adult per leaf)	Below 5.0	5.1-20.0	Above 20.0
Whitefly (per square inch)	Below 2.0	2.1-5.0	Above 5.0

**Table 2. Survey and surveillance of insect pest of sugarcane in Punjab during 2016-17**

S. No.	Varieties	Location	Name of Pest	Per cent incidence	Remark
1.	Co 89003 CoJ 64 Co 238	Mukerian Dasuya Gurdaspur Fazilka	Termite ( <i>Odontotermes obesus</i> )	1-2	In sandy soil termite attack was more
2.	Co 238 CoJ 85 Co 89003 CoJ 88	Faridkot Phagwara Bhogpur Dasuya Dhuri Fazilka	Early shoot borer ( <i>Chilo infuscatellus</i> )	4-5	
3.	Co 238 CoJ 85 Co 89003	Budhewal Gurdaspur Nakodar Batala Amloh Nawanshahar	Top borer ( <i>Scirpophaga excerptalis</i> )	3-4	-
4.	CoJ 85 Co 238	Dasuya Mukerian Phagwara Batala Gurdaspur Ajnala Nakodar	Pyrilla ( <i>Pyrilla perpusilla</i> )	3-4/leaf (7-8%)	-
5.	CoJ 85 Co 238	Morinda Dhuri	Whitefly ( <i>Aleurolobus barodensis</i> )	Traces	-
6.	Co 238 Co 89003 CoJ 64	Dhuri Amloh Fazilka Mukatsar Faridkot	Mite ( <i>Oligonychus indicus</i> )	5-6/cm square (5-6% )	-
7.	Co 238 CoJ 85 CoJ 88 Co 89003	Budhewal Ludhiana Phagwara Ajnala Dhuri Morinda	Black bug ( <i>Cavelerious excavatus</i> )	3-4/Plant (7-8%)	Black bug incidence more in sugarcane ratoon crop

8	Co 238 CoJ 88 CoJ 85	Mukerian Dasuya Dhuri Kapurthala Gurdaspur Batala	Root borer ( <i>Emmalocera depressella</i> )	4-5	-
9.	Co 238 CoJ 85 CoJ 64 Co 89003	Ajnala Budhewal Nawanshahar Gurdaspur Amloh Nakodar Morinda Phagwara	Stalk borer ( <i>Chilo auricilius</i> )	6-7	-

**Table 3. Incidence of insect pests and bioagents in sugarcane (2016-17)**

Month	Percent incidence of early shoot borer	Percent parasitism (ESB)		Percent incidence of Top borer	Percent parasitism (Tb)			Percent incidence of Stalk borer	Percent parasitism (Stb)		Percent incidence of <i>Pyrilla</i> (Nymph/adult per leaf)	Percent parasitism on <i>Pyrilla</i> nymph
		<i>Trichogramma chilonis</i>	<i>Stenobraccon</i> sp.		<i>Rhaconotus</i> sp.	<i>Isotima javensis</i>	<i>Stenobracon</i> sp.		<i>Sturmiopsis inference</i>	<i>Cotesia flavipes</i>		<i>Epiricania melanoleuca</i>
11 April, 2016	2.5	2.0	3.6	-	-	-	-	-	-	-	-	-
11 May, 2016	12.6	4.0	4.9	3.0	-	1.0	1.0	-	-	-	-	-
11 June, 2016	9.6	-	3.0	7.6	3.6	3.1	5.0	-	-	-	-	-
11 July, 2016	1.8	-	1.1	13.0	5.5	4.2	6.0	-	-	-	1.0	-
11 August, 2016	-	-	-	4.5	2.0	2.1	3.1	-	-	-	5.6	4.8
11 September, 2016	-	-	-	1.0	1.0	-	2.0	2.2	2.0	1.0	7.5	6.0
11 October, 2016	-	-	-	-	-	-	-	7.9	3.5	2.0	4.0	3.5
11 November, 2016	-	-	-	-	-	-	-	11.0	5.0	3.5	-	-
11 December, 2016	-	-	-	-	-	-	-	3.9	2.1	1.1	-	-
11 January, 2017	-	-	-	-	-	-	-	1.5	-	-	-	-

ESB (Early Shoot Borer), Tb (Top Borer) and Stb (Stalk Borer)



**Table 4. Number of Early shoot borer, Top borer and Stalk borer moth trapped at weekly interval with weather parameters (2016-17)**

Standard Week	Date	Early shoot borer	Top borer	Stalk borer	Average Temperature °C		Average Relative Humidity %		Total Rain fall (mm)
					Max	Min	Morning	Evening	
11	14.03.16	0.0	0.0	0.0	9.9	22.3	90.9	56.1	28.0
12	21.03.16	0.0	0.0	0.0	29.9	10.4	84.4	36.0	0.0
13	28.03.16	0.0	0.0	0.0	32.0	12.1	83.9	33.9	0.0
14	04.04.16	0.0	0.0	0.0	33.6	17.0	70.0	29.7	0.0
15	11.04.16	0.0	0.0	0.0	35.4	15.9	65.4	22.4	0.0
16	18.04.16	0.0	0.0	0.0	40.4	18.7	58.6	20.6	0.0
17	25.04.16	2.0	0.0	0.0	40.0	15.3	52.1	13.4	0.0
18	02.05.16	5.0	0.0	0.0	39.7	20.1	49.0	22.6	0.0
19	09.05.16	7.0	0.0	0.0	40.6	23.3	57.0	28.3	0.0
20	16.05.16	10.0	2.0	0.0	42.3	23.4	54.1	19.9	0.0
21	23.05.16	5.0	4.0	0.0	38.9	23.7	63.6	30.9	15.0
22	30.05.16	4.0	5.0	0.0	40.0	25.9	60.6	27.9	8.0
23	06.06.16	9.0	8.0	0.0	41.3	28.3	56.0	27.7	0.0
24	13.06.16	8.0	7.0	0.0	36.6	25.0	63.9	36.9	0.5
25	20.06.16	6.0	6.0	0.0	36.3	24.7	75.0	57.4	18.0
26	27.06.16	4.0	9.0	0.0	36.6	29.4	68.6	59.7	6.0
27	04.07.16	5.0	11.0	0.0	32.7	26.6	85.6	63.7	0.0
28	11.07.16	2.0	13.0	0.0	37.4	27.4	85.0	67.3	0.0
29	18.07.16	4.0	12.0	0.0	31.7	26.4	84.1	61.4	0.0
30	25.07.16	2.0	9.0	0.0	33.7	26.3	86.4	73.6	0.0
31	01.08.16	1.0	10.0	0.0	35.4	27.7	80.6	59.0	0.0
32	08.08.16	0.0	7.0	0.0	33.7	26.4	83.3	67.4	0.0
33	15.08.16	1.0	5.0	0.0	34.7	25.0	85.6	60.3	0.0
34	22.08.16	0.0	5.0	0.0	34.3	25.7	86.6	67.3	0.0
35	29.08.16	0.0	3.0	0.0	31.9	23.9	87.9	67.4	0.0
36	05.09.16	0.0	5.0	0.0	33.7	25.4	86.7	56.1	0.0
37	12.09.16	0.0	4.0	2.0	33.6	24.0	83.7	52.6	0.0
38	19.09.16	0.0	2.0	3.0	36.0	25.9	84.7	52.7	0.0
39	26.09.16	0.0	2.0	5.0	34.3	24.0	87.9	57.7	0.0
40	03.10.16	0.0	0.0	6.0	36.0	23.7	91.3	55.1	0.0
41	10.10.16	0.0	0.0	7.0	34.6	20.1	89.3	35.3	0.0
42	17.10.16	0.0	0.0	8.0	35.1	16.4	85.1	31.0	0.0
43	24.10.16	0.0	0.0	10.0	33.7	14.1	89.0	29.6	0.0
44	31.11.16	0.0	0.0	11.0	31.3	12.4	90.4	39.3	0.0
45	07.11.16	0.0	0.0	8.0	30.7	9.9	92.3	28.7	0.0
46	14.11.16	0.0	0.0	7.0	28.9	8.7	85.7	30.4	0.0
47	21.11.16	0.0	0.0	9.0	27.9	8.7	87.6	31.1	0.0
48	28.11.16	0.0	0.0	8.0	27.6	7.7	88.1	34.7	0.0
49	05.12.16	0.0	0.0	7.0	25.1	6.6	94.6	48.1	0.0
50	12.12.16	0.0	0.0	6.0	19.7	7.3	96.6	63.1	0.0
51	19.12.16	0.0	0.0	6.0	18.7	4.3	95.3	40.9	0.0
52	26.12.16	0.0	0.0	3.0	23.1	5.0	92.6	48.0	0.0
1	02.01.17	0.0	0.0	2.0	22.7	8.3	95.1	57.1	0.0
2	09.01.17	0.0	0.0	0.0	19.1	7.7	95.1	43.9	0.0
3	16.01.17	0.0	0.0	2.0	17.1	5.9	94.1	63.7	11.0
4	23.01.17	0.0	0.0	1.0	18.6	7.0	93.1	63.7	30.5
5	30.01.17	0.0	0.0	2.0	19.7	6.3	96.3	63.9	0.0
6	06.02.17	0.0	0.0	0.0	24.4	7.7	91.7	53.3	2.5
7	13.02.17	0.0	0.0	0.0	24.9	9.3	89.9	44.3	0.0

<b>8</b>	<b>20.02.17</b>	0.0	0.0	0.0	23.8	11.2	94.0	54.0	8.0
<b>9</b>	<b>27.02.17</b>	0.0	0.0	0.0	23.8	11.2	94.0	54.0	8.0

**Table 5. Correlation of weather parameters with moth catches (2016-17)**

<b>Correlation coefficient</b>	<b>Early shoot borer</b>	<b>Top borer</b>	<b>Stalk borer</b>
Maximum Temperature	0.54	0.40	0.18
Minimum Temperature	0.52	0.74	-0.40
Relative Humidity % (Morning)	-0.72	-0.18	0.42
Relative Humidity % (Evening)	-0.24	0.46	-0.18
Rain fall	-0.08	-0.03	-0.19

**Table 6. Incidence of borer complex in treatment and control plot**

<b>Treatment</b>	<b>Percent incidence of Early shoot borer</b>	<b>Percent incidence of Top borer</b>	<b>Percent incidence of Stalk borer</b>
Pheromone (treatment)	7.45	8.84	5.78
Control	12.33	13.75	9.67
Percent reduction	39.58	35.70	40.22

**Table 7. Bioefficacy of new insecticides for the control of sugarcane early shoot borer during 2016-17**

Treatment	Cumulative percent incidence of early shoot borer (ESB)	Germination (%)	Number of millable cane (t/ha)	Cane yield (t/ha)	Growth Parameter				Quality parameter			
					Total cane height (cm)	Millable cane height (cm)	Number of internodes	Girth of cane (cm)	Brix (%)	Sucrose (%) in Juice	Purity (%)	CCS (%)
Fipronil 0.3 G @ 25 kg	4.00	53.92	68.96	82.08	273.60	245.83	20.33	2.14	19.26	17.36	90.12	12.12
Chlorantraniliprole 0.4G @ 22.5 kg	1.00	55.56	73.25	88.68	282.00	253.83	22.50	2.17	19.36	17.48	90.26	12.21
Chlorantraniliprole 18.5 SC @ 375 ml/ha	0.68	54.71	73.89	89.52	283.17	254.13	22.67	2.18	19.40	17.51	90.26	12.23
Spinosad 45SC @ 90 ml/ha	3.29	56.11	69.00	83.34	276.67	248.77	21.00	2.16	19.32	17.40	90.06	12.14
Flubendiamide 39.35 SC @ 125 ml/ha	2.79	56.42	70.82	85.71	279.00	250.45	21.67	2.16	19.36	17.44	90.10	12.17
Phorate 10 G @ 15 kg/ha	4.54	54.70	70.11	78.52	270.73	237.67	18.67	2.11	19.17	17.26	90.07	12.04
Carbofuron 3 G @ 33 kg/ha	4.15	56.92	68.63	79.26	271.53	242.73	19.33	2.13	19.23	17.32	90.04	12.08
Control	12.31	54.30	59.63	70.16	254.93	220.67	16.33	1.99	18.05	16.16	89.49	11.24
CD (0.05)	0.83	NS	1.84	2.57	3.82	3.59	0.94	0.22	0.20	0.15	0.18	0.10