ANNUAL REPORT 2015-16

ALL INDIA CO-ORDINATED RESEARCH PROJECT ON SUGARCANE

ZARS, VC FARM (UAS,BENGALORE), MANDYA (KARNATAKA)

RESULTS OF AGRONOMY AND ENTOMOLOGY TRIALS

2. AICRP on Sugarcane (Agronomy)

Experiment 1.

1. **Title: AS 64. Response of sugarcane crop to different plant nutrients in varied agro-ecological situation**
2. **Objectives:** To study the differential response of sugarcane crop to different nutrients
3. **Technical program**

Design : RBD
No. of treatments : 13
No. of replications : 3
Variety : Co-86032
Date of planting : 21-01-2015
Date of harvest : 05-02-2016

4. **Inference:**

Initial soil properties: The initial soil analysis of the experimental site indicated that, the soil was low in organic carbon (0.37%), low in available nitrogen (225 kg/ha), available P_2O_5 (18.2 kg/ha) and available K_2O (130 kg/ha). The sulphur content of the soil was optimum (12.5 ppm). While, the micro nutrients *viz.*, Mn (2.45 ppm) and Fe (2.62 ppm) were also present in sufficient quantity. Whereas, Zn content was slightly low (0.47 ppm).

Sugarcane growth and yield parameters: The germination percentage recorded at 45 DAPS was not influenced due to application of nutrients. The yield attributes *viz.*, single cane weight (2.12 kg), cane length (2.49 m), cane girth (3.90 cm), internodal length (12.70 cm), No. of internodes (26.3) and millable canes (81.57 '000/ha); and finally cane yield (149.8 t/ha) were significantly higher in treatment which received fertilizers based on soil test results as compared to no fertilizer application (Control), application of N and NP alone; and also application of NPK with Mn. But, was on par with application of all the three primary nutrients in combination with secondary and micronutrients. Among the micronutrients, application of Mn resulted in slight toxicity to crop and resulted in significantly lower cane yield (Table 1).

Sugarcane quality parameters: Cane juice was analyzed for quality parameters after harvest. The sucrose % and CCS % were not influenced significantly due to application of nutrients in isolation and in different combinations. However, sugar yield was varied significantly and soil test based fertilizer application recorded significantly higher sugar yield (21.18 t/ha) as compared to control (9.43 t/ha), N alone (11.17 t/ha), NP alone (13.99 t/ha) and application of NPK with Mn (16.66 t/ha).

Nutrient uptake by crop: The significant variation was observed in post-harvest analysis of plants for uptake of major and micro nutrients (Table 4).

Application of fertilizers based on soil test results recorded significantly higher amount of uptake of N, P and K (4446.32, 33.28 and 228.74 kg/ha, respectively) as compared to application of either N or NP or NPK or Application FYM @ 20 t/ha. However, it was on par with rest of the treatments. While, the lowest uptake of major nutrients was observed in control plot (250.60, 21.58 and 165.85 kg/ha, respectively). While, the uptake of sulphur, an important secondary nutrient was significantly higher in the treatments which receives soil application of sulphur *viz.*, NPK+S (49.85 kg/ha), NPK+S+Zn (50.12 kg/ha), NPK+S+Zn+Fe (49.52 kg/ha) and also soil application of fertilizers based on soil test results (49.36 kg/ha). While, the lowest uptake of sulphur was noticed in control plot (32.58 kg/ha) followed by application of only N (33.56 kg/ha).

The uptake of micro nutrients by sugarcane at the time of harvest was influenced significantly due to application of plant nutrients. The significantly higher uptake of Fe was registered in the treatments which received soil application of FeSO4 *i.e.* NPK+Fe (13.25 ppm/ha) NPK+S+Zn+Fe (14.12 ppm/ha) and also soil test based fertilizer application (13.28 ppm/ha). The uptake of Mn was higher in the treatments which received soil application of Mn *i.e.* NPK+Mn (4.85 ppm/ha) and NPK+S+Zn+Fe+Mn (4.92 ppm/ha). While, Zn uptake was also higher in the treatments which received soil application of $ZnSO_4$ *viz.*, NPK+Zn (0.963 ppm/ha), NPK+S+Zn (0.962 ppm/ha), NPK+S+Zn+Fe (0.972 ppm/ha) and NPK+S+Zn+Fe+Mn (0.960 ppm/ha).

Soil chemical properties after harvest of crop: Soil chemical properties *viz.*, soil pH, Electrical Conductivity and soil organic carbon content were not varied significantly due to application different plant nutrients. However, as compared to initial soil chemical properties, the soil pH, EC and OC content were slightly improved (Table 2).

Available soil nutrients status: The soil available nutrient status after harvest of the crop was varied significantly due to application of various plant nutrients (Table 2). Among the treatments significantly higher amount soil available N, P_2O_5 and K_2O were registered in the treatment which received soil application of fertilizers based on soil test results (280.12, 35.69 and 168.54 kg/ha, respectively) as compared to control, N , NP and application of FYM @ 20 t/ha. The availability of sulphur was significantly higher in the treatments which received soil application of sulphur *viz.*, NPK+S (52.36 kg/ha), NPK+S+Zn (48.59 kg/ha), NPK+S+Zn+Fe (50.21 kg/ha) and also NPK+S+Zn+Fe+Mn (52.31 kg/ha). While, the lowest soil available sulphur was noticed in control plot (32.56 kg/ha) followed by application of only N (33.69 kg/ha).

The soil availability of micronutrients after the harvest of crop was influenced significantly due to application of plant nutrients. The significantly amount of Fe was registered in the treatments which received soil application of FeSO4 *i.e.* NPK+Fe (12.45 ppm/ha) NPK+S+Zn+Fe (12.85 ppm/ha) and NPK+S+Zn+Fe+Mn (12.41 ppm/ha). The availability of Mn was higher in the treatments which received soil application of Mn *i.e.* NPK+Mn (12.36 ppm/ha) and NPK+S+Zn+Fe+Mn (12.12 ppm/ha). While, Zn uptake was also higher in the treatments which received soil application of $ZnSO_4$ *viz.*, NPK+Zn (1.85 ppm/ha), NPK+S+Zn (1.91 ppm/ha), NPK+S+Zn+Fe (1.85 ppm/ha) and NPK+S+Zn+Fe+Mn (1.93 ppm/ha).

Table 1. Yield & yield attributes of sugarcane as influenced by application of different plant nutrients.

Treatment		Germination % at 45 DAP	Single cane weight (kg)	Cane length (m)	Cane girth (cm)	Internodal length (cm)	No. of inter nodes	Millable cane ('000/ha)	Cane yield (t/ha)	Sucrose %	CCS %	CCS (t/ha)
T_1	Control (No fertilizer)	57.7	1.07	1.88	2.52	9.23	19.60	52.43	69.4	18.98	13.61	9.43
T_2	N	57.6	1.21	2.12	2.89	9.13	20.93	61.57	79.6	19.49	13.94	11.17
T_3	NP	59.1	1.37	2.26	2.94	9.90	20.60	72.54	100.7	19.35	13.89	13.99
T_4	NPK	54.6	1.83	2.38	3.40	11.33	24.13	76.57	138.9	19.60	14.15	19.65
T_5	NPK + S	57.5	1.92	2.42	3.51	12.03	24.67	78.01	141.5	19.34	13.84	19.60
T_6	NPK + Zn	58.4	1.90	2.39	3.63	11.76	24.67	78.79	141.2	18.86	13.34	18.88
T_7	NPK + Fe	58.8	1.88	2.35	3.67	10.90	24.27	76.67	137.9	19.62	13.98	19.27
T_8	NPK + Mn	56.7	1.34	2.18	3.02	10.40	19.80	72.43	118.5	19.71	14.06	16.66
T_9	NPK + S + Zn	56.5	1.93	2.34	3.77	12.23	24.67	78.17	145.9	19.92	14.18	20.69
T_{10}	NPK + S + Zn + Fe	61.0	1.95	2.45	3.87	12.27	24.33	77.32	146.5	19.50	14.00	20.52
T_{11}	NPK + S + Zn + Fe + Mn	58.2	1.53	2.24	3.24	11.03	20.17	72.96	128.1	18.85	13.33	17.06
T_{12}	STBF application	56.0	2.12	2.49	3.90	12.70	26.27	81.57	149.8	19.60	14.14	21.18
T_{13}	FYM / CPM	56.4	1.26	1.95	2.89	10.00	18.80	62.85	84.9	18.76	13.48	11.43
S.Em+		3.01	**0.11**	**0.13**	**0.16**	**0.63**	**1.22**	**4.05**	**4.71**	**0.42**	**0.33**	**0.82**
CD @ 5%		NS	**0.31**	**0.38**	**0.46**	**1.84**	**3.57**	**11.83**	**13.75**	**NS**	**NS**	**2.39**
CV (%)		9.07	**11.39**	**10.03**	**8.14**	**9.94**	**9.40**	**9.69**	**6.70**	**3.79**	**4.16**	**8.40**

STBF – Soil test based fertilizer application

Table 2. Soil properties after the harvest of crop as influenced by different plant nutrients.

Treatment	pH	EC (dS m^{-1})	OC (%)	Soil Available major nutrients (kg/ha)			Soil Available secondary nutrients (kg/ha)	Soil available micro nutrients (PPM)		
				N	P_2O_5	K_2O	S	Fe	Mn	Zn
T_1	7.62	0.235	0.258	196.98	22.69	110.62	32.56	8.56	6.12	0.72
T_2	7.53	0.268	0.351	260.21	25.36	125.12	33.69	9.12	6.85	0.81
T_3	7.62	0.256	0.359	263.21	32.15	130.21	37.52	9.25	6.47	0.78
T_4	7.56	0.271	0.385	271.58	33.25	152.36	38.89	10.15	7.18	0.75
T_5	7.42	0.274	0.392	273.56	34.12	162.31	52.36	9.52	7.52	0.89
T_6	7.63	0.275	0.386	269.58	33.89	161.24	36.12	9.62	7.15	1.85
T_7	7.38	0.268	0.385	274.50	32.87	159.85	37.14	12.45	6.95	0.92
T_8	7.64	0.253	0.368	252.36	35.62	163.32	35.62	9.41	12.36	0.78
T_9	7.82	0.271	0.412	276.39	33.74	164.21	48.59	9.25	7.25	1.91
T_{10}	7.56	0.268	0.421	275.62	32.15	168.54	50.21	12.85	7.11	1.85
T_{11}	7.45	0.258	0.353	261.25	35.21	166.25	52.31	12.41	12.12	1.93
T_{12}	7.35	0.262	0.435	280.12	35.69	175.25	38.52	9.52	6.68	0.89
T_{13}	7.21	0.240	0.321	205.69	24.52	125.52	35.2	9.05	6.52	0.78
S.Em. ±	**0.25**	**0.058**	**0.066**	**6.42**	**0.98**	**8.52**	**1.32**	**0.46**	**0.52**	**0.12**
CD @ 5%	**NS**	**NS**	**NS**	**18.82**	**2.89**	**25.56**	**3.89**	**1.35**	**1.55**	**0.41**

Initial soil analysis: Soil Chemical properties: pH: 7.5, EC: 0.252 dS m^{-1}, OC: 0.420%
Soil nutrient status: N – 225 kg/ha, P_2O_5 – 18.2 kg/ha, K_2O – 130 kg/ha and S – 12.5 ppm
Mn – 2.45 ppm, Fe – 2.62 ppm, Zn – 0.47 ppm

Table 3. Cane yield of sugarcane (t/ha) as influenced by different treatments (Pooled data of 4 years)

Treatment		2011-12	2012-13	2014-15	2015-16	Pooled
T_1	Control (No fertilizer)	65.05	50.55	58.8	69.4	58.1
T_2	N	82.36	54.56	76.25	79.6	71.1
T_3	NP	96.64	64.07	88.55	100.7	83.1
T_4	NPK	103.59	86.06	97.96	138.9	95.9
T_5	NPK + S	104.95	85.99	97.54	141.5	96.2
T_6	NPK + Zn	105.17	86.75	100.96	141.2	97.6
T_7	NPK + Fe	103.81	85.42	100.15	137.9	96.5
T_8	NPK + Mn	103.59	86.17	102.36	118.5	97.4
T_9	NPK + S + Zn	110.92	84.75	101.39	145.9	99.0
T_{10}	NPK + S + Zn + Fe	115.86	91.56	106.51	146.5	104.6
T_{11}	NPK + S + Zn + Fe + Mn	117.49	89.93	108.79	128.1	105.4
T_{12}	STBF application	122.51	93.53	109.85	149.8	108.6
T_{13}	FYM @ 20 t/ha	-	58.51	88.12	84.9	73.3
	S.Em±	**6.66**	**1.76**	**4.44**	**4.7**	**4.3**
	CD @ 5%	**19.53**	**5.15**	**12.95**	**13.8**	**12.5**

Summary: The pooled data of 4 years revealed that (Table 3) application of plant nutrients based on soil test results recorded significantly higher yield (108.5 t/ha) as compared to no fertilizer application (58.1 t/ha), application of only N (71.1 t/ha), NP (83.1 t/ha) and NPK only (95.9 t/ha). However, it was on par with all other treatments which received micro and secondary nutrients along with recommended dose of NPK fertilizers.

Table 4. Uptake of nutrients by the sugarcane crop at the time of harvest as influenced by different plant nutrients.

Treatment	Nutrient uptake by sugarcane at harvest (kg/ha)						
	N	**P**	**K**	**S**	**Fe**	**Mn**	**Zn**
T_1	250.60	21.58	165.85	32.58	7.12	2.25	0.810
T_2	277.62	22.31	175.41	33.56	6.85	2.65	0.832
T_3	287.54	28.56	181.20	34.14	8.52	2.82	0.812
T_4	410.62	29.52	205.62	45.56	10.21	3.56	8.532
T_5	420.62	32.51	212.50	49.85	11.20	3.58	0.861
T_6	420.25	31.25	221.41	45.62	9.85	3.62	0.963
T_7	412.92	32.14	221.54	46.52	13.25	3.54	0.847
T_8	363.95	25.69	195.40	40.52	9.12	4.85	0.824
T_9	427.36	30.58	218.41	50.12	9.52	3.65	0.962
T_{10}	437.36	31.24	222.14	49.52	14.12	3.85	0.972
T_{11}	393.95	28.75	196.52	46.78	9.75	4.92	0.960
T_{12}	446.32	33.58	228.74	49.36	13.28	3.67	0.845
T_{13}	267.62	24.78	185.21	35.63	7.52	2.42	0.831
S.Em. ±	**13.25**	**0.69**	**10.41**	**0.71**	**0.63**	**0.45**	**0.095**
CD @ 5%	**38.45**	**1.98**	**30.86**	**2.11**	**1.85**	**1.30**	**0.271**

Experiment 2.

1. **Title: AS – 68: Impact of integrated application of organics and inorganics in improving soil health and sugarcane productivity (Ratoon I).**
2. **Objectives:** To develop nutrient management strategy for sustaining soil health and sugarcane production

3. **Technical program**

Design : RBD
No. of treatments : 09
No. of replications : 3
Variety : Co-86032
Date of ratoon initiation (DARI) : 21-01-2015
Date of harvest : 05-02-2016

4.Inference:

A filed experiment was conducted during the 2014-15 and first ratoon was initiated during 2015-16 at ZARS, V. C. Farm, Mandya to develop nutrient management strategies for sustaining soil health and sugarcane production. The data on germination percentage after 45 DARI indicated that, the germination percentage was significantly higher in the treatments which received 100% RDF + organic manures and biofertilizer (57.80 to 67.0%). While, the lower germination per cent was recorded in the treatments which received only 50% RDF (52.17%), FYM @ 20 t/ha + 50% RDF (55.33%) and FYM @ 10 t/ha + Biofertilizers + 50% RDF (52.73%).

Application of FYM @ 20 t /ha + inorganic nutrient application based on soil test results recorded significantly higher ratoon yield (90.33 MT ha^{-1}) compared to all other treatments (Table 5). However, it was on par with application of FYM @ 20 t / ha + 100% RDF (88.07 MT ha^{-1}, respectively), application of FYM @ 10 t / ha + biofertilizer (*Azotobacter/Acetobacter* + *PSB*) + 100% RDF (85.50 MT ha^{-1}, respectively) and application of FYM @ 10 t/ha + biofertilizer (*Azotobacter/ Acetobacter* + *PSB*) + soil test basis fertilizer application (84.72 MT ha^{-1}, respectively). This increased ratoon yield in above treatments was mainly attributed to increased yield parameters *viz*., single cane weight, cane length, cane girth, internodal length, No. of internodes, and No. millable cane ha^{-1} (1.03 kg, 1.93 m, 2.80 cm, 9.50 cm, 23.0 and 88.3 thousand ha^{-1}, respectively in T6; 0.96 kg, 1.90 cm, 2.77 cm, 9.33 cm 22.50 and 85.9 thousand ha^{-1}, respectively in T5; 0.93 kg, 1.84 m, 2.61 cm, 9.73 cm, 21.80 and 84.3 thousand ha^{-1}, respectively in T8 and 0.96 kg, 1.88 m, 2.69 cm, 9.73 cm, 22.33 and 83.8 thousand ha^{-1}, respectively in T9).

Soil physical and chemical properties after harvest of crop:

Soil physical and chemical properties of soil *viz.*, pH, EC, OC and BD after harvest of crop did not influenced significantly due to integrated application of organics and inorganics (Table 7).

Soil available nutrient status after harvest of crop:

The soil available N, P_2O_5 and K_2O content of soil differed significantly due to integrated application of organics and inorganics. Among the treatments, significantly higher amount of available N was observed in the treatment T6 (298.57 kg/ha) as compared to other treatments. However, it was on par with T5, T8 and T9 (286.98, 282.50 and 286.55 kg/ha, respectively). While, significantly lower amount of soil available N was registered in control plots (178.53 kg/ha). The soil available P_2O_5 content was significantly higher in the treatment T5 (36.58 kg/ha) as compared to T1 (20.15 kg/ha) T2 (28.95 kg/ha) and T3 (33.52 kg/ha). However, it was on par with rest of the treatments. A similar trend was also observed with respect to availability of soil K2O content after the harvest of the crop (Table 7).

Summary: The data on cane and ratoon yield (Table 6) indicated that, application of FYM @ 20 t /ha + inorganic nutrient application based on soil test results recorded significantly higher cane and ratoon yield (96.58 and 90.33 MT ha^{-1}, respectively) compared to all other treatments. However, it was on par with application of FYM @ 20 t / ha + 100% RDF (93.12 and 88.07 MT ha^{-1}, respectively), application of FYM @ 10 t / ha + biofertilizer (*Azotobacter/Acetobacter + PSB*) + 100% RDF (90.63 and 85.50 MT ha^{-1}, respectively) and application of FYM @ 10 t/ha + biofertilizer (*Azotobacter/ Acetobacter + PSB*) + soil test basis fertilizer application (88.73 and 84.72 MT ha^{-1}, respectively).

Table 5. Growth and yield of sugarcane as influenced by integrated application of organics and inorganics

Treatment	Germination % 45 DARI	Single cane weight (kg)	Cane length (m)	Cane girth (cm)	Internodal length (cm)	No. of inter nodes	Millable cane ('000/ha)	Cane yield (t/ha)	Sucrose %	CCS %	CCS (t/ha)
T_1	52.17	0.63	1.47	1.56	7.03	15.93	76.6	52.60	19.13	13.59	7.16
T_2	57.80	0.88	1.81	1.69	8.87	21.40	83.1	66.90	18.75	13.31	8.91
T_3	58.57	0.96	1.86	2.64	9.20	21.70	76.9	79.63	18.62	13.08	10.41
T_4	55.33	0.81	1.91	2.44	8.73	18.57	85.9	68.07	18.63	13.18	8.96
T_5	65.17	0.96	1.90	2.77	9.33	22.50	88.3	88.07	17.58	12.41	10.94
T_6	66.63	1.03	1.93	2.80	9.50	23.00	76.7	90.33	18.67	13.28	12.04
T_7	52.73	0.74	1.70	2.38	8.30	18.60	84.3	69.33	19.12	13.63	9.44
T_8	67.00	0.93	1.84	2.61	9.73	21.80	83.8	85.50	19.46	13.79	11.79
T_9	67.00	0.96	1.88	2.69	9.73	22.33		84.72	18.91	13.57	11.51
S.Em+	**3.73**	**0.06**	**0.05**	**0.18**	**0.46**	**1.98**	**2.92**	**2.82**	**0.45**	**0.37**	**0.65**
CD@5 %	**11.18**	**0.17**	**0.14**	**0.55**	**1.38**	**5.94**	**8.76**	**8.32**	**NS**	**NS**	**1.94**
CV%	**10.72**	**11.31**	**4.46**	**13.27**	**8.95**	**16.63**	**6.25**	**8.70**	**4.16**	**4.86**	**11.05**

T_1: No organic + 50% RDF, T2: No organic + 100% RDF, T3: No organic + soil test based recommendation, T4: Application of FYM/Compost @ 20 tonnes / ha + 50% RDF (inorganic source), T5: Application of FYM/Compost @ 20 tonnes / ha + 100% RDF (inorganic source), T6: Application of FYM/Compost @ 20 tonnes / ha + in organic nutrient application based on soil test (rating chart), T7: Application of FYM/Compost @ 10 tonnes / ha + biofertilizer (*Azotobacter/ Acetobacter + PSB*) + 50% RDF, T8: Application of FYM/Compost @ 10 tonnes / ha + biofertilizer (*Azotobacter/ Acetobacter + PSB*) + 100% RDF and T9: Application of FYM/Compost @ 10 tonnes / ha + biofertilizer (*Azotobacter/ Acetobacter + PSB*) + soil test basis.

Table 6. Cane yield of plant and ratoon cane as influenced by by integrated application of organics and inorganics

Treatment	Cane yield (t/ha)		
	Plant cane	**Ratoon**	**% ratoon yield decrease over plant cane**
T_1: No organic + 50% RDF	62.33	52.60	15.6
T2: No organic + 100% RDF	75.33	66.90	11.2
T3: No organic + soil test based recommendation	80.94	79.63	1.6
T4: Application of FYM/Compost @ 20 tonnes / ha + 50% RDF (inorganic source)	76.33	68.07	10.8
T5: Application of FYM/Compost @ 20 tonnes / ha + 100% RDF (inorganic source)	93.12	88.07	5.4
T6: Application of FYM/Compost @ 20 tonnes / ha + in organic nutrient application based on soil test (rating chart)	96.58	90.33	6.5
T7: Application of FYM/Compost @ 10 tonnes / ha + biofertilizer (*Azotobacter/ Acetobacter* + *PSB*) + 50% RDF	78.31	69.33	11.5
T8: Application of FYM/Compost @ 10 tonnes / ha + biofertilizer (*Azotobacter/ Acetobacter* + *PSB*) + 100% RDF	90.63	85.50	5.7
T9: Application of FYM/Compost @ 10 tonnes / ha + biofertilizer (*Azotobacter/ Acetobacter* + *PSB*) + soil test basis	88.73	84.72	4.5
S.Em±	**4.87**	**3.82**	**-**
CD @ 5 %	**14.59**	**11.46**	**-**
CV (%)	**10.11**	**8.70**	**-**

Table 7. Soil physical and chemical properties after harvest of crop as influenced by integrated application of organics and inorganics

Treat	pH	EC ($dS\ m^{-1}$)	OC (%)	BD (Mg/m^3)	Soil Available Nutrients (kg/ha)		
					N	P_2O_5	K_2O
T_1	0.742	0.235	0.232	1.49	178.53	20.15	108.95
T_2	0.760	0.264	0.245	1.48	224.50	28.95	123.56
T_3	0.790	0.276	0.358	1.48	235.65	33.52	135.68
T_4	0.730	0.292	0.425	1.25	256.82	35.62	162.54
T_5	0.720	0.296	0.435	1.22	286.98	36.58	174.52
T_6	0.720	0.299	0.455	1.24	298.57	36.12	175.62
T_7	0.732	0.286	0.448	1.28	278.91	33.85	172.31
T_8	0.738	0.285	0.45	1.26	282.50	34.12	169.85
T_9	0.734	0.279	0.446	1.28	286.55	34.74	172.32
S.Em	0.210	0.030	0.078	0.11	6.12	0.85	8.42
CD @ 5%	NS	NS	NS	NS	18.25	2.52	25.12

Experiment 3.

1. **Title: AS – 69: Use of plant growth regulators (PGRs) for enhanced yield and quality of sugarcane.**
2. **Objectives:**
   - To accelerate rate and extent of sugarcane germination through the use of PGRs
   - To assess the effect of PGRs on sugarcane growth, yield and juice quality
3. **Technical program**

   Design : RBD
   No. of treatments : 08
   No. of replications : 3
   Variety : Co-86032
   Date of planting : 21-01-2015
   Date of harvest : 05-02-2016
4. **Inference:** To accelerate rate and extent of sugarcane germination, the seed setts were treated with plant growth hormones. The results of the first year study indicated that, planting of setts after overnight soaking in 100 ppm ethrel solution resulted in significantly higher germination percentage (71.8-73.6 % at 50 DAP) as compared to other treatments, but was on par with overnight soaking of setts in 50 ppm ethrel solution. The sett treatment with 50 or 100 per cent ethrel solution accelerate the germination of cane buds and recorded more than 50% of germination in 30 DAP itself as compared to control (Water spray) recorded 50% germination at 45-50 DAP (Table 8).

The cane yield was significantly higher in the treatment receiving overnight soaking of cane setts in 100 ppm ethrel solution followed by 35 ppm GA3 spray at 60, 120 and 150 DAP (158.8 MT ha^{-1}) as compared to other treatments (Table 9). However, it was on par with overnight soaking of setts in 50 ppm ethrel solution followed by 35 ppm GA3 spray at 60, 120 and 150 DAP (150.57 MT ha^{-1}) and overnight soaking of setts in 100 ppm ethrel solution (148.0 MT ha^{-1}). This increased cane yield in above treatment was mainly attributed to increase in yield parameters *viz.*, single cane weight, cane length, cane girth, internodal length, No. of internodes and No. of millable cane ha^{-1} (1.63 kg, 2.36 m, 2.97 cm, 11.63 cm, 23.63 and 87.0 thousand ha-1, respectively in 100 ppm ethrel solution followed by 35 ppm GA3 spray at 60, 120 and 150 DAP; 1.57 kg, 2.06 m, 2.88 cm, 10.33 cm, 21.77 and 85.4 thousand ha-1, respectively in overnight soaking of setts in 50 ppm ethrel solution followed by 35 ppm GA3 spray at 60, 120 and 150 DAP and 1.39 kg, 2.14 m, 2.85 cm, 10.33 cm, 21.67 and 85.5 thousand ha^{-1}, respectively in overnight soaking of setts in 100 ppm ethrel solution).

Summary: Overnight soaking of setts in 50 or 100% ethereal solution followed by 35 ppm GA3 spray at 60, 120 and 150 DAP found to enhance the germination percentage and cane yield.

Table 8: Influence of PGRs on germination percentage in sugarcane

Treatment	Germination %				
	10 DAP	**20 DAP**	**30 DAP**	**40 DAP**	**50 DAP**
T_1	5.09	18.52	31.48	40.28	44.44
T_2	4.63	31.94	46.76	62.50	62.96
T_3	8.33	44.44	58.80	63.89	64.35
T_4	12.04	47.22	60.19	70.83	71.76
T_5	5.56	30.09	45.37	51.39	52.31
T_6	7.41	37.04	49.07	64.81	65.74
T_7	11.57	46.30	62.96	71.30	72.69
T_8	12.50	47.22	62.50	72.22	73.61
S.Em. +	**1.47**	**3.62**	**2.96**	**3.52**	**3.28**
CD@5%	**4.44**	**10.98**	**8.97**	**10.67**	**9.96**
CV%	**30.25**	**16.57**	**9.82**	**9.80**	**8.96**

T_1: Conventional planting/ Farmers' practice (3-bud setts)
T_2: Planting of setts after overnight soaking in water
T_3: Planting of setts after overnight soaking in 50 ppm ethrel solution
T_4: Planting of setts after overnight soaking in 100 ppm ethrel solution
T_5: T1+GA_3 spray (35 ppm) at 90, 120 and 150 DAP
T_6: T2+ GA_3 spray (35 ppm) at 90, 120 and 150 DAP
T_7: T3 + GA_3 (35 ppm) spray at 90, 120 and 150 DAP
T_8: T4 + GA_3 (35 ppm) spray at 90, 120 and 150 DAP

Table 9: Influence of PGRs on growth and yield of sugarcane

Treatment	Single cane weight (kg)	Cane length (m)	Cane girth (cm)	Internodal length (cm)	No. of internodes	Millable cane ('000/ha)	Cane yield (t/ha)	Sucrose %	CCS %	CCS (t/ha)
T_1	0.88	1.68	2.01	7.99	18.23	72.7	119.57	17.52	12.39	14.82
T_2	1.18	1.91	2.61	8.94	18.87	78.1	125.70	18.19	12.83	16.22
T_3	1.37	2.04	2.81	9.87	20.57	82.9	141.30	18.50	13.10	18.52
T_4	1.39	2.14	2.85	10.33	21.67	85.5	147.97	18.57	13.17	19.53
T_5	0.98	1.71	2.29	8.80	19.07	77.7	123.39	18.65	13.20	16.29
T_6	1.34	1.82	2.67	9.87	19.57	81.6	130.10	18.67	13.22	17.23
T_7	1.57	2.06	2.88	10.33	21.77	85.4	150.57	18.82	13.43	20.23
T_8	1.63	2.36	2.97	11.63	23.63	87.0	158.80	19.00	13.42	21.29
S.Em.±	**0.11**	**0.13**	**0.14**	**0.62**	**0.94**	**1.98**	**8.03**	**0.44**	**0.34**	**1.29**
CD@5%	**0.35**	**0.40**	**0.41**	**1.88**	**2.84**	**6.02**	**24.35**	**NS**	**NS**	**3.91**
CV%	**15.34**	**11.62**	**8.97**	**11.02**	**7.93**	**4.23**	**10.13**	**4.17**	**4.50**	**12.41**

T_1: Conventional planting/ Farmers' practice (3-bud setts)
T_2: Planting of setts after overnight soaking in water
T_3: Planting of setts after overnight soaking in 50 ppm ethrel solution
T_4: Planting of setts after overnight soaking in 100 ppm ethrel solution
T_5: T1+GA_3 spray (35 ppm) at 90, 120 and 150 DAP
T_6: T2+ GA_3 spray (35 ppm) at 90, 120 and 150 DAP
T_7: T3 + GA_3 (35 ppm) spray at 90, 120 and 150 DAP
T_8: T4 + GA_3 (35 ppm) spray at 90, 120 and 150 DAP

3. Plant Protection (Sugarcane Entomology)

1) **Experiment No**. E.4.1

Title: Evaluation of zonal varieties/genotypes for their reaction against major insect pests
Objectives: To grade the entries in Zonal varietal trials for their reaction by key pests in the area
Date of Sowing: 13.02.2015
Design: RBD
IVT Early (12+3) 2 Replications.

Table: 1. Reaction of Sugarcane genotypes under IVT Early trial against ESB, TSB and INB

	Percent Incidence						
Genotypes	**ESB**				**TSB**	**INB**	**INB %**
	30DAP	**60DAP**	**90DAP**	**120DAP**	**210DAP**	**%**	**Intensity**
Co 12001	0.25	0.41	2.06	1.79	1.66	30.0	1.83
Co 12003	0.22	0.36	0.00	0.00	0.39	20.0	2.38
Co 12006	0.25	0.42	3.58	1.73	1.64	30.0	1.92
Co 12007	0.21	0.53	2.58	0.88	0.79	30.0	3.30
Co 12008	0.51	0.45	2.57	0.46	0.42	40.0	3.50
CoM 12081	0.28	1.60	2.15	0.00	0.69	90.0	9.45
CoM 12082	0.49	0.00	3.09	1.53	1.24	10.0	0.60
CoM 12083	0.45	0.55	0.54	0.00	1.17	30.0	3.97
CoN 12071	0.42	1.11	2.02	1.14	1.06	40.0	2.91
CoN 12072	0.00	0.62	2.25	1.41	1.34	40.0	2.90
CoT 12366	0.42	0.00	1.60	0.45	0.41	50.0	3.40
CoT 12367	0.00	0.76	0.47	0.40	0.37	50.0	4.17
Co 85004 (C)	0.61	2.44	2.54	0.69	0.57	50.0	3.94
Co 94008(C)	0.65	1.15	3.96	1.37	0.51	50.0	4.28
CoC 671(C)	0.78	2.68	5.39	1.52	2.33	30.0	2.02

IVT Midlate (15+2) 2 Replications

Table: 2. Reaction of Sugarcane genotypes under IVT Midlate trial against ESB, TSB, INB

	Percent Incidence						
Genotypes	**ESB**				**TSB**	**INB**	**INB %**
	30DAP	**60DAP**	**90DAP**	**120DAP**	**210DAP**	**%**	**Intensity**
Co 12009	0.25	1.69	2.35	1.05	0.53	20.0	1.61
Co 12012	0.40	1.65	1.46	0.95	0.82	20.0	1.55
Co 12014	0.22	1.39	1.07	2.01	0.43	10.0	0.58
Co 12016	0.29	1.04	2.75	0.99	0.47	0.00	0.00
Co 12017	0.54	1.35	1.85	0.58	0.00	20.0	1.61
Co 12019	0.19	1.46	1.62	0.48	0.00	10.0	0.56
Co 12021	0.59	2.05	2.11	1.96	0.49	20.0	1.72
Co 12024	0.36	2.54	0.98	0.00	0.00	0.00	0.00
CoM 12084	0.43	0.41	1.04	0.52	0.46	30.0	2.26
CoM 12085	0.51	0.84	1.25	2.11	0.89	20.0	2.03
CoM 12086	0.70	1.24	1.86	1.09	0.00	00.0	0.00
CoN 12073	0.57	0.93	2.20	1.85	1.05	00.0	0.00
CoN 12074	1.47	1.37	1.11	0.49	0.44	00.0	0.00
CoT 12368	2.29	1.90	2.65	1.98	1.01	20.0	0.97
VSI 12121	0.97	0.82	2.39	1.07	0.87	20.0	1.97
Co 86032(C)	1.03	1.54	3.23	2.39	1.57	30.0	1.82
Co 99004(C)	1.09	1.05	3.54	2.46	1.99	10.0	0.61

AVT Early - I PC (8+3) 3Replications

Table: 3 Reaction of Sugarcane genotypes under AVT Early I PC trial against ESB, TSB and INB

	Percent Incidence						
Genotypes	**ESB**				**TSB**	**INB**	**INB %**
	30DAP	**60DAP**	**90DAP**	**120DAP**	**210DAP**	**%**	**Intensity**
Co 10004	0.00	0.94	1.33	0.34	0.89	20.0	1.25
Co 10005	0.84	1.61	0.55	0.82	0.88	10.0	0.59
Co 10006	0.56	1.67	2.54	0.93	4.53	20.0	1.39
Co 10024	0.27	1.91	2.21	2.06	3.16	10.0	0.73
Co 10026	0.60	1.39	1.67	0.00	0.63	30.0	2.05
Co 10027	0.82	1.44	1.81	1.24	2.43	10.0	0.63
Co T 10004	0.74	1.29	0.51	0.00	2.00	20.0	1.18
Co T 10004	0.35	0.94	2.55	0.39	0.58	70.0	3.83
Co 85004(C)	0.83	1.37	2.17	1.61	1.48	20.0	1.21
Co 94008(C)	0.84	1.58	1.74	0.86	0.64	60.0	3.29
CoC 671(C)	1.22	1.37	1.85	0.90	1.82	40.0	2.38

AVT Midlate I PC (11+2) 2Replications

Table: 4. Reaction of Sugarcane genotypes under AVT Midlate I PC against ESB, TSB and INB

	Percent Incidence						
Genotypes	**ESB**				**TSB**	**INB**	**INB %**
	30DAP	**60DAP**	**90DAP**	**120DAP**	**210DAP**	**%**	**Intensity**
Co 10015	0.32	0.40	1.51	2.63	1.02	20.0	5.10
Co 10017	0.31	0.28	1.06	1.98	2.48	50.0	12.96
Co 10031	0.50	0.30	0.00	0.94	1.44	30.0	7.69
Co 10033	0.93	0.64	0.62	1.21	1.51	30.0	7.89
CoM 10083	0.32	0.51	1.15	1.69	0.00	0.00	0.00
PI 10131	0.44	0.49	0.52	0.00	1.23	30.0	5.55
PI 10132	0.00	0.40	0.00	1.30	2.14	50.0	10.64
CoVC 10061	0.55	0.58	1.28	0.00	0.00	0.00	0.0
CoT 10369	0.65	0.35	3.23	0.62	2.12	50.0	11.11
CoT 10368	0.18	0.33	0.54	0.35	0.00	0.00	0.00
Co09009	0.14	0.27	0.98	0.00	1.55	30.0	8.82
Co99004(C)	0.00	0.34	2.50	0.00	1.55	30.0	7.14
Co 86032(C)	0.41	0.55	1.14	0.92	1.03	20.0	5.71

AVT Early - II PC (3+3) 4Replications

Table: 5. Reaction of Sugarcane genotypes under AVT Early II PC against ESB, TSB and INB

	Percent Incidence						
Genotypes	**ESB**				**TSB**	**INB**	**INB %**
	30DAP	**60DAP**	**90DAP**	**120DAP**	**210DAP**	**%**	**Intensity**
Co 09004	0.51	1.29	0.63	0.24	0.21	10.0	0.50
Co 09072	0.43	1.14	3.36	0.52	0.49	5.00	0.32
Co 09007	0.50	1.43	1.52	0.46	0.00	15.00	1.31
Co85004(C)	0.73	1.21	3.27	0.81	0.37	5.00	0.26
Co 94008(C)	1.24	1.02	1.67	0.82	0.44	10.0	1.59
CoC 671(C)	0.84	0.87	1.53	0.60	0.19	0.00	0.00

Trial (#Genotypes screened +Checks)	**Genotypes showing LS reaction to three borer pests (ESB,TSB and INB)**
IVT Early(12+3)2Replications	Co 12003, Co 12006 CoM 12002,CoM 12083
AVT Early - I PC(8+3) 3Replications	Co 10004, Co 10005,CoT 10367
AVT Early - II PC(3+3) 4Replications	Co 09004
IVT Midlate(15+2) 2Replications	Co 12009, Co 12012 CoM 12085,CoN 12074,VSI 12121
AVT Midlate I PC(11+2) 2Replications	Co 10015, Co 10017 CoM 10083, PI 10131,CoVC 10061

5. **Inference**: Among the genotypes screened under different categories, eighteen genotypes have shown less susceptible reaction against all the three borers viz. Early shoot borer, Top shoot borer and Internode borer.

2. Experiment No. **E.28**

1. Title: Survey and surveillance of sugarcane insect pests.

2. Objective: To identify the key insect pests in the area.

3. **Experimental details**: Survey was conducted once in a month in different sugar factory areas of Mandya district and the findings were presented briefly in the table given below

4. Results:

Sl.No	Pest	Level of Incidence (%)
1	**Early Shoot Borer**	2.90 – 18.50
2	**Top Shoot Borer**	0.63 – 6.50
3	**Inter Node Borer**	18.0 – 62.25
4	**Sugarcane Pyrilla**	<0.50 adult / nymph / clump
5	**Mealy bug**	22.50 %Incidence with 36.84 % Intensity
6	**Woolly aphid**	Few clumps to one gunta area (30-50%leaf area covered by aphids)10instances
7	**Mite**	20 -45% shoots showing symptoms with an average of 13mites/Cm^2
8	**Root grub**	5 instances larval population ranging from 3-5 grubs/clump

3. **Inference**: Among the borer pests Internode borer and among the sucking pests Mealy bug registered higher level of incidence. Overall insect pest activity was low during the year.

1. **Experiment No. E.30**

1. Title: Monitoring of insect pests and bio-agents in sugarcane agro ecosystem

2. Objective: To find out the activity of sugarcane pests and their bio-agents.

3. Experimental details:

c) Location: ZARS V.C.Farm Mandya b) Design: Single block of 0.5ac

c) No. of entries: Co 86032 d) Irrigation/Rain fed: Irrigated

d) Replication: - f) Fertilizer: 25:100:125 NPK (kg /ha)

g) Spacing: h) Plot size: 0.5ac

4. **Date of Sowing**: 22.02.2015

Monitoring of insect pests and bio agents in Sugarcane Agro ecosystem

Time of observation	Percent Incidence			Woolly aphid	Mealy bug		Natural Enemies
	ESB	TSB	INB		% Incidence	% Intensity	
30 DAP	1.90	-	-		-	-	
60 DAP	2.84	-	-		-	-	
90 DAP	1.31	-	-		-	-	
120DAP	0.63	-	-		-	-	
150 DAP	-	0.81	-	25%leaf area covered	-	-	*Encarsia flavoscutellum* 1adult/leaf
180 DAP	-	-	-	50%leaf area covered	-	-	*Encarsia flavoscutellum* 3adult/leaf
210 DAP	-	2.31			11.66	24.54	
At harvest	-		21.50				

5. Results: Cumulative incidence of ESB in Co 86032 sugarcane variety was 6.68 % in the first four months after planting. Seven months after planting the incidence of TSB was3.81%.. Aphid, whitefly, and pyrilla appeared in very small numbers but failed to establish and spread. Encarsia (1-3 adults/leaf) kept the woolly aphid under control. Unusual heavy rainfall during the months of May, August to October and continuous rainfall during the month of November resulted in lower activity of ESB and TSB and higher incidence of INB in Mandya area.

6. Inference: The incidence of ESB and TSB was greatly reduced because of more rainfall during the months of May and August-October. Incidence of INB was more because of favorable conditions prevailed during the later part of the season.

2. Experiment No. E.36

1. Title: Management of borer complex of sugarcane through lures.

2. Objective: To manage the sugarcane borers.

3. Experimental details:

a)Location: ZARS V.C.Farm Mandya b) Design:

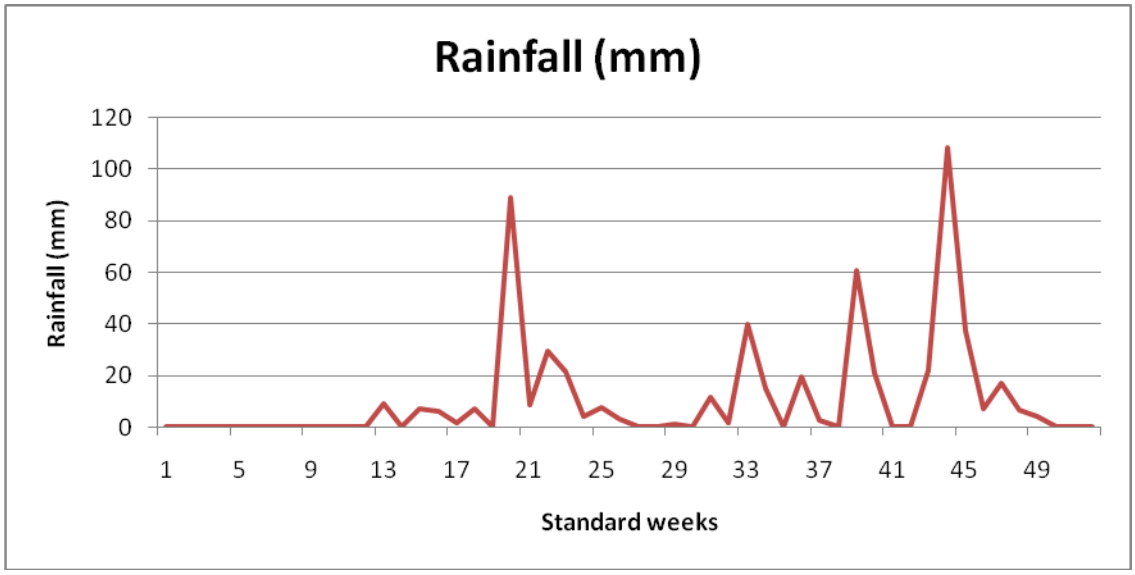
c) No. of entries Co 86032 d) Irrigation/Rain fed: Irrigated

e) Replication: - f) Fertilizer: 25:100:125 NPK (kg /ha)

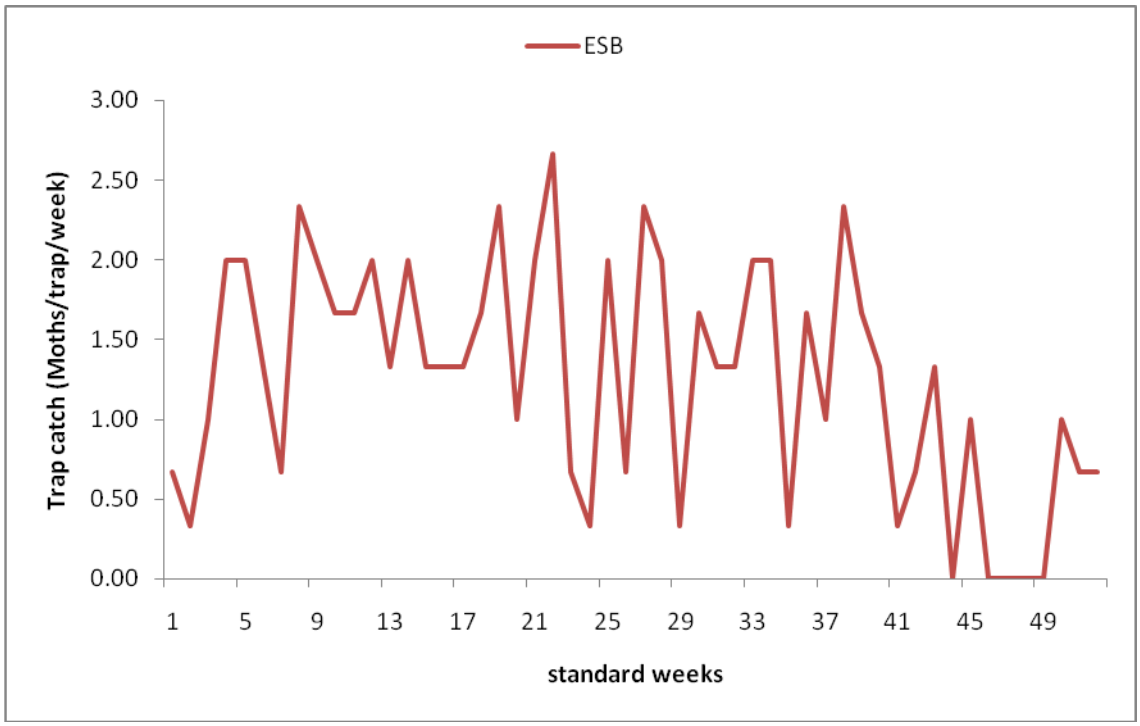
g) Spacing: h) Plot size: 0.5ac

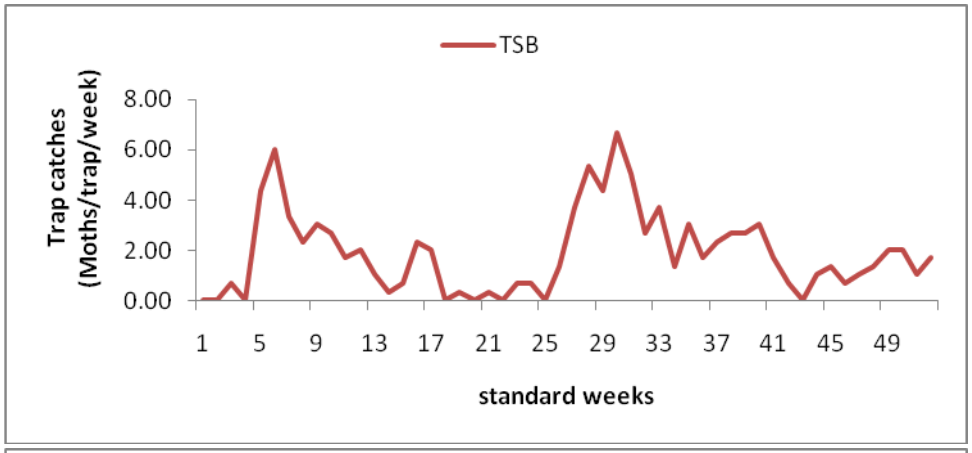
4. **Date of Sowing**: 09.02.2015

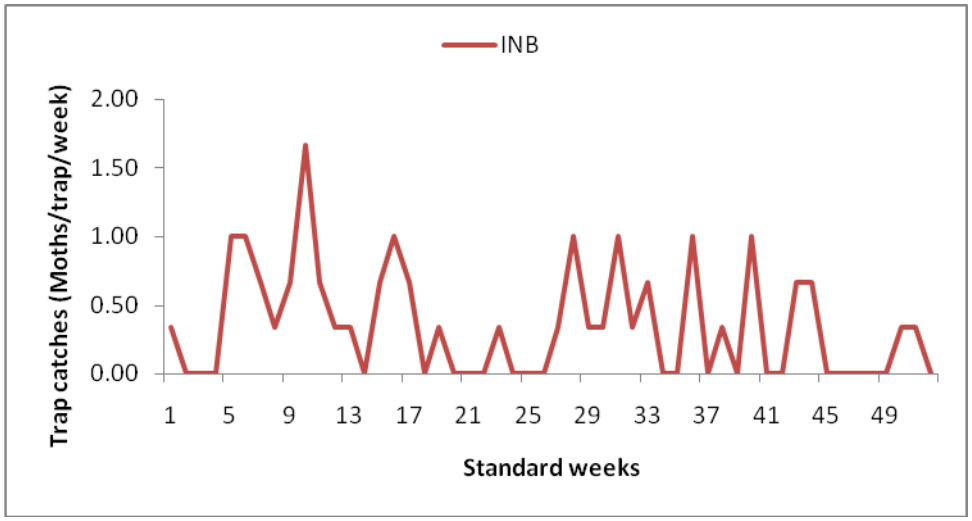
Actual Standard weekly rainfall(mm) for the year -2015



Trap catches of different borers from January- December 2015







5. Results: ESB & TSB moths were active throughout the year. Characteristic peak of ESB was absent during 20th Standard week (May3rd week) because of unusual heavy rainfall (109mm,7 rainy days) during the month of May. Top shoot borer activity was also very low because of heavy rainfall received from 32 – 44 th standard week (August to October 2014, 197.4mm, 17rainy days) and 168.6mm of rainfall during the month of November with 11 rainy days. Moth activity of Inter node borer was low throughout the season.

During the season, early shoot borer and top shoot borer incidence was very low. The cumulative ESB incidence in the control block remained at 4.05 % while it was 3.47% in the lure managed block. Top shoot borer incidence was 2.84% in lure managed block and it remained at 2.20% in the control block. Peak activity of ESB (2.5moths/trap/week), TSB (6.55moths/trap/week) and INB (1.755moths/trap/week) was observed during 22^{nd,} ^{30th} and 11th Standard Meteorological Week respectively.

6. Inference: Incidence of borer pests between lure managed block and control plot did not differ significantly.

3. **Experiment No. E.37**

1. Title: Bioefficacy of new insecticides for the control of sugarcane early shoot borer.

2. Objective: To find out the effective strategy for the management of sugarcane early shoot borer.

3. Experimental details:

a) Location: ZARS V.C.Farm Mandya b) Design: RBD c) Variety: VCF 0517

d) Irrigation/Rain fed: Canal Irrigated e) Replication: Three Fertilizer: 25:100:125 NPK (kg /ha)

g) Spacing: h) Plot size: 27m2

4. Date of Sowing: 27.12.2015

5. Results: **Bio-efficacy of new insecticides in the management of sugarcane early shoot borer**

Treatments	**Treatment details**	**Mean ESB Incidence (%)**	**Yield Tonnes/ha**
T1	Fipronil @ 25 kg/ha at planting and 60DAP	3.62 (18.51)*	71.55
T2	Chlorantraniliprole0.4G @ 22.5kg/ha at planting and 60DAP	3.20 (17.74)	79.51
T3	Chlorantraniliprole18.5SC @ 375ml/ha at 30 and 60DAP	3.15 (17.58)	70.07
T4	Spinosad 45SC @ 90ml/ha at 30 and 60DAP	5.41 (22.68)	60.77
T5	Flubendiamide 39.35SC @125ml/ha at 30 and 60 DAP	3.60 (17.1)	66.48
T6	Cartap hydrochloride 4G@ 12.5kg/ha at planting and 60DAP	4.69 (21.16)	56.16
T7	Phorate 10G@15kg/ha at planting and 60DAP	6.22 (24.74)	58.17
T8	Carbofuran 3 @33.0kg/ha at planting and 60DAP	7.71 (27.41)	54.97
T9	Chlorpyriphos 20EC @1500ml/ha at 30 and 60 DAP	8.28 (27.83)	54.23
T10	Control	15.92(39.91)	50.00
CD@5%		0.80	11.84
CV (%)		22.81	11.10
*Figures in the Parenthesis are arcsine transformed values and those outside are original values			

Inference: Among the five new insecticides tested against sugarcane early shoot borer, soil application of Chlorantraniliprole 0.4G @ 22.5kg/ha at the time of planting and 60DAP, spray application of Chlorantraniliprole 18.5SC @ 375ml/ha and Flubendiamide 39.35SC at 30 and 60 DAP were found effective in controlling the Early shoot borer.

Monthly normal and actual rainfall of ZARS, V.C. Farm, Mandya for the year 2015-16