ALL INDIA CO-ORDINATED RESEARCH PROJECT

ON

SUGARCANE

ANNUAL REPORT (2013-14)

PUNJAB AGRICULTURAL UNIVERSITY

REGIONAL RESEARCH STATION

KAPURTHALA -144 601 (Punjab)

INTRODUCTION

Sugarcane research and development programme was shifted to PAU, Regional Research Station, Kapurthala during 2013-14 from PAU, Seed Farm, Ladhowal (Ludhiana). The present location of the Sugarcane Research farm is accessible to a majority of the sugar mills of the state, being almost in the heart of the sugarcane belt. It is almost 25 km from the previous centre at Jalandhar and about 100 km from the headquarter i.e. PAU, Ludhiana. The AICRP on Sugarcane and state programs of different disciplines are now being implemented at Kapurthala centre.

The facilities for laboratory analysis of sugarcane juice and fiber and a sugarcane pathology lab have been set up. A juice extraction and jaggery manufacture complex have also been established.

The sugarcane research team has been strengthened with adequate scientific and field staff pertaining to all disciplines. Additionally, the post of biochemist is likely to be filled up soon. The soil at PAU, RRS Kapurthala farm is loamy, medium in organic carbon, very high in available P and K.

The research trials were conducted as per the technical programs and monitored by the team constituted by the Project Coordinator, AICRP(S), Lucknow, during 2013-14. The results of various trials of Crop Improvement, Agronomy, Plant Pathology and Entomology disciplines are detailed in this report.

Crop Improvement

There were eight IVT and AVT trials of early and mid-late maturity groups. The fluff supply program too was followed, crosses made and selection in different settling stages given after discussing the various trials.

1. Initial Varietal Trial Early (IVT-E)

Three test clones and two standards were evaluated in this trial for different cane yield and quality traits and data generated is appended in (Table 1). None of test clones surpassed the high yielding standard CoPant 84211 (79.85t/ha) for cane yield. However, two clones viz, Co10035 and CoH10261 were at par with standards for commercial cane sugar (CCS t/ha) having 8.76 and 8.60 CCS (t/ha), respectively. Clone CoH 10261 has highest 18.26 %

sucrose (10 m) followed by CoJ 64 having 17.33% sucrose. Similarly, CCS (%) was highest for CoH 10261 (12.93%) that was comparable to standard CoJ 64 (12.17%). The other cane characters of this clone were stalk length (2.31m), cane diameter (1.98cm) and single cane weight (0.98kg).

2. Advanced Varietal Trial Early I Plant (AVT-E I Plant)

In this trial, five test clones along with two standards were evaluated at RRS Kapurthala for cane yield and quality traits (Table 2). Three clones were found significantly superior for cane yield over standards. The clone CoPb 09181 ranked 1st for cane yield (103.52 t/ha) closely followed by CoLk 09202 (96.67 t/ha) and CoH 09262 (94.45 t/ha). CCS (t/ha) among test clones ranged from 8.04 (t/ha) to 10.92 (t/ha) and CoPb 09181 (10.92 t/ha) was the highest followed by CoH 09262 (9.88 t/ha). This genotype has sucrose 15.30 % (10 months) followed by CoH 09262 (15.07 %) that are comparable to standards CoPant 84211 (15.62 %). For CCS % (10 m) CoPb 09181 (10.59 %) ranked 3rd after both the standards and closely followed by CoH 09262 (10.47 %) and CoH 09263 (10.26 %). The clone CoPb 09181 had highest stalk length (2.71m), cane diameter (2.73cm) and single cane wt. (1.26kg).

3. Advanced Varietal Trial Early II Plant (AVT-E II Plant)

Among the clones and standards tested in this trail, CoPb 08212 ranked at 1st position for CCS t/ha (12.84), cane yield (101.26 t/ha) and 2nd for sucrose 10 months (17.98 %) and CCS 10 months (12.67 %) followed by CoPb 08211 having CCS t/ha (12.28), cane yield (95.0 t/ha). However it ranked 1st for sucrose 10 month (18.46 %) and CCS 10 month (12.93 %). Both these clones have higher stalk length, stalk diameter, single cane weight and NMC (Table3).

4. Advanced Varietal Trial Early Ratoon

In Advanced varietal trial early ratoon trial clone CoS 08233 had the highest CCS (8.41 t/ha), cane yield (96.34 t/ha), sucrose (17.30 %), NMC 9 months (‘000/ha) 97.89 which was at par with other two test clones CoPb 08212 and CoPb 08211 having corresponding values CCS (8.33, 7.56 t/ha), cane yield (68.97, 62.18 t/ha), sucrose (17.20, 17.22 %), CCS (12.09,

12.17 %) and NMC (‘000/ha) 9 months (92.01, 82.87), respectively (Table 4). All the test clones were statistically superior to standards for above mentioned traits.

5. Initial Varietal Trial Mid-Late (IVT-M/L)

Ten test clones along with three standards were evaluated for cane yield and quality attributes in this trial during 2013-14. Among the test clones CoPb 10183 ranked 1st for cane yield (114.81 t/ha) and CCS (12.34 t/ha). Other promising clones for cane yield were CoPb 10181 (102.68 t/ha), CoH 1262 (100.96 t/ha) and CCS t/ha CoH 10262 (10.68 t/ha) and CoH 10263 (10.21 t/ha) followed by CoPb 10181 (9.52 t/ha). For quality traits like CCS % (12 m) the top three genotypes were CoPb 10211 (12.18 %), Co 11039 (12.17 %) and CoH 10263 (12.03 %). However, for sucrose % (12 m) the promising clones were Co 10039 (17.43 %), CoPb 10211 (17.35 %) and CoH 10263 (17.07 %). All these clones were significantly superior to standards for cane yield attributes like stalk length, stalk diameter, single cane weight and NMC 12 months (Table 5).

6. Advanced Varietal Trial Mid-Late I Plant (AVT-M/L I Plant)

This Trial consisted of five test clones and three standards evaluated for cane yield, its attributes and quality parameters. Data appended in Table 6 showed that the top three clones for cane yield and CCS (t/ha) were Co 09022 (131.73 t/ha, 13.60 t/ha), CoH 09264 (126.57 t/ha, 12.47 t/ha) and CoPb 09214 (110.65 t/ha, 11.54 t/ha). For sucrose % (12 m) promising clones were CoS 09232 (15.33 %), CoPb 09214 (15.07 %) and Co 09022 (15.05%) closely followed CoH 09264 (14.48%). Similarly, for CCS % (12 m) CoS 09232 (10.52 %), CoPb 09214 (10.47 %) and Co 09022 (12.41 %) were the high scoring clones that were statistically at par with standards. All these clones have other desirable attributes like stalk length, stalk diameter, single cane weight and NMC 12 months.

7. Advanced Varietal Trial Mid-Late II Plant (AVT-M/L II Plant)

In Advanced varietal trial mid-late II Plant, nine clones including six test and three standards were assessed for quality and cane yield attributes during 2013-14. All the clones

were significantly superior for cane yield and CCS t/ha. The promising three clones for cane yield were CoPb 08217 (118.0 t/ha), CoS 08234 (117.24 t/ha) and CoH 08263 (110.74 t/ha) closely followed by CoH 08264 (108.54 t/ha). However for CCS (t/ha) the promising clones were CoPb 08217 (13.58 t/ha), CoH 08263 (12.29 t/ha), CoH 08264 (12.12 t/ha) and CoS 08234 (11.75 t/ha). For quality traits like sucrose % (12 m) and CCS % (12 m) the standard CoPant 97222 scored the highest followed by CoPb 08217, CoH 08264 and CoH 08263 scoring these traits to the tune of 16.89 & 11.91, 16.63 & 11.51, 16.11 & 11.17 and 16.04 & 12.12 per cent, respectively (Table 7). All the test clones were comparable to standards for other cane yield attributes like NMC (‘000/ha), stalk length, stalk diameter and single cane weight. The Pol % cane ranged from 11.50 to 13.19 %.

8. Advanced Varietal Trial Mid-Late Ratoon (AVT-M/L Ratoon)

Advanced varietal trial mid-late -ratoon conducted with six test clones and three standards showed that cane yield among clones ranged from 57.59 t/ha to 72.66 t/ha. The promising clones for cane yield were CoH 08262 (72.66 t/ha) followed by CoPb 08217 (70.18 t/ha), CoS 08234 (68.03 t/ha) and CoH 08264 (67.48 t/ha). For CCS t/ha the superior clones found were CoPb 08217 (8.02 t/ha), CoH 08264 (7.77 t/ha), CoH 08262 (7.29 t/ha) and CoS 08232 (7.27 t/ha). The top two test clones in terms of sucrose % and CCS % were CoH 08264 (16.63, 11.51) and CoPb 08217 (16.50, 11.43) that were superior to high scoring standard CoS 8436 (15.60, 10.81), respectively (Table 8).

Project B.IV Fluff Supply Program

Selections in ratooned seedlings as USF Ladhowal have been made and 2387 clones advanced to clonal stage I, on visual basis and HR Brix. One hundred and eighty nine clones have been advanced to clonal stage II and 18 to PYT. Seven clones have been advanced to early maturity group and 18 to mid-late group in state trials and are under multilocation testing.

During 2013-14 the fluff received was stored since the process of shifting was going on. The fluff has been sown and seedling nursery would be transplanted soon.

Table1 Initial Varietal Trial Early (IVT-E) 2013-14, North West Zone, Kapurthala centre

S.No.	Clone	CCS (t/ha)	Cane yield (t/ha)	Brix % (10 m)	Sucrose % (10 m)	Purity % (10 m)	CCS % (10 m)	Extraction % (10 m)	NMC at (10 m) ('000/ha)	Stalk Length (m)
1	**Co 10035**	8.76	75.82	17.67	16.32	92.92	11.54	60.29	86.55	2.31
2	**CoH 10261**	8.60	66.31	19.58	18.26	92.91	12.93	64.98	57.88	1.84
3	**CoS 10231**	6.15	55.92	18.27	16.00	87.60	11.02	61.59	58.38	2.06
Stds										
1	**CoJ 64**	8.54	70.17	18.97	17.33	91.38	12.17	60.74	85.28	2.00
2	**CoPant 84211**	8.95	79.85	18.34	16.22	88.45	11.22	59.06	93.88	1.93
	CD	0.25	2.33	0.72	0.68	1.73	0.52	2.37	10.88	NS
	CV	17.08	14.39	2.55	2.64	1.25	2.89	11.01	9.25	10.9

S.No.	Clone	Stalk diameter (cm)	Single cane weight (kg)	Brix % (8 m)	Sucsose % (8 m)	Purity % (8 m)	CCS % (8 m)	No. of Shoots ('000/ha) 240 days	No. of Tillers ('000/ha) 120 days	Germination % (45 days)
1	**Co 10035**	1.98	0.89	17.31	16.26	90.67	11.38	95.21	99.53	41.60
2	**CoH 10261**	2.64	1.15	18.00	16.76	91.00	11.75	63.66	66.56	40.90
3	**CoS 10231**	2.28	0.96	17.03	15.33	90.65	10.72	64.21	67.13	41.73
Stds										
1	**CoJ 64**	2.18	0.82	18.69	17.09	91.88	12.03	95.18	99.50	47.18
2	**CoPant 84211**	2.09	0.84	15.12	12.40	81.87	8.25	103.26	107.96	49.65
	CD	0.28	0.18	0.52	0.44	1.61	0.37	14.99	15.67	3.59
	CV	8.42	18.79	2.01	1.86	1.17	2.26	11.54	11.54	5.27

Table2 Advanced Varietal Trial -Early I Plant (AVT-E I plant) North West Zone – PAU, RRS, Kapurthala centre

S.No.	Clone	CCS (t/ha)	Cane yield (t/ha)	Brix % (10 m)	Sucrose % (10 m)	Purity % (10 m)	CCS % (10 m)	Extraction % (10 m)	NMC at (10 m) ('000/ha)	Stalk Length (m)
1	**CoH 09262**	9.88	94.45	16.89	15.07	89.22	10.47	51.23	97.65	2.59
2	**CoH 09263**	9.35	91.48	16.49	14.75	89.46	10.26	48.82	101.48	2.39
3	**CoIk 09202**	9.36	96.67	16.29	14.14	86.57	9.68	45.96	103.87	2.50
4	**CoPb 09181**	10.92	103.52	17.29	15.30	88.32	10.59	53.21	82.22	2.71
5	**CoH 09246**	8.28	83.33	17.59	14.67	83.27	9.86	56.26	97.41	2.30
Stds										
6	**CoJ 64**	8.04	67.22	18.73	17.04	91.01	11.95	49.43	102.04	2.33
7	**CoPant 84211**	9.07	83.89	17.61	15.62	88.86	10.83	52.93	129.75	2.38
	CD	1.94	11.20	1.41	NS	4.13	0.05	3.36	8.20	0.10
	CV	13.01	9.94	4.6	6.55	2.64	7.63	3.7	17.36	7.48

S.No.	Clone	Stalk diameter (cm)	Single cane weight (kg)	Brix % (8 m)	Sucsose % (8 m)	Purity % (8 m)	CCS % (8 m)	No. of Shoots ('000/ha) 240 days	No. of Tillers ('000/ha) 120 days	Germination % (45 days)
1	**CoH 9262**	2.37	0.99	16.42	14.41	88.43	9.97	119.60	122.92	44.20
2	**CoH 9263**	2.62	0.92	15.63	13.76	88.07	9.50	113.00	116.14	46.83
3	**Colk 9202**	2.47	0.94	15.03	12.56	83.53	8.45	105.20	108.12	44.97
4	**CoPb 09181**	2.73	1.26	14.47	12.49	86.16	8.53	118.80	122.10	47.00
5	**CoH 9246**	2.47	0.86	16.97	14.02	82.60	8.40	133.60	137.31	45.37
Stds										
6	**CoJ 64**	2.47	0.66	18.77	16.91	90.10	11.80	110.20	113.26	44.10
7	**CoPant 84211**	2.10	0.65	15.60	13.47	87.20	9.25	150.20	154.37	44.93
	CD	0.06	0.18	1.07	0.95	2.76	0.70	5.60	10.20	NS
	CV	8.58	11.53	3.75	3.83	1.78	4.06	18.26	18.22	6.95

Table3 Advanced Varietal Trial -Early II Plant (AVT-E II plant) 2013-14, North West Zone, Kapurthala centre

S.No.	Clone	CCS (t/ha)	Cane yield (t/ha)	Brix % (10 m)	Sucrose % (10 m)	Purity % (10 m)	CCS % (10 m)	Extraction % (10 m)	NMC at (10 m) ('000/ha)	Stalk Length (m)
1	**CoPb 08211**	12.28	95.00	20.21	18.43	91.16	12.93	51.27	87.61	2.09
2	**CoPb 08212**	12.84	101.26	19.43	17.98	92.11	12.67	52.04	103.14	2.07
3	**COS 08233**	10.20	82.09	19.54	17.76	90.45	12.42	51.23	78.37	1.98
Stds										
4	**CoJ 64**	10.54	84.91	19.10	17.62	92.27	12.43	52.22	92.19	1.94
5	**CoPant 84211**	10.80	93.17	18.46	16.63	90.06	11.61	51.77	93.64	2.04
	CD	1.53	11.88	0.58	0.80	NS	0.86	0.12	10.05	0.08
	CV	8.55	8.45	1.95	2.98	1.77	3.63	5.76	7.17	9.65

S.No.	Clone	Stalk diameter (cm)	Single cane weight (kg)	Brix % (8 m)	Sucsose % (8 m)	Purity % (8 m)	CCS % (8 m)	No. of Shoots ('000/ha) 240 days	No. of Tillers ('000/ha) 120 days	Germination % (45 days)
1	**CoPb 08211**	1.68	1.09	19.19	17.27	90.49	12.07	96.37	100.75	40.99
2	**CoPb 08212**	1.65	0.98	18.47	16.60	89.00	11.52	113.45	118.61	42.53
3	**COS 08233**	1.86	1.04	18.21	16.48	90.45	11.52	86.20	90.12	45.28
Stds										
4	**CoJ 64**	1.60	0.92	18.33	17.27	90.27	12.07	101.41	106.02	43.57
5	**CoPant 84211**	1.53	1.00	17.59	15.59	88.50	10.79	103.00	107.68	40.49
	CD	NS	0.03	1.85	0.02	NS	0.01	11.06	11.56	4.39
	CV	11.45	7.80	4.63	5.98	1.77	6.72	7.17	7.17	4.36

Table 4 Advanced Varietal Trial (Early) Ratoon 2013-14, North West Zone, Kaputhala/Ludhiana

S. No.	Clone	CCS (t/ha)	Cane yield t/ha	Brix (%)	Sucrose (%)	Purity (%)	CCS (%)	Ext. (%)	NMC at 9 m ('000/ha)	Stalk Length (m)	Stalk Diameter (cm)	Single cane weight (kg)	No. of shoots ('000/ha) 180 days	No. of tillers ('000/ha) 90 days
1	**CoPb 08211**	7.56	62.18	18.60	17.22	92.58	12.17	44.30	82.87	2.02	2.30	0.76	112	112
2	**CoPb 08212**	8.33	68.97	18.8	17.20	91.48	12.09	45.31	92.01	2.12	2.24	0. 75	121	132
3	**CoS 08233**	8.41	69.34	19.00	17.30	91.05	12.13	43.59	97.89	2.66	2.02	0.72	132	152
Stds														
1	**CoJ 64**	7.02	59.02	19.23	17.14	89.34	11.92	48.77	82.78	2.07	2.28	0.68	114	126
2	**CoPant 84211**	6.78	60.12	18.60	16.36	87.95	11.29	41.24	84..78	2.23	2.16	0.70	133	141
	CD	1.12	6.58	NS	NS	0.43	0.37	3.75	8.67	0.12	NS	0.07	10.4	13.4
	CV%	9.44	9.02	2.52	2.64	0.35	2.03	5.45	10.21	4.35	3.12	4.25	9.45	8.90

Table 5 Initial Varietal Trial Midlate (IVT-ML) 2013-14, North West Zone, Kapurthala centre

S.No.	Clone	CCS (t/ha)	Cane yield (t/ha)	Brix % (12 m)	Sucrose % (12 m)	Purity % (12 m)	CCS % (12 m)	Extraction % (12 m)	NMC at (12 m) ('000/ha)	Stalk Length (m)
1	**Co 10036**	7.64	71.31	17.26	15.41	89.31	10.71	51.29	80.84	2.76
2	**Co 10037**	8.00	70.76	17.88	16.12	90.17	11.26	52.68	85.03	2.03
3	**Co 10039**	9.25	76.39	19.21	17.43	90.19	12.17	50.59	78.92	2.04
4	**CoH 10262**	10.68	100.96	17.50	15.56	88.82	10.79	53.41	95.31	2.20
5	**CoH 10263**	10.21	84.66	18.41	17.07	92.16	12.03	51.26	77.44	2.55
6	**Co pant 10221**	9.20	87.38	17.91	15.41	86.03	10.52	49.08	87.03	2.11
7	**CoPb 10181**	9.54	102.68	15.53	13.55	87.37	9.32	52.20	99.08	2.40
8	**CoPb 10182**	9.24	88.27	17.45	15.38	88.10	10.63	54.52	83.49	2.28
9	**CoPb 10183**	12.34	114.81	17.77	15.87	84.74	10.74	49.28	102.94	2.50
10	**CoPb 10211**	8.85	72.70	19.01	17.35	91.24	12.18	51.98	85.99	1.56
Stds										
11	**CoS 767**	7.75	80.35	16.70	14.47	85.28	9.70	54.14	87.01	2.43
12	**CoS 8436**	9.99	84.42	18.69	16.91	90.52	11.83	52.03	80.25	1.79
13	**CoPant 97222**	8.31	75.09	18.04	16.01	88.75	11.10	49.12	87.35	2.27
	CD	1.50	1.65	1.02	1.21	3.06	0.94	1.70	12.72	0.31
	CV	19.32	20.50	3.43	4.53	2.05	5.10	4.22	8.68	19.46

Table 5 (contd.) Initial Varietal Trial Midlate (IVT-ML) 2013-14, North West Zone, Kapurthala centre

S.No.	Clone	Stalk diameter (cm)	Single cane weight (kg)	Brix % (10 m)	Sucsose % (10 m)	Purity % (10 m)	CCS % (10 m)	No. of Shoots ('000/ha) 240 days	No. of Tillers ('000/ha) 120 days	Germination % 45 Days
1	**Co 10036**	2.08	0.88	15.40	12.92	86.07	8.83	88.92	92.96	39.53
2	**Co 10037**	2.25	0.83	15.83	13.91	88.27	9.12	93.53	97.78	40.00
3	**Co 10039**	2.35	0.97	17.83	15.95	88.77	11.06	86.82	90.76	41.27
4	**CoH 10262**	2.30	1.06	16.20	15.11	89.43	10.56	104.84	109.61	41.50
5	**CoH 10263**	2.27	1.12	15.80	14.63	91.17	10.27	85.18	89.06	42.13
6	**CoPant 10221**	2.48	1.00	16.50	14.39	87.23	9.89	95.73	100.08	38.73
7	**CoPb 10181**	2.38	1.04	15.23	13.42	87.63	9.52	108.99	113.95	42.80
8	**CoPb 10182**	2.23	1.05	16.73	14.54	86.77	9.97	91.84	96.02	41.03
9	**CoPb 10183**	2.32	1.13	16.50	13.75	83.30	9.23	113.23	118.38	40.73
10	**CoPb 10211**	2.43	0.85	17.53	16.05	89.63	11.17	94.59	98.89	42.80
Stds										
11	**CoS 767**	2.25	0.92	16.63	14.21	82.33	9.32	95.71	100.07	40.83
12	**CoS 8436**	2.60	1.05	17.67	15.65	88.47	10.83	88.28	92.29	44.40
13	**CoPant 97222**	2.13	0.86	15.97	13.91	87.00	9.55	96.09	100.46	49.87
	CD	0.17	0.05	1.28	1.54	3.14	1.17	14.00	14.63	2.44
	CV	10.20	20.14	2.62	6.28	2.12	6.90	8.68	8.67	3.45

Table 6 Advanced Varietal Trial – Midlate I Plant (AVT-ML I Plant) 2013-14, North West Zone, Kapurthala centre

S.No.	Clone	CCS (t/ha)	Cane yield (t/ha)	Brix % (12 m)	Sucrose % (12 m)	Purity % (12 m)	CCS % (12 m)	Extraction % (12 m)	NMC at (12 m) ('000/ha)	Stalk Length (m)
1	**Co 09022**	13.60	131.73	17.05	15.05	88.26	10.41	48.36	98.99	2.23
2	**CoH 09264**	12.47	126.57	16.93	14.48	85.53	9.86	52.07	98.16	2.63
3	**CoLk 09204**	8.85	105.36	15.23	12.58	82.30	8.39	53.24	94.61	2.28
4	**CoPb 09214**	11.54	110.65	16.87	15.07	89.27	10.47	49.13	110.39	2.54
5	**CoS 09232**	11.08	105.14	17.61	15.33	89.27	10.52	56.65	97.25	2.42
Stds										
6	**CoS 767**	10.49	100.79	17.22	15.11	87.38	10.39	46.72	107.37	2.30
7	**CoS 8436**	9.67	89.00	17.43	15.61	89.54	10.86	56.58	96.07	1.82
8	**CoPant 97222**	10.15	87.44	18.12	16.60	91.58	11.67	57.05	98.94	2.10
	CD	1.02	3.60	1.09	1.20	2.11	0.91	4.37	3.50	0.44
	CV	7.28	17.19	3.67	4.62	1.39	5.13	4.76	12.96	11.16

S.No.	Clone	Stalk diameter (cm)	Single cane weight (kg)	Brix % (10 m)	Sucsose % (10 m)	Purity % (10 m)	CCS % (10 m)	No. of Shoots ('000/ha) 240 days	No. of Tillers ('000/ha) 120 days	Germination % 45 Days
1	**Co 09022**	2.55	1.32	14.03	13.10	87.93	9.14	107.34	119.27	42.10
2	**CoH 09264**	2.25	1.29	15.17	12.13	81.00	8.02	131.74	146.38	42.43
3	**CoLk 09204**	2.20	1.12	14.32	11.75	82.00	7.83	126.07	134.08	40.30
4	**CoPb 09214**	2.08	1.01	16.17	14.81	87.83	10.22	141.39	157.10	43.23
5	**CoS 09232**	2.42	1.08	15.96	13.92	85.90	9.49	123.53	137.25	43.33
Stds										
6	**CoS 767**	2.18	0.95	16.91	14.75	87.40	10.14	116.42	129.36	39.83
7	**CoS 8436**	2.30	0.93	16.39	14.76	88.77	10.23	115.22	128.02	39.73
8	**CoPant 97222**	2.30	0.88	15.67	13.84	88.93	9.60	107.29	119.21	38.73
	CD	0.08	0.18	1.13	1.03	2.40	0.77	8.25	9.20	1.48
	CV	11.80	9.43	4.15	4.35	1.59	4.71	20.40	20.46	6.11

Table 7 Advanced Varietal Trial – Midlate II Plant (AVT-ML II Plant) 2013-14, North West Zone, Kapurthala centre

S.No.	Clone	CCS (t/ha)	Cane yield (t/ha)	Brix % (12 m)	Sucrose % (12 m)	Purity % (12 m)	CCS % (12 m)	Pol % Cane (12 m)	Extraction % (12 m)	NMC at (12 m) ('000/ha)
1	**CoH 08262**	10.93	105.31	16.58	14.92	89.56	10.39	11.58	56.37	86.18
2	**CoH 08263**	12.29	110.74	18.06	16.04	88.80	11.12	12.23	59.96	81.18
3	**CoH 08264**	12.12	108.52	18.15	16.11	88.78	11.17	12.42	57.55	81.50
4	**CoPb 08217**	13.58	118.00	18.81	16.63	88.41	11.51	13.19	62.31	91.20
5	**CoS 08234**	11.75	117.24	17.49	14.82	84.73	10.04	11.60	59.23	94.47
6	**CoS 08235**	11.13	103.03	17.46	15.60	89.35	10.84	11.91	56.09	85.71
Stds										
7	**CoS 767**	7.89	77.93	17.34	14.82	85.44	10.08	11.50	56.32	84.39
8	**CoS 8436**	10.00	93.93	17.38	15.42	88.98	10.70	11.64	56.54	82.14
9	**CoPant 97222**	9.00	75.74	18.33	16.89	92.10	11.91	11.92	50.10	82.50
	CD	2.22	14.98	0.99	1.18	2.71	0.94		2.10	6.30
	CV	11.74	12.56	3.25	4.37	1.77	5.03		8.50	7.45

S.No.	Clone	Stalk Length (m)	Stalk diameter (cm)	Single cane weight (kg)	Brix % (10 m)	Sucsose % (10 m)	Purity % (10 m)	CCS % (10 m)	No. of Shoots ('000/ha) 240 days	No. of Tillers ('000/ha) 120 days	Germination % 45 Days
1	**CoH 08262**	1.92	2.62	1.08	15.38	13.26	87.84	9.14	104.80	108.71	42.49
2	**CoH 08263**	1.99	2.55	1.17	15.40	12.99	84.30	8.78	101.46	105.25	40.87
3	**CoH 08264**	2.42	2.70	1.20	17.31	14.84	85.72	10.11	97.91	101.57	43.23
4	**CoPb 08217**	1.97	2.63	1.14	16.41	14.20	85.97	9.69	110.98	115.13	49.40
5	**CoS 08234**	2.43	2.53	1.13	16.06	13.80	82.88	9.41	110.97	115.12	55.17
6	**CoS 08235**	2.04	2.37	1.01	15.40	13.16	85.31	8.95	109.02	113.10	51.83
Stds											
7	**CoS 767**	2.04	2.03	0.78	16.64	14.26	83.71	9.72	107.01	111.01	52.19
8	**CoS 8436**	1.78	2.02	0.98	16.27	13.65	83.79	9.20	103.45	107.31	53.73
9	**CoPant 97222**	1.82	2.03	0.77	16.21	14.41	88.91	9.99	104.62	108.54	54.21
	CD	0.40	0.47	0.24	0.45	0.20	NS	0.80	5.99	3.50	4.18
	CV	11.40	11.61	13.58	5.81	7.02	2.18	7.75	3.30	3.75	4.91

Table 8 Advanced Varietal Trial (Mid late) Ratoon 2013-2014, North West Zone, Location–Kapurthala/Ludhiana

S. No.	Clone	CCS (t/ha)	Cane yield t/ha	Brix (%)	Sucr. (%)	Purity (%)	CCS (%)	Ext. (%)	NMC at 11 m ('000/ha)	Stalk Length (m)	Stalk Diameter (cm)	Single cane weight (kg)	No. of shoots ('000/ha) 240 days	No. of tillers ('000/ha) 120 days
1	CoH 08262	7.39	72.66	16.70	14.80	88.62	10.74	46.01	85.97	2.17	2.64	0.870	127	132
2	CoH 08263	6.96	64.94	17.33	15.53	89.61	10.72	47.26	75.41	2.11	2.48	0.850	113	127
3	CoH 08264	7.77	67.48	18.53	16.63	89.75	11.51	50.40	76.95	2.12	2.58	0.935	114	132
4	CoPb 08217	8.02	70.18	18.69	16.50	88.28	11.43	48.48	79.94	2.27	2.52	0.890	129	139
5	CoS 08234	7.27	68.03	17.55	15.45	88.03	10.69	41.25	76.95	2.17	2.48	0.880	119	134
6	CoS 08235	7.04	65.87	17.23	15.50	89.96	10.68	46.82	74.20	2.23	2.42	0.898	116	133
Stds														
1	CoS 767	6.51	61.56	17.43	15.33	87.95	10.58	47.83	76.36	2.11	2.21	0.780	123	137
2	CoS 8436	6.22	57.59	17.18	15.60	90.80	10.81	45.75	61.67	1.61	2.66	0.901	109	123
3	CoPant 97222	7.02	68.45	16.90	14.88	88.05	10.25	47.54	78.45	2.17	2.32	0.880	117	143
	CD	1.05	8.08	0.51	0.54	0.82	0.41	3.61	10.12	0.12	0.18	0.098	13.12	16.4
	CV%	9.18	9.09	1.69	2.00	0.54	2.18	4.45	9.15	5.25	4.25	6.49	9.08	8.90

Agronomy

Project No.	**AS-42**	
Location	PAU, Regional Research Station, Kapurthala	
Title	Agronomic evaluation of promising new sugarcane genotypes	
Objective	To test the performance of early and mid –late maturing varieties under different nitrogen levels.	
Year of start	Long term experiment	
Treatments		
Early Varieties		
a) Varieties	**b) Fertilizer doses**	
V_1 – Co 06032	F_1 – 75 % of recommended dose of N	
V_2 – Co 07025	F_2 – 100 % of recommended dose of N	
V_3 – CoPb 09181	F_3 – 125 % of recommended dose of N	
V_4 – CoJ 83		
Mid Varieties		
a) Varieties	**b) Fertilizer doses**	
V_1 – CoJ 88	F_1 – 75 % of recommended dose of N	
V_2 – CoPb 06219	F_2 – 100 % of recommended dose of N	
V_3 – CoH 06266	F_3 – 125 % of recommended dose of N	
V_4 – Co Pb 05211		
Experimental Design	Factorial RBD	
Replication	3	
	Early set	**Mid set**
Date of planting	28-02-2013	07-03-2013
Date of harvesting	05-12-2013	14-02-2014

EARLY MATURITY SET

The experiments on early and mid genotypes were conducted on loamy soil, tested medium in organic carbon (0.66 %), very high in available P (59.5 kg/ha) and very high in available K (925 kg/ha). Three genotypes Co 06032, Co 07025 and CoPb 09181 were tested against check variety CoJ 83 (Table 42.1). The genotypes recorded significant differences in terms of growth and cane

yield. The genotype CoPb 91 recorded significantly high cane yield (89.5 t ha^{-1}) which was 35.6% higher than standard CoJ 83 and was at par with Co 06032. The number of tillers of genotype Co 6032 and CoPb 91 were significantly less than of Co 07025 and check CoJ 83. The number of millable canes of genotypes Co 06032, CoPb 09181 and CoJ 83 were significantly higher (99.0, 98.7 & 89.9 t/ha, respectively) than Co 07025 (64.1 t/ha). Even though the single cane weight of the genotype Co 07025 was significantly higher than Co 06032 & check CoJ 83 and at par with CoPb 09181 but due to more no. of millable canes of CoPb 91 than Co 07025, the cane yield of the former was significantly higher than the latter. The quality aspect of early genotypes revealed that all the genotypes differed significantly in terms of Pol % (juice). The Pol % of the check CoJ 83 was highest followed by CoPb 91, Co 07025 and Co 06032, respectively.

Table- 42.1 Effect of genotypes and fertilizer levels on performance of sugarcane (Early set)

Treatments	**Germination %**	**Tiller Count (000/ha)**	**Cane length (cm)**	**Internodes/ cane**	**Millable canes (000/ha)**	**Cane yield (t/ha)**	**Single Cane wt. (g)**	**Pol % juice**
Co 06032	38.2	135.4	225.6	21.4	99.0	80.6	876.7	14.83
Co 7025	39.8	152.0	227.9	23.8	64.1	77.3	1270.0	15.75
CoPb 91	40.1	134.8	221.6	19.3	98.7	89.5	1043.3	16.92
CoJ 83	42.3	155.0	181.6	24.2	89.9	66.0	725.6	18.42
CD (0.05)	**NS**	**11.7**	**NS**	**3.4**	**18.5**	**12.0**	**212.6**	**0.61**
Fertility level								
75 % of rec. N	39.3	130.0	208.3	21.9	90.9	78.4	961.7	16.10
100 % of rec. N	40.2	151.2	212.9	21.9	89.6	78.9	928.3	16.45
125 % of rec. N	40.8	154.4	221.3	22.7	83.3	78.2	1046.7	16.28
CD (0.05)	**NS**	**12.1**	**NS**	**NS**	**NS**	**9.9**	**NS**	**NS**
V x N	**NS**	**NS**	**NS**	**NS**	**NS**	**NS**	**NS**	**NS**

Application of either 100% or 125% of the recommended dose of nitrogen to the early maturing genotypes helped in significantly improving the number of tillers, as compared to the treatments 75% of the recommended dose of nitrogen was applied. The other growth parameters like germination, cane length, internodes per cane, followed a similar trend as that of number of

tillers but the level of significance could not be achieved. The highest cane yield of 78.9 t ha^{-1} was obtained when the nitrogen was applied at the recommended rates (100 % N).

Summary:

Genotype CoPb 09181 recorded the highest cane yield while the standard check CoJ 83 recorded highest Pol % juice. The cane yield with 100% of recommended nitrogen was highest i.e.78.9 t/ha and was at par with other two fertilizer levels**.**

MID MATURITY SET:

Among the mid maturing group, all the genotypes CoJ 88, Co Pb 05211, CoH 06266 and CoPb 06219 showed significant differences in terms of growth and cane yield (Table 42.2). CoH 06266 recorded the highest cane yield of 88.8 t ha^{-1} which was significantly better than CoPb 05211and CoJ88 but was at par with CoPb 06219. The extent of increase in cane yield with CoH 06266 over the check variety CoJ88 was found to be 20.7%. The number of tillers and millable caes too recorded significant differences and exhibited the trend as CoPb 06219 > CoH 06266 > CoJ 88 > CoPb 05211.

Table- 42.2 Effect of genotypes and fertilizer levels on performance of sugarcane (Mid set)

Treatments	**Germination %**	**Tiller Count (000/ha)**	**Cane length (cm)**	**Internodes /cane**	**Millable canes (000/ha)**	**Cane yield (t/ha)**	**Single Cane wt. (g)**	**Pol % juice**
CoJ 88	35.8	136.5	185.4	21.7	101.6	73.6	734.4	19.45
Co Pb 06219	40.2	162.1	208.6	23.1	108.6	88.1	804.4	14.91
CoH 06266	27.2	103.5	229.9	24.2	93.3	88.8	972.1	16.25
CoPb 05211	30.3	84.5	184.9	23.0	85.0	69.4	801.1	17.55
CD (0.05)	**10.8**	**7.1**	**NS**	**NS**	**NS**	**10.1**	**NS**	**0.43**
Fertility level								
75 % of rec. N	33.6	121.5	197.9	22.8	89.5	71.2	805.8	16.91
100 % of rec. N	33.4	125.3	199.9	22.3	99.8	82.5	831.3	17.03
125 % of rec. N	33.6	118.4	209.2	23.9	102.1	85.7	847.1	17.18
CD (0.0 5)	**NS**	**NS**	**NS**	**NS**	**NS**	**7.4**	**NS**	NS
V x N	NS	NS	NS	**NS**	NS	NS	NS	NS

The cane quality too was influenced, as the standard check CoJ 88, recorded significantly highest Pol % juice followed by CoPb 05211, CoH 06266 & CoPb 06219, respectively.

Restricting the application of nitrogen to 75% of the recommended dose significantly reduced the cane yield as compared to the 100% or 125% of the recommended dose of nitrogen. Different nitrogen levels did not show any significant effect on other growth parameters and the cane quality recorded except plant height where 150 % N recorded significantly higher plant height than 75% of recommended Nitrogen.

Summary

The genotype CoH 06266 recorded the highest cane yield and was comparable to CoPb 6219 being significantly better than the genotype CoPb 05211 & the check CoJ88. The all three new genotypes were significantly poor to check variety CoJ 88 in terms of Pol % juice. Fertilizing the crop with 100% recommended dose of nitrogen i.e. 150 kg N ha^{-1} significantly improved cane yield over 75% of the recommended dose of nitrogen but was at par to 125% of the recommended dose of nitrogen.

Project No.	**AS-64**
Location	PAU Regional Research Station, Kapurthala
Title	Response of sugarcane crop to different plant nutrients in varied agro-ecological situations
Objective	To study differential response of sugarcane crop to different nutrients.
Year of start	February- March 2011-2012
Experimental Design	RBD
Replication	3
Variety	CoJ 88
Date of Planting	15-02-2013
Date of harvesting	13-01-2014

Table 62.1 Details of different treatments	
T_1	Control (no fertilizer)
T_2	N applied from Urea as per recommendation
T_3	NP (P applied @ 12 kg P_2O_5/ ha from DAP)
T_4	NPK (P applied @ 12 kg P_2O_5/ ha from DAP)
T_5	NPK + S (S was added from elemental sulphur @ 40kg/ha in sub-tropical region)
T_6	NPK + Zn (Zn was added @ 25 kg Zn/ha from $ZnSO_4$ in sub-tropical region)
T_7	NPK + Fe (Fe was applied @ 5kg Fe from $FeSO_4$ as Foliar spray in sub-tropical.)
T_8	NPK + Mn (Mn was applied @ 5kg Mn from $MnSO_4$ as foliar spray in sub-tropical)
T_9	NPK + S + Zn
T_{10}	NPK + S + Zn + Fe
T_{11}	NPK + S + Zn + Fe + Mn
T_{12}	Soil test based fertilizer application

The soil of the experimental field being loamy in nature , tested medium in organic carbon (0.66 %), very high in available P (59.5 kg/ha) and very high in available K (925 kg/ha).The data presented in table 64.1 showed non-significant differences in germination , growth parameters and cane yield of sugarcane when different nutrients were applied in variable combinations .

Table- 64.1 Effect of application of different plant nutrients on productivity of sugarcane.

Treatments		Germination %	Tiller Count (000/ha)	Cane length (cm)	Internodes / cane	Single Cane wt. (g)	Millable canes (000/ha)	Cane yield (t/ha)	Pol % juice	CCS %
T_1	Control	37.0	117.8	169.0	16.9	706.7	106.4	74.7	16.67	11.40
T_2	N	36.8	165.9	196.7	17.0	830.0	124.4	109.7	17.68	12.30
T_3	NP	34.9	159.3	203.0	17.7	826.7	121.9	111.6	18.22	12.78
T_4	NPK	35.0	144.2	202.7	18.0	863.3	117.6	100.3	18.66	13.06
T_5	NPK + S	34.6	140.4	204.0	18.2	856.7	120.8	104.6	16.80	11.30
T_6	NPK + Zn	31.7	146.2	203.0	18.2	853.3	114.0	99.2	16.82	11.75
T_7	NPK + Fe	33.1	143.7	195.0	18.4	859.7	115.1	100.4	18.13	12.62
T_8	NPK + Mn	33.6	153.6	189.3	17.6	866.7	116.8	100.6	16.84	11.76
T_9	NPK + S + Zn	35.1	181.8	197.3	18.9	879.0	113.1	98.2	17.93	12.48
T_{10}	NPK + S + Zn + Fe	31.3	160.9	196.0	18.0	893.3	110.7	99.2	19.22	13.46
T_{11}	NPK + S + Zn + Fe + Mn	32.3	149.9	194.7	18.1	896.7	107.3	98.8	18.20	12.68
T_{12}	Soil Test Based fert. appln	33.7	180.3	198.0	17.0	893.3	118.9	107.1	18.18	12.72
T_{13}	FYM @ 20 t/ha	35.0	177.2	195.0	16.8	726.7	107.7	79.4	16.61	11.38
CD (0.05)		**NS**	**27.6**	**19.3**	**NS**	**76.9**	**10.3**	**18.9**	**NS**	**NS**

Among all the treatments applied, the treatment where only N & P was applied recorded the highest cane yield of 111.6 t ha^{-1} which showed a significant increase of 49.4 % over the control plot where no nutrient was applied and was at par with the treatments where N alone (109.7 t/ha) or in combination with P, K, and S .The soil test based fertilizer application also recorded statistically similar cane yield (107.1 t/ha) . Number of millable canes recorded with application of N alone were significantly higher to control and the treatments supplemented with NPK with combinations of Zn,S,Fe &Mn while it was at par to all other treatments. Application of nitrogen alone sustained similar level of productivity as that of other treatments. Even with application of all the nutrients in

T_{11} i.e. NPK + S + Zn + Fe + Mn, no additional yield could be obtained. Hence, the results indicate that in the absence of soil test reports, the Punjab farmer can go for the sole application of recommended dose of nitrogenous fertilizer i.e. 150 kg N ha^{-1} without suffering any significant loss in the cane yield. Applying additional nutrients like P, K, S, Zn, Mn, Fe failed to cause any appreciable effect in the cane yield and seemed to increase only the cost of production. Applying different nutrients in variable combinations could not influence the quality aspects in terms of Pol% and CCS%.

Summary:

Soil test based fertilizer application should be followed for attaining optimum cane yield. In the absence of fertility report of the field, one should only apply the nitrogenous fertilizer at recommended dose of 150 kg ha^{-1} to get the optimum yield.

Project No.	**AS-63**
Location	PAU, Regional Research Station, Kapurthala
Title	Plant geometry in relation to mechanization in sugarcane
Objective	To work out optimum plant geometry for use of farm machinery. To study varietal response to plant geometry
Year of start	2011-12
Main plot	
Plant geometry	i) 120 cm row spacing
	ii) 150 cm row spacing
	iii) 30 : 120 cm paired row
Sub Plot	
Varieties	i) CoJ 64
	ii) CoJ 83
	iii) CoJ 88
	iv) CoS 8436
Date of Planting	9 March 2013
Experimental Design	Split plot
Replication	4

The soil of the experimental field being loamy in nature, tested medium in organic carbon (0.66 %), very high in available P (59.5 kg/ha) and very high in available K (925 kg/ha). The data

revealed that the crop planted at diffrent geometry showed non-significant differences with respect to germination, however plant height, cane length, no. of millable canes were significantly high when crop was planted at 30 : 120 cm paired row system than at 120 & 150 cm spacing, whereas the later two were at par with each other. Similar trend was also observed in cane yield where the paired row planting produced significantly high cane yield (110.1 t/ha) than 120 & 150 cm spacing.

Among different varieties the variety CoJ 64 recorded significantly higher tiller count, plant height and cane length than all other three varieties. The variety CoJ 83 produced significantly lower number of millable canes than all other varieties. The variety CoS 8436 gave highest cane yield (86.3 t/ha) followed by CoJ 88, CoJ 83 and CoJ 64, respectively. However, the differences were non-significant. No Interaction effects were observed among varieties and plant geometries.

Summary:

All the varieties performed better under 30: 120 cm paired row system than at 120 & 150 cm row spacing.

Table : 63.1: Plant geometry in relation to mechanization in sugarcane

Treatments	Germination %	Tiller Count (000/ha)			Plant Height (cm)		Inter-nodes /cane	Cane length (cm)	Millable canes (000/ha)	Single Cane wt (g)	Cane yield (t/ha)	% juice
		90	120	180	120	180						
Plant Geometry												
150 cm spacing	40.3	80.5	99.4	107.6	127.5	173.4	17.4	175.3	85.4	724.4	63.1	17.25
120 cm spacing	41.4	81.9	102.2	109.4	134.4	178.2	17.1	174.8	100.5	710.9	74.2	17.52
30: 120 cm	36.4	91.9	107.1	117.2	144.1	189.6	17.8	198.6	113.1	698.8	81.0	17.12
CD (0.05)	**NS**	**NS**	**NS**	**NS**	**8.1**	**10.8**	**NS**	**12.9**	**9.5**	**NS**	**17.5**	**NS**
Varieties												
i) CoJ 64	44.9	94.7	113.4	119.3	149.3	205.8	16.8	213.6	106.5	709.3	74.3	17.80
ii) CoJ 83	34.7	95.8	100.1	106.9	136.5	173.3	16.6	181.0	93.8	707.7	67.1	17.59
iii) CoJ 88	38.4	77.8	99.2	111.4	132.5	176.3	17.5	171.7	99.6	703.4	72.5	17.35
iv) CoS 8436	39.4	70.7	98.9	108.0	123.0	166.1	18.8	164.3	98.7	725.2	76.1	16.43
CD (0.05)	**NS**	**20.2**	**NS**	**11.2**	**NS**	**22.4**	**2.1**	**17.0**	**11.0**	**NS**	**NS**	**0.41**
G X V	NS	NS	NS	NS	NS	**NS**	**NS**	NS	NS	NS	**NS**	NS

Project No.	**AS-65**
Location	PAU, Regional Research Station Kapurthala
Title	Enhancing sugarcane productivity and profitability under wheat – sugarcane cropping system
Objective	To allow farmers to plant sugarcane in time and harvest potential yields in wheat + sugarcane relay copping system.
Year of start	September 2011
Experimental Design	RBD
Replication	3
Variety	CoJ 64
Date of Planting Sugarcane	**22.10.2012**
Date of harvesting Autumn Sugarcane Spring Sugarcane After Wheat harvest	 2.12.2013 04.03.2014 04.03.2014

Treatments	
T_1	Autumn Sugarcane rows sown 90 cm apart
T_2	Autumn Sugarcane + Wheat (1:2)
T_3	Autumn Sugarcane + Wheat (1:3)
T_4	Wheat (15 Nov.) followed by sugarcane after harvest
T_5	Wheat (15 Dec.) followed by sugarcane after harvest
T_6	FIRB Wheat on 15 Nov. + Feb. sugarcane in furrows
T_7	FIRB Wheat on 15 Nov. + Mar. sugarcane in furrows
T_8	FIRB Wheat on 15 Dec. + Feb. sugarcane in furrows
T_9	FIRB Wheat on 15 Dec. + Mar. sugarcane in furrows

The soil of the experimental field being loamy in nature, tested medium in organic carbon (0.66 %), very high in available P (59.5 kg/ha) and very high in available K (925 kg/ha). The experiment was laid out with an objective to provide an option for all the wheat growers to harvest the potential yield of sugarcane through an agronomic intervention of timely planting in standing wheat. This will help the farmers to diversify from the traditional paddy- wheat rotation to wheat – sugarcane relay cropping system. The data presented in table 65.1 showed non-significant differences for germination, and cane girth of sugarcane under different methods of wheat-

sugarcane intercropping and relay cropping. However, different ways of intercropping wheat in sugarcane and it's relay cropping recorded significant differences in terms of tiller count, cane length, number of millable canes and cane yield. The tiller count and cane length was significantly reduced when sugarcane was planted late i.e. after harvesting of wheat crop (both Nov. and Dec. sown crop). Sole sugarcane planted in autumn recorded significantly highest cane length (213.3cm) and millable canes (110.9 t/ha) when compared to sugarcane after harvest of 15 Nov. & 15 Dec. sown wheat and was at par with all other treatments where sugarcane was planted in standing wheat crop either in Feb. or in March.

It was observed that sole sugarcane planted in autumn produced significantly higher cane yield than the sugarcane planted after harvesting of 15 Nov. & 15 Dec. sown wheat crop and also higher than Autumn sown crop where three rows of wheat were planted. The cane yield of autumn sown sole crop was at par with Autumn sown crop with two rows of wheat as intercrop and the treatments where sugarcane was planted in standing wheat crop, indicating thereby the possibility of timely planting of sugarcane in furrow irrigated raised bed wheat. The yield of wheat was maximum in the treatment T_4 when wheat was sown on 15 Nov. and sugarcane was planted after wheat harvest and it was at par with all the treatments where wheat was sown on 15 Nov. but was significantly better than those treatments where wheat was sown on 15 Dec. The cane equivalent yield was also significantly less when sugarcane was planted after harvesting of 15 Nov. & 15 Dec. sown wheat crop. Highest cane equivalent yield was achieved when autumn sown crop was intercropped with two rows of wheat (90.5 t/ ha) and was at par with treatment (T_6 & T_7) i.e. sugarcane relay cropped in Feb. and Mar. in 15 Nov. FIRB wheat. It was significantly superior to the sole sugarcane planted in autumn. The cane quality of autumn sown and relay cropped sugarcane was significantly superior to the sugarcane crop planted late after harvesting of wheat.

Table- 65.1 Effect of planting methods and irrigation levels on performance of sugarcane

Treatments		Germination %	Tiller Count (000/ha)	Cane length (cm)	Cane girth (cm)	Millable canes (000/ha)	Cane yield (t/ha)	Single cane wt.(g)	Wheat Yield (q/ha)	Cane equivalent yield (t/ha)	Pol % juice
T_1	**Autumn Sugarcane**	**45.3**	**151.4**	**213.3**	**1.85**	**110.9**	**81.3**	**740.0**	**-**	**81.3**	**18.67**
T_2	Autumn Sugarcane + Wheat (1:2)	44.0	154.5	201.1	1.80	105.8	74.3	705.0	34.8	90.5	18.99
T_3	Autumn Sugarcane + Wheat (1:3)	44.3	151.5	204.7	1.79	103.7	70.2	680.0	36.6	87.2	19.17
T_4	Sug. after harvest of 15 Nov.Wheat	34.5	110.5	178.0	1.75	89.1	58.2	620.0	38.2	76.2	17.59
T_5	Sug. after harvest of 15 Dec Wheat	36.2	108.0	174.0	1.54	86.9	57.4	611.0	29.4	71.1	17.69
T_6	Feb. cane in furrows of 15 Nov. FIRB Wheat	43.0	154.2	206.0	1.97	99.1	72.3	695.0	33.1	87.7	18.69
T_7	Mar. cane in furrows of 15 Nov.FIRB Wheat	42.7	151.3	204.8	1.83	97.3	71.6	687.0	33.9	87.4	18.97
T_8	Feb. cane in furrows of 15 Dec. FIRB Wheat	43.4	153.0	198.9	1.79	98.3	73.2	698.0	25.8	85.2	18.32
T_9	Mar. cane in furrows of 15 Dec. FIRB Wheat	42.4	152.8	198.0	1.78	97.2	72.0	707.0	27.0	84.6	18.57
CD (0.05)		**NS**	**28.3**	**16.8**	**NS**	**10.1**	**11.1**	**70.3**	**6.3**	**9.1**	**0.62**

Summary

The highest cane equivalent yield of 90.5 t/ha was obtained in the treatment T2 having autumn sugarcane + wheat (1:2) and was at par with relay cropping in standing wheat crop and significantly better than sole sugarcane crop and where sugarcane was planted after wheat harvest.

Project No.	**AS-66**
Location	PAU, Regional Research Station Kapurthala
Title	Priming of cane node for accelerating germination
Objective	To allow farmers to cut down the seed cost besides increasing germination
Year of start	March 2012
Experimental Design	RBD
Replication	3
Variety	CoJ 88
Date of Planting Sugarcane	**03-02-2013**
Date of harvesting	--------

Treatments	
T_1	Unprimed cane node
T_2	Treating cane node in hot water at 50^0C for 2 hours
T_3	Treating cane node in hot water with 3% urea solution at 50^0C for 2 hours
T_4	Priming cane node with cattle dung, cattle urine and water in 1:2:5 ratio
T_5	Conventional 3 bud sett planting
T_6	Primed and sprouted cane node (incubated for four days after priming)

The soil of the experimental field being loamy in nature , tested medium in organic carbon (0.66 %), very high in available P (59.5 kg/ha) and very high in available K (925 kg/ha). The objective was to cut down the seed cost and increase germination percentage of the single cane node.

In this experiment the optimum germination was achieved in only T5 where conventional three budded sets were planted whereas all other treatments had very poor germination. Hence the data was not recorded.

Plant Pathology

Project No	**: PP-14**
Location	: PAU Regional Research Station, Kapurthala
Title	: Identification of pathotypes/races in red rot pathogen
Objectives	: To gather information on the major pathotypes of red rot
Year of experiment	: 29th (Year of start 1984-85)
Technical Programme	: A given set of differentials to be inoculated by plug method with different local isolates of red rot pathogen and observations to be recorded on disease development after sixty days.
Technical programme for the next year	: To continue with recently collected red rot isolates.

Technical Report:

Fourteen differentials were inoculated by plug method on 26.08.2013 using conidial suspension separately from each of 9 red rot pathotypes / isolates (5 pathotypes and 4 new isolates) collected from Punjab state. The five pathotypes were CF 01 from Co 1148, CF 03 from CoJ 64, CF 07 from CoJ 64, CF 08 from CoJ 84 and CF 09 from CoS 767 and the newly collected 4 isolates were RI-291 from Co 89003 Ajnala sugar mill area, RI-292 from CoS 8436 Dhuri sugar mills area, RI-293 from CoJ 64 Budhewal mill area and RI-294 from CoJ 85 from Ajnala mill area. Observations on disease development as per technical programme were recorded 60 days after inoculations and host reaction was categorized into three groups viz., Resistant (R), Intermediate (X) and Susceptible (S).

The perusal of data contained in Table PP-I revealed that all the isolates/ pathotypes were avirulent on BO 91, Baragua and SES 594 and virulent on Co 997, CoJ 64 and Khakai. Out of 9 tested pathotypes/isolates the new isolate namely RI-291 from Co 89003 and RI-293 from CoJ 64 respectively showed clear cut reactions i.e. Resistant, Intermediate and Susceptible on the tested differentials. RI-291 from Co 89003 isolate showed resistant (R) on 5 differentials (Co 7717, CoS 767, BO 91, Baragua and SES 594), Intermerdiate (X) on 3 (Co 419, Co 975 and Co 1148) and susceptible (S) on rest of the 6 differentials; whereas isolate RI-293 from CoJ 64 showed resistant (R) on 8 (Co 975, Co 1148, Co 7717, CoS 767, CoS 8436, BO 91, Baragua and SES 594) intermediate on 2 (Co 419 and Co 62399) and susceptible reaction on 4 (Co 997, CoC 671, CoJ 64 and Khakai). A new isolate RI-292 from CoS 8436 showed resistant reaction (R) on 5 and susceptible (S) on the remaining 9

differentials and isolate RI-294 from CoJ 85 showed susceptible reaction (S) on 9 differentials and resistant (R) on 5 differentials. An isolate RI- 291 from Co 89003 although resemble with pathotype CF 09 from CoS 767 but it showed resistant reaction to CoS 767, intermediate reaction to Co 1148 and susceptible to CoS 8436 and Co 62399. We can say it is somewhat different from pathotype CF 09 from CoS 767. Newly tested isolate RI-293 from CoJ 64 also resemble with pathotype CF 09 from CoS 767 and CF 07 from CoJ 64 as it showed resistant reaction on seven differentials. A new isolates RI-292 from CoS 8436 gave similar reaction on all the differentials as by the pathotype CF 08 from CoJ 84 except it showed susceptible reaction on CoS 8436 and resistant reaction on Co 1148. We can say it is quite virulent as pathotype CF 08. Similarly the new isolate RI-294 from CoJ 85 from Ajnala mill quite resemble with CF 08 and as virulent as pathotype CF 08. Further confirmation will be carried out this year.

Summary

Newly collected isolates RI-292 from CoS 8436 and RI-294 from CoJ 85 from Dhuri mill area are found as virulent as pathotype CF 08. RI-292 from CoS 8436 is susceptible on its host and it needs further confirmation for considering a new pathotype.

Project No	**: PP-17**
Location	: PAU Regional Research Station, Kapurthala
Title	: Evaluation of pre-zonal /zonal varieties/genotypes for resistance to red rot, smut and wilt
Objectives	: a)To gather information on the relative resistance to red rot of the entries in the pre zonal/zonal varieties
Year of experiment	: 27th (year of start 1986-87)
Technical Programme	: Early and Mid-Late genotypes/varieties to be evaluated against red rot both by the plug and cotton swab with pathotypes CF 08 and CF 09 separately
Technical programme for the next year	: To Continue with new entries

Technical Report:

A: Red Rot

The material provided by Sugarcane Breeding Section was inoculated by plug and cotton swab methods on 26/08/2013 using a conidial suspension of two red rot pathotypes separately viz., CF 08 from CoJ 84 and CF 09 from CoS 767. In cotton swab method two canes in each of the twenty clumps were inoculated by removing the lower most green leaf sheath and immediately placing the cotton swab (dipped in freshly prepared inoculum suspension) around the cane covering nodal region. The cotton swab was held in place by wrapping the parafilm over the swab. Observations on disease development were recorded up to 60 days of inoculations and varieties were categorized on 0-9 scale.

AVT (Early) Plant 1

Five genotypes along with two checks CoJ 64 and Co Pant 84211 were evaluated against pathotype CF 08 and CF 09 separately. Two entries namely; CoH 09263 and CoS 09246 behaved as MR/ R by plug and cotton swab methods by both the pathotypes separately (Table PP 2). Three entries CoH 09262, CoLk 09202 and CoPb 09181 showed MS and MR with CF 08 and CF 09 respectively by plug method and R by cotton swab method. The checks behaved as HS/S.

AVT (Early) Plant II

Three genotypes along with two checks CoJ 64 and Co Pant 84211 were evaluated against pathotype CF 08 and CF 09 separately. An entry CoPb 08212 behaved as MR/ R by plug and cotton swab methods by both the pathotypes separately (Table PP 2) while two entries CoPb 08211 and CoS 08233 showed MS and MR with CF 08 and CF 09 respectively by plug method and R by cotton swab method. The two checks behaved as HS/ S.

AVT (Mid late) Plant I

Five entries along with 3 checks CoS 767, CoS 8436 and Co Pant 97222 were tested against pathotype CF 08 and CF 09 separately. An entry Co 09022 and a check CoS 8436 behaved as MR/R by plug and cotton swab methods by both the pathotypes separately (Table PP 2). Three genotypes namely; CoH 09264, CoPb 09214 and CoS 09232 showed MS and MR with CF 08 and CF 09 respectively by plug method and R by cotton swab method. Genotype CoLk 09204 behaved MS/R by plug and cotton swab method. Check variety CoPant 97222 behaved as MS/ S whereas CoS 767 behaved as S/HS with CF 08/CF 09 respectively by plug method and susceptible (S) by cotton swab method.

AVT (Mid late) Plant II

Six genotypes along with three checks checks CoS 767, CoS 8436 and Co 1148 were evaluated against pathotype CF 08 and CF 09 separately. Three genotypes viz; CoH 08262, CoS 08234, CoS 08235 and a check CoS 8436 were found MR/R by plug and cotton swab method with both the pathotypes. Three genotype namely CoH 08263, CoH 08264 and CoPb 08217 showed MS and MR with CF 08 and CF 09 respectively by plug method and R by cotton swab method. Check variety CoPant 97222 behaved as MS/ S whereas CoS 767 behaved as S with CF 08 and HS/S with CF 09 by both the methods.

IVT (Early)

Three genotypes along with two checks CoJ 64 and Co Pant 84211 were evaluated against pathotype CF 08 and CF 09 separately. Two genotypes i.e., Co 10035 and CoS 10231 were found MR/R to both the pathotypes with plug and cotton swab methods. Genotype CoH 10261 was found MS and MR with CF 08 and CF 09 respectively by plug method and R by cotton swab method.

IVT (Mid late)

Ten genotypes along with three checks CoS 767, CoS 8436 and CoPant 97222 were evaluated against pathotypes CF 08 and CF 09 individually. Seven genotypes namely; Co 10039, CoH 10262, CoPant 10221, CoPb 10181, CoPb 10182, CoPb 10183 and CoPb 10211 and check CoS 8436 were found MR/R by plug and cotton swab method by both the pathotypes. A genotypes Co 10036 was found MR/R with CF 08 and MS/R with CF 09 by plug and cotton swab method while genotype Co 10037 was found MS/R with CF 08 and MR/R with CF 09 by both the methods. One genotype CoH 10263 showed HS/S with CF 08/CF 09 by plug method and susceptible (S) by cotton swab method. Check variety CoPant 97222 showed MS/S reaction on both the pathotypes while check CoS 767 showed S/HS with CF 08/ CF 09 respectively by plug and cotton swab method.

Summary

Thirty two genotypes tested against red rot pathotypes CF 08 and CF 09 separately by plug and cotton swab methods. In AVT (Early) Plant I Two entries namely; CoH 09263 and CoS 09246 behaved as MR/ R by plug and cotton swab methods by both the pathotypes separately. In AVT (Early) Plant II an entry CoPb 08212 behaved as MR/ R by plug and cotton swab methods by both the pathotypes separately. In AVT (Mid late) Plant I an entry Co 09022 and a check CoS 8436 behaved as MR/R by plug and cotton swab methods by both the pathotypes separately while three genotypes namely; CoH 09264, CoPb 09214 and CoS 09232 showed MS and MR with CF 08 and CF 09 respectively by plug method and R by

cotton swab method. In AVT (Mid late) Plant II three genotypes viz; CoH 08262, CoS 08234, CoS 08235 and a check CoS 8436 were found MR/R by plug and cotton swab method with both the pathotypes while three genotype namely CoH 08263, CoH 08264 and CoPb 08217 showed MS and MR with CF 08 and CF 09 respectively by plug method and R by cotton swab method. In IVT (Early) two genotypes namely; Co 10035 and CoS 10231 and in Midlate seven genotypes namely; Co 10039, CoH 10262, CoPant 10221, CoPb 10181, CoPb 10182, CoPb 10183 and CoPb 10211 and check CoS 8436 were found MR/R by plug and cotton swab method by both the pathotypes.

Project No: PP-17

Objectives : b) To gather information on the relative resistance to smut of the entries in the pre zonal/zonal varieties

Year of experiment : 18th (year of start 1995-96)

Technical Programme : Genotypes to be evaluated against smut (*Ustilago scitaminea*) by steeping of setts (3-budded) for 30 minutes in a mixed spore suspension . Observations to be recorded at weekly intervals and genotypes rated on cumulative percent disease incidence.

Technical programme for the next year : To continue with new entries

Technical Report:

Smut

Thirty two genotypes and 6 pathological standards (Co 740, Co 1158, Co 7915, Co 62175, NCO 310, Katha) evaluated against smut by steeping method. Observation on disease appearance was recorded at weekly intervals throughout the crop season and simultaneously rouging out of smutted clumps each time to avoid secondary spread of the disease. The genotypes were categorized based on cummulative percent smut incidence.

Out of 32 genotypes, twelve genotypes namely CoH 09262, CoPb 08212, CoS 09232, CoH 10261, CoS 10231, Co 10036, Co 10037, Co 10039, CoH 10262, CoPant 10221, CoPb 10181 and CoPb 10183 were rated as moderately resistance (MR) (Table PP-3). Of the remaining 20 entries, 17 were rated as moderately susceptible (MS), 3 entries namely CoH 09263, Co 10035 and CoH 10263 were rated as susceptible (S). Among six pathological standards, five (740, Co 1158, Co 62175, NCO 310 and Katha) were found highly susceptible

(HS) and Co 7915 as moderately resistant (MR).

Summary

Out of 32 genotypes, 12 genotypes namely CoH 09262, CoPb 08212, CoS 09232, CoH 10261, CoS 10231, Co 10036, Co 10037, Co 10039, CoH 10262, CoPant 10221, CoPb 10181 and CoPb 10183 behaved as MR, 17 as MS and 3 as S and out of 6 pathological standards, five genotypes (Co 740, Co 1158, Co 62175, NCO 310 and Katha) were highly susceptible and Co 7915 as moderately resistant.

Project No : PP-17

Objectives	: c) To gather information on the relative resistance to wilt of the entries in the pre zonal/zonal varieties
Year of experiment	: 13th (year of start 2000-01)
Technical Programme	: Genotypes to be evaluated against wilt by planting under wilt sick soil
Technical programme for the next year	: To Continue with new entries

Technical Report:

Wilt

Thirty two entries with two standards Co 7717 and Co 89003 were evaluated for wilt at PAU Regional Research Station, Kaputhala. The symptoms on the standing canes were recorded after 10 months of planting. The mean wilt severity index was worked out based on the number of canes sampled.

Out of 32 genotypes 15 behaved as R (grade 0), 13 genotypes namely CoH 09262, CoH 09263, CoPb 9181, CoS 09246, CoPb 08211, CoH 08263, CoPb 08217, CoS 08234, Co 10035, Co 10036, Co 10037, Co 10039 and CoPb 10183 as MR (grade 1), 3 genotypes viz; CoH 08262, Co 767, CoPb 09211 and CoLk 09204 as MS (grade 2), 1 genotype CoH 08262 behaved as S (grade 3) and 2 standards viz; Co 07717 and Co 89003 as HS (grade 4) given in Table PP-4.

Summary

Out of 32 genotypes, 15 were resistant to wilt, 13 were moderately resistant, 3 were moderately susceptible and one CoH 08262 was susceptible. Check varieties namely Co 7717 and Co 89003 were found highly susceptible to wilt only.

Project No **: PP-22**

Location : PAU Regional Research Station, Kapurthala

Title : Survey of sugarcane diseases naturally occurring in the area on important sugarcane varieties

Objectives : To gather information on the diseases naturally occurring in the area on released varieties.

Year of experiment : 24th (year of start 1989-90)

The disease survey on sugarcane crop was conducted in 9 Cooperative sugar mills viz., Bhogpur, Budhewal, Batala, Gurdaspur, Nawan Shahar, Ajnala, Morinda, Nakodar and Fazilka and 7 private mill areas three times during July, September and November. Recommended varieties CoJ 83, CoH-119 and CoJ 89 were found free from red rot disease in all mills areas. Red rot was observed on ratoon as well as plant crop CoS 8436 with an incidence (traces to 8.5 per cent) in Amloh, Morinda and Dhuri mills area and in traces on varieties CoJ 64, CoJ 85 and Co 89003 in Ajnala, ButtarSevian, Nawanshahr and Budhewal mills areas. Varieties Co 89003, CoJ 88 and Co 238 were found infected with smut in traces in Batala and Fazilka mills area. Light to mild incidence (traces to 8 per cent) of wilt was observed on Co 89003 in Dhuri, Amloh, ButtarSevian, Gurdaspur, Batala and Ajnala mills area. Pokkah Boeng disease was observed on variety Co 238 (traces to 3%) in Amloh, Dhuri, Gurdaspur, Budhewal, Bhogpur, Phagwara, Dasuya and Ajanala Sugarmill areas. Red stripe/top rot disease in traces to 3 % was observed on CoJ 85 in Batala, Gurdaspur, ButtarSevian, Bhogpur and Mukerian sugar mills area (Table PP-5)

Project No : **PP-23**

Location : PAU Regional Research Station, Kapurthala

Title : Assessment of ISH genotypes for resistance to red rot

Objectives :To gather information on Saccharum spp. and elite genotypes for resistance to red rot so that the resistant genotypes could be used in breeding programme as possible donors for resistance.

Technical Report:

Forty-two ISH genotypes were inoculated by plug method on 28. 08. 2013 using red rot pathotypes CF 08 from CoJ 84 and CF 09 from CoS 767. Observations on disease

development were recorded after 60 days of inoculations and genotypes were rated on 0-9 scale.

Of the 42 genotypes, none behaved as resistant, fourteen genotypes namely ISH 01, 07, 108, 113, 118, 119, 135, 148, 203, 211, 264, 269, 277 and ISH 286 were found MR, one genotype ISH 115 was found MS, one ISH 31 was susceptible and 7 were HS to both the pathotypes by plug method of inoculation (Table PP-6). Four genotypes namely ISH 105, ISH 144, ISH 185 and ISH 313 were found MR to CF 08 and HS to CF 09 whereas two genotypes ISH 12 and ISH 284 were HS to CF 08 and MR to CF 09. Three genotypes ISH 49, ISH 191 and ISH 224 were found MS to CF 08 and MR to Cf 09 whereas ISH 260 was MR to CF 08 and MS to CF 09. Three ISH entries ISH 281, ISH 309 and ISH 314 were MS to CF 08 and HS to CF 09 where as genotype ISH 193 was MS/S to CF 08/ CF 09. Seven ISH entries ISH 88, ISH 114, ISH 187, ISH 265, ISH 267, ISH 273 and ISH 308 were HS to both CF 08 and CF 09 pathotypes.

Summary

Of the 42 genotypes, none behaved as Resistant, fourteen genotypes namely ISH 01, 07, 108, 113, 118, 119, 135, 148, 203, 211, 264, 269, 277 and ISH 286 were found MR, one genotype ISH 115 was found MS, one ISH 31 was S and 7 were HS to both the pathotypes by plug method of inoculation.

Table PP-1: Pathogenic behavior of isolates of *Colletotrichum falcatum* on host differentials-Kapurthala (PAU)

Sr No	Pathotypes/ Isolates	Source	Reaction* on host differentials													
			Co 419	Co 975	Co 997	Co 1148	Co 7717	Co 62399	CoC 671	CoJ 64	CoS 767	CoS 8436	Bo 91	Baragua	Khakai	SES 594
1	**CF- 01**	**Co 1148**	**R**	**S**	**S**	**S**	**R**	**S**	**S**	**S**	**R**	**R**	**R**	**R**	**S**	**R**
2	**CF- 03**	**CoJ 64**	**R**	**R**	**S**	**R**	**R**	**R**	**S**	**S**	**R**	**R**	**R**	**R**	**S**	**R**
3	**CF-08**	**CoJ 84**	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**R**	**R**	**R**	**R**	**S**	**R**
4	**CF-09**	**CoS 767**	**X**	**X**	**S**	**S**	**R**	**R**	**S**	**S**	**S**	**R**	**R**	**R**	**S**	**R**
5	**CF-07**	**CoJ 64**	**X**	**R**	**S**	**S**	**R**	**R**	**X**	**S**	**R**	**R**	**R**	**R**	**S**	**R**
6	**RI- 291**	**Co 89003**	**X**	**X**	**S**	**X**	**R**	**S**	**S**	**S**	**R**	**S**	**R**	**R**	**S**	**R**
7	**RI- 292**	**CoS 8436**	**S**	**S**	**S**	**R**	**S**	**S**	**S**	**S**	**R**	**S**	**R**	**R**	**S**	**R**
8	**RI- 293**	**CoJ 64**	**X**	**R**	**S**	**R**	**R**	**X**	**S**	**S**	**R**	**R**	**R**	**R**	**S**	**R**
9	**RI-294**	**CoJ 85**	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**R**	**R**	**R**	**R**	**S**	**R**

Reaction* R = Resistant; X = Intermediate; S = Susceptible

Date of inoculation: 26.08.2013

Date of observations: 26.10.2013

Table PP- 2: Evaluation of AVT/IVT sugarcane genotypes for red rot resistance- Kapurthala (PAU)

S. No.	Genotypes	Plug method				Cotton swab method	
		CF 08		CF 09		CF-08	CF 09
		S*	R**	S**	R**	R**	R**
AVT (Early) Plant I							
1	CoH 09262	4.1	MS	3.4	MR	R	R
2	CoH 09263	3.7	MR	3.5	MR	R	R
3	CoLk 09202	4.3	MS	3.7	MR	R	R
4	CoPb 09181	4.3	MS	3.5	MR	R	R
5	CoS 09246	3.4	MR	3.3	MR	R	R
6	CoJ 64	8.4	HS	8.2	HS	S	S
7	Co Pant 84211	6.2	S	8.1	HS	S	S
AVT (Early) Plant II							
1	CoPb 08211	4.8	MS	3.5	MR	R	R
2	CoPb 08212	3.9	MR	3.5	MR	R	R
3	CoS 08233	5.4	MS	3.7	MR	R	R
4	CoJ 64	8.4	HS	8.2	HS	S	S
5	CoPant 84211	6.2	S	8.1	HS	S	S
AVT (Mid Late) Plant I							
1	Co 09022	3.6	MR	3.3	MR	R	R
2	CoH 09264	4.8	MS	3.6	MR	R	R
3	CoLk 09204	5.7	MS	4.3	MS	R	R
4	CoPb 09214	5.3	MS	3.7	MR	R	R
5	CoS 09232	4.7	MS	3.5	MR	R	R
6	CoS 767	7.2	S	8.4	HS	S	S
7	CoS 8436	3.4	MR	3.1	MR	R	R
8	CoPant 97222	5.7	MS	5.4	MS	S	S
AVT (Mid Late) Plant II							
1	CoH 08262	3.9	MR	3.4	MR	R	R
2	CoH 08263	5.7	MS	3.5	MR	R	R
3	CoH 08264	5.8	MS	4.2	MR	R	R
4	CoPb 08217	5.3	MS	3.8	MR	R	R
5	CoS 08234	3.8	MR	3.5	MR	R	R
6	CoS 08235	3.9	MR	3.3	MR	R	R
7	CoS 767	7.2	S	8.4	HS	S	S
8	CoS 8436	3.4	MR	3.1	MR	R	R
9	CoPant 97222	5.7	MS	5.4	MS	S	S
IVT (Early)							
1	Co 10035	3.9	MR	3.5	MR	R	R
2	CoH 10261	4.9	MS	3.4	MR	R	R
3	CoS 10231	3.6	MR	3.7	MR	R	R
4	CoJ 64	8.4	HS	8.2	HS	S	S
5	Co Pant 84211	6.2	S	8.1	HS	S	S

IVT (Midlate)							
1	Co 10036	3.8	MR	4.3	MS	R	R
2	Co 10037	4.6	MS	3.8	MR	R	R
3	Co 10039	3.8	MR	3.5	MR	R	R
4	CoH 10262	3.7	MR	3.4	MR	R	R
5	CoH 10263	8.3	HS	6.7	S	S	S
6	CoPant 10221	3.5	MR	3.3	MR	R	R
7	CoPb 10181	3.8	MR	3.3	MR	R	R
8	CoPb 10182	3.9	MR	3.6	MR	R	R
9	CoPb 10183	4.0	MR	3.5	MR	R	R
10	CoPb 10211	3.5	MR	3.3	MR	R	R
11	CoS 767	7.2	S	8.4	HS	S	S
12	CoS 8436	3.4	MR	3.1	MR	R	R
13	CoPant 97222	5.7	MS	5.4	MS	S	S

	***Score**	**** Reaction**
Date of inoculation : 26.08.2013	0-2	R (Resistant)
Date of Observation: 26.10.2013	2.1-4	MR (Moderately Resistant)
Pathotypes/Isolates used:-	4.1-6	MS (Moderately Susceptible)
CF-08 from CoJ 84	6.1-8	S (Susceptible)
CF-09 from CoS 767	> 8	HS (Highly Susceptible)

Table PP- 3: Evaluation of sugarcane genotypes for smut resistance- Kapurthala (PAU)

S.No.	Genotypes	Score	Reaction	S.No.	Genotypes	Score	Reaction
AVT (Early) Plant I				**IVT (Early)**			
1	CoH 09262	8.0	MR	1	Co 10035	22.5	S
2	CoH 09263	23.5	S	2	CoH 10261	7.0	MR
3	CoLk 09202	13.5	MS	3	CoS 10231	8.5	MR
4	CoPb 9181	15.0	MS	4	CoJ 64	24.5	S
5	CoS 09246	14.0	MS	5	CoPant 84211	25.0	S
6	CoJ 64	24.5	S	**IVT (Midlate)**			
7	CoPant 84211	25.0	S	1	Co 10036	9.0	MR
AVT (Early) Plant II				2	Co 10037	8.5	MR
				3	Co 10039	8.0	MR
1	CoPb 08211	11.0	MS	4	CoH 10262	9.0	MR
2	CoPb 08212	8.5	MR	5	CoH 10263	24.0	S
3	CoS 08233	16.0	MS	6	CoPant 10221	8.0	MR
4	CoJ 64	24.5	S	7	CoPb 10181	9.5	MR
5	CoPant 84211	25.0	S	8	CoPb 10182	12.5	MS
AVT (Mid Late) Plant I				9	CoPb 10183	9.5	MR
1	Co 09022	13.0	MS	**10**	CoPb 10211	12.0	MS
2	CoH 09264	15.5	MS	11	CoS 767	22.0	S
3	CoLk 09204	17.0	MS	12	CoS 8436	12.5	MS
4	CoPb 09214	13.5	MS	13	CoPant 97222	14.0	MS
5	CoS 09232	12.0	MR	**Standards**			
6	CoS 767	22.0	S	1	Co 740	32.0	HS
7	CoS 8436	12.5	MS	2	Co 1158	35.0	HS
8	CoPant 97222	14.0	MS	3	Co 7915	8.5	MR
AVT (Mid Late) Plant II				4	Co 62175	34.0	HS
1	CoH 08262	13.0	MS	5	NCO 310	33.5	HS
2	CoH 08263	15.5	MS	6	Katha	36.5	HS
3	CoH 08264	13.5	MS	Disease incidence Nil	=	R (Resistant)	
4	CoPb 08217	15.5	MS	Disease incidence 0.1-10%	=	MR(Moderate Resistant)	
5	CoS 08234	14.0	MS	Disease incidence 10.1% - 20%	=	MS (Moderate Susceptible)	
6	CoS 08235	15.5	MS				
7	CoS 767	22.0	S	Disease incidence 20.1- 30%	=	S (Susceptible)	
8	CoS 8436	12.5	MS				
9	CoPant 97222	14.0	MS	Disease incidence > 30 %	=	HS (Highly susceptible)	

Table PP-4: Evaluation of sugarcane genotypes for wilt resistance- Kapurthala (PAU)

S.No.	Genotypes	Score	Reaction	S.No.	Genotypes	Score	Reaction
AVT (Early) Plant I				**IVT (Early)**			
1	CoH 09262	1.0	MR	1	Co 10035	1.0	MR
2	CoH 09263	1.0	MR	2	CoH 10261	0.0	R
3	CoLk 09202	0.0	R	3	CoS 10231	0.0	R
4	CoPb 9181	1.0	MR	4	CoJ 64	0.0	R
5	CoS 09246	1.0	MR	5	CoPant 84211	1.0	MR
6	CoJ 64	0.0	R	**IVT (Midlate)**			
7	CoPant 84211	1.0	MR	1	Co 10036	1.0	MR
AVT (Early) Plant II				2	Co 10037	1.0	MR
1	CoPb 08211	1.0	MR	3	Co 10039	1.0	MR
2	CoPb 08212	0.0	R	4	CoH 10262	0.0	R
3	CoS 08233	0.0	R	5	CoH 10263	0.0	R
4	CoJ 64	0.0	R	6	CoPant 10221	0.0	R
5	CoPant 84211	1.0	MR	7	CoPb 10181	0.0	R
AVT (Mid Late) Plant I				8	CoPb 10182	0.0	R
1	Co 09022	0.0	R	9	CoPb 10183	1.0	MR
2	CoH 09264	0.0	R	**10**	CoPb 10211	0.0	R
3	CoLk 09204	2.0	MS	11	CoS 767	2.0	MS
4	CoPb 09214	0.0	R	12	CoS 8436	0.0	R
5	CoS 09232	0.0	R	13	CoPant 97222	0.0	R
6	CoS 767	2.0	MS	**Standards**			
7	CoS 8436	0.0	R	1	Co 7717	4.0	HS
8	CoPant 97222	0.0	R	2	Co 89003	4.0	HS
AVT (Mid Late) Plant II							
1	CoH 08262	3.0	S				
2	CoH 08263	1.0	MR				
3	CoH 08264	2.0	MS				
4	CoPb 08217	1.0	MR				
5	CoS 08234	1.0	MR				
6	CoS 08235	2.0	MS				
7	CoS 767	2.0	MS				
8	CoS 8436	0.0	R				
9	CoPant 97222	0.0	R				

Grade		Reaction
0	**=**	**R**
1	**=**	**MR**
2	**=**	**MS**
3	**=**	**S**
4	**=**	**HS**

PP- 5: Survey of sugarcane diseases naturally occurring in the Punjab State on important sugarcane varieties

Name of disease	Location	Disease incidence	Varieties affected	Crop stage when observed
Red rot	Dhuri, Ajanala, Amloh, ButtarSevian, Morinda, Nawanshahr, Budhewal	Traces to 8.5%	CoS 8436, CoJ 64, CoJ 85, Co 89003	5 Months (July)
Wilt	Dhuri, Amloh, Buttar Sevian, Gurdaspur, Batala, Ajanala	Traces to 8%	Co 89003	9 Months (November)
Smut	Batala, Fazilka	Traces	Co 89003 CoJ 88 Co 238	3 Months (May) 8 Months (October)
Bacterial red stripe disease/ top rot.	Batala, Gurdaspur, Buttar Sevian , Bhogpur, Mukerian	Traces to 3%	CoJ 85	5 Months (July)

Table PP- 6: Assessment of elite and ISH genotypes for resistance to red rot by plug method.

Sr. No.	Variety / Treatment	CF 08		CF 09	
		Score	Reaction	Score	Reaction
1.	ISH 01	3.6	MR	3.3	MR
2.	ISH 07	3.7	MR	3.3	MR
3.	ISH 12	8.5	HS	3.4	MR
4.	ISH 31	7.3	S	7.6	S
5.	ISH 49	4.6	MS	3.7	MR
6.	ISH 88	9.0	HS	9.0	HS
7.	ISH 105	3.4	MR	8.2	HS
8.	ISH 108	3.3	MR	3.8	MR
9.	ISH 113	3.3	MR	3.2	MR
10.	ISH 114	9.0	HS	8.4	HS
11.	ISH 115	4.7	MS	4.5	MS
12.	ISH 117	3.5	MR	7.2	S
13.	ISH 118	3.3	MR	3.2	MR
14	ISH 119	3.4	MR	3.6	MR
15	ISH 135	3.6	MR	3.8	MR
16	ISH 137	7.5	S	3.8	MR
17.	ISH 144	3.8	MR	8.4	HS
18.	ISH 148	3.3	MR	3.5	MR
19	ISH 159	3.5	MR	7.5	S
20	ISH 185	3.4	MR	8.5	HS
21	ISH 187	8.5	HS	8.8	HS
22	ISH 191	4.4	MS	3.7	MR
23	ISH 193	5.5	MS	6.5	S
24	ISH 203	3.7	MR	3.2	MR
25	ISH 211	3.4	MR	3.6	MR
26	ISH 224	4.5	MS	3.4	MR
27	ISH 260	3.7	MR	3.4	MS
28	ISH 264	3.4	MR	3.3	MR
29	ISH 265	8.4	HS	8.7	HS
30	ISH 267	8.8	HS	8.5	HS
31	ISH 269	4.2	MR	3.5	MR
32	ISH 273	8.7	HS	8.6	HS
33	ISH 277	3.6	MR	3.4	MR
34	ISH 281	4.2	MS	8.4	HS
35	ISH 282	7.6	S	8.5	HS
36	ISH 284	8.5	HS	3.5	MR
37	ISH 286	3.6	MR	3.8	MR
38	ISH 287	8.5	HS	3.5	MR
39	ISH 308	8.7	HS	8.3	HS
40	ISH 309	5.8	MS	8.5	HS
41	ISH 313	3.8	MR	8.8	HS
42	ISH 314	5.2	MS	8.5	HS
Date of inoculation: 28/08/2013 Date of Observation: 28/10/2013			Pathotypes/ Isolates used CF-08 from CoJ 84, CF-09 from CoS 767		

ENTOMOLOGY

I. Evaluation of varieties for their reaction against major insect pests.

Project No.	**E. 4.1**
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.

Technical Report:

Genotypes	Zonal Varietal Trials, 37 entries
Design	RBD
Replications	Three
Plot size	27 sq. m.
Date of planting	22-3-2013

Thirty seven genotypes comprising of thirteen early maturing (three under IVT E, five under AVT E I plant and three under AVT E II plant) and twenty four late maturing (ten under IVT ML, five 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 one genotype viz. CoS 09246 showed moderately susceptible) ranged from 0.00 to 5.00 (CoPb

09263 and Co 09022). The other genotypes showed early shoot borer incidence ranged from 5.68 to 10.00 (CoPb 10181, Co 10035, CoH 10261, CoS 10231, CoJ 64, CoPant 84211, CoH 09262, CoLk 09202, CoPb 09181, CoPb 08211, CoPb 08212, CoS 08233, Co 10036, Co 10037, Co 10039, CoH 10262, CoH 10263, CoPant 10221, CoPb 10182, CoPb 10183, CoPb 10211, CoS 767, CoS 8436, CoPant 97222, CoH 09264, CoLk 09204, CoPb 09214, CoS 09232, CoH 08262, CoH 08263, CoH 08264, CoPb 08217, CoS 08234 and CoS 08235). Only one genotype viz. CoS 09246 (IVT E I) showed moderately susceptible to early shoot borer incidence was above fifteen percent (Table1). The cumulative incidence of top borer was recorded less susceptible to moderate susceptible. However, it ranged from 4.44 per cent in CoH 09262 (IVT E I) to 10.71 per cent in CoPant 10221 (AVT ML) in all the genotypes evaluated which exhibited low to moderately susceptible reaction against top borer. The per cent incidence of stalk borer ranged from 2.67 per cent in CoS 08235 (AVT ML II) to 12.00 per cent in CoPant 084211 (AVT E I). However, the genotypes under six different group showed less susceptible reaction to stalk borer (0.01-0.16 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 4.44 to 10.71 per cent. The genotypes tested also showed less than two per cent infestation index reaction to the stalk borer.

II. Survey and Surveillance of insect pests of Sugarcane

Project No.	**E. 28**
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.*, CoJ 85, Co 238 and Co 89003 around sugar factories at Nawansahar, Budhewal and Dhuri. The incidence of early shoot borer, top borer and stalk borer ranged between 5-8, 7-10 and 7-9

per cent, respectively, in different varieties of sugarcane *viz.*, CoJ 85, CoJ 83, CoJ 88, Co 238, CoH 119, Co 89003 and CoS 8436 in different cane growing areas of Punjab. The incidence of pyrilla, whitefly, mite, mealy bug and black bug were found in traces (Table 2).

Summary

Most of the sugar mill areas surveyed exhibited low insect pest incidence. Early shoot borer, top borer, stalk borer and termite were recorded as major insects in sugarcane. The per cent incidence of early shoot borer, top borer, stalk borer and termite varied from low to moderate range. The incidence of pyrilla, whitefly, mite, mealy bug and black bug were found in traces.

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

Project No.	**E. 30**
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	20.03.13
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 was recorded. The early shoot borer incidence started from 2nd week of May and reached its peak level of 9.0 per cent in 2nd week of July which thereafter, declined to 3.0 per cent in the 2nd week of August. The activity of predator *Cheilomenes sexmaculata* (1-2 predator/plant) was observed against early shoot borer in 2nd week of June to July. The top

borer incidence started from month of July and reached to its peak level of 10.2 per cent in 2nd week of September. Thereafter, top borer incidence decreased to 5.6 per cent in the 2nd fortnight of October. The bio-agents *viz., Isotima javensis* and *Stenobracon* sp. were recorded as 1.2 and 2.0 per cent in the month of July, respectively and 2.5 and 1.0 per cent in the month of August, respectively. The stalk borer incidence started from last week of August and reached to its peak level of 8.8 per cent in the month of October and thereafter, stalk borer incidence declined. Parasitization by bio-agents *viz*., *Sturmiopsis inference* and *Cotesia flavipes* were observed 1.0 and 2.0 percent in the month of September, respectively and again *Cotesia flavipes* 1 per cent was observed in the month of October. The activity of pyrilla on sugarcane initiated from first 1st week of August and continued up to last week of October. Activity of bio-agent *viz., Epiricania melanoleuca* 2 per cent parasitization was observed in the month of September and 1 per cent observed in month of October (Table 3).

Summary

The incidence of early shoot borer ranged from 3 to 9.0 per cent from 2nd week of May to August. The activity of predator *Cheilomenes sexmaculata* (1-2 predator/plant) was observed against early shoot borer in 2nd week of June to July. Top borer incidence was 5.6 and 10.2 per cent in the month of July to 2nd fortnight of October. Stalk borer incidence varied from 2.0 to 8.8 per cent from last week August to December. The bio-agents *viz., Isotima javensis* and *Stenobracon* sp. were recorded as 1.2 and 2.0 per cent in the month of July, respectively and 2.5 and 1.0 per cent in the month of August, respectively. The stalk borer incidence started from last week of August and reached to its peak level of 8.8 per cent in the month of October Parasitization by bio-agents *viz*., *Sturmiopsis inference* and *Cotesia flavipes* were observed 1.0 and 2.0 percent in the month of September, respectively and again *Cotesia flavipes* 1 per cent was observed in the month of October. The activity of Pyrilla on sugarcane initiated from first 1st week of August and continued up to last week of October. Activity of its bio-agent *viz., Epiricania melanoleuca* 2 per cent parasitization was observed in the month of September and 1 per cent observed in month of October.

IV. Management of borer complex of sugarcane through lures

Project:	**E.36**
Location:	Punjab Agricultural University, Regional Research Station, Kapurthala.
Title:	Management of borer complex of sugarcane through lures.
Objective:	To manage sugarcane borers (early shoot borer, top borer and stalk borer) through pheromone traps
Year of start:	2008-09
Variety:	CoJ 88
Date of planting:	22.03.2013
Area:	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 the 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 18th MW (Monthly Week) (first week of May) to 38th MW (Third week of September). Thereafter, it was found to be nil up to 8th MW (3rd week of February 2014). The highest number of early shoot borer catches (9 moths/trap) trapped in 25th MW (third week of June) when maximum and minimum temperature was 41.3 and 27.9 ^{0}C. The early shoot borer moth catches were positively (r = 0.52 and 0.42) correlated with maximum and minimum temperature, respectively, while it was negatively correlated with morning relative humidity (r = -0.35), evening relative humidity (r = -0.12) and rainfall (r = -0.13) (Table 4 and 5). Incidence of early shoot borer in treatment and control plots was 5.67 and 7.87 per cent, respectively, Thus there was reduction of 27.95 per cent in the incidence of early shoot borer by lure alone (Table 6).

Activity of top borer started from 23rd MW (first week of June) to 43rd MW (last week of October) and thereafter, it was found to be nil up to the harvest of crop. The highest number of top borer catches (6 moths/trap) trapped during 31th MW (first week of August) when maximum and minimum temperature was 35.9 and 26.4 ^{0}C. The top borer moth catches were positively (r = 0.32 and 0.39) correlated with maximum and minimum temperature,

respectively, and also positively correlated with morning and evening relative humidity (r = 0.04 and 0.17), while it was negatively correlated with rain fall (r = -0.08). Incidence of top borer in treatment and control plots was 6.87 and 8.91 per cent, respectively, Thus there was reduction of 22.89 per cent in the incidence of top borer by lure.

The activity of stalk borer started from 36th MW (first week of September) to 1st MW (first week of January), thereafter, it was found to be nil up to the harvest of crop. The highest number of stalk borer catches (4 moths/trap) were trapped in 40th MW (first week of October) when maximum and minimum temperature were 35.9 and 18.1 ^{0}C. The stalk borer moth catches were positively correlated with (r = 0.06) with maximum temperature, morning relative humidity (r = 0.25) while it was negatively correlated with (r = -0.15) with minimum temperature and evening relative humidity (r = -0.02) and rainfall (r = -0.11) (Table 4 and 5). Incidence of stalk borer in treatment and control plots was 8.21 and 9.23 per cent, respectively, Thus there was reduction of 11.05 per cent in the incidence of stalk borer by pheromone (Table 6).

Summary

The activity of early shoot borer started from first week of May to third week of September. The highest numbers of early shoot borer were trapped in third week of June Incidence of early shoot borer in treatment and control plots was 5.67 and 7.87 per cent, respectively, Thus there was reduction of 27.95 per cent by lure alone. The activity of top borer was started from first week of June to last week of October. The highest numbers of top borer were trapped in first week of August. Incidence of top borer in treatment and control plots was 6.87 and 8.91 per cent, respectively, Thus there was reduction of 22.89 per cent in the incidence of top borer by lure. The activity of stalk borer started from first week of September to first week of January. The highest numbers of stalk were trapped in first week of October. Incidence of stalk borer in treatment and control plots was 8.21 and 9.23 per cent, respectively, Thus there was reduction of 11.05 per cent in the incidence of stalk borer.

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

Project:	**E.37.**
Location:	Punjab Agricultural University, Regional Research Station, Kapurthala.
Title:	Bioefficacy of new insecticides for the control of sugarcane early shoot borer.
Objective:	To find out effective strategy for the management of sugarcane early shoot borer
Year of start:	2013-14
Variety:	CoJ 88
Date of planting:	28.03.2013
Area:	800 sq m

An experiment was conducted to test the efficacy of different insecticidal treatments against sugarcane early shoot borer (*Chilo infuscatellas* Snellen) at Punjab Agricultural University, Regional Research Station, Kapurthala during spring 2013-14. 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 24 SC @ 250 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 (1.63%). Its application also resulted in significant increase for germination percentage (33.7%), cane yield (89.67t/ha), total cane height (281.33 cm), sucrose percent in juice (17.91%) and Commercial Cane Sugar (CCS) (12.77%). This was followed by Chlorantraniliprole 0.4G @ 22.5 kg/ha treatment having percent incidence of early shoot borer (2.28%) and thereby increased other parameters significantly *viz.* germination percentage (31.97%), cane yield (88.23t/ha), total cane height (279.67 cm), sucrose percent in juice (17.85%) and CCS (12.75%) (Table 7). The corresponding values for incidence of ESB and other parameters in control treatment were percent incidence of early shoot borer highest

(8.74%) and minimum germination percentage (21.89%), cane yield (76.33t/ha), total cane height (266.33 cm), sucrose percent in juice (16.78%) and CCS (11.94%), 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 germination percentage, cane yield, total cane height, sucrose (% in juice) and CCS (%) closely followed by the insecticides, Chlorantraniliprole 0.4G @ 22.5 kg, Flubendiamide 24 SC @ 250 ml/ha, Spinosad 45SC @ 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 4.44 to 10.71 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. Early shoot borer, top borer, stalk borer and termite were recorded as major insects in sugarcane. The per cent incidence of early shoot borer, top borer, stalk borer and termite varied from low to moderate range. The incidence of pyrilla, whitefly, mite, mealy bug and black bug were found in traces.
3. The incidence of early shoot borer ranged from 3 to 9.0 per cent from 2nd week of May to August. The activity of predator *Cheilomenes sexmaculata* (1-2 predator/plant) was observed against early shoot borer in 2nd week of June to July. Top borer incidence was 5.6 and 10.2 per cent in the month of July to 2nd fortnight of October. Stalk borer incidence varied from 2.0 to 8.8 per cent from last week August to December. The bio-agents *viz.*, *Isotima javensis* and *Stenobracon* sp. were recorded as 1.2 and 2.0 per cent in the month of July, respectively and 2.5 and 1.0 per cent in the month of August, respectively. The stalk

borer incidence started from last week of August and reached to its peak level of 8.8 per cent in the month of October Parasitization by bio-agents *viz*., *Sturmiopsis inference* and *Cotesia flavipes* were observed 1.0 and 2.0 percent in the month of September, respectively and again *Cotesia flavipes* 1 per cent was observed in the month of October. The activity of Pyrilla on sugarcane initiated from first 1st week of August and continued up to last week of October. Activity of its bio-agent *viz., Epiricania melanoleuca* 2 per cent parasitization was observed in the month of September and 1 per cent observed in month of October.

4. The activity of early shoot borer started from first week of May to third week of September. The highest numbers of early shoot borer were trapped in third week of June Incidence of early shoot borer in treatment and control plots was 5.67 and 7.87 per cent, respectively, Thus there was reduction of 27.95 per cent by lure alone. The activity of top borer was started from first week of June to last week of October. The highest numbers of top borer were trapped in first week of August. Incidence of top borer in treatment and control plots was 6.87 and 8.91 per cent, respectively, Thus there was reduction of 22.89 per cent in the incidence of top borer by lure. The activity of stalk borer started from first week of September to first week of January. The highest numbers of stalk were trapped in first week of October. Incidence of stalk borer in treatment and control plots was 8.21 and 9.23 per cent, respectively, Thus there was reduction of 11.05 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 germination percentage, cane yield, total cane height, sucrose (% in juice) and CCS (%) closely followed by the insecticides, Chlorantraniliprole 0.4G @ 22.5 kg, Flubendiamide 24 SC @ 250 ml/ha, Spinosad 45SC @ 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

Sr. No	Genotype	Shoot borer	Top borer incidence (%)			Stalk borer		
		Cumulative percent Incidence	III Brood	IV Brood	Cumulative	Incidence (%)	Intensity (%)	Infestation index
IVT Varietal Trial (Early)								
1	Co 10035	6.82	5.56	1.05	6.61	8.00	0.75	0.06
2	CoH 10261	6.32	6.93	0.99	7.92	5.33	0.67	0.04
3	CoS 10231	7.61	4.35	2.17	6.52	6.67	1.00	0.07
CK	CoJ 64	8.24	7.06	2.35	9.41	9.33	1.00	0.09
	CoPant 84211	7.23	6.02	2.41	8.43	10.67	1.17	0.12
CD (0.05)		0.23	0.46	0.08	0.54	0.90	0.19	0.01
AVT Varietal Trial (Early I plant)								
1	CoH 09262	7.78	2.22	2.22	4.44	5.33	0.58	0.03
2	CoPb 09263	4.94	3.70	2.47	6.17	5.33	0.67	0.04
3	CoLk 09202	8.14	5.81	1.16	6.98	9.33	0.58	0.05
4	CoPb 09181	6.98	6.17	2.47	8.64	5.33	0.75	0.04
5	CoS 09246	15.12	3.49	1.16	4.65	6.67	0.42	0.03
CK	CoJ 64	7.61	8.14	2.17	10.31	10.67	1.17	0.12
	CoPant 84211	9.57	5.32	3.19	8.51	12.00	1.33	0.16
CD (0.05)		1.35	1.07	0.54	0.86	1.07	0.25	0.04
AVT Varietal Trial (Early II plant)								
1	CoPb 08211	7.37	5.26	4.21	9.47	8.00	0.83	0.07
2	CoPb 08212	6.67	3.33	2.22	5.56	5.33	0.58	0.03
3	CoS08233	8.75	5.00	3.75	8.75	8.00	0.83	0.07
CK	CoJ 64	9.76	7.32	2.50	9.82	9.33	1.08	0.10
	CoPant 84211	10.00	5.00	3.85	8.85	10.67	1.00	0.11
CD (0.05)		0.78	0.54	0.35	0.42	1.14	0.18	0.03
IVT Varietal Trail (Mid late)								
1	Co 10036	6.52	4.35	3.26	7.61	6.67	0.83	0.06
2	Co 10037	7.32	6.10	3.66	9.76	5.33	0.67	0.04
3	Co 10039	10.00	7.50	2.50	10.00	6.67	0.75	0.05
4	CoH 10262	9.20	4.44	2.22	6.67	5.33	0.67	0.04
5	CoH 10263	8.05	5.75	3.45	9.20	8.00	0.83	0.07
6	CoPant 10221	7.79	8.33	2.38	10.71	6.67	0.92	0.06
7	CoPb 10181	5.68	5.00	2.50	7.50	8.00	0.83	0.07
8	CoPb 10182	6.90	4.60	3.45	8.05	6.67	0.75	0.05
9	CoPb 10183	8.05	6.25	2.47	8.72	8.00	0.83	0.07
10	CoPb 10211	6.90	5.75	3.49	9.24	6.67	0.67	0.04
CK	CoS 767	8.54	7.23	2.41	9.64	10.67	1.00	0.11
	CoS 8436	8.86	7.59	1.27	8.86	10.67	1.33	0.14
	CoPant 97222	9.41	5.88	3.53	9.41	9.33	1.00	0.09
CD (0.05)		0.62	0.64	0.35	0.56	0.87	0.09	0.01

(Contd…)

Table 1. Screening of varieties for resistance to insect pests (contd)

AVT Varietal Trial (Mid late I plant)								
1	Co 09022	4.88	4.88	1.22	6.10	6.67	0.75	0.05
2	CoH 09264	6.82	5.68	3.41	9.09	9.33	0.83	0.08
3	CoLk 09204	6.67	4.44	2.22	6.67	8.00	0.92	0.07
4	CoPb 09214	7.23	6.02	2.41	8.43	8.00	1.17	0.09
5	CoS 09232	6.67	5.56	1.11	6.67	6.67	0.83	0.06
CK	CoS 767	8.24	7.37	1.05	8.42	10.67	1.17	0.12
	CoS 8436	7.95	5.68	2.27	7.95	10.67	1.08	0.12
	CoPant 97222	7.41	8.64	1.23	9.88	9.33	0.92	0.09
CD (0.05)		0.69	0.91	0.57	0.88	1.07	0.11	0.02
AVT Varietal Trial (Mid late II plant)								
1	CoH 08262	6.90	5.75	2.30	8.05	8.00	0.58	0.05
2	CoH 08263	6.67	6.67	1.11	7.78	5.33	0.50	0.03
3	CoH 08264	7.78	5.56	3.33	8.89	5.33	0.75	0.04
4	CoPb 08217	7.14	4.76	2.38	7.14	8.00	0.83	0.07
5	CoS 08234	7.45	6.38	1.06	7.45	6.67	0.67	0.04
6	CoS 08235	7.29	6.25	3.13	9.38	2.67	0.50	0.01
CK	CoS 767	8.33	7.45	2.13	9.57	10.67	0.92	0.10
	CoS 8436	7.95	6.82	1.14	7.95	9.33	1.00	0.09
	CoPant 97222	9.09	6.49	2.60	9.09	10.67	1.17	0.12
CD (0.05)		0.47	0.49	0.53	0.55	1.66	0.14	0.02

Grade

Pest	LS	MS	HS
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 2013-14

S. No.	Varieties	Location	Name of Pest	Per cent incidence	Remark
1.	CoJ 85, Co 238, Co 89003	Nawanshahar, Budhewal, Dhuri	Termite	1-2	Termite damage was more in sandy soil
2.	CoJ 85 CoJ 83 CoJ 88 Co 238 CoH 119 Co 89003	Nawanshahar,`Phagwara Ajnala, Gurdaspur , Dhuri, Budhewal , Bhogpur	Early shoot borer	5-8	Late planting of sugarcane showed more incidence of early shoot borer
3.	Co 238	Budhewal , Bhogpur , Phagwara, Ajnala, Gurdaspur, Mukerian, Dhuri, Morinda	Top borer	13-16	Top borer incidence was higher in variety Co 238 -
	CoJ 85 CoJ 88, CoH 119 CoS 8436	Budhewal , Bhogpur , Phagwara, Ajnala, Gurdaspur, Mukerian, Dhuri, Morinda	Top borer	7-10	
4.	CoJ 85 CoJ 88 Co 238 CoH 119 CoS 8436	Gurdaspur, Phagwara, Ajnala, Mukerian, Dhuri. Nawanshahar, Budhewal	Pyrilla	Traces	-
5.	CoJ 85 CoJ 88 Co 238	Mukerian, Nawanshahar Budhewal	Whitefly	Traces	-
6.	CoJ 85 Co 238	Faridkot, Abohar	Mite	Traces	-
7.	Co 238 CoH 119 CoS 8436	Phagwara, Gurdaspur, Mukerian	Mealy bug	Traces	-
8.	CoJ 85 Co 238 CoH 119 CoS 8436	Ludhiana, Gurdaspur , Phagwara, Mukerian	Black bug	Traces	-
9.	CoJ 85 CoJ 83 CoJ 88 Co 238 CoS 8436	Nawanshahar, Phagwara, Ajnala, Gurdaspur, Mukerian, Budhewal , Morinda	Stalk borer	7-9	Stalk borer incidence was declined with recommendation of new insecticide in the state

Table 3. Incidence of insect pests and bioagents in sugarcane (2013-14)

Month	**Percent incidence of early shoot borer**	Predator (ESB)/ per plant	**Percent incidence of Top borer**	Percent parasitism (Tb)		**Percent incidence of Stalk borer**	Percent parasitism (Stb)		**Percent incidence of Pyrilla**	Percent parasitism (Pyrilla)
		Cheilomenes sexmaculata		*Isotima javensis*	*Stenobracon* sp.		*Sturmiopsis inference*	*Cotesia flavipes*		*Epiricania melanoleuca*
April, 12	-	-	-	-	-	-	-	-	-	-
May, 12	4.5	-	-	-	-	-	-	-	-	-
June, 12	5.8	1.0	-	-	-	-	-	-	-	-
July, 12	9.0	2.0	6.4	1.2	2.0	-	-	-	-	-
August,12	3.0	-	9.8	2.5	1.0	Traces	-	Traces	Traces	Traces
September, 12	-	-	10.2	-	-	6.8	1.0	2.0	2.0	2.0
October, 12	-	-	5.6	-	-	8.8	-	1.0	1.0	1.0
November, 12	-	-	-	-	-	6.0	Traces	-	-	-
December, 12	-	-	-	-	-	2.0	-	-	-	-
January, 12	-	-	-	-	-	-	-	-	-	-

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 (2013-14)

Standard Week	Date	Early shoot borer	Top borer	Stalk borer	Average Temperature °C		Average Relative Humidity %		Total Rain fall (mm)
					Max	Min	Morning	Evening	
12	**22.03.13**	0.00	0.00	0.00	27.5	15.0	92.3	50.7	30.2
13	**29.03.13**	0.00	0.00	0.00	33.0	15.8	87.0	36.1	0.0
14	**5.04.13**	0.00	0.00	0.00	36.9	16.8	75.7	23.4	10.6
15	**12.04.13**	0.00	0.00	0.00	32.3	15.8	64.9	18.3	11.8
16	**19.04.13**	0.00	0.00	0.00	36.4	16.9	48.1	24.4	9.8
17	**26.04.13**	0.00	0.00	0.00	35.4	15.1	54.1	23.6	14.0
18	**3.05.13**	1.00	0.00	0.00	38.3	18.3	44.3	18.3	0.0
19	**10.05.13**	3.00	0.00	0.00	41.4	22.1	59.9	34.1	0.0
20	**17.05.13**	1.00	0.00	0.00	41.8	24.1	46.0	21.7	0.0
21	**24.05.13**	4.00	0.00	0.00	42.9	23.1	51.9	34.6	0.0
22	**31.05.13**	8.00	0.00	0.00	44.0	25.0	69.6	42.0	0.0
23	**7.06.13**	4.00	1.00	0.00	41.9	24.2	76.4	52.4	0.0
24	**14.06.13**	5.00	3.00	0.00	43.2	26.4	79.7	58.7	0.0
25	**21.06.13**	9.00	1.00	0.00	41.3	27.9	77.0	50.6	0.0
26	**28.06.13**	2.00	1.00	0.00	40.6	28.4	81.4	58.1	0.0
27	**5.07.13**	1.00	0.00	0.00	37.3	26.9	83.9	70.3	7.2
28	**12.07.13**	0.00	0.00	0.00	36.1	26.9	80.6	60.0	29.0
29	**19.07.13**	0.00	0.00	0.00	37.9	26.1	84.3	69.3	7.6
30	**26.07.13**	0.00	2.00	0.00	36.1	26.9	83.3	60.9	6.2
31	**2.08.13**	1.00	6.00	0.00	35.9	26.4	87.1	76.9	8.4
32	**9.08.13**	0.00	1.00	0.00	34.4	25.6	88.9	71.9	6.6
33	**16.08.13**	0.00	0.00	0.00	35.1	26.5	91.1	71.1	31.3
34	**23.08.13**	0.00	0.00	0.00	33.8	25.6	88.6	62.3	12.4
35	**30.08.13**	0.00	0.00	0.00	36.3	25.6	86.1	57.6	9.4
36	**6.09.13**	0.00	3.00	2.00	34.5	25.1	85.6	66.3	21.4
37	**13.09.13**	0.00	0.00	0.00	32.1	23.7	85.9	53.1	212.2
38	**20.09.13**	1.00	0.00	1.00	34.1	21.0	90.1	63.6	0.0
39	**27.09.13**	0.00	2.00	3.00	35.9	19.7	86.4	60.0	0.0
40	**4.10.13**	0.00	0.00	4.00	35.9	18.1	92.7	65.9	0.0
41	**11.10.13**	0.00	3.00	1.00	33.7	15.2	93.3	53.4	0.2
42	**18.10.13**	0.00	0.00	2.00	32.7	13.6	89.3	35.4	3.4
43	**25.10.13**	0.00	1.00	0.00	30.3	11.9	89.6	37.0	0.0
44	**1.11.13**	0.00	0.00	1.00	32.1	12.9	88.7	41.1	0.0
45	**8.11.13**	0.00	0.00	0.00	28.9	10.2	93.4	36.9	0.0
46	**15.11.13**	0.00	0.00	3.00	27.6	7.9	90.7	32.1	0.0
47	**22.11.13**	0.00	0.00	1.00	26.8	6.4	93.7	38.4	0.0
48	**29.11.13**	0.00	0.00	3.00	24.1	5.0	92.1	43.9	0.0
49	**6.12.13**	0.00	0.00	0.00	25.1	4.9	93.0	46.1	0.0
50	**13.12.13**	0.00	0.00	0.00	20.6	6.2	94.1	66.7	13.0
51	**20.12.13**	0.00	0.00	0.00	17.5	4.9	95.4	64.9	0.0
52	**27.12.13**	0.00	0.00	0.00	13.1	6.6	92.4	53.3	0.0
1	**3.01.14**	0.00	0.00	1.00	11.4	3.6	94.1	72.4	0.0
2	**10.01.14**	0.00	0.00	0.00	20.9	2.2	93.1	77.1	0.0
3	**17.01.14**	0.00	0.00	0.00	18.8	3.9	97.7	85.4	9.6
4	**24.01.14**	0.00	0.00	0.00	21.6	1.5	97.4	80.0	0.0
5	**31.01.14**	0.00	0.00	0.00	21.1	6.1	95.6	83.6	0.0
6	**7.02.14**	0.00	0.00	0.00	23.0	3.3	94.3	76.0	0.0
7	**14.02.14**	0.00	0.00	0.00	20.5	7.9	92.6	77.4	24.8
8	**21.02.14**	0.00	0.00	0.00	20.7	9.2	92.9	76.4	63.0

Table 5. Correlation of weather parameters with moth catches (2013-14)

Correlation coefficient	Early shoot borer	Top borer	Stalk borer
Maximum Temperature	0.52	0.32	0.06
Minimum Temperature	0.42	0.39	-0.15
Relative Humidity % (Morning)	-0.35	0.04	0.25
Relative Humidity % (Evening)	-0.12	0.17	-0.02
Rain fall	-0.13	-0.08	-0.11

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

Treatment	Percent incidence of Early shoot borer	Percent incidence of Top borer	Percent incidence of Stalk borer
Pheromone (treatment)	5.67	6.87	8.21
Control	7.87	8.91	9.23
Percent reduction	27.95	22.89	11.05

Table 7. Bioefficacy of new insecticides for the control of sugarcane early shoot borer during 2013-14

Treatment	Cumulative percent incidence of early shoot borer (ESB)	Germination (%)	Tillering percent at 120 (000/ha)	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	3.34	27.78	116	73.67	83.67	274.00	221.33	19.00	2.17	18.71	17.76	94.92	12.69
Chlorantraniliprole 0.4G @ 22.5 kg	2.28	31.97	125	78.33	88.23	279.67	225.30	21.00	2.21	18.82	17.85	94.86	12.75
Chlorantraniliprole 18.5 SC @ 375 ml/ha	1.63	33.37	128	81.10	89.67	281.33	226.23	21.67	2.22	18.95	17.91	94.51	12.77
Spinosad 45SC @ 90 ml/ha	3.05	29.21	118	75.09	85.16	276.00	223.33	20.00	2.18	18.71	17.81	95.21	12.74
Flubendiamide 24 SC @ 250 ml/ha	2.85	30.59	121	76.38	86.23	277.67	224.13	20.67	2.19	18.72	17.82	95.23	12.75
Phorate 10 G @ 15 kg/ha	4.31	25.00	113	72.34	81.65	272.33	217.24	18.00	2.13	18.69	17.73	94.85	12.66
Carbofuron 3 G @ 33 kg/ha	4.09	26.43	115	73.760	82.67	273.67	219.08	19.00	2.15	18.65	17.76	95.23	12.70
Control	8.74	21.89	109	66.67	76.33	266.33	212.33	17.00	2.07	17.84	16.78	94.07	11.94
CD (0.05)	0.084	0.057	0.066	3.35	2.41	6.11	4.66	1.56	0.050	0.094	0.17	NS	0.19

NS – Non Significant