

ANNUAL REPORT
ALL INDIA COORDINATED RESEARCH PROJECT
(SUGARCANR ENTOMOLOGY)

2016-17



SUGARCANE SECTION
CCS HARYANA AGRICULTURAL UNIVERSITY, HISAR
REGIONAL RESEARCH STATION, UCHANI, KARNAL

ANNUAL REPORT ENTOMOLOGY FOR 2016-17, CCSHAU, RRS, UCHANI,
KARNAL

Project E. 4.1: Evaluation of zonal varieties/genotypes for their reaction against major insect-pests.

A total of forty-two entries/genotypes of sugarcane were screened at RRS, Uchani, Karnal against major moth borers (shoot borer, top borer, stalk borer and root borer) and sucking pests (Pyrilla, whitefly, black bug and webbing mite) that included entries in six trials viz. nine under IVT (Early), four under AVT (Early)-I Plant, four under AVT (Early)-II Plant, thirteen under IVT- Midlate, six under AVT (Midlate)-I Plant and six under AVT (Midlate)-II Plant with 2 standards for early and 3 for midlate (Tables 1.1-1.6). All the evaluated genotypes showed susceptibility to the major borer species and sucking pests to varying extent.

Table 1.1a: Reaction of sugarcane genotypes in Initial Varietal Trial (Early) against major borers

Sr. No.	Variety/Genotype	Borer (% infestation)				Grade of infestation			
		Shoot Borer	Top Borer	Stalk borer*	Root borer	Shoot Borer	Top Borer	Stalk borer*	Root borer
1	Co 13033	5.4	4.4	0.8	16.4	LS	LS	LS	MS
2	Co 13034	4.9	2.4	1.0	31.6	LS	LS	LS	HS
3	CoLk 13201	7.4	5.9	1.2	33.7	LS	LS	LS	HS
4	CoLk13202	12.6	4.7	0.7	17.4	LS	LS	LS	MS
5	CoLk 13203	6.2	3.8	0.3	16.9	LS	LS	LS	MS
6	CoPant 13221	3.8	4.5	1.1	34.8	LS	LS	LS	HS
7	CoPant 13222	1.7	4.9	2.3	20.5	LS	LS	MS	MS
8	CoPb 13181	4.6	4.1	1.3	15.6	LS	LS	LS	MS
9	CoS 13231	5.9	4.8	1.2	32.4	LS	LS	LS	HS
CK	CoJ 64	4.3	3.4	1.6	27.6	LS	LS	LS	MS
	Co 0238	3.8	5.7	0.9	22.6	LS	LS	LS	MS

*Infestation Index

In IVT- early, (Table 1.1a) nine genotypes were evaluated against two standards CoJ 64 and Co 0238. Shoot borer, *Chilo infuscatellus* incidence ranged from 1.7 to 12.6 per cent in different genotypes and all genotypes including standard checks were categorised as least susceptible. Incidence of top borer, *Scirpophaga excerptalis* ranged from 2.4 to 5.9 per cent in all

tested genotypes and all genotypes were categorised as least susceptible. In case of stalk borer, *Chilo auricilius* infestation index ranged from 0.3 to 2.3 in all genotypes. Out of which, one genotype (CoPant 13222) was categorised under moderately susceptible and rest were least susceptible. Root borer, *Emalocera depressella* incidence ranged from 15.6 to 28.7 per cent. The highest infestation (34.8 %) was recorded in CoPant 13221 and all tested genotypes including standard checks were categorised as moderately resistant except CoPant 13221, Co 13034, CoLk 13201 and CoS 13231.

Table 1.1b: Reaction of sugarcane genotypes in Initial Varietal Trial (Early) against major sucking pests

Sr. No	Variety/ Genotype	Sucking pests infestation				Grade of infestation			
		Pyrilla	White fly	Black bug	Webbing mite	Pyrilla	White fly	Black bug	Webbing mite
1	Co 13033	3.3	0.7	3.8	17.6	LS	LS	LS	MS
2	Co 13034	1.8	2.9	3.5	2.4	LS	MS	LS	LS
3	CoLk 13201	2.0	0.8	3.3	8.4	LS	LS	LS	LS
4	CoLk13202	1.5	1.2	3.8	6.9	LS	LS	LS	LS
5	CoLk 13203	2.3	2.8	3.5	12.4	LS	MS	LS	MS
6	CoPant 13221	1.5	1.4	3.5	3.1	LS	LS	LS	LS
7	CoPant 13222	0.8	0.8	2.3	5.9	LS	LS	LS	LS
8	CoPb 13181	2.6	1.6	3.4	8.4	LS	LS	LS	LS
9	CoS 13231	1.8	1.5	2.8	5.4	LS	LS	LS	LS
CK	CoJ 64	1.8	2.1	2.5	9.8	LS	MS	LS	LS
	Co 0238	4.7	1.9	8.6	5.6	LS	LS	LS	LS

Pyrilla population (nymph & adult)/leaf; Whitefly population (nymph & puparia)/2.5q.cm; Black bug population/leaf; Webbing mite (% leaf incidence)

In all the tested genotypes, (Table 1.1b) *Pyrilla* incidence ranged from 0.8 to 4.7 nymphs/adults per leaf and all tested genotypes were found least susceptible. All genotypes exhibited least to moderately susceptible reaction against whitefly and infestation ranged from 0.7 to 2.9 nymphs & puparia/2.5 sq.cm. All tested genotypes except Co 13034, CoLk 13203 & CoJ 64 (standard check) were found least susceptible against whitefly. In the tested entries, the reaction against black bug varied from 2.3 to 8.6 black bug/leaf and all tested entries were graded as least

susceptible. The grade of infestation against webbing mite was also recorded least susceptible in all tested genotypes except, Co 13033 and CoLk 13203 which showed moderately susceptible reaction.

Table 1.2a: Reaction of sugarcane genotypes in Advance Varietal Trial (Early) - I Plant against major borers

Sr No.	Variety/Genotype	Borer (% infestation)				Grade of infestation			
		Shoot Borer	Top Borer	Stalk borer*	Root borer	Shoot Borer	Top Borer	Stalk borer*	Root borer
1	Co 12026	6.4	5.7	1.6	23.2	LS	LS	LS	MS
2	Co 12027	5.4	4.3	2.2	29.4	LS	LS	MS	MS
3	CoLk 12203	3.9	6.4	0.6	28.6	LS	LS	LS	MS
4	CoPant 12221	7.1	2.2	1.8	23.5	LS	LS	LS	MS
CK	CoJ 64	4.3	3.4	1.6	27.6	LS	LS	LS	MS
	Co 0238	3.8	5.7	0.9	22.6	LS	LS	LS	MS

*Infestation Index

Shoot borer infestation ranged from 3.8 to 7.1 per cent in all tested genotypes under AVT(Early) –I Plant and all entries were categorised as least susceptible (Table1.2a). The top borer incidence was found to be lowest (2.2 %) in CoPant 12221 and all genotypes showed least susceptible reaction (Table 1.2a). The incidence of stalk borer was registered as low as 0.6 infestation index in CoLk 12203 and all screened genotypes exhibited least susceptible reaction except Co 12027 which showed moderate susceptible reaction. All tested genotypes exhibited moderately susceptible reaction against root borer.

Table 1.2b: Reaction of sugarcane genotypes in Advance Varietal Trial (Early)- I Plant against major sucking pests

Sr No.	Variety/Genotype	Sucking pests infestation				Grade of infestation			
		Pyrilla	White fly	Black bug	Webbing mite	Pyrilla	White fly	Black bug	Webbing mite
1	Co 12026	1.8	1.8	3.3	2.6	LS	LS	LS	LS
2	Co 12027	3.3	3.3	5.0	6.4	LS	MS	LS	LS
3	CoLk 12203	1.8	1.2	4.4	3.6	LS	LS	LS	LS
4	CoPant 12221	2.5	1.1	3.8	8.0	LS	LS	LS	LS
CK	CoJ 64	1.8	2.1	2.5	9.8	LS	MS	LS	LS
	Co 0238	4.7	1.9	8.6	5.6	LS	LS	LS	LS

Pyrilla population (nymph & adult)/leaf; Whitefly population (nymph & puparia) / 2.5 sq.cm; Black bug population/leaf; Webbing mite (% leaf incidence)

Among all the evaluated genotypes (Table 1.2b), all genotypes including standard checks (CoJ 64 & Co 0238) exhibited least susceptible reaction against *Pyrilla* incidence, whereas, all genotypes showed least susceptible to whitefly except Co 12027 and Co J 64(check) which showed moderate susceptible reaction. The infestation of black bug in this category varied from 2.5 to 8.6 and all tested genotypes including standard check (CoJ 64&Co 0238) were reported as least susceptible. All tested genotypes were also found least susceptible against webbing mite.

Table 1.3a: Reaction of sugarcane genotypes in Advance Varietal Trial (Early) - II Plant against major borers

Sr No.	Variety/Genotype	Borer (% infestation)				Grade of infestation			
		Shoot Borer	Top Borer	Stalk borer*	Root borer	Shoot Borer	Top Borer	Stalk borer*	Root borer
1	CoH 11262	8.4	6.5	1.9	17.4	LS	LS	LS	MS
2	CoLk 11201	8.2	5.6	1.7	16.2	LS	LS	LS	MS
3	CoLk 11202	7.8	3.4	0.9	19.7	LS	LS	LS	MS
4	CoLk 11203	3.6	2.8	1.3	17.8	LS	LS	LS	MS
CK	CoJ 64	4.3	3.4	1.6	27.6	LS	LS	LS	MS
	CoPant 84211	4.8	6.4	1.2	28.7	LS	LS	LS	MS

*Infestation Index

All the screened genotypes in AVT (Early)- II Plant (Table 1. 3a) against shoot borer showed a range of infestation from 3.6 to 8.4 per cent and were observed as least susceptible including standard checks(CoJ 64 & CoPant 84211). All the tested genotypes in AVT (Early)- II Plant were categorised under least susceptible against top borer infestation. All the screened genotypes(Table 1. 3a) against stalk borer showed a range of infestation from 0.9 to 1.9 infestation index and were observed as least susceptible including standard checks(CoJ 64 & CoPant 84211). All tested genotypes showed moderately susceptible reaction against root borer and infestation ranged from 16.2 to 28.7 per cent.

Table 1.3b: Reaction of sugarcane genotypes in Advance Varietal Trial (Early)- II Plant against major sucking pests

Sr No.	Variety/Genotype	Sucking pests infestation				Grade of infestation			
		Pyrilla	White fly	Black bug	Webbing mite	Pyrilla	White fly	Black bug	Webbing mite
1	CoH 11262	1.8	2.1	2.5	8.1	LS	MS	LS	LS
2	CoLk 11201	2.5	1.7	3.5	6.9	LS	LS	LS	LS
3	CoLk 11202	2.3	2.1	4.3	7.4	LS	MS	LS	LS
4	CoLk 11203	3.4	1.1	3.6	7.4	LS	LS	LS	LS
CK	CoJ 64	1.8	2.1	2.5	9.8	LS	MS	LS	LS
	CoPant 84211	3.6	2.4	8.3	6.7	LS	MS	LS	LS

Pyrilla population (nymph & adult)/leaf; Whitefly population (nymph & puparia) / 2.5 sq.cm; Black bug population/leaf; Webbing mite (% leaf incidence)

All the four evaluated entries viz. CoH 11262, CoLk 11201, CoLk 11202 and CoLk 11203 exhibited least susceptible reaction along with standard checks (CoJ 64 and CoPant 84211) against *Pyrilla*. While, CoLk 11202, CoH 11262 and standard checks (CoJ 64 & CoPant 84211) showed moderately susceptible reaction against whitefly and other two genotypes (CoLk 11201 and CoLk 11203) were found least susceptible (Table 1.3b). All the tested entries were found least susceptible against black bug and webbing mite including standard checks.

Table 1.4a: Reaction of sugarcane genotypes in Initial Varietal Trial -Midlate against major borers

Sr No.	Variety/Genotype	Borer (% infestation)				Grade of infestation			
		Shoot Borer	Top Borer	Stalk borer*	Root borer	Shoot Borer	Top Borer	Stalk borer*	Root borer
1	Co 13035	4.6	2.7	1.2	18.4	LS	LS	LS	MS
2	Co 13036	6.4	4.6	1.8	32.8	LS	LS	LS	HS
3	CoH 13261	6.8	4.2	1.7	17.2	LS	LS	LS	MS
4	CoH 13262	8.6	3.8	1.5	19.6	LS	LS	LS	MS
5	CoH 13263	8.7	3.7	1.6	19.4	LS	LS	LS	MS
6	CoLk 13204	4.1	3.8	1.4	22.3	LS	LS	LS	MS

7	CoLk 13205	3.6	3.6	1.5	34.7	LS	LS	LS	HS
8	CoPant 13223	4.8	3.2	1.4	16.9	LS	LS	LS	MS
9	CoPant 13224	4.7	3.9	2.4	31.8	LS	LS	MS	HS
10	CoPb 13182	4.7	3.9	1.5	18.5	LS	LS	LS	MS
11	CoPb 13183	6.8	2.9	1.2	32.4	LS	LS	LS	HS
12	CoS 13232	7.4	4.5	1.7	31.2	LS	LS	LS	HS
13	CoS 13233	4.5	2.9	1.5	26.4	LS	LS	LS	MS
CK	CoS 767	5.7	1.8	0.4	22.5	LS	LS	LS	MS
	CoS 8436	15.9	3.7	1.8	29.6	MS	LS	LS	MS
	CoPant 97222	4.5	2.4	1.2	20.8	LS	LS	LS	MS

***Infestation Index**

In the IVT Midlate trial (Table 1.4 a) thirteen entries were evaluated against three standards (CoS 767, CoS 8436 & CoPant 97222). The shoot borer incidence varied between 3.6 and 15.9 per cent. The genotype CoLk 13205 contained the lowest incidence while, the genotype CoS 8436 (standard check) recorded the highest incidence. All tested genotypes except CoS 8436 (standard check) were categorised in least susceptible category against shoot borer. All the tested entries including checks showed least susceptible reaction against top borer. All the entries showed least to moderate reaction against stalk borer. Lowest infestation index (0.4) was reported in CoS 767 (check) and highest (2.4) in CoPant 13224. All genotypes showed least susceptible reaction against stalk borer except CoPant 13224. While the incidence of root borer in all entries was moderate to high. All genotypes showed moderate susceptible reaction against root borer except Co 13036, CoLk 13205, CoPant 13224, CoPb 13183 and CoS 13232 which were reported highly susceptible against this pest.

Table 1.4b: Reaction of sugarcane genotypes in Initial Varietal Trial -Midlate against major sucking pests

Sr No	Variety/ Genotype	Sucking pests infestation				Grade of infestation			
		Pyrilla	White fly	Black bug	Webbing mite	Pyrilla	White fly	Black bug	Webbing mite
1	Co 13035	2.4	1.7	4.6	8.4	LS	LS	LS	LS
2	Co 13036	3.8	1.8	2.4	3.5	LS	LS	LS	LS

3	CoH 13261	2.6	1.7	4.5	9.5	LS	LS	LS	LS
4	CoH 13262	2.8	1.2	4.6	5.8	LS	LS	LS	LS
5	CoH 13263	2.6	1.6	2.9	10.2	LS	LS	LS	MS
6	CoLk 13204	2.2	2.1	3.9	6.6	LS	MS	LS	LS
7	CoLk 13205	2.6	1.7	6.2	8.7	LS	LS	LS	LS
8	CoPant 13223	2.5	1.5	4.4	3.9	LS	LS	LS	LS
9	CoPant 13224	3.9	1.5	4.9	5.7	LS	LS	LS	LS
10	CoPb 13182	2.7	1.6	4.2	5.4	LS	LS	LS	LS
11	CoPb 13183	2.4	2.1	3.4	9.2	LS	MS	LS	LS
12	CoS 13232	2.6	2.5	3.8	6.6	LS	MS	LS	LS
13	CoS 13233	2.9	1.7	6.4	8.4	LS	LS	LS	LS
C K	CoS 767	1.3	1.9	3.3	12.5	LS	LS	LS	MS
	CoS 8436	1.8	1.8	3.3	7.6	LS	LS	LS	LS
	CoPant 97222	2.3	2.4	4.0	5.6	LS	MS	LS	LS

Pyrilla population (nymph & adult)/leaf; Whitefly population (nymph & puparia) / 2.5 sq.cm; Black bug population/leaf; Webbing mite(% leaf incidence)

Thirteen entries were evaluated under IVT midlate (Table 1.4b) against sucking pests. *Pyrilla* incidence ranged from 1.3 to 3.9 nymph & adult/leaf. All genotypes were found least susceptible against *Pyrilla*. Lowest whitefly infestation (1.2 nymphs & puparia / 2.5 sq.cm). was observed in CoH 13262 and highest in CoS 13232(2.5 nymphs & puparia/2.5 sq.cm). All tested genotypes were categorised as least susceptible except CoLk 13204, CoPb 13183, CoS 13232 and CoPant 97222 (check) against whitefly. The infestation of black bug in this class ranged from 2.4 (Co 13036) to 6.4 (CoS 13233) black bug/ leaf and all genotypes were categorised as least susceptible including standard check. In case of webbing mite invasion, all genotypes were classed as least susceptible except CoH 13263 and CoS 767 (check).

Table 1.5a: Reaction of sugarcane genotypes in Advanced Varietal Trial (Midlate) -I Plant against major borers

Sr No.	Variety/Genotype	Borer (% infestation)				Grade of infestation			
		Shoot Borer	Top Borer	Stalk borer*	Root borer	Shoot Borer	Top Borer	Stalk borer*	Root borer
1	Co 12029	8.4	1.8	1.2	27.4	LS	LS	LS	MS
2	CoH 12263	6.7	2.8	1.3	16.7	LS	LS	LS	MS
3	CoLk 12205	5.5	2.5	1.9	27.3	LS	LS	LS	MS
4	CoPant 12226	6.6	3.8	1.3	23.8	LS	LS	LS	MS
5	CoPb 12211	5.2	2.6	2.2	24.4	LS	LS	MS	MS
6	CoS 12232	4.3	1.6	0.6	23.8	LS	LS	LS	MS
CK	CoS 767	5.7	1.8	0.4	22.5	LS	LS	LS	MS
	CoS 8436	15.9	3.7	1.8	29.6	MS	LS	LS	MS
	CoPant 97222	4.5	2.4	1.2	20.8	LS	LS	LS	MS

*Infestation Index

In AVT (Midlate)- I Plant (Table 1.5a), six entries were evaluated against three standards. The shoot borer incidence ranged from 4.3 (CoS 12232) to 15.9 per cent (CoS 8436, standard check). All genotypes were reported least susceptible against shoot borer except CoS 8436 (check). The top borer incidence was also quite low reaching a maximum of 3.8 per cent in CoPant 12226. However, all the tested entries including standard checks were categorized in least susceptible against top borer. All the entries, with their infestation index varying between 0.4 (CoS 767, check) to 2.2 (CoPb 12211) were found to be low to moderately susceptible against stalk borer. All entries were found least susceptible against stalk borer except CoPb 12211. None of entry was found least susceptible against root borer. All tested genotypes showed moderate susceptible reaction against root borer.

Table 1.5b: Reaction of sugarcane genotypes in Advanced Varietal Trial (Midlate) – I Plant against major sucking pests

Sr No	Variety/ Genotype	Sucking pests infestation				Grade of infestation			
		Pyrilla	White fly	Black bug	Webbing mite	Pyrilla	White fly	Black bug	Webbing mite
1	Co 12029	2.5	0.7	5.0	10.4	LS	LS	LS	MS
2	CoH 12263	2.8	2.2	2.5	2.5	LS	MS	LS	LS

3	CoLk 12205	2.0	2.7	3.5	6.9	LS	MS	LS	LS
4	CoPant 12226	2.5	1.4	3.5	7.5	LS	LS	LS	LS
5	CoPb 12211	2.3	2.1	3.0	9.6	LS	MS	LS	LS
6	CoS 12232	2.0	2.3	3.3	5.6	LS	MS	LS	LS
CK	CoS 767	1.3	1.9	3.3	12.5	LS	LS	LS	MS
	CoS 8436	1.8	1.8	3.3	7.6	LS	LS	LS	LS
	CoPant 97222	2.3	2.4	4.0	5.6	LS	MS	LS	LS

Pyrilla population (nymph & adult)/leaf; Whitefly population (nymph & puparia) / 2.5 sq.cm; Black bug population/leaf; Webbing mite(% leaf incidence)

Entries tested in AVT(Midlate)- I Plant against sucking pests *i.e.*, *Pyrilla*, whitefly, black bug and webbing mites were categorised under least to moderately susceptible including checks (Table 1.5b). All tested entries were recorded in least susceptible category against *Pyrilla*. Minimum infestation of whitefly (0.7 nymphs & puparia/2.5 sq.cm) was observed in genotype Co 12029 and maximum(2.7 nymphs & puparia/2.5 sq.cm) in CoLk 12205. All genotypes were categorised as least susceptible against whitefly except CoH 12263, CoLk 12205, CoPb 12211, CoS 12232 and CoPant 97222(check). All tested genotypes including standard checks were categorised in least susceptible category against black bug. All genotypes except CoS 767(check) were also observed as least susceptible against webbing mite.

Table 1.6a: Reaction of sugarcane genotypes in Advanced Varietal Trial (Midlate) - II Plant against major borers

Sr No.	Variety/Genotype	Borer (% infestation)				Grade of infestation			
		Shoot Borer	Top Borer	Stalk borer*	Root borer	Shoot Borer	Top Borer	Stalk borer*	Root borer
1	Co 11027	5.8	4.8	1.5	23.2	LS	LS	LS	MS
2	CoH 11263	5.1	3.6	1.4	27.6	LS	LS	LS	MS
3	CoLk 11204	2.1	1.8	1.7	15.8	LS	LS	LS	MS
4	CoLk 11206	6.6	2.1	1.1	20.8	LS	LS	LS	MS
5	CoPb 11214	2.6	2.9	1.3	30.6	LS	LS	LS	HS
6	CoS 11232	4.8	3.5	1.9	22.4	LS	LS	LS	MS
CK	CoS 767	5.7	1.8	0.4	22.5	LS	LS	LS	MS

	CoS 8436	15.9	3.7	1.8	29.6	MS	LS	LS	MS
	CoPant 97222	4.5	2.4	1.2	20.8	LS	LS	LS	MS

*Infestation Index

All genotypes evaluated in AVT midlate –II Plant (Table 1.6a) against shoot borer were found least susceptible except CoS 8436 and infestation ranged from 2.1 to 15.9 per cent including standard checks. Lowest incidence (2.1%) was observed in CoLk 11204 and highest (15.9%) in CoS 8436 (check). All entries tested against top borer infestation showed least susceptible reaction including standard checks. In case of stalk borer, infestation ranged from 0.4 to 1.8 infestation index and all the genotypes were categorised as least susceptible. Root borer infestation ranged from 15.8 to 30.6 per cent including standard checks in tested entries and all genotypes were categorised moderately susceptible except CoPb 11214 which were reported highly susceptible.

Table 1.6b: Reaction of sugarcane genotypes in Advanced Varietal Trial (Midlate II Plant) against major sucking pests

Sr No.	Variety/ Genotype	Sucking pests (% infestation)				Grade of infestation			
		Pyrilla	White fly	Black bug	Webbing mite	Pyrilla	White fly	Black bug	Webbing mite
1	Co 11027	1.8	1.1	2.3	9.4	LS	LS	LS	LS
2	CoH 11263	3.6	1.4	3.5	8.1	LS	LS	LS	LS
3	CoLk 11204	4.8	3.7	3.3	7.9	LS	MS	LS	LS
4	CoLk 11206	1.8	2.0	5.5	5.6	LS	LS	LS	LS
5	CoPb 11214	3.2	4.5	4.0	5.5	LS	MS	LS	LS
6	CoS 11232	4.3	4.9	4.3	3.5	LS	MS	LS	LS
CK	CoS 767	1.3	1.9	3.3	12.5	LS	LS	LS	MS
	CoS 8436	1.8	1.8	3.3	7.6	LS	LS	LS	LS
	CoPant 97222	2.3	2.4	4.0	5.6	LS	MS	LS	LS

Pyrilla population (nymph & adult)/leaf; Whitefly population (nymph & puparia) / 2.5 sq.cm; Black bug population/leaf; Webbing mite(% leaf incidence)

All genotypes tested against *Pyrilla* were found least susceptible. Lowest infestation of whitefly was observed in genotype Co 11027 (1.1 nymphs & puparia / 2.5 sq.cm) and

highest(4.9 nymphs & puparia / 2.5 sq.cm) in CoS 11232. All genotypes were categorised as least susceptible against whitefly except CoLk 11204, CoPb 11214, CoS 11232 and CoPant 97222(check). All tested genotypes were observed least susceptible against black bug. All tested genotypes were also observed least susceptible against webbing mite except CoS 767(check).

Project E.28: Survey and surveillance of sugarcane insect- pests

A roving survey of Mills zones of Cooperative sugar factories viz. Karnal, Yamuna Nagar, Shahabad, Rohtak, Assandh, Panipat, Sonipat and Jind was carried out for insect- pests of sugarcane crop. Survey of insect-pests during pre-monsoon season revealed that in Sugar Mill Zone Karnal, a low to moderate incidence of termites (4.5-12.4%) in plant crop in varieties Co 89003, Co 0238, Co 0118, Co 05011 and CoH 160 was observed in sandy soils. Low to moderate incidence of pink stem borer, *Sesamia inferens* was observed during month of March to first fortnight of April. A moderate incidence of thrips (6-11%), low to moderate incidence of early shoot borer (2.8-12.4 %) and low incidence of top borer (2-3 %) was observed in plant and ratoon crop in varieties CoJ 85, Co 89003, Co 0238, Co 0118, Co 05011, CoS 8436, CoP84212 and CoH 160. Low to moderate incidence of black bug (4-12 bugs/whorl) was observed in ratoon crop. During monsoon season in Karnal sugar mill zone, top borer incidence was observed low to moderate and stalk borer moderate incidence in Co 0238, Co 89003, Co 05011, CoS 8436, CoP 84212 and CoH 160 varieties of sugarcane. However, black bug population was recorded low to high (8-36 bugs/whorl) in plant and ratoon crop. Moderate to high incidence (10-74 % leaves infested) of webbing mite was reported in Karnal sugar mill zone during month of July. Incidence of root borer was low to moderate (8-17%) and low to moderate (1-4 grub/m²) incidence of white grub in sandy soils. During post monsoon season, low to moderate incidence of stalk borer (8.5-27.4 %), medium to high incidence of root borer (7.2-20.4%), low to high incidence of whitefly (0-14.6 nymphs & puparia/2.5 cm²), medium to high incidence of black bug (16-43 bugs/whorl), moderate to high incidence of white grub (3-7 grubs/m²), low incidence of top borer and low incidence of *Pyrilla* was observed in Co 89003, Co 0238, CoH 119, Co 05011, CoH 160, CoP 84212 Co J 85 & Co 0118 varieties. However, parasitization of *Pyrilla* was reported to be very less and only 0.5-0.8 cocoons/leaf of *Epiricania melanoleuca* (nymphal-adult parasitoid) were found. This may be due to factor that farmers might have adopted injudicious use of insecticides for control of pests in sugarcane.

Table 2: Incidence of sugarcane insect- pests in mill zones of Haryana during 2016-17

Sugar Mills Zone	Season	Varieties	Insect-pests	Per cent incidence (%)	Remarks
Karnal	Pre-monsoon	Co J 85, Co 89003, Co 0118 CoH 160,Co 0238, Co 05011, CoS 8436 & CoP 84212	Termite	4.5 -12.4	Termite damage more in sandy soils More damage during March. Infestation under drought conditions -- Infestation in ratoon crop. -
			Pink stem borer	2.0-8.0	
			Thrips	6-11	
			Shoot borer Black bug	2.8-12.4 4-12	
			Top borer	bugs/whorl 2-3	
	Monsoon	Co 0238,Co 89003,CoH160, Co05011,CoS8436, & CoP 84212	Top borer	3-8	More infestation in Co 0238 - Infestation in plant & ratoon crop. - - Grub damage more in sandy soils
			Stalk borer Black bug	12.5-22.3 8-36	
			Webbing mite	bugs/whorl 10-74% leaves infested	
			Root borer White grub	8-17 1-4 grub/m ²	
	Post monsoon	Co 89003, Co 0238,CoH 160, Co 05011, CoP 84212 Co J 85, CoH 119 & Co 0118	Stalk borer	8.5-27.4	More infestation in mismanaged fields - More infestation on water lodged fields. Grub damage more in sandy soils - - - -
Root borer			7.2-20.4		
Whitefly			0-14.6 nymphs & puparia/2.5 cm ²		
White grub			3-7 grubs/m ²		
Pyrilla			0.1-1.0 nymphs/ adults/leaf		
<i>Epiricania melanoleuca</i>			0.5-0.8 cocoon/leaf		
Black bug			16-43 bugs/whorl		
Yamuna Nagar	Monsoon	Co 89003, Co 0238& Co 05011	Top borer	2-5	- In water logged fields Infestation in plant & ratoon crop. -
			Webbing mite Whitefly	14-52 leaves infested 2-5 nymphs & puparia/2.5 cm ²	
			Black bug	12-39 bugs/whorl	
Shahbad	Monsoon	Co 89003, Co 0238 & CoH 160	Webbing mite Black bug	6-32% leaves infested 8-32 bugs/whorl	- Infestation in plant & ratoon crop. -
			Top borer	26.-12.5	

	Post-monsoon	Co 0238 & Co 89003	Stalk borer Top borer Pyrilla <i>Epiricania melanoleuca</i>	3.4-8.7 2-4 1-4 nymphs & adults/leaf 2-6 cocoons/leaf	- - -
Rohtak	Pre-monsoon	Co 89003, Co 0118, CoH 160, CoH 119 & Co 0238	Thrips Shoot borer Black bug	4-16 4.8-20.6 6-16 bugs/whorl	Infestation under drought conditions Infestation under drought conditions Infestation in ratoon crop.
Assandh	Monsoon	Co 89003, Co 0238 & CoS 88230	Webbing mite Whitefly Black bug Top borer	6.5-32 % leaves infested 1.0-2.5 nymphs & puparia/2.5 cm ² 8-27 bugs/whorl 0-8.6	- In water logged fields Infestation in ratoon crop. -
	Post monsoon	Co 89003, Co 0238 & CoS 88230	White fly Stalk borer	1-2 nymphs & puparia/2.5 cm ² 6-17	In water logged fields More in mismanaged fields
Panipat	Monsoon	Co 0238 & CoH 160	Stalk borer Top borer Root borer	2-4 2-10.2 12-20	- - -
	Post monsoon	Co 89003, Co 0238 & CoH 160	Stalk borer Top borer Pyrilla <i>Epiricania melanoleuca</i>	3.5-12.0 2-4 0-1.3 nymphs & adults/leaf 3-6 cocoons/leaf	- -
Sonipat	Post monsoon	Co 89003, Co 0238 & CoH 160	Stalk borer Top borer Black bug	3.5-12.0 2-4 2-8 nymphs & adults/whorl	- - Damage in month of February
Jind	Post monsoon	CoH 160, CoH 119, Co 89003 & Co 05011	Whitefly Pyrilla <i>Epiricania melanoleuca</i> Stalk borer	1-2 nymphs & puparia/2.5 cm ² 2-4 nymphs & adults/leaf 1-6 cocoons/leaf 4-10	-

Black bug :Nymph&adult/whorl; Thrips : infested leaves(%); Whitefly : Nymph & puparia/2.5 sq. cm.; Pyrilla : Nymphs & adults/leaf; Stalk borer: infestation (%); *Epiricania melanoleuca* : cocoons/leaf.

Survey of sugarcane in Yamuna Nagar mill zone during monsoon season revealed that moderate to high incidence of webbing mite (14-52% leaves infested), moderate to high incidence of whitefly (2-5 nymphs & puparia/ 2.5cm²), high incidence of black bug (12-39 bugs/whorl) was observed in varieties Co 0238, Co 05011 and Co 89003. During monsoon season (August) in Shahbad sugar mill zone, a low to moderate incidence of webbing mite (6-32 % leaves infested) and low to high incidence of black bug (8-32 bugs/whorl) was observed in Co 89003, Co 0238 and CoH 160. Low to moderate incidence of top borer (2.6-12.5%) in Co 0238 was observed. During post monsoon season in Shahbad zone, low to moderate incidence of stalk borer, low incidence of top borer and low to moderate incidence of pyrilla was observed. However, parasitization of *Pyrilla* was also reported and 2-6 cocoons/leaf of *Epiricania melanoleuca* (nymphal-adult parasitoid) which controlled *Pyrilla* population.

Survey of sugarcane crop in Rohtak sugar mill zones during pre- monsoon season revealed that infestation by thrips, early shoot borer and black bug was low to moderate in Co 89003, Co 0118, CoH 160, CoH 119 & Co 0238. Survey of sugar mill zone Assandh during monsoon season revealed that incidence of webbing mite was observed low to high (6.5-32 % leaves infested), low incidence of top borer (0-8.6%), low to medium incidence of whitefly (1.0-2.5 nymphs & puparia /2.5 cm²) and low to moderate incidence of black bug in varieties CoS 88230, Co 0238 and Co 89003. During post monsoon season, low to moderate incidence of stalk borer and whitefly was observed.

During monsoon season, incidence of top borer and stalk borer was reported moderate in sugar mill zone of Panipat in varieties Co 0238 & CoH 160. However, root borer infestation was moderate to high. During post monsoon season, stalk borer incidence was low to moderate, top borer incidence low and low incidence of *Pyrilla* was observed. However, population of its nymphal-adult parasitoid (3-6 cocoons/leaf) was also present in field which kept *Pyrilla* population below economic threshold. Low to moderate incidence of stalk borer, low incidence of top borer and black bug was observed in Sonipat mill zone during post monsoon season. Incidence of whitefly, stalk borer and *Pyrilla* was observed low to moderate in different villages of Jind sugar mill in varieties CoH 119, Co 89003, Co 05011 and CoH 160.

Project E. 30: Monitoring of insect pests and bio-agents in sugarcane agro-ecosystems

During the initial stage of crop establishment, pink stem borer, *Sesamia inferens* was the major pest in March planted sugarcane variety Co 0238. Damage to crop by this pest started just after germination of crop and remained up to mid April (Table 3.1). Infestation by this pest ranged

from 1.2 to 7.9 per cent during March to April, 2016. During formative phase of crop (April-June), early shoot borer, *Chilo infuscatellus* was the major pest sugarcane variety Co 0238 during pre-monsoon period (Table 3.1). The damage occurrence of shoot borer was started in first fortnight of April, its incidence being relatively low in end April (1.4 per cent). During month of May, shoot borer incidence increased to a maximum of 5.6 per cent. During month of June shoot borer incidence reached to a maximum of 7.8 per cent. The incidence of this borer species was noticed to decline subsequently and was recorded 6.8 per cent (cumulative incidence). Thereafter incidence of early shoot borer was not noticed. Top borer infestation was observed to begin in mid May with an infestation level reaching 6.3 per cent in end October. The infestation was shown to rise with the build up of second brood raising the population density to 4.7 per cent in end July. It increased (5.4%) by end August (third brood) and 6.2 per cent in last week of September (fourth brood). The infestation of this borer species in variety Co 0238 was 6.2 per cent during September when the pest reached the fifth brood. The damage of stalk borer started during month of July, its incidence being relatively low in end July (0.6 infestation index). During month of September, stalk borer incidence started increasing and reached to a maximum of 1.8 infestation index during months of February-March. The incidence of root borer was noticed during month of July (12.8 %). During August its population reached 13.6 per cent and there after population of root borer increased gradually and reached to a maximum of 24.5 per cent during month of March.

Table 3.1: Incidence of insect-pests during 2016-17 in variety Co 0238 at RRS, Uchani

Period of observation	Mean incidence (%)					Mean number		Mean leaf incidence (%)		Mean number/ 2.5 sq.cm
	Pink stem borer	Shoot borer (cumulative)	Top borer	Stalk* borer	Root borer	Black bug/ central whorl	Pyrilla / leaf	Webbing mite	Thrips	Whitefly
March, 2016	1.2	-	-							
April, 2016	7.9	1.4	-	-	-	-	-	-	-	-
May, 2016	-	5.6	2.3	-	-	1.7	-	-	2.6	-
June, 2016	-	7.8	2.9	-	-	5.4	-	0.8	4.2	-
July, 2016	-	5.2	4.7	0.6	12.8	7.2	1.1	4.8	2.1	0.3
August, 2016	-	-	5.4	0.6	13.6	9.4	1.8	5.9	-	2.6
September, 2016	-	-	6.2	0.7	15.4	7.9	2.1	5.4	-	1.5
October, 2016	-	-	6.3	0.8	17.2	5.2	2.4	2.6	-	1.9
November, 2016	-	-	-	1.0	17.8	2.3	4.4	0.4	-	0.8
December, 2016	-	-	-	1.1	19.4	0.6	1.2	0.2	-	0.4
January, 2017	-	-	-	1.5	20.2	-	-	-	-	-
February, 2017	-	-	-	1.8	23.2	-	-	-		
March, 2017	-	-	-	1.8	24.5	-	-	-		

*Infestation Index

The black bug, *Cavelerius sweeti* infestation in the crop was first recorded during May (1.7 nymph/adults per whorl). It increased during June when the crop were found to inhabit a mean of 5.4 nymphs and adults/ whorl and 9.4 nymphs and adults/whorl during month of August. The number was lowered to a mean of 2.3/ shoot in the month of November. It declined (0.6 bugs/whorl) in the subsequent month, but the pest infestation persisted in the crop till end December. Leaf hopper, *Pyrilla perpusilla* was noticed to begin in July and remained in the crop till December. It was naturally controlled by the egg and nymphal- adult parasitoids. Whitefly appeared in end July and its population was recorded 0.3 nymphs and puparia/2.5 sq. cm² and reached to a maximum of 2.6 nymphs and puparia/2.5 sq. cm² during August, 2016 and there after its population decreased and remained up to December. Similarly, webbing mite also appeared during end June with incidence (0.8 % infested leaves). It increased slowly to a mean per cent webbing leaves of 5.9 during month of August and subsequently declined to 0.2 per cent webbed leaves by December. Minor infestation by grasshoppers and thrips was also observed in this variety.

Table 3.2: Natural enemy complex of *Pyrilla perpusilla* at RRS Uchani during 2016

Period of observation	<i>Cheiloneurus pyrillae</i>	<i>Tetrastichus pyrillae</i>	<i>Epiricania melanoleuca</i>	Total parasitism
1-15 May,2016	-	-	-	-
16-31 May, 2016	-	-	-	-
1-15 June,2016	-	-	-	-
16-30 June, 2016	-	-	-	-
1-15 July, 2016	-	-	-	-
16-31 July, 2016	-	4.8	2.4	7.2
1-7 August, 2016	-	12.6	2.2	14.8
8-15August, 2016	3.6	15.2	3.4	22.2
16-23 August, 2016	8.6	16.8	2.1	27.5
24- 31August, 2016	12.2	14.2	13.5	39.9
1-7 Sept, 2016	14.9	12.6	24.2	51.7
8-15 Sept, 2016	13.7	10.8	25.1	49.6
16-23 Sept, 2016	14.2	8.6	28.5	51.3
24-30 Sept, 2016	12.1	6.4	38.1	56.6
1-7 October, 2016	2.3	0.6	44.6	50.5
8-15 Oct, 2016	-	-	47.4	47.4
16-23 Oct, 2016	-	-	50.2	50.2
24-31 Oct, 2016	-	-	48.3	48.3
1-7 November, 2016	-	-	47.6	47.6
8-15 November, 2016	-	-	15.4	15.4
16-23 Nov, 2016	-	-	6.7	6.7
24 Nov-01 Dec,2016	-	-	-	-

In pre-monsoon (May and June) duration of 2016, spiders, beetles and earwigs were the main natural enemies recorded in the experimental field. The population of spiders and coccinellids during 2016 was observed to be 1-3/ plant. The earwigs were observed feeding on eggs and young nymphs of black bug during May-June. A natural parasitism (4.6 %) of whitefly was also recorded by *Encarsia* sp. A strong natural parasitism of eggs, nymphs and adults of *Pyrilla perpusilla* from second fortnight of July to third week of November in variety Co 0238 was observed that helped contain its population in the region. The parasitism build up was first observed during second fortnight of July when the leaf hopper infested field of variety Co 0238 recorded 4.8 per cent parasitism by *Tetrastichus pyrillae*. The parasitism build up by *Epiricania melanoleuca* was also observed during second fortnight of July (2.4 per cent). The nymphal adult parasitoid, *E. melanoleuca* remained active from second fortnight July to third week of November, with a maximum parasitism of 50.2 percent recorded during third week of October. A rapid increase in *Pyrilla* parasitism was subsequently recorded during August- October. A maximum of total parasitism measuring 56.6 percent by both egg and nymphal adult parasitoids was recorded during fourth week of September (Table 3.2). *Cheiloneurus pyrillae* and *Tetrastichus pyrillae* were the dominant egg parasitoids during monsoon and post monsoon period, attaining a peak parasitic activity to the tune of 14.9 and 16.8 percent, respectively. Thereafter, consistent and gradual decline in parasitic activity of *C. pyrillae* and *T.pyrillae* was observed , while these remained up to first week of October.

Table 3.3: Natural enemy complex of sugarcane pests at RRS Uchani during 2016

Insect-pest	Stage	Natural enemies	Parasitism (%)
Top borer, <i>Scirpophaga excerptalis</i>	Egg	<i>Trichogramma chilonis</i>	2.1
Stalk borer, <i>Chilo auricilius</i>	Egg	<i>Trichogramma chilonis</i>	2.4
Top borer, <i>Scirpophaga excerptalis</i>	Larva	<i>Isotima javensis</i>	5.2
		<i>Cotesia flavipes</i>	5.6
		<i>Beauveria bassiana</i>	7.4
Stalk borer, <i>Chilo auricilius</i>	Larva	<i>Sturmiopsis inferens</i>	5.8
		<i>Cotesia flavipes</i>	6.2
		<i>Beauveria bassiana</i>	5.8
Root borer, <i>Polychola (Emmalocera) depressella</i>	Larva	<i>Beauveria bassiana</i>	4.8
Whitefly, <i>Aleurolobus</i> sp.	Nymph	<i>Encarsia</i> sp.	4.6

A natural parasitism of top borer and stalk borer eggs by egg parasitoid, *Trichogramma chilonis* was observed. Parasitism of top and stalk borer eggs by egg parasitoid was recorded 2.1 and 2.4 per cent, respectively. Parasitism by *Isotima javensis*, *Cotesia flavipes* and *Beauveria bassiana* of top borer larvae was 5.2, 5.6 and 7.4 per cent, respectively (Table 3.3). In case of

stalk borer, parasitism by *Sturmiopsis inferens*, *Cotesia flavipes* and *Beauveria bassiana* was 5.8, 6.2 and 5.8 per cent, respectively during post monsoon season. The larvae of root borer collected from field showed parasitism to the extent of 4.8 per cent by *Beauveria bassiana* during month of September. A natural parasitism (4.6%) of whitefly nymphs by *Encarsia* sp. was also observed.

Project E.34: Standardization of simple and cost effective techniques for mass multiplication of sugarcane bio-agents.

A.) *Trichogramma japonicum* for top borer (*Scirpophaga excerptalis*) and *Trichogramma chilonis* for stalk borer (*Chilo auricilius*) management:

Bio-control laboratory at CCSHAU, RRS Uchani carried out mass multiplication of egg parasitoid, *Trichogramma* sp. namely *Trichogramma chilonis* and *Trichogramma japonicum* on eggs of *Corcyra cephalonica*. *Corcyra* larvae feed was prepared from coarsely milled maize grains (Plate 1 & 2). The bio-control laboratory produced and supplied 782 *Tricho* cards to the 81 cane growers for use of *Trichogramma japonicum* for top borer (*Scirpophaga excerptalis*) and *Trichogramma chilonis* for stalk borer (*Chilo auricilius*) management (Table 4.1).

B.) *Epiricania melanoleuca* for sugarcane leaf hopper, *Pyrilla perpusilla* management:

Nymphal and adult parasitoid, *Epiricania melanoleuca* of sugarcane leaf hopper, *Pyrilla perpusilla* was also mass multiplied in laboratory and supplied to cane growers for release in sugarcane fields. The initial culture of *Pyrilla* and nymphal-adult parasitoid, *Epiricania melanoleuca* was started by collecting nymphs and adults of *Pyrilla* and cocoons of parasitoid from the sugarcane fields. The culture was initially started in glass jars (15x 20 cm) and mass multiplied in wooden cages as per technology developed and designed by Radadia *et al.* (Plate 3 & 4). The bio-control laboratory produced and supplied 418 egg masses and 4766 cocoons of nymphal and adult parasitoid, *Epiricania melanoleuca* to 59 cane growers for *pyrilla* management (Table 4.1).

Table 4.1: Production of bio-agents at RRS Uchani,Karnal (Haryana) during 2016

Month	<i>T. japonicum</i> cards produced (no.)	No. of farmers	<i>T.chilonis</i> cards produced (no.)	No. of farmers	cocoons of <i>E. melanoleuca</i> produced(no.)	No egg masses	No. of farmers
June,2016	05	01	0	0	0	0	0
July,2016	43	05	34	05	0	0	0
August,2016	73	09	167	18	0	0	0
Sept,2016	64	07	359	31	244	85	26
Oct,2016	0	0	37	05	4285	247	32
Nov,2016	0	0	0	0	237	86	11
Dec,2016	0	0	0	0	0	0	0
Total	185	22	597	59	4766	418	59



Plate 1



Plate 2



Plate 3



Plate 4

Project E.36 : Management of borer complex of sugarcane through lures

To evaluate the management of borer complex of sugarcane (shoot, top and stalk borer) through pheromone trap, a field experiment was conducted in 0.4 ha. of sugarcane field of variety CoH 160. Crop was planted on March 16, 2016 and completed germination second week of April. Three pheromone traps for each pest (shoot, top and stalk borer) were installed in 0.4 ha. on 10th of April, 2016 and another 0.4 ha. field was taken as control plot without traps. Moths trapped were recorded at weekly interval. Pheromone lures were changed at monthly intervals. The present investigations revealed that first shoot borer, *C. infuscatellus* moth capture (2.5 moths/trap) was recorded in 15th SMW (Table 5.1). The number of captures increased speedily up to 23th SMW reaching 9.6 moths/ trap. Thereafter, moth capture decreased gradually during the next six weeks and no moths of shoot borer were trapped after 29th SMW, 2016. Infestation by shoot borer ranged from 1.8 to 2.2 per cent in trap installed field as compared to 2.1 to 6.8 per cent in without trap installed field (Table 5.3).

Top borer, *S. excerptalis* moths were trapped during 19th SMW,2016 onwards. The first top borer moth catches were observed during 19th SMW,2016 where an average of 1.2 moths/trap were trapped(Table 5.1). Thereafter, captures increased gradually and reached to a maximum of 7.1 moths/trap during 29th SMW. Thereafter, a gradual decrease was observed up to 36th SMW where moth trapping was observed 0.7 moths/trap. After 36th SMW no top borer adult moth was trapped. Infestation by top borer ranged from 1.2 to 3.5 per cent in trap installed field as compared to 1.6 to 6.6 per cent in without trap installed field (Table 5.3).

The activity of stalk borer, *C. auricilius* fluctuated widely between mid July (28th SMW,2016) to first week of January (1st SMW,2017). First trapping of stalk borer was observed during 28th SMW with an average trapping of 1.6 moths/trap(Table 5.1). Thereafter, captures increased gradually and reached to a maximum of 9.8 moths/trap during 37th SMW. Thereafter, a gradual decrease was observed up to 1st SMW,2017 where moth trapping was observed 0.6 moths/trap. After first SMW,2017 no stalk borer adult moth was trapped. Infestation by stalk borer ranged from 0.2 to 1.1 infestation index in trap installed field as compared to 0.6 to 2.8 infestation index in without trap installed field (Table 5.3).

Table 5.1. Weekly pheromone traps catches from April,2016 to January, 2017 at Uchani, Karnal (Haryana)

Standard week	Month	Mean no. of moths/ trap			Average Temperature (°C)		Average Relative Humidity (%)		Total Rainfall (mm)
		ESB	Top borer	Stalk borer	Max.	Min.	Morning	Evening	
14	3-9 April	-	-	-	36.3	19.2	68.4	23.7	00.0
15	10-16	2.5	-	-	35.8	16.8	55.9	15.4	00.0
16	17-23	2.2	-	-	39.4	20.8	53.9	16.4	00.0
17	24-30	2.6	-	-	38.4	17.4	39.7	08.0	00.0
18	1-7 May	5.2	-	-	38.8	22.3	48.1	27.3	00.0
19	8-14	5.8	1.2	-	37.1	23.7	66.9	35.0	24.2
20	15-21	5.4	1.8	-	41.6	24.9	52.3	27.4	00.0
21	22-28	6.2	1.6	-	37.8	24.2	64.1	34.4	10.4
22	29-4 June	7.1	2.6	-	38.6	25.4	63.1	33.5	00.0
23	05-11	9.6	2.9	-	39.9	26.0	70.3	32.3	00.0
24	12-18	6.4	3.8	-	38.2	26.0	66.3	38.3	14.5
25	19-25	5.6	5.2	-	36.3	26.8	73.9	56.0	05.9
26	25-2July	3.1	4.9	-	37.1	27.4	82.1	56.3	19.4
27	3-9	0.4	6.2	-	33.8	25.7	89.4	70.6	85.6
28	10-16	0.0	6.8	1.6	34.4	27.7	83.9	68.9	12.0
29	17-23	0.6	7.1	2.1	32.0	26.3	89.9	73.4	10.6
30	24-30	0.0	3.6	2.4	34.0	26.4	87.9	71.6	14.2
31	31-6 August	-	3.8	2.8	32.6	26.1	86.1	71.9	00.0
32	7-13	-	2.9	3.2	31.4	25.4	95.3	85.7	126.4
33	14-20	-	0.0	4.1	32.4	25.4	90.4	70.4	73.6
34	21-27	-	2.2	4.6	33.1	25.5	87.4	70.1	63.7
35	28-3 Sept	-	0.0	3.8	32.8	24.9	88.2	70.4	28.2
36	04-10	-	0.7	8.4	31.7	24.5	92.1	70.7	19.8
37	11-17	-	-	9.8	33.3	24.5	86.3	64.7	01.8
38	18-24	-	-	7.8	34.3	24.3	88.7	56.3	00.0
39	25-1 Oct	-	-	6.7	33.3	23.0	89.1	60.0	00.0
40	2-8	-	-	6.4	34.4	24.2	92.3	62.4	00.0
41	9-15	-	-	5.4	33.8	18.2	84.3	38.4	00.0

42	16-22	-	-	5.8	33.4	15.4	83.4	29.7	00.0
43	23-29	-	-	4.2	32.2	14.8	87.6	34.7	00.0
44	30-5 Nov	-	-	4.7	29.8	12.3	94.7	35.7	00.0
45	6-12	-	-	5.2	29.3	11.6	91.3	41.3	00.0
46	13-19	-	-	3.6	27.6	09.5	87.6	31.7	00.0
47	20-26	-	-	3.1	28.8	11.4	73.9	27.4	00.0
48	27-03 Dec	-	-	1.8	24.4	09.2	98.0	57.4	00.0
49	4-10	-	-	0.0	21.2	09.9	100.0	70.6	00.0
50	11-17	-	-	0.8	22.0	07.3	95.6	49.0	00.0
51	18-24	-	-	0.0	21.5	06.5	93.0	55.4	00.0
52	25-31	-	-	0.0	22.2	08.3	99.1	62.7	08.0
1	1-7 Jan			0.6	16.2	03.4	99.6	61.3	19.0
2	8-15			0.0	17.5	05.0	98.7	63.3	03.6

Table 5.2: Correlation analysis between moth catches and weather parameters at Uchani, Karnal (Haryana) during 2016-17

Correlation coefficient	Early shoot borer	Top borer	Stalk borer
Maximum temperature	0.62	0.47	0.32
Minimum temperature	0.39	0.32	0.28
Relative humidity (%) Morning	-0.74	0.24	0.18
Relative humidity (%) Evening	-0.42	0.18	0.16
Rainfall	-0.23	-0.27	-0.21

Table 5.3. Observations on borers infestation from pheromone trap and control plot during 2016-17

Period observation	Shoot borer		Top borer		Stalk borer	
	% infestation		% infestation		infestation index	
	With pheromone trap	Without pheromone trap	With pheromone trap	Without pheromone trap	With pheromone trap	Without pheromone trap
April,2016	1.8	2.1	-	-	-	-
May, 2016	2.0	2.5	1.2	1.6	-	-
June, 2016	2.1	6.8	3.2	3.8	-	-
July, 2016	2.2	6.8	3.1	4.8	-	-
August, 2016	-	-	3.4	5.2	0.2	0.6
September, 2016	-	-	3.5	5.8	0.4	0.9
October, 2016	-	-	3.4	6.6	0.4	0.8
November, 2016	-	-	-	-	1.1	1.4
December, 2016	-	-	-	-	1.0	2.3
January,2017	-	-	-	-	1.1	2.7
February, 2017	-	-	-	-	1.1	2.8