150 YEARS OF CELEBRATING THE MAHATMA

ALL INDIA COORDINATED RESEARCH PROJECT ON SUGARCANE

TECHNICAL REPORT
2018-2019

CROP PRODUCTION
(AGRONOMY & SOIL SCIENCE)

Compiled by

Dr. T.K. Srivastava, Principal Scientist
&
Principal Investigator

ICAR-Indian Institute of Sugarcane Research, Lucknow 226002 (U.P.)

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CONTENTS

PROJECT No.: AS-68

Title : Impact of integrated application of organics and in-organics in improving soil health and sugarcane productivity

Objective : To develop nutrient management strategy for sustaining soil health and sugarcane production.

Year of start : 2014 – 2015

Locations : All the participating centres

Cropping system : Sugarcane – Ratoon-I – Ratoon-II

Treatment & Methodology:

Treat-ments	Sugarcane (plant crop)	Ratoon-I	Ratoon- II
T1	No organic + 50% RDF	Application of trash at 10 tonnes/ ha + 50% RDF	Application of trash at 10 tonnes/ ha + 50% RDF
T2	No organic + 100% RDF	Application of trash at 10 tonnes/ ha + 100% RDF	Application of trash at 10 tonnes/ ha + 100% RDF
T3	No organic + soil test based recommendation	Application of trash at 10 tonnes/ ha + soil test basis (NPK application)	Application of trash at 10 tonnes/ ha + soil test basis (NPK application)
T4	Application of FYM/Compost @ 20 tonnes / ha + 50% RDF (inorganic source)	Application of FYM/Compost @ 20 tonnes / ha + 50% RDF (inorganic source)	Application of FYM/Compost @ 20 tonnes / ha + 50% RDF (inorganic source)
T5	Application of FYM/Compost @ 20 tonnes / ha + 100% RDF (inorganic source)	Application of FYM/Compost @ 20 tonnes / ha + 100% RDF (inorganic source)	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)	Application of FYM/Compost @ 20 tonnes / ha + in organic nutrient application based on soil test (NPK application)	Application of FYM/Compost @ 20 tonnes / ha + in organic nutrient application based on soil test (NPK application)
T7	Application of FYM/Compost @ 10 tonnes / ha + biofertilizer (*Azotobacter/ Acetobacter + PSB*) + 50% RDF	Application of FYM/Compost @ 10 tonnes / ha + biofertilizer (*Azotobacter/ Acetobacter + PSB*) + 50% RDF	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	Application of FYM/Compost @ 10 tonnes / ha + biofertilizer (*Azotobacter/ Acetobacter + PSB*) + 100% RDF	Application of FYM/Compost @ 10 tonnes / ha + biofertilizer (*Azotobacter/ Acetobacter + PSB*) + 100% RDF
T9	Application of FYM/Compost @ 10 tonnes / ha + biofertilizer (*Azotobacter/ Acetobacter + PSB*) + soil test basis	Application of FYM/Compost @ 10 tonnes / ha + biofertilizer (*Azotobacter/ Acetobacter + PSB*) + soil test basis (NPK application)	Application of FYM/Compost @ 10 tonnes / ha + biofertilizer (*Azotobacter/ Acetobacter + PSB*) + soil test basis (NPK application)

Note:

1. The application rate of biofertilizer (*Azotobacter/ Acetobacter* + PSB) will be 5 kg/acre (solid based fertilizer 10^{7-8}cfu).
2. $ZnSO_4$ @ 25 kg/ha will be applied at the start of the cycle.
3. Trash will be inoculated with cellulolytic organism such as *Trichoderma viride* @ 500 g/tonne.
4. The experiment will be conducted in permanent field lay out.

Design : RBD
Replications : Three
Plot size : 6 rows of 6 m length
Planting season: February – March / Main season

Observations to be recorded:

1. Germination count/ plant population at 30 and 45 DAP / DAR
2. Tiller population at 120 and 150 DAP/DAR
3. Millable canes, length, girth and cane weight at harvest
4. Cane and sugar yield
5. Juice quality parameters (Brix, pol, purity) at 10 and 12 months age
6. Soil analysis initial and after harvest of each crop (bulk density, infiltration rate, organic carbon, soil pH, EC, available N, P_2O_5, K_2O in kg/ha)
7. Economics
8. Nutrient uptake (N, P, K)) at harvest (optional)
9. Soil microbial parameters (optional)

SUMMARY REPORT FOR THE LAST YEAR (2017-18)

The trial initiated during the year 2014-15 with allotment to all the centres. However, during the year 2017-18 only 19 centres carried out the trial.

NORTH WEST ZONE

1. FARIDKOT

Plant cane yield (101.4 t/ha) was the highest with application of FYM @ 20 t/ha + inorganic nutrient based on soil test (T6) which was significantly higher over all other treatments except T5.

2. LUCKNOW

Highest number of tillers (176.9 thousand /ha at 120 days after planting), shoot count (165.3 thousand/ha at 180 DAP), number of millable canes (124.8 thousand/ha), plant cane yield (89.20 t/ha) and sugar yield (10.69 t/ha) were recorded under the treatment where application of FYM @ 20t/ha was done along with soil test (rating chart) based inorganic fertilizer recommendations.

3. PANTNAGAR

Highest cane yield in ratoon was recorded in the treatment T6 - application of FYM @ 20 tonnes/ha + inorganic nutrient application based on soil test (NPK application). Highest cane yield in T6 was due to higher NMC, cane girth, cane length and weight of individual cane. CCS yield was recorded highest in T5 which was significantly higher over rest of the treatments.

4. UCHANI

FYM 20 t/ ha + 100% RDF through inorganic source (T6) and FYM @ 10 t/ ha + biofertilizer (Azotobacter/ Acetobacter + PSB) + soil test basis (T9) were found best and at par treatments in terms of number of tillers (146.4, 144.3 thousands/ha) , millable canes (116.5, 117.2 thousands/ha) and cane yield (101.3, 99.8 t/ha) and sugar yield (12.79, 12.27 t/ha) as compared to rest of the treatments.

5. KAPURTHALA

Soil test based fertilizer application (190 kg N ha^{-1}) along with 20 t ha^{-1} FYM produced highest plant cane yield that was statistically similar under treatment T3, T5 and T9 but it was significantly higher over the cane yield produced under remaining treatments. Cane yield produced under treatments T2, T4 and T7 were also similar but significantly higher than the cane yield under treatment T1.

6. SHAHJAHANPUR

Application of FYM @ 10 tonnes/ ha + bio – fertilizers (Azotobacter + PSB) + application of nutrients on soil test basis (NPK) produced significantly higher cane yield (114.10 t/ha) than that of other treatments. CCS% in cane was found to be more or less similar.

7. SRIGANGANAGAR

Cane yield (80.3 t/ha) was the highest with the application of FYM @ 20 tones/ha + inorganic nutrient based on soil test (T6) which was significantly higher over other treatments except T5 – application of FYM @ 20 q/ha + 100% RDF (77.9 t/ha), T9 - Application of FYM/Compost @ 10 t/ ha + biofertilizer (Azotobacter/

Acetobacter + PSB) + soil test basis NPK application (77.1 t/ha) and T8 - Application of FYM/Compost @ 10 t/ha + biofertilizer (Azotobacter/ Acetobacter + PSB) + 100% RDF (75.2 t/ha).

PENINSULAR ZONE

8. THIRUVALLA

In both the ratoon crops (I & II) among the various treatments T8 (FYM/compost @ 10 t/ha + biofertilizer (Azotobacter/Acetobacter + PSB) +100 RDF) recorded significantly higher values for cane length (265.07 and 255.83 cm, respectively), MCC (73240 and 71320/ha) and resulted in maximum yield (81.10 and 74.48 t/ha).

9. MANDYA

The data indicated that, application of FYM @ 20 t/ha + inorganic nutrient application based on soil test results recorded significantly higher cane yield (156.93 t/ha) compared to all other treatments. However, it was on par with application of FYM @ 20 t/ ha + 100% RDF (141.30 t/ha), application of FYM @ 10 t/ ha + biofertilizer (Azotobacter + PSB) + 100% RDF (146.27 t/ha) and application of FYM @ 10 t/ha + biofertilizer (Azotobacter + PSB) + soil test basis fertilizer application (149.80 t/ha).

10. SANKESHWAR

Soil test based nutrients application along with 20 t/ha farm yard manure recorded highest plant cane yield (119.83 t/ha), number of millable canes (97500/ha) and CCS yield (11.36 t/ha). However, treatments with soil test based nutrients application recorded on par cane yield irrespective of application of organics and microbial inoculants. The lowest cane yield (92.43 t/ha) was recorded in 50 percent inorganics without any organics application.

11. PADEGAON

Sugarcane (CoM 0265) was planted on 02.202.2017 and harvested on 07.03.2018. Higher cane yield (176.94 t/ha), CCS yield (21.15 t/ha) and number of millable cane (83093) were observed in treatment T6 receiving RDF as per soil test along with 20 t/ha FYM and it was found at par with treatment T9, T5 and T8. The brix, sucrose (%), CCS (%) and purity (%) were found to be non-significant.

12. NAVSARI

The first ratoon crop was initiated on 12.12.2016 and harvested on 18.12.2017. Ratoon cane yield (120.15 t/ha) was recorded significantly highest with T9 over T3 and remained at par with T4, T5, T6 and T7. CCS yield was not significantly influenced due to various nutrient management treatments. Various quality parameters were not significantly influenced due to different nutrient management treatments at 10 and 12 months.

13. COIMBATORE

In second ratoon sugarcane crop, 20 t FYM + 150 STCR based fertilizer application was found beneficial in improving cane yield over rest of the nutrient management treatments. The treatment 20 t FYM + 150 STCR based fertilizer application recorded the highest NMC (95150 NMC/ha) and cane yield (84.56 t/ha).

Sugarcane juice analysis done at 12 months revealed that Sucrose %, Purity % and CCS % were not influenced significantly by application of organics and inorganics.

14. PUNE

The results concluded that application of FYM /compost @ 10 t/ha with inorganic fertilizer based on soil test and biofertilizer or application of FYM /compost @ 20 t/ha with inorganic fertilizer based on soil test increased cane yield by 13.4 t/ha.

EAST COAST ZONE

15. CUDDALORE

Application of FYM/Compost @ 10 tones/ha + biofertilizers (Acetobacter + PSB) + soil test based NPK fertilizer recorded significantly the maximum cane yield (157.69 t/ha), CCS (12.35 %) and sugar yield (19.47) with B:C ratio of 3.37 and it was comparable with treatment (T8) application of FYM/Compost @ 10 tonnes ha-1 + biofertilizer (Azotobacter + PSB) + 100 % RDF.

16. ANAKAPALLE

The results indicated that application of FYM @ 10 t/ha + biofertilizer + 100% inorganic nutrient (87.6 t/ha) or application of FYM @ 10 t/ha+ biofertilizer+ inorganic nutrient application based on soil test (86.9 t/ha) registered significantly higher cane yield as compared to the other treatments. Application of trash at 10 tonnes /ha + 50% RDF registered lowest cane yield of 69.7 t/ha.

17. NAYAGARH

Results obtained from plant crop indicated that application of FYM/Compost @ 10t/ha + Azotobacter + PSB with 100% RDF (T8) and application of FYM/Compost @ 10t/ha + Azotobacter + PSB + Soil test based (NPK) fertilizer application (T9) recorded higher percentage of germination at 45 DAP i.e. 55.56 and 60.59%, respectively. The NMC and Cane yield were 86660 & 93.04 t/ha in T8 and 91500 & 98.35 t/ha in T9, respectively. This exhibits the positive effect of organic manures and bio fertilizers on cane yield.

NORTH CENTRAL ZONE

18. SEORAHI

Application of FYM @ 10 t/ha+ Bio-fertilizer (Azotobacter + PSB) + soil test basis (NPK Application) gave significantly higher cane yield at par with FYM @ 10 t/ha+ Bio-fertilizer (Azotobacter + PSB) +100 per cent RDF and FYM @ 20 t/ha + Inorganic nutrient application based on soil test. Sucrose percent was not affected significantly by different treatments.

19. PUSA

Integrated application of nutrients was found effective in improving soil fertility and cane yield. The application of fertilizers on soil test i.e. 200 kg N, 100 kg P2O5 and 100 kg K2O along with organics @ 20 t/ha was found suitable for boosting cane yield and maintaining soil fertility in calcareous soil of Bihar.

CURRENT YEAR (2018-19) REPORT

NORTH WESTERN ZONE

1. FARIDKOT

Sugarcane variety CoJ 88 planted last year was ratooned on 10.3.2018. Ratoon cane yield (91.5 t/ha) was the highest (**Table AS 68.1.1**) with application of FYM/Compost @ 20 tonnes / ha + inorganic nutrient based on soil test (T6) which was significantly higher than all treatments except no organic + soil test based recommendation T3 (83.3 t/ha) and T5 (88.1 t/ha). These treatments also have the residual effect of FYM applied to plant crop. Same trend was there for CCS t/ha.

Table AS 68.1.1: Performance of first ratoon (second cycle) crop as influenced due to nutrient management in plant-ratoon system at Faridkot

Treat-ment	No. of Shoots 000/ha	NMC 000/ha	Cane length (cm)	Cane dia. (cm)	Single cane wt. (g)	Cane yield (t/ha)	Sucrose (%)	CCS %	CCS t/ha
T_1	213.9	100.0	203	2.44	1062	77.8	18.85	13.25	10.29
T_2	217.6	122.4	205	2.51	1064	81.1	19.05	13.41	10.87
T_3	221.7	122.0	206	2.49	1109	83.3	19.24	13.49	11.24
T_4	212.8	119.6	204	2.42	1028	80.4	19.07	13.42	10.78
T_5	220.2	127.6	206	2.51	1108	88.1	19.25	13.65	12.03
T_6	226.1	130.0	206	2.52	1139	91.5	19.18	13.56	12.40
T_7	183.3	121.8	198	2.43	1142	75.9	19.13	13.49	10.23
T_8	217.4	122.6	208	2.47	1153	80.7	19.09	13.46	10.87
T_9	220.2	121.1	204	2.37	1102	81.4	19.14	13.48	10.99
CD (5%)	NS	13.8	NS	NS	NS	8.8	NS	NS	1.17

2. LUCKNOW

In the first ratoon crop the highest rate of sprouting (93.4%) was observed under the treatment of only organic matter application along with FYM. Highest number of tillers (180.2 thousand/ha at 120 days after planting), shoot count (175.6 thousand/ha at 180 DAP), number of millable canes (120.5 thousand/ha), cane yield (84.20 t/ha) and sugar yield (10.55 t/ha) were recorded under the treatment where application of FYM @ 20t/ha was done along with soil test (rating chart) based inorganic fertilizer recommendations. However it was found comparable to the treatment of FYM @ 10 t/ha along with biofertilizer and soil test basis inorganic fertilizers application. The yield attributing characters *viz*., cane length (220.60 cm), cane girth (2.30 cm) and weight of individual cane (1.10kg) were recorded significantly highest with the

application of FYM @ 20 t/ha along with inorganic fertilizers applied on the basis of soil test rating chart. The quality parameters, brix value and pol (%) were significantly improved with application of FYM and biofertilizers. The soil health indicators viz. bulk density (1.27 M/m^3), infiltration rate (4.64 mm/hr) and soil organic carbon (0.47%) showed positive responses with the application of organic manure in the system (**Table AS 68.2.1)**.

Table AS 68.2.1: Performance of first ratoon crop as influenced due to nutrient management in plant-ratoon system at Lucknow

Treatment	Sprouts (%)	Tiller/ shoot Population (000/ha)		NMC ('000/ha)	Yield (t/ha)	CCS (t/ha)
		120 DAP	180 DAP			
50 %RDF	84.3	120.5	124.9	81.6	51.60	5.86
100 % RDF	83.7	140.7	140.6	93.4	72.20	8.09
STBR	84.5	136.8	139.4	87.6	73.90	9.01
20 t 50 %	88.9	142.8	146.8	89.2	68.90	7.76
20 + 100	88.4	170.5	174.3	108.6	83.70	9.97
20 + STRC	90.2	180.2	175.6	120.5	84.20	10.55
10+ B +50	87.6	130.8	140.8	107.6	76.90	9.19
10+B+100	88.8	165.5	168.7	114.8	82.40	10.19
10+ B STB	89.2	170.6	174.6	122.2	84.50	9.92
Organic	93.4	135.2	140.8	104.6	72.60	8.45
SEm ±	0.92	2.27	2.17	2.48	1.49	0.80
CD (P=0.05)	2.86	7.25	6.89	8.96	5.26	2.41

3. SHAHJAHANPUR

Sugarcane ratoon crop with variety Cos 08279 was initiated on 16.02.2018 and harvested on 28.02.2019.Experimental data (**Table AS 68.3.1**) revealed that application of FYM @ 10 tonnes/ ha + bio-fertilizers (Azotobacter + PSB) + inorganic nutrients on soil test basis (NPK) produced significantly higher cane yield (99.20 t/ha) than that of other treatments. CCS% in cane was not affected significantly with various treatments.Soil of experimental field was low in organic carbon (0.44%) and phosphorus (7.8 kg/ha) and medium in potash (134kg/ha) with pH 7.5.

Table AS 68.3.1: Performance of first ratoon as influenced due to nutrient management in plant-ratoon system at Shahjahanpur

Treatment	Stubbles (000/ha)	Shoots (000/ha)		NMC (000/ha)	Cane yield (t/ha)	CCS (%)
		120 DAR	150 DAR			
Application of trash @ 10/ha + 50% RDF	26.97	115.5	143.0	102.20	74.50	11.08
Application of trash @10/ha + 100 % RDF	28.94	117.1	149.3	108.91	82.40	10.82
Application of trash @10/ha + Application on soil test basis.	30.09	126.1	153.5	112.50	84.10	11.25
Application of FYM @ 20 t/ha + 50% RDF (inorganic sources).	28.47	121.4	151.1	108.33	78.50	10.84
Application of FYM @20 t/ha + 100 % RDF (inorganic sources).	31.26	127.0	163.4	116.43	79.70	10.87

Application of FYM @20 t/ha + inorganic nutrients application based on soil test.	28.13	129.2	160.8	120.37	94.70	10.82
Application of FYM @10 t/ha+ bio fertilizers (*Azotobactor* + P.S.B) +50%RDF	30.21	124.7	159.2	114.81	82.10	11.15
Application of FYM @ 10 t/ha+ bio fertilizers *(Azotobactor* + P.S.B) + 100% RDF	28.59	130.0	165.2	121.87	88.40	11.16
Application of FYM @ 10 t/ha+ bio fertilizers (*Azotobactor* + P.S.B)+ inorganic nutrients application on soil test basis	31.94	142.0	175.6	126.50	99.20	10.70
SE±	**2.72**	**2.31**	**2.57**	**2.35**	**1.82**	**0.17**
CD at 5%	**NS**	**4.91**	**5.44**	**4.98**	**3.86**	**NS**

4. UCHANI

The experiment consisting of nine treatments was conducted in randomized block design with three replications on early maturing and good ratooning variety CoH 160. The first ratoon was initiated on March 20, 2018 during spring season. Recommended dose of NPK for sugarcane plant crop in Haryana is 150-50-50 kg/ha whereas for ratoon crop is 225-50-50 NPK kg/ha. Doses of phosphorus, potash as per treatments were applied at the time of ratoon initiation whereas dose of nitrogen was applied in three equal splits as top dressing (April, May & June). The crop was irrigated at 8-10 days intervals during pre-monsoon period and 20 days interval during post monsoon period. The plant crop was harvested on March 12, 2019.

The treatments with 100 % RDF and soil test based fertilizer with and without FYM application being at par produced significantly higher number of tillers, millable canes and ratoon cane yield as compared to the treatments of 50 % RDF with and without FYM (**Table AS 68.4.1**). Application of 20 t/ha FYM with 50 % RDF or 100% RDF or soil test based fertilizers application produced similar number of tillers, millable canes, cane yield in comparison to the treatments of 10 t/ha FYM + Biofertilizers application with 50 % RDF or 100% RDF or Soil test based fertilizers application. FYM/Compost 20 t/ ha + 100% RDF through inorganic source (T6) and FYM/Compost @ 10 t/ ha + biofertilizer (Azotobacter/ Acetobacter + PSB) + soil test basis (T9) were found best and at par treatments in terms of number of tillers, millable canes and ratoon cane and sugar yield as compared to rest of the treatments. So FYM 10t /ha can be saved with application of biofertilizer in sugarcane crop in addition in increasing the population of soil microorganism.

Summary: FYM 20 t/ ha + 100% RDF through inorganic source (T6) and FYM @ 10 t/ ha + biofertilizer (Azotobacter/ Acetobacter + PSB) + soil test basis (T9) were found best and at par treatments in terms of number of tillers (18.4, 142.9 thousands/ha), millable canes (119.1,116.5 thousands/ha) and ratoon cane yield (96.6, 94.0 t/ha) and sugar yield as compared to rest of the treatments.

Table AS 68.4.1: Performance of first ratoon crop as influenced due to nutrient management in plant-ratoon system at Uchani

Treatment	Tillers (000/ha)	NMC (000/ha)	Cane weight (g)	Cane yield (t/ha)	CCS (%)	Sugar yield (t/ha)
Application of trash at 10 t/ ha + 50% RDF	95.5	85.2	713	58.7	12.48	7.29
Application of trash at 10 t/ ha + 100% RDF	134.6	109.2	821	86.5	12.53	10.79
Application of trash at 10 t/ ha + soil test basis (NPK application)	136.8	110.6	827	88.3	12.55	11.04
Application of FYM/Compost @ 20 t/ ha + 50% RDF (inorganic source)	115.7	96.3	761	70.7	12.45	8.80
Application of FYM/Compost @ 20 t/ ha + 100% RDF (inorganic source)	146.2	118.7	835	95.7	12.54	12.00
Application of FYM/Compost @ 20 t/ ha + in organic nutrient application based on soil test (NPK application)	148.4	119.1	840	96.6	12.53	12.10
Application of FYM/Compost @ 10 t/ ha + biofertilizer (*Azotobacter/ Acetobacter* + *PSB*) + 50% RDF	108.7	93.1	755	67.9	12.47	8.47
Application of FYM/Compost @ 10 t / ha + biofertilizer (*Azotobacter/ Acetobacter* + *PSB*) + 100% RDF	140.7	115.3	830	92.4	12.56	11.61
Application of FYM/Compost @ 10 t/ ha + biofertilizer (*Azotobacter/ Acetobacter* + *PSB*) + + in organic nutrient application based on soil test (NPK application)	142.9	116.5	836	94	12.55	11.80
CD at 5%	10.7	8.9	44	6.9	NS	0.82

PENINSULAR ZONE

5. SANKESHWAR

The yield and yield attributes recorded in first ratoon cane indicated significant differences among the treatments. Application of trash at 10 tonnes/ha along with soil test based nutrients application recorded highest cane yield (100.41 t/ha), number of millable canes (80680/ha) and CCS yield (13.65 t/ha). However, treatments with soil test based nutrients application recorded on par cane yield irrespective of application of organics along with microbial inoculants and also with application of FYM/Compost at 20 tonnes/ha along with 50% or 100%RDF. The lowest cane yield (81.11 t/ha) was recorded in 50 percent inorganics with application of FYM/Compost at 10 tonnes/ha along with microbial inoculants (**Table AS 68.5.1**).

All the quality parameters differed significantly for treatment variations in ratoon cane. Significantly lowest brix and POL was recorded in 100 percent inorganics

with application of FYM/Compost at 10 tonnes/ha along with microbial inoculants. Significantly lowest CCS and Purity percent was noticed with 50 percent inorganics with application of trash at 10 tonnes/ha. Not much variation with respect to initial and after harvest of ratoon cane was observed among the treatment combinations.

Table AS 68.5.1: Performance of sugarcane first ratoon crop as influenced due to nutrient management at Sankeshwar

Treatment	Cane yield t/ha	NMC 000/ha	Cane height in cm	Cane girth in cm	Single cane weight (kg)	CCS Yield t/ha
1	89.42	64.45	220.00	2.80	1.40	11.60
2	97.53	65.10	225.00	2.90	1.50	13.21
3	100.41	80.68	233.33	2.97	1.53	13.65
4	97.53	65.63	195.33	2.70	1.22	13.30
5	97.74	78.17	222.67	2.72	1.25	12.89
6	98.87	71.00	226.00	2.88	1.44	12.89
7	81.11	65.73	188.00	2.61	1.23	10.93
8	81.21	62.35	214.78	2.85	1.33	10.70
9	96.92	66.43	222.33	2.96	1.47	12.70
Mean	**93.42**	**68.84**	**214.78**	**2.82**	**1.38**	**12.43**
Sem ±	**2.94**	**5.07**	**18.39**	**0.09**	**0.10**	**0.44**
CD 5%	**8.82**	**15.21**	**55.13**	**0.28**	**0.29**	**1.33**

EAST COAST ZONE

6. NAYAGARH

Results obtained from first ratoon crop indicated that application of FYM/Compost @ 10t/ha + (Azotobacter + PSB) +100% RDF (T8) and Application of FYM/Compost @ 10t/ha + Azotobacter + PSB + Soil test based (NPK) fertilizer application (T9) recorded higher percentage of germination at 45 DAR i.e. 43.70 and 46.89%, respectively. These treatments subsequently performed better than other treatment combinations leading to higher yield parameters and cane yield. The length and girth of the cane were also higher 3.12m & 2.46 cm in T8 and 3.21m & 2.51 cm in T9, respectively. The NMC and Cane yield were 76.5'000 & 80.5 t/ha in T8 and 78.1'000 & 82.1 t/ha in T9, respectively. This exhibits the positive effect of organic manures and bio fertilizers on cane yield(**Table AS 68.6.1**).

Table AS 68.6.1: Performance of sugarcane first ratoon crop as influenced due to nutrient management in plant-ratoon system at Nayagarh

Treatment	Germination %		No of shoots (000/ha)		Length of cane (m)	Girth of cane (cm)	Weight of cane (kg)	NMC (000/ha)	Cane yield (t/ha)
	30 DAR	45 DAR	120 DAR	150 DAR					
Application of trash @ 10t/ha + 50% RDF	31.41	34.57	50.96	54.01	2.38	1.92	1.18	61.62	62.77
Application of trash @ 10t/ha + 100% RDF	32.29	38.28	55.49	59.70	2.89	2.20	1.36	66.86	72.69

Application of trash @ 10t/ha + Soil test based fert. application (NPK)	32.54	41.75	59.87	63.58	3.06	2.29	1.50	69.08	73.47
Application of FYM/Compost @ 20t/ha+ 50% RDF	32.08	40.81	58.59	60.88	2.42	2.19	1.25	64.04	64.87
Application of FYM/Compost @ 20t/ha+ 100% RDF	36.17	43.05	61.74	64.77	2.81	2.31	1.39	71.63	73.93
Application of FYM/Compost @ 20t/ha+ Soil test based fert. application (NPK)	38.47	43.36	64.34	66.52	2.93	2.49	1.51	72.96	74.80
Application of FYM/Compost @ 10t/ha+(Azotobacter+PSB)+50 % RDF	35.26	40.35	63.88	64.89	2.71	2.31	1.37	68.48	67.55
Application of FYM/Compost @ 10t/ha+(Azotobacter+PSB)+100% RDF	39.66	43.70	67.64	69.80	3.11	2.46	1.53	76.48	80.49
Application of FYM/Compost @ 10t/ha + Azotobacter + PSB + Soil test based fert application (NPK)	42.40	46.89	69.25	71.18	3.21	2.50	1.577	78.08	82.09
SEm±	1.622	1.808	2.21	2.027	0.144	0.082	0.076	2.394	2.645
CD at 5 %	4.998	5.571	6.82	6.244	0.443	0.254	0.235	7.377	8.150
CV%	7.89	7.56	6.26	5.49	8.78	6.21	9.36	5.93	6.32

NORTH CENTRAL ZONE

7. PUSA

The experimental soil was calcareous, low in organic carbon (0.44%) and available N (221.4 kg/ha) & K (74.1 kg/ha) and medium in P (11.6 kg/ha). The mid-late variety (BO 154) of sugarcane was planted on 07.02.2017 and harvested on 05.03.2018 after that first ratoon crop was taken which was harvested on 06.02.2019. The effect on growth and yield attributing parameters indicated that number of tillers, millable canes, and single cane weight (SCW) and cane yield were significantly affected due to different treatments but plant height and girth was non- significant. The highest

number of tillers at 150 DAR (151330/ha) and NMC (119270/ha) were recorded in T6 receiving fertilizer on soil test basis alongwith organics @ 20 tonnes/ha and lowest tillers (75000/ha) and NMC (54630/ha)in T1 receiving only 50% RDF. The cane yield was significantly higher in treatments T2 (49.32 t/ha) and T3 (65.99 t/ha) receiving RDF and application of fertilizer on soil test basis over T1 (32.24) having 50% RDF (**Table AS 68.7.1**).

Addition of organics @ 10 & 20 t/ha alongwith fertilizers further increased the cane yield. The highest cane yield (79.82 t/ha) was recorded in treatment T6 receiving fertilizer on soil test basis alongwith FYM @ 20 t/ha which was significantly superior over T4 (46.8 t/ha) receiving 50% RDF alongwith FYM @ 20 t/ha. The cane juice quality viz. brix, sucrose and purity percent was not affected due to different treatments. However, Sugar yield followed the similar trend of cane yield and maximum sugar yield (9.97 t/ha) was noticed in T6 (**Table AS 68.7.1**). The post-harvest soil showed significant improvement in available soil nutrients viz. N, P, K, treated plots over control. The available N, P, K ranged from 181.8 -299.8, 10.73 – 19.88, and 64.0 – 91.7 kg/ha. Integration of nutrients with compost @ 10 & 20 t/ha significantly improved the organic carbon status of the post-harvest soil. The organic carbon in FYM treated plots ranged from 0.47- 0.58%. However, the integration of nutrients had no significant effect on pH and EC.

Summary: Integrated application of nutrients was found effective in improving soil fertility and cane yield. The application of fertilizers on soil test basis alongwith organics @ 20 t/ha was found suitable for boosting cane yield and maintaining soil fertility in calcareous soils of Bihar.

Table AS 68.7.1: Performance of sugarcane first ratoon crop as influenced due to nutrient management in plant-ratoon system at Pusa

Treatment	Tiller (‘000/ha) 150 DAR	Plant height (cm)	Girth (cm)	SCW (kg)	NMC (‘000/ha)	Cane yield (t/ha)
T_1	75.0	214	2.20	0.588	54.63	32.24
T_2	126.6	226	2.21	0.645	76.63	49.32
T_3	146.0	236	2.28	0.693	95.07	65.99
T_4	90.0	233	2.27	0.684	68.43	46.80
T_5	143.3	243	2.27	0.742	95.60	71.19
T_6	151.3	234	2.26	0.754	119.27	79.82
T_7	96.6	227	2.40	0.688	68.27	46.85
T_8	132.0	225	2.17	0.751	94.93	71.15
T_9	147.9	226	2.24	0.748	118.53	78.53
SEm ±	6.1	8.06	0.051	0.02	5.98	4.48
CD (P=0.05)	18.6	NS	NS	0.07	18.08	13.55
CV (%)	8.6	6.08	3.91	5.71	12.03	12.71

8. SEORAHI

The experimental field was medium in organic carbon, medium in available phosphorus and low in potash with pH 8.13. Sugarcane ratoon crop was initiated on 22 March 2018 and harvested on 1 April 2019. Application of FYM@ 10 t/ha+ bio-fertilizers (Azotobacter+PSB) + soil test basis NPK application treatment produced significantly higher clump population (34.92 thousand/ha), NMC (107.54 thousand/ha)

and cane yield (83.99 t/ha) as compared to other treatments except the treatment T8. Shoot population (162.30 thousand/ha) was noted significantly higher in application of FYM @ 10 t/ha+ bio-fertilizer (Azotobacter+PSB) +100 per cent RDF treatment compared to T1, T4 and T7 but at par with remaining treatments. Sucrose percent was not affected significantly due to different application of fertilizer doses and sources treatments but maximum sucrose (19.55 per cent) was recorded in application of FYM/ @ 10 tonnes/ha+ biofertilizers (Azotobacter+ PSB) + soil test basis NPK application (**Table AS 68.8.1**).

Summary: Cane yield was observed significantly higher in application of FYM @ 10 t/ha+ bio-fertilizer (Azotobacter+PSB) + soil test basis NPK application over remaining treatments but at par with FYM @ 10 t/ha+ Bio-fertilizer (Azotobacter+PSB) +100 per cent RDF. Sucrose percent was not affected significantly due to different treatments.

Table AS 68.8.1: Performance of ratoon crop as influenced due to nutrient management in plant-ratoon system at Seorahi

Treatment	Clumps ('000/ha)	Shoots ('000/ha)	NMC ('000/ha)	Cane Yield(t/ha)	Sucrose %
T_1	25.00	125.26	64.55	52.64	17.98
T_2	29.89	147.35	91.93	71.69	18.63
T_3	32.80	153.30	93.52	75.92	18.96
T_4	26.45	135.84	72.75	68.91	19.29
T_5	33.60	157.41	95.24	77.78	18.60
T_6	32.94	155.55	94.58	76.06	18.30
T_7	27.51	139.42	75.53	52.78	18.80
T_8	34.79	157.93	96.29	83.20	19.24
T_9	34.92	162.30	107.54	83.99	19.55
SEm±	1.37	7.33	2.57	2.62	0.38
CD(P=0.05)	4.14	22.15	7.78	7.94	NS

Important Observations:

The experiment was carried out at 08 stations as a number of stations have already completed two cycles of the system. Following salient points emerged from findings:

- Combined application of organic and inorganic sources of nutrients was found conspicuously better over the use of fertilizers alone across the centres located in different agro-climatic conditions.
- Sugarcane trash used as mulch in ratoon crops has little contribution as a source of nutrients as organic amendments like FYM or compost recorded significant improvement in cane and sugar yield over that with trash mulching under the use of recommended dose of fertilizers across the locations.
- Use of organic sources of nutrients in plant ratoon system brings about substantial enhancement of soil health parameters in most of the sugarcane growing soils.

PROJECT NO.: AS 70

Title : Scheduling irrigation with mulch under different sugarcane planting methods

Objectives : To enhance crop and water productivity in sugarcane

Year of Start **:** 2016-17

Year of Completion **:** 2019-20

Participating centres **:** All centres

Treatment (A) :

North West, North Central and North East Zones

Combination of planting methods and mulch practices

P_1: Conventional flat planting (75 cm row spacing) with organic mulching @ 6 t/ha (sugarcane trash/paddy straw/any other available crop residue)

P_2: Conventional flat planting (75 cm row spacing) without mulch

P_3: Paired row trench planting (30:120 cm row spacing) with organic mulching @ 6 t/ha.

P_4: Paired row trench planting (30:120 cm row spacing) without mulch.

Peninsular, East Coast Zones

Combination of planting methods, green manure and mulch practices

P_1: Furrow planting (120 cm row spacing) without mulching

P_2: Furrow planting (120 cm row spacing) with green manure (*dhaincha*/sunnhemp /cowpea) sowing at 30 DAP, mulching at 75 DAP and earthing-up at 110 DAP.

P_3: Furrow planting (120 cm row spacing) with alternate skip furrow irrigation* after earthing-up without mulching.

P_4: Furrow planting (120 cm row spacing) with alternate skip furrow irrigation* after earthing-up + green manure/brown mulching.

*First irrigation to be given in furrow nos. 1, 3, 5. Second irrigation to be given in furrow nos. 2 & 4. Similar schedule should be followed in successive irrigation.

Treatment (B) :

Irrigation schedule (IW/CPE)

I_1: 0.60
I_2: 0.80
I_3: 1.00

Irrigation water depth: 7.5 cm

Details of Methodology:

Recommended variety of sugarcane will be planted in spring season. Entire dose of N, P and K fertilizers as per recommendation of the region will be applied before onset of monsoon as per the recommendation.

Treatments (12):

Planting methods: 4
Irrigation regime: 3

Design **:** Strip plot design
Replication **:** 3
Plot size **:** 6m width x 8m length

Observations to be recorded:

A. Soil parameters

1. Initial and final soil fertility status as well as physical parameters (bulk density and infiltration rate)
2. Moisture (%) before each irrigation up to onset of monsoon
3. Quantity of water applied
4. Water use efficiency

B. Sugarcane:

1. Germination (%)
2. Periodic tiller population 90, 120, 180 DAP/DAR
3. Plant height at 90, 120, 180 DAP/DAR
4. Growth parameters i.e., NMC, cane length, diameter and cane weight
5. Juice quality (brix, pol % and purity %)
6. Cane and sugar yields (t/ha).

SUMMARY OF RESULTS OBTAINED DURING LAST YEAR (2017-18)

The trial was initiated during 2017-18. The trial was allocated to all the centres however, only 18 centres conducted the trial. Centre wise summary for the centres reporting for the year 2018-19 is given below (9).

NORTH WEST ZONE

1. FARIDKOT

Among the planting methods paired row trench planting with trash mulching recorded maximum (100.7 t/ha) and significantly higher cane yield than all other methods of planting. Trash mulching resulted in significantly higher cane yield than without trash mulching irrespective of planting methods. Cane yield increased successively and significantly with increase in irrigation water application from 0.6 to 1.0 IW/CPE. Apparent water productivity (AWP) and total water productivity (TWP) were significantly higher in paired row trench planting than conventional planting.

2. KOTA

Based on the two year of study, it can be concluded that paired row trench planting (30:120 cm row spacing) with organic mulching sugarcane trash @ 6 t/ha was found better with respect to number of tillers, plant height, millable canes, cane yield, cane weight, brix (%) and water use efficiency, resulted in significantly higher net return over P1 and P2 planting methods. However, irrigation water at IW: CPE ratio of 0.80 was found economical in sugarcane yield when compared with 0.60 and 1.00 IW: CPE ratios and also noted significantly enhancement in economics with each successive increase in irrigation regimes from 0.60 to 0.80 IW: CPE ratio which was proportionally more than the increase in irrigation water i.e. IW: CPE ratio of 1.00.

3. LUCKNOW

Sugarcane yield (114.3 t/ha) was significantly higher under paired-row trench planting with trash mulching than conventional flat method of planting along with trash mulching (101.9 t/ha) followed by paired-row trench planting with no mulching (98.3 t/ha) and conventional flat method of planting with no mulching (95.9 t/ha). The WUE was found maximum under paired-row trench planting with trash mulching (0.982 t/ha-cm) followed by conventional flat method of planting with trash mulching (0.877 t/ha-cm) and paired-row trench planting (0.845 t/ha-cm).

4. SHAHJAHANPUR

Paired row trench planting (120:30 cm row spacing) with organic mulch@ 6 t/ha produced higher cane yield (79.17 t/ha) and maximum water use efficiency (1109.30 kg/ha cm) than those of other planting methods and mulch practices. Irrigation schedule at 1.00 IW/CPE ratio (I3) produced significantly higher cane yield (79.80t/ha) with minimum water use efficiency (1088.75) followed by 0.80 IW/CPE ratio (I2) with cane yield of 75.58 t/ha and water use efficiency (1228.25 kg/ha cm).

5. UCHANI

Significantly higher germination, tillers, NMC, cane weight and cane yield were recorded in paired row trench planting (30:120 cm) as compared to conventional planting at 75 cm row spacing. Trash mulching resulted in significantly higher cane

yield as compared to without mulching treatments. Interaction between method of planting and irrigation levels was found non-significant. Total (Irrigation+ rainfall) water was calculated as 175.7, 190.7 and 205.7 cm in conventional and 153.7, 162.7 and 171.7 cm in paired row trench planting at 0.6, 0.8 and 1.0 IW/CPE irrigation schedule, respectively. Highest yield of cane produced/1000 litres of irrigation (12.18 kg) water was recorded in trench planting at 0.8 IW/CPE irrigation schedule

PENINSULAR ZONE

6. MANDYA

Furrow planting (120 cm row spacing) with alternate skip furrow irrigation after earthing up + dhaincha green manure mulching found to enhance the water use efficiency and gave at par yield as that of 120 cm row spaced furrow planting with dhaincha green manure with full irrigation at IW/CPE ratio 1.0.

EAST COAST ZONE

7. NAYAGARH

Furrow planting (120 cm row spacing) with alternate skip furrow irrigation after earthing-up + brown mulching method produced higher NMC and cane yield of 91442/ha and 100.59 t/ha respectively which was closely followed by furrow planting (120 cm row spacing) with brown mulching (NMC and cane yield 90699/ha and 100.06 t/ha). Irrigating the crop at IW/CPE ratio of 1.0 produced highest NMC and sugarcane yield of 92930/ha and 106.30 t/ha, respectively which is significantly different from irrigating the crop at IW/CPE ratio of 0.6 (NMC and cane yield 85.03'000/ha and 92.433 t/ha respectively).

NORTH CENTRAL ZONE

8. PUSA

Paired row trench planting (30: 120 cm row spacing) with trash mulching @ 6 t/ha (P3) being at par with paired row trench planting (30: 120 cm row spacing) without trash mulching (P4) produced significantly higher millable canes (143300/ha) and cane yield (99.5 t/ha) over other planting methods. Among the levels of irrigation, irrigation scheduled at IW: CPE ratio 1.00 recorded the significantly higher plant population (224500/ha), cane diameter (2.37 cm) and millable canes (125000/ha).

9. SEORAHI

Among planting methods, paired row trench planting (120:30 cm row spacing) with organic mulch @ 6t/ha (P3) treatment gave significantly higher germination per cent, shoot population, NMC and cane yield over conventional flat planting (75 cm row spacing) with organic mulch @ 6t/ha (P1) and conventional flat planting (75 cm row spacing) without mulch (P2) treatments but among the irrigation scheduling IW/CPE 1.0 ratio was found the best. Cane yield increased with increase in IW/CPE ratio. Sucrose per cent was not affected significantly with different treatments.

Important Observations: The experiment was initiated during the year (2016-17) and was allotted to all the centres, however only 18 centres carried out the trial as per the technical programme. Salient findings are enumerated below:

- Planting of sugarcane in paired rows (120: 30) with mulching of trash (6 t/ha) in the inter-row spaces out yielded the conventional flat method with or without mulch at all the centres in north western, north central and north eastern zones. Being in the climatic region of high evaporative demand sugarcane crop responded up to 1.0 IW/CPE irrigation regime in the zones, however similar yields have been recorded with 0.8 IW/CPE ratio at many centres. Trash mulching could effectively save 20-26% irrigation water over no-mulching.
- Sugarcane crop in peninsular and east coast zones responded to furrow planting (120 cm) and skip furrow irrigation combined with the use of leguminous crop as green manure till 75 DAP, as mulch during tillering and thereafter residue incorporation. As far irrigation regimes, IW/CPE ratio 1.0 was found to result in higher cane productivity, however it can be restricted to 0.8 for getting higher water use efficiency in these zones.
- Use of mulch in sub-tropical zones and green manuring followed by mulching and residue incorporation resulted in tropical zones resulted in higher net return.

CURRENT YEAR (2017-18) REPORT

NORTH WEST ZONE

1. FARIDKOT

Among the planting methods paired row trench planting with trash mulching recorded maximum (99.7 t/ha) and significantly higher cane yield than all methods of planting (**Table AS 70.1.1**). Trash mulching resulted in significantly higher cane yield than without trash mulching irrespective of planting methods. Cane yield increased successively and significantly with increase in irrigation water application from 0.6 to 1.0 IW/CPE. Apparent water productivity (AWP) and Total water productivity (TWP) were significantly higher in paired row trench planting than conventional planting (**Table AS 70.1.2**). Among irrigation schedules AWP decreased successively with increase in water input from 0.6 to 1.0 IW/CPE.

Table AS 70.1.1: Effect of planting methods and irrigation regime on sugarcane yield at Faridkot

Planting method/ Irrigation schedule (IW/CPE)	Cane Yield (t/ha)				Irrigation water input(cm)				Total water input (cm)#			
	I1 (0.6)	I2 (0.8)	I3 (1.0)	Mean	I1 (0.6)	I2 (0.8)	I3 (1.0)	Mean	I1 (0.6)	I2 (0.8)	I3 (1.0)	Mean
P1	91.2	94.4	99.2	94.9	60	75	97.5	77.5	94.6	107.7	135.1	112.5
P2	84.6	89.8	93.3	89.2	60	75	97.5	77.5	94.6	107.7	135.1	112.5
P3	94.3	100.5	104.4	99.7	24	30	39	31.0	58.6	62.7	76.6	66.0
P4	88.3	92.9	97.6	92.9	24	30	39	31.0	58.6	62.7	76.6	66.0
Mean	89.6	94.4	98.6		42.0	52.5	68.3		76.6	85.2	105.9	
LSD (p=0.05	MOP=4.8; IS=4.0; Interaction=NS											

Irrigation water input + Effective rainfall (I1= 34.6 cm, I2=32.7, I3=37.6)
P1: Conventional flat planting (at 75 cm row spacing) with mulching @ 6.00 t/ha, P2: Conventional flat planting (at 75 cm row spacing) without mulch, P3: Paired row trench planting (at 30: 120 cm row spacing) with mulching @ 6.0 t/ha, P4: Paired row trench planting (at 30: 120 cm row spacing) without mulch

Table AS 70.1.2: Water productivity under varying methods of planting and irrigation schedule

Planting methods/ irrigation schedule (IW/CPE)	Apparent water productivity (kg/m^3)				Total water productivity (kg/m^3)			
	I1 (0.6)	I2 (0.8)	I3 (1.0)	Mean	I1 (0.6)	I2 (0.8)	I3 (1.0)	Mean
P1	15.2	12.6	10.2	12.7	9.6	8.7	7.3	8.5
P2	14.1	12	9.6	11.9	8.9	8.3	6.9	8.0
P3	39.3	33.5	26.8	33.2	16.1	16	13.6	15.2
P4	36.8	30.9	24.8	30.8	15.1	14.8	12.6	14.2
Mean	26.4	22.3	17.9		12.4	12.0	10.1	
LSD (p=0.05)	MOP=1.7; IS=0.9; Interaction=1.8				MOP=0.8; IS=0.5; Interaction=NS			

2. KOTA

Significant variation on germination and tillers population at 90 DAP, 120 DAP and 180 DAP stages was observed by paired row trench planting (30:120 cm row spacing) with organic mulching sugarcane trash @ 6 t/ha. Paired row trench planting (30:120 cm row spacing) with organic mulching sugarcane trash @ 6 t/ha had significant effect on plant height at different stage, cane length, NMC, cane weight over P1 and P2 and at par with the paired row trench planting (30:120 cm row spacing) without mulch treatments. Data presented in Table **AS 70.2.1** revealed that significantly higher NMC (147.18 thousand /ha), cane weight (999.00 g/plant), cane yield (91.79 t/ha) were obtained with the paired row trench planting (30:120 cm row spacing) with organic mulching sugarcane trash @ 6 t/ha over P1 and P2 treatments and at par with P4 treatments. The effect of planting methods with and without mulch on cane diameter and quality parameters was not significant. There were differences in cost of cultivation, GR, NR owing to different treatment cost. The higher GR (252419 Rs/ha) and NR (146709 Rs/ha) and B: C ratio (1:2.39) recorded with paired row trench planting (30:120 cm row spacing) with organic mulching sugarcane trash @ 6 t/ha, which was significantly higher over P1 and P2 and at par with P4 treatments. The water use efficiency was significantly higher under paired row trench planting (30:120 cm row spacing) with organic mulching sugarcane trash @ 6 t/ha over P1 and P2 and at par with the paired row trench planting (30:120 cm row spacing) without mulch treatments. The lowest water use efficiency was recorded under conventional planting without mulching. This was mainly due to lower soil moisture contribution and water storage in the root zone depth leads to lower tonnage of in conventional planting method.

Irrigation regimes had significant impact on growth and yield attributes (Table **AS 70.2.2**). Significantly higher germination tiller population, plant height NMC and cane weight recorded at an IW: CPE ratio of 0.80 over IW: CPE ratio of 0.60 and at par with an IW: CPE ratio of 1.00 was due to sufficient moisture availability during the critical period. The higher cane yield and quality parameters were recorded at IW: CPE ratio of 0.80 over IW: CPE ratio of 0.60 but at par with an IW: CPE ratio of 1.00. Since cane yield is the result of additive and complementary effect of plant growth and yield attributing characters and the growth and yield attributes had better expression at optimum irrigation owing to adequate quantity and balanced proportion of water supply during the crop growth stages. Maximum WUE was recorded at IW: CPE ratio of 0.80 which was significantly higher over IW: CPE ratio of 1.00 but statistically at par with an IW: CPE ratio of 0.60.

The cost of production /ha was higher (108110 Rs/ha) under irrigation regime of IW: CPE ratio of 1.00 than 0.60 (100885 Rs/ha).Thus, irrigation regime of IW: CPE ratio of 0.80 recorded significantly higher net return, gross return and B: C ratio than IW: CPE 0.60 and on at par with IW: CPE 1.00. Economics increased significantly with each successive increase in irrigation regimes from 0.60 to 0.80 IW: CPE ratio. After that it did not increased proportionally with each successive increase in irrigation regimes from 0.80 to 1.00 IW: CPE ratio.

Summary: Based on the three years of study, it can be concluded that paired row trench planting (30:120 cm row spacing) with organic mulching of sugarcane trash @ 6 t/ha was found better with respect to number of tillers, plant height, millable canes, cane yield, cane diameter, cane weight, brix (%), CCS yield(t/ha) and water use

efficiency, resulted in significantly higher net return over P1 and P2 planting methods and at par with P4 treatment. However, irrigation water at IW: CPE ratio of 0.80 was found economical in sugarcane yield when compared with 0.60 and 1.00 IW: CPE ratios. Maximum WUE was recorded at IW: CPE ratio of 0.80 which was significantly higher over IW: CPE ratio of 1.00 but statistically at par with an IW: CPE ratio of 0.60 and also noted significant enhancement in economics with each successive increase in irrigation regimes from 0.60 to 0.80 IW: CPE ratio which was proportionally more than the increase in irrigation water i.e. IW: CPE ratio of 1.00.

Table AS 70.2.1: Effect of planting method, mulching and irrigation regime on growth and yield of sugarcane at Kota

Treatment	Cane diameter (cm)	NMC (000/ ha)	Cane weight (g)	Cane yield (t/ha)	Sucrose (%)	CCS yield (t/ha)
A. Combination of planting methods and mulch practices						
P_1: Conventional flat planting (75 cm row spacing) with organic mulching sugarcane trash @ 6 t /ha	2.86	124.7	884.4	82.99	16.89	9.66
P_2: Conventional flat planting (75 cm row spacing) without mulch	2.87	118.4	840.5	81.00	16.88	9.41
P_3: Paired row trench planting (30:120 cm row spacing) with organic mulching sugarcane trash @ 6 t/ha.	3.10	147.1	983.3	91.79	17.30	10.95
P_4: Paired row trench planting (30:120 cm row spacing) without mulch.	2.99	139.1	900.0	87.49	17.12	10.29
SEm ±	0.09	3.27	24.06	1.90	0.48	0.47
CD (P=0.05)	0.31	11.30	83.25	6.56	1.67	1.63
CV	9.06	7.40	8.00	6.63	8.49	14.06
B. Irrigation schedule (IW/CPE)						
I_1 : 0.60	2.93	124.9	861.6	78.41	16.03	8.58
I_2 : 0.80	2.96	137.8	940.0	90.54	17.86	11.16
I_3 : 1.00	2.98	134.2	904.5	88.50	17.25	10.49
SEm ±	0.02	2.41	16.07	1.24	0.32	0.15
CD (P=0.05)	0.06	9.48	63.07	4.86	1.27	0.61
CV	1.84	6.32	6.17	5.00	6.59	5.31

Table AS 70.2.2: Effect of treatments on water use efficiency and economics at Kota

Treatment	Total Irrigation water (mm)	No of irrigation	WUE (kg/ha-mm)	Treatment cost (Rs/ha)	Production cost (Rs/ha)	Gross returns (Rs/ha)	Net returns Rs/ha)	B: C ratio
A. Planting methods								
P_1	900	12	43.37	17867	105077	228219	123143	2.17
P_2	900	12	42.49	16100	103310	222750	119440	2.16

P_3	900	12	48.25	18500	105710	252419	146709	2.39
P_4	900	12	45.91	16700	103910	240594	136684	2.31
SEm ±			1.00			5213	5213	0.050
CD (P=0.05)			3.47			18038	18038	0.174
CV			6.69			7	12	6.675
B. Irrigation schedule (IW/CPE)								
I_1 : 0.60	670	9	46.39	13675	100885	215623	114738	2.14
I_2 : 0.80	905	13	47.28	17300	104510	248990	144480	2.38
I_3 : 1.00	1128	15	41.35	20900	108110	243375	135265	2.25
SEm ±			0.68			3406	3406	0.033
CD (P=0.05)			2.67			13370	13370	0.130
CV			5.23			5	9	5.089

Common cost of cultivation: Rs 87,210/ ha Cane price: Rs 2750/ton
Irrigation charge: Rs 1300/ irrigation, Mulching cost: Rs 400/t, Charges for furrow and paired Row: Rs 1300 and 1850/ha.

3. LUCKNOW

Sugarcane yield varied significantly due to different planting methods and trash mulching. Paired-row trench planting (30:120cm row spacing) with trash mulching (75.19 t/ha) being at par with conventional flat method of planting along with trash mulching (74.22 t/ha) resulted in significantly higher cane yield than that of conventional flat method of planting with no trash mulching (63.42 t/ha). The higher cane yield under paired-row trench planting with trash mulching was attributed to more number of millable cane (95.92 x 000/ha), **Table AS 70.3.1**. The juice quality parameters brix, sucrose content and purity per cent, remained statistically at par among all the four methods of planting. The trash application led to higher sugarcane yields, irrespective of irrigation scheduling. The higher cane yield (73.86 t/ha) under irrigation schedule at 0.8 IW: CPE might be attributed better initial crop growth, higher number of millable cane (92.27 x 000/ha) owing to optimum irrigation frequency with trash mulching at the time of crop establishment. The irrigation schedules at IW: CPE 0.8 recorded 10 % and 6.7% higher cane yield compared to 0.6 and 1.0 IW: CPE ratio, respectively. Water use efficiency was found maximum under paired-row trench planting with trash mulching (0.432 t/ha- cm) followed by conventional flat method of planting with trash mulching (0.427 t/ha-cm). The cane yield and water use efficiency can be increased significantly by trash mulching.

Table AS 70.3.1: Effect of planting methods and irrigation scheduling on sugarcane at Lucknow

Treatment	Germination (%) (45 DAP)	NMC ('000/ha)	Total water applied (cm)	Cane yield (t/ha)	WUE (t/ha-cm)	Juice Quality Parameters		
						^{O} Brix	Sucrose (%)	Purity (%)
Planting method								
Conventional flat+ no mulch (75 cm row spacing)	34.97	87.72	173.9	63.42	0.365	20.03	17.89	89.35
Conventional flat+ trash mulch (75 cm row spacing)	34.55	90.62	173.9	74.22	0.427	20.24	18.10	89.45
Paired-row trench planting+ no mulch (30:120 cm row spacing)	36.86	87.93	173.9	67.29	0.387	20.24	18.15	89.68
Paired-row trench planting+ trash mulch (30:120 cm row spacing)	36.03	95.92	173.9	75.19	0.432	20.24	18.07	89.38
CD (P=0.05)	NS	4.23	-	5.84	-	NS	NS	NS
Irrigation Schedule (IW : CPE)								
0. 60	35.25	88.43	161.4	67.01	0.415	20.08	17.93	89.41
0.80	35.74	92.27	176.4	73.86	0.418	20.29	18.18	89.62
1.00	38.82	90.94	183.9	69.21	0.376	20.18	18.03	89.36
CD (P=0.05)	NS	2.29	-	5.30	-	NS	NS	NS

Total water applied: 173.9cm; Effective rain: 131.40 cm; Irrigation water applied: 0.60 IW: CPE= 30 cm; 0.80 IW: CPE= 45.0 cm; 1.0 IW: CPE= 52.5 cm.

4. SHAHJAHANPUR

The soil of the experimental field was sandy loam in texture, low in organic carbon (0.32%), phosphorus (13.20 kg/ha) and medium in potassium (151.20 kg/ha) with 7.14 pH value. The experimental crop with variety CoS 08279 was planted on 16.03.2018 and harvested on 16.03.2019.The experimental results (**Table AS 70.4.1**) showed that paired row trench planting (30:120 cm row spacing) with organic mulch@ 6 t/ha produced higher cane yield (89.07 t/ha) and maximum water use efficiency (1090.20 kg/ha-cm) than those of other planting methods and mulch practices. Irrigation schedule at 1.00 IW/CPE ratio (I3) produced significantly higher cane yield (90.05 t/ha) with minimum water use efficiency (1050.25) followed by 0.80 IW/CPE ratio (I2) with cane yield of 84.50 t/ha and water use efficiency of 1130.45 kg/ha-cm.

Summary: Paired row trench planting (120:30 cm row spacing) with organic mulch@ 6 t/ha produced higher cane yield (89.07 t/ha) and maximum water use efficiency (1090.20 kg/ha cm). Irrigation schedule at 1.00 IW/CPE ratio (I3) produced significantly higher cane yield (90.05 t/ha) with minimum water use efficiency (1050.25).

Table AS 70.4.1: Effect of planting methods and irrigation regimes on sugarcane at Shahjahanpur

Treatment	Germination (%)	Shoots (000/m)	NMC (000/ha)	Plant height (m)	Cane yield (t/ha)	CCS (%)	Water use efficiency (kg/ha-cm)
A- Combination of planting methods and mulch practices							
P_1: Conventional flat planting (75 cm row spacing) with organic mulching@ 6 t/ha (sugarcane trash).	40.87	152.02	112.57	2.36	84.36	11.79	1063.65
P_2: Conventional flat planting (75 cm row spacing) without mulch	43.33	129.35	108.08	2.44	82.80	11.98	1045.25
P_3: Paired row trench planting (30: 120cm row spacing) with organic mulching @ 6 t/ha.	54.73	157.18	128.93	2.34	89.07	11.97	1090.20
P_4: Paired row trench planting (30: 120cm row spacing) without mulch.	54.23	146.88	122.73	2.34	86.13	11.94	1052.75
SE±	0.72	1.57	6.13	0.04	0.74	0.10	-
CD at 5%	1.83	3.99	NS	NS	1.81	NS	-
B. Irrigation schedule (IW/ CPE) with irrigation water depth 7.5 cm							
I_1 – 0.60	47.70	137.17	113.20	2.33	82.23	11.99	1170.75
I_2 – 0.80	47.40	148.44	118.24	2.36	84.50	11.88	1130.45
I_3 – 1.00	49.60	160.95	122.60	2.43	90.05	11.97	1050.25
SE±	0.59	1.36	2.95	0.03	0.21	0.05	-
CD at 5%	NS	3.79	NS	NS	0.59	NS	-

5. UCHANI

The experiment was conducted during spring season on mid maturing variety CoH 167. The crop was planted at spacing of 75 cm and 30: 120 cm (Trench) on March 8, 2018. The crop was fertilized with 150-60-60 NPK kg/ha. Sugarcane trash was applied as per treatments. The soil of the experimental field was sandy loam in texture with bulk density of 1.63 g/cm3, infiltration rate 1.78 mm/hours (basic), low in organic carbon (0.35) medium in available phosphorus (11.2 kg/ha) and medium in available K (180 kg/ha).

Pan evaporation rate readings were recorded from pan evaporimeter installed at the farm. Average pan evaporation rate values were 4.2, 6.4, 7.7 and 7.7 mm/day for the month of March, April, May and June 2018 (Pre-monsoon period), respectively. Soil moisture per cent (on volume basis) before each irrigation in 1.0, 0.8 and 0.6 IW/CPE treatments recorded during pre-monsoon period was 12.8-13.7 %, 10.6-11.5 %

and 8.0-8.5 %, respectively. The crop was irrigated as per treatments up to June end. The crop was irrigated as per requirement during post monsoon period. The crop received 1374 mm total rainfall during the crop season out of which 317 mm during pre-monsoon, 985 during monsoon (July 2018 to September 2018) and 71.2 mm during post monsoon (October 2018 to March 2019). Maximum rainfall of 549 mm and 310.5 was recorded during the month of July and September 2018. No rainfall was received in October 2018 and November 2018 months. Monthly average maximum temperature of 29.4, 35.4, 38.6 and 36.3 0C was recorded during March, April, May and June 2018 (Pre-monsoon period), respectively. Maximum monthly average temperature values ranges from 38.6 oC (May 2018) to 18.4 oC (January 2019) during crop season. Minimum monthly average temperature values ranges from 26.0 oC (June and July 2018) to 5.7 oC (December 2018) during the crop growth season. Total evaporation during the crop season was recorded as 1586.7 mm. The crop was harvested on March 10, 2019.

Significantly higher germination, tillers, NMC, cane weight and cane yield were recorded in paired row trench planting (30:120 cm) as compared to conventional planting at 75 cm row spacing (**Table AS 70.5.1**). The trash application led to higher sugarcane yields irrespective of irrigation scheduling. CCS percent was not affected due to different planting methods.Germination was not affected due to irrigation schedule as the irrigation schedule was followed after complete germination. No significant differences among different irrigation schedules were observed in growth and yield parameters due to frequent rains during pre-monsoon season. Interaction between method of planting and irrigation levels was found non-significant.

Irrigation of 7.5 cm was applied in conventional planting whereas; it was worked out as 4.5 cm in paired row trench planting on wet area basis (60 % of total plot area). Irrigation was given on wet area basis. Total irrigation water applied during pre-monsoon season was 22.5, 30.0 and 30.0 cm in conventional planting and 18.0, 22.5 and 22.5 cm in paired row trench planting method at 0.6, 0.8 and 1.0 IW/CPE schedule, respectively. During post monsoon, 60 and 50 cm irrigation water was applied in conventional and paired row trench planting, respectively. Total (pre+ post monsoon) irrigation water of 82.5, 90.0 and 90.0 cm in conventional planting and 68.0, 72.5 and 72.5 cm in paired row trench planting was applied at 0.6, 0.8 and 1.0 IW/CPE irrigation schedule, respectively. Total (Irrigation+ rainfall) water was calculated as 219.9, 227.4 and 227.4 cm in conventional and 205, 209.9 and 209.9 cm in paired row trench planting at 0.6, 0.8 and 1.0 IW/CPE irrigation schedule, respectively. Highest yield of cane produced/1000 litres of irrigation water applied was recorded in paired row trench planting at 0.6 IW/CPE followed by 0.8 IW/CPE ratio irrigation schedule with trash mulching (**Table AS 70.5.2**).

Summary: No significant differences in growth yield and yield attributing characters were observed among all the irrigation regimes due to frequent rains during pre-monsoon period. Sugarcane yield (95.2 t/ha) was significantly higher under paired-row trench planting with trash mulching than conventional flat method of planting along with trash mulching (82.2 t/ha) followed by paired-row trench planting with no mulching (88.6 t/ha) and conventional flat method of planting with no mulching (75.5 t/ha). The trash mulching led to higher sugarcane yields irrespective of irrigation scheduling. Interaction between method of planting and irrigation levels was found

non-significant. Total (Irrigation+ rainfall) water was calculated as 219.9, 227.4 and 227.4 cm in conventional and 205, 209.9 and 209.9 cm in paired row trench planting at 0.6, 0.8 and 1.0 IW/CPE irrigation schedule, respectively. Highest yield of cane produced/1000 litres of irrigation (13.72 and 13.29 kg) water was recorded in paired row trench planting at 0.6 IW/CPE and 0.8 IW/CPE irrigation schedule with trash mulching. The cane yield and water use efficiency can be significantly increased with trash mulching in sugarcane crop.

Table AS 70.5.1: Effect of planting methods and irrigation regimes on sugarcane at Uchani

Treatments	Germination (%)	Tillers (000/ha) 120 DAP	NMC (000/ha)	Cane wt. (g)	Cane yield (t/ha)
Planting methods					
Conventional planting with trash mulching	43.8	120.8	102.9	845	82.2
Conventional planting without trash mulching	44.5	112.8	96.5	808	75.5
Paired row trench with trash mulching	47.9	139.5	116.6	867	95.2
Paired row trench without trash mulching	47.5	129.2	109.7	840	88.6
CD at 5%	2.7	7.6	6.2	23	4.3
Irrigation schedule (IW/CPE)					
0.6	45.8	121.4	104.3	837	83.2
0.8	46.2	127.4	107.5	842	86.5
1.0	45.9	128.0	107.6	842	86.5
CD at 5%	NS	NS	NS	NS	NS

Table AS 70.5.2: Irrigation water applied and rainfall received during the crop season at Uchani

Planting methods	IW/ CPE	No. of irrigation	Irrigation depth (cm)	Post monsoon irrigation (cm)	Total irrigation (cm)	Total rainfall (cm)	Total water (Irrigation + rainfall) (cm)	Cane yield (t/ha)	Cane produced per 1000 litres of irrigation water (kg)
Conventional planting with trash mulching	0.6	02	7.5	60	82.5	137.4	219.9	79.7	9.66
Conventional planting with trash mulching	0.8	03	7.5	60	90.0	137.4	227.4	83.6	9.28

Conventional planting with trash mulching	1.0	03	7.5	60	90.0	137.4	227.4	83.4	9.26
Conventional planting without trash mulching	0.6	02	7.5	60	82.5	137.4	219.9	72.9	8.84
Conventional planting without trash mulching	0.8	03	7.5	60	90.0	137.4	227.4	76.4	8.49
Conventional planting without trash mulching	1.0	03	7.5	60	90.0	137.4	227.4	76.4	8.48
Paired row trench with trash mulching	0.6	02	4.5	50	68.0	137.4	205.4	93.3	13.72
Paired row trench with trash mulching	0.8	03	4.5	50	72.5	137.4	209.9	96.3	13.29
Paired row trench with trash mulching	1.0	03	4.5	50	72.5	137.4	209.9	96.1	13.25
Paired row trench without trash mulching	0.6	02	4.5	50	68.0	137.4	205.4	87.0	12.80
Paired row trench without trash mulching	0.8	03	4.5	50	72.5	137.4	209.9	89.4	12.34
Paired row trench without trash mulching	1.0	03	4.5	50	72.5	137.4	209.9	89.3	12.31

PENINSULAR ZONE

6. MANDYA

The initial soil analysis of the experimental site indicated that, the soil was low in organic carbon (0.39%), neutral in pH (6.70), low in available nitrogen (220 kg/ha), available P_2O_5 (18.5 kg/ha) and available K_2O (130 kg/ha). Sugarcane planting was done on 25.1.2018 and the crop was harvested on 2.2.19.

Among the planting methods, 120 cm row spaced furrow planting with *dhaincha*green manure sown 30 DAP and mulching at 75 DAP recorded significantly higher cane yield (161.0 t/ha) as compared to others (**Table AS 70.6.1**). However, it was at par with 120 cm row spaced furrow planting with alternate skip furrow irrigation after earthing up + *dhaincha*green manure mulching (155.2t/ha). While, the lower cane

yield was noticed in 120 cm row spaced furrow planting with alternate skip furrow irrigation without mulching (145.3 t/ha). Among the irrigation schedules, IW/CPE ratio of 1.0 recorded significantly higher yield (170.8 t/ha) as compared to IW/CPE ratio of 0.60 (131.8 t/ha). While, it was at par with IW/CPE ratio of 0.80 (155.6 t/ha). Among the interactions, significantly higher cane yield was observed in P2I3 (180.5 t/ha). However, it was on par with P4I3 (170.6 t/ha) and P1I3 (168.1 t/ha).

The irrigation water used was significantly lower in 120 cm spaced furrow planting with alternate skip furrow irrigation after earthing + green manure mulching (1751 mm) and it saved 16% of irrigation water. However, it was at par with 120 cm spaced furrow planting with alternate skip furrow irrigation after earthing without mulching (1828 mm). While,higher irrigation water used was observed with 120 cm spaced furrow planting without mulching (2083 mm). Scheduling of irrigation at IW/CPE ratio of 0.6 consumed lowest amount of irrigation water (1725mm) and saved 18% of irrigation water. While, the highest amount of irrigation water was consumed by IW/CPE ratio of 1.0 (2095 mm).

Table AS 70.6.1: Effect of treatments on sugarcane at Mandya

Treatment	Single cane weight (kg)	Cane length (m)	Millable cane ('000/ha)	Cane yield (t/ha)	Sucrose %	CCS %	CCS (t/ha)	Water used (mm)
Planting methods								
P1	1.93	2.30	82.81	149.4	19.04	13.47	20.12	2083
P2	2.10	2.41	85.87	161.0	19.17	13.68	22.00	2010
P3	1.64	1.97	80.78	145.3	19.56	13.82	20.05	1828
P4	1.77	2.13	81.73	155.2	19.55	13.89	21.54	1751
S.Em.±	0.04	0.04	0.55	2.36	0.11	0.06	0.33	22.0
CD @ 5%	0.14	0.13	1.91	8.18	NS	NS	1.15	76.0
Scheduling of irrigation								
I1	1.66	2.03	79.33	131.8	19.33	13.91	18.34	1725
I2	1.85	2.20	83.55	155.6	19.37	13.65	21.24	1934
I3	2.07	2.37	85.51	170.8	19.29	13.59	23.20	2095
S.Em.±	0.02	0.06	1.30	3.06	0.10	0.06	0.46	12.1
CD @ 5%	0.09	0.24	5.10	12.01	NS	NS	1.82	47.5
Planting methods X Irrigation Scheduling								
P1I1	1.68	2.12	79.33	129.5	18.87	13.43	17.39	1837
P1I2	1.96	2.34	83.56	150.5	19.20	13.53	20.38	2170
P1I3	2.14	2.43	85.52	168.1	19.05	13.45	22.60	2241
P2I1	1.94	2.21	81.44	137.3	19.07	14.00	19.21	1814
P2I2	2.11	2.44	86.64	165.4	19.33	13.60	22.50	2024
P2I3	2.25	2.57	89.55	180.5	19.11	13.46	24.29	2190
P3I1	1.46	1.83	76.73	123.5	19.76	14.03	17.33	1671
P3I2	1.60	1.94	81.73	148.4	19.49	13.63	20.22	1835
P3I3	1.87	2.14	83.87	163.9	19.43	13.79	22.60	1977
P4I1	1.57	1.96	79.83	137.0	19.61	14.18	19.43	1577
P4I2	1.73	2.10	82.25	158.0	19.47	13.83	21.86	1705
P4I3	2.02	2.32	83.11	170.6	19.57	13.67	23.32	1972
S.Em.±	0.05	0.07	2.77	3.00	0.22	0.07	0.25	33.0
CD @ 5%	0.15	0.21	8.54	10.16	NS	NS	0.76	101.7

7. PUNE

The pooled results of two plant canes are presented in Table1. Among the combination of planting methods and mulch practices, 120 cm row spaced furrow planting with sun hemp green manure sowing at 30DAP, mulching at 75 DAP and earthing up at 110 DAP (P2) recorded significantly higher cane yield of 154.96 t/ha , however it was at par with cane yield of 144.09 t/ha recorded in Furrow planting (120 cm row spacing) with alternate skip furrow irrigation after earthing up without mulching. Among the irrigation schedules, IW/CPE ratio of 1.0 recorded significantly higher cane yield of 146.59 t/ha and it was at par with cane yield (139.76 t/ha) recorded in 0.8 IW/CPE irrigation schedule (**Table AS 70.7.1**).The interaction of planting methods, mulching practices and irrigation schedule did not show significant differences.

The data on CCS(%) and sugar yield (t/ha) recorded at harvest indicate that planting methods, mulching practices and irrigation schedule did not express its significance on CCS(%). The sugar yield (21.95 t/ha) was significantly higher in 120 cm row spaced furrow planting with sunnhemp green manure mulching (P2). The irrigation schedule 1.0 IW/CPE recorded significantly higher sugar yield (20.98 t/ha) it was at par with sugar yield recorded in irrigation schedule of 0.8 IW/CPE ratio (20.28 t/ha).The interaction of planting methods, mulching practices and irrigation schedule did not show significant differences in sugar yield.

The lowest water use (211.39 ha-cm) wasobserved in furrow planting of 120 cm row spacing with alternate skip furrow irrigation after earthing up with sunnhemp green manure mulching which has resulted in highest water use efficiency of 0.68 t/ha-cm. Among the different irrigation schedules, water application at 0.60 IW/CPE ratio recorded the highest water use efficiency of 0.63 t/ha-cm.

Summary: The furrow planting of 120 cm spacing with sun hemp green manure mulching and irrigation schedule of 1.00 IW/CPE was found superior for cane yields, however it was at par with cane yield recorded in 120 cm row spaced furrow planting with alternate skip furrow irrigation after earthing up with sun hemp green manure mulching. The highest water use efficiency was recorded in furrow planting of 120 cm row spacing with alternate skip furrow irrigation after earthing up with sun hemp green manure mulching.

Table AS 70.7.1: Effect of various treatments on sugarcane at Pune

Treatment	Cane Yield t/ha	Sugar Yield (t/ha)	NMC ('000/ha)	Millable height cm	No. of Internodes	Cane dia.(cm)	CCS (%)
Combination of planting method and mulch practices							
P_1 : Furrow planting (120 cm row spacing) without mulching	131.09	18.95	89041	274.64	25.64	3.21	14.54
P_2 : Furrow planting (120 cm row spacing) with green manure mulching	154.96	21.95	93119	286.72	26.55	3.32	14.34
P_3 : Furrow planting (120 cm row spacing) with	130.68	19.29	86980	270.66	25.49	3.20	14.61

alternate skip furrow irrigation without mulching							
P_4 : Furrow planting (120 cm row spacing) with alternate skip furrow irrigation + green manure mulching	144.09	20.58	91672	283.39	26.05	3.30	14.39
S. E ± C.D. at 5%	2.02 5.96	0.28 0.82	652.77 1926.85	3.22 9.52	0.11 0.33	0.01 0.03	0.18 N.S.
Irrigation schedule (IW/CPE)							
I_1 : 0.60	134.26	19.39	88667	271.78	25.31	3.22	14.45
I_2 : 0.80	139.76	20.28	90554	279.26	26.02	3.25	14.56
I_3 : 1.00	146.59	20.98	91388	285.42	26.48	3.30	14.40
S. E ± C.D. at 5%	1.75 5.16	0.24 0.68	565.31 1668.71	2.79 8.25	0.10 0.29	0.01 0.03	0.15 N.S.

Table AS 70.7.2: Effect of various treatments on water use and water productivity at Pune

Treatment	Cane Yield t/ha	Quantity of water applied (ha-cm)	Water use efficiency (t/ha-cm)
Combination of planting method and mulch practices			
P_1 : Furrow planting (120 cm row spacing) without mulching	131.09	262.91	0.4986
P_2 : Furrow planting (120 cm row spacing) with green manure mulching	154.96	255.21	0.6072
P_3 : Furrow planting (120 cm row spacing) with alternate skip furrow irrigation without mulching	130.68	218.32	0.5985
P_4 : Furrow planting (120 cm row spacing) with alternate skip furrow irrigation + green manure mulching	144.09	211.39	0.6816
Irrigation schedule (IW/CPE)			
I_1 : 0.60	134.26	211.70	0.6341
I_2 : 0.80	139.76	236.57	0.5907
I_3 : 1.00	146.59	263.66	0.5559

EAST COAST ZONE

8. NAYAGARH

The experiment was laid out in strip plot design with three replications. Furrow planting (120 cm row spacing) with alternate skip furrow irrigation after earthing-up + brown mulching method produced higher NMC and cane yield of 90944/ha and 100.35t/ha, respectively (**Table AS 70.8.1**) which is closely followed by furrow planting (120 cm row spacing) with brown mulching (NMC and cane yield 90919/ha and 99.906 t/ha, respectively). Irrigating the crop at IW/CPE ratio of 1.0 produced highest NMC and sugarcane yield of 91922/ha and 105.48 t/ha, respectively which is significantly different from irrigating the crop at IW/CPE ratio of 0.6 (NMC and cane

yield 85558/ha and 92.19 t/ha, respectively). Planting method x irrigation schedule interaction was found not significant. However maximum water use efficiency was recorded with IW/CPE of 0.6 (820.35 kg/ha-cm) followed by IW/CPE ratio of 0.8 (777.29 kg/ha-cm). Furrow planting (120 cm row spacing) with alternate skip furrow irrigation after earthing-up + brown mulching treatment recorded higher water use efficiency (788.16 kg/ha-cm) than other planting methods (**Table AS 70.8.2**).

Table AS 70.8.1: Effect of different treatments on sugarcane at Nayagarh

Treatment	Germination % at 45 DAP	No of tillers (000/ha) at 120 DAP	NMC (000/ha)	Cane yield (t/ha)	Juice Brix %	CCS %	CCS yield (t/ha)
Planting methods							
P_1	51.422	85.723	87.132	99.820	21.278	12.042	11.920
P_2	53.730	87.737	90.919	99.906	20.817	12.156	12.195
P_3	54.092	83.590	87.434	99.101	21.518	11.868	11.682
P_4	53.407	85.231	90.944	100.358	20.692	11.842	11.843
Sem+	0.849	1.618	1.021	1.285	0.451	0.191	0.287
CD at 5 %	NS	NS	2.995	NS	NS	NS	NS
Irrigation schedule							
I_1	52.628	81.607	85.558	92.193	20.742	11.862	10.844
I_2	53.191	86.722	89.843	101.718	21.302	12.024	12.282
I_3	53.670	88.383	91.922	105.485	21.185	12.045	12.603
SEm+	0.735	1.401	0.972	1.113	0.390	0.165	0.249
CD at 5 %	NS	4.109	2.85	3.264	NS	NS	0.730

Table AS 70.8.2: Effect of different treatments on water use efficiency at Nayagarh

Treatments	Cane yield (t/ha)	Quantity of water applied (ha-cm)	Water use efficiency (kg/ha-cm)
Planting method			
P_1	99.820	147.2	762.853
P_2	99.101	147.93	772.513
P_3	99.916	140.9	779.856
P_4	100.358	137.9	788.166
Irrigation schedule			
I_1	92.193	132.15	820.355
I_2	101.718	142.95	777.29
I_3	105.485	152.35	729.897

NORTH CENTRLA ZONE

9. PUSA

The data presented in (**Table AS 70.9.1**) revealed that the maximum plant population (216100/ha), cane length (333.7 cm), millable canes (143200/ha) and cane yield (104.5 t/ha) were noticed under paired row trench planting (30: 120 cm) with trash mulching @ 6 t/ha (P3) being statistically comparable to paired row trench planting (30: 120 cm) without trash mulching (P4). However, brix, pol and purity percent were found to be non-significant.The number of irrigation was 6, 5 and 3 at IW: CPE ratios 1.00, 0.80 and 0.60, respectively. The total water applied on the basis of depth (7.5 cm) and number of irrigations was 45, 37.5 and 22.5 cm at IW: CPE ratios of

1.00, 0.80 and 0.60, respectively (**Table AS 70.9.1**). Among the level of irrigation, irrigation scheduled at IW: CPE ratio 1.00 recorded the higher plant population (226600/ha), plant height (343.5 cm), cane length (318.9 cm), cane diameter (2.40 cm), millable canes (147200/ha) and cane yield (104.7 t/ha). However, plant height, cane length, cane diameter and cane yield recorded at IW: CPE ratio 1.00 was statistically similar to IW: CPE ratio 0.80. Quality parameters remain unaffected due to different irrigation levels.

Table AS 70.9.1: Effect of treatments on sugarcane at Pusa

Treatment	Germination (%) at 45 DAP	Plant population ($\times 10^3$/ha) at 120 DAP	Plant height (cm) at 240 DAP	Cane length (cm) at harvest	Cane diameter (cm)	Millable canes ($\times 10^3$/ha)	Single cane weight (g)	Cane yield (t/ha)
Planting method with and without mulch								
P_1: Conventional flatplanting (75 cm rowspacing) with trashmulching @ 6 t/ha	36.4	184.6	306.8	281.4	2.21	123.9	729	85.0
P_2: Conventional flat planting (75 cm row spacing) without mulching	33.4	164.2	296.4	272.6	2.15	116.6	724	82.0
P_3: Paired row trenchplanting (30: 120 cmrow spacing) with trash mulching @ 6 t/ha	34.8	216.1	360.6	333.7	2.40	143.2	755	104.5
P_4: Paired row trench planting (30: 120 cmrow spacing) without trash mulching	37.1	201.1	347.3	320.5	2.35	138.8	751	99.8
SEm (±)	1.26	7.5	11.2	5.2	0.07	4.42	32.4	3.2
CD (P=0.05)	NS	23.7	NS	16.4	NS	13.9	NS	10.0
CV (%)	8.8	9.6	8.4	6.2	7.4	8.3	10.7	8.4
Irrigation schedule (IW/CPE)								
I_1 0.60	34.5	153.4	305.0	281.5	2.14	113.4	710	79.4
I_2 0.80	35.6	194.1	334.5	305.7	2.29	131.2	746	94.4

I_3	1.00	36.1	226.6	343.5	318.9	2.40	147.2	763	104.7
	SEm (±)	0.56	4.5	6.22	4.4	0.03	2.03	15.3	2.2
	CD (P=0.05)	NS	27.2	37.8	26.5	0.21	12.4	NS	12.9
	CV (%)	6.7	9.9	8.0	6.1	6.37	6.6	8.8	9.6

10. SEORAHI

The experimental field was medium in organic carbon (0.51%), medium in available phosphorus (17.60 kg per ha) and low in potash (59.20 kg per ha) with pH 8.05. Sugarcane crop was planted on 19 March 2018 and harvested on 21 March 2019. Paired row trench planting (120:30 cm row spacing) with organic mulch @ 6t/ha treatment gave significantly higher germination per cent (65.14), shoot population (173.88 thousand/ha), NMC (125.87 thousand/ha) and cane yield (110.21 t/ha) over remaining treatments of planting methods except paired row trench planting (120:30 cm row spacing) without mulch treatment. Lowest cane yield (79.26 t/ha) was obtained in conventional flat planting (75 cm row spacing) without mulch treatment. Irrigation scheduling IW/CPE 1.0 ratio treatment gave significantly higher germination (59.92 per cent), Shoot population (171.34 thousand/ha), NMC (118.15 thousand per ha) and cane yield (103.89 t/ha) over remaining treatments of irrigation scheduling. Sucrose (%) was not affected significantly by the different treatments of irrigation schedules and planting methods. Water productivity was recorded maximum 5.89 q/ha-cm in paired row trench planting (120:30 cm row spacing) with organic mulch @6t/ha and 5.34 q/ha-cm in irrigation schedule IW/CPE ratio 1.0 treatments (**Table AS 70.10.1**).

Summary: Treatment of paired row trench planting (120:30 cm row spacing) with organic mulch @6t/ha treatment gave significantly higher germination, shoot population, NMC and cane yield over conventional flat planting (75 cm row spacing) with organic mulch @6t/ha and conventional flat planting (75 cm row spacing) without mulch.Among different irrigation scheduling treatments IW/CPE ratio 1.0 gave significantly higher performance. Cane yield and sucrose per cent were increased with increase in the IW/CPE ratio. Sucrose per cent was not affected significantly with different treatments of planting methods and irrigation schedules.

Table As 70.10.1: Effect of different treatments on sugarcane at Seorahi

Treatments	Germination %	Shoot (000/ha)	NMC (000/ha)	Cane Yield (t/ha)	Sucrose %
Planting methods					
P_1	46.68	150.46	98.14	79.26	19.52
P_2	47.49	146.66	92.82	75.34	19.38
P_3	65.14	173.88	125.87	110.21	19.75
P_4	63.52	163.92	120.13	100.85	19.36
SEm±	1.89	4.20	3.80	3.06	0.27
CD(P=0.05)	6.51	14.48	13.10	10.57	NS
Irrigation schedules					
I_1	51.88	146.57	99.78	79.88	19.37
I_2	55.32	158.28	109.78	90.48	19.57
I_3	59.92	171.34	118.15	103.89	19.57
SEm±	1.12	3.19	2.79	1.89	0.16
CD(P=0.05)	4.39	12.50	10.92	7.40	NS

Table AS 70.10.2: Effect of different treatments on sugarcane water productivity at Seorahi

Treatment	Irrigation Water applied (mm)	Total rainfall (mm)	Total water applied (mm)	Cane yield (q/ha)	water productivity (q/ha-cm)
Planting methods					
P_1	300	1569.92	1869.92	792.59	4.24
P_2	300	1569.92	1869.92	753.44	4.03
P_3	300	1569.92	1869.92	1102.12	5.89
P_4	300	1569.92	1869.92	1008.50	5.39
Irrigation schedules					
I_1	225	1569.92	1794.92	798.81	4.45
I_2	300	1569.92	1869.92	904.76	4.84
I_3	375	1569.92	1944.92	1038.90	5.34

NORTH EASTERN ZONE

11. BETHUADHARI

Planting of sugarcane was done on 6.3.2018 with variety CoLK94184. Results indicated that the highest cane yield (103.09 t/ha) was obtained with the trench planting (30:120 cm row spacing) with organic mulching @ 6 t/ha followed by that of trench planting without mulching. Among irrigation scheduling treatments keeping IW: CP ratio one brought about highest cane yield (94.53 t/ha) significantly better over the other two IW: CP ratio (**Table AS 70.11.1**). Interaction between planning methods and irrigation scheduling was found significant for cane yield being highest (115.32 t/ha) at IW: CP ratio 1.0 when planted in trenches with mulching (**Table AS 70.11.2**).

Table AS 70.11.1: Effect of various treatments on sugarcane growth and yield at Bethuadhari

Treatments	**Cane Diameter (cm)**	**Cane Weight (kg)**	**Brix (%)**	**Pole (%)**	**Purity (%)**	**CCS (%)**	**Cane yield (t/ha)**	**Sugar Yield (t/ha)**
Irrigation schedule(IW/CPE) with depth of irrigation 7.5cm								
I_1	1.18	1.16	19.02	17.36	91.26	11.75	74.75	8.79
I_2	1.42	1.21	19.28	17.62	91.41	11.80	85.91	10.15
I_3	1.58	1.25	19.43	17.73	91.20	11.88	94.53	15.01
SEm(±)	0.05	0.04	0.04	0.10			2.81	0.78
CD (P=0.05)	0.15	0.11	0.12	0.29	NS	NS	8.44	2.35
Planting methods and mulch practice								
P_1	1.28	1.19	19.17	17.42	90.83	11.74	79.23	9.31
P_2	1.21	1.17	18.90	17.17	90.86	11.63	70.21	8.17
P_3	1.65	1.26	19.62	17.97	91.57	12.04	103.09	12.41
P_4	1.45	1.21	19.28	17.72	91.90	11.82	97.73	10.37
SEm(±)	0.05	-	0.08	0.07	-	-	2.54	0.67
CD(P=0.05)	0.16	NS	0.25	0.20	NS	NS	7.61	2.01
CV	7.25	5.64	7.33	5.45	7.23	6.34	7.45	6.52
Interaction	Sig	NS	NS	NS	NS	NS	Sig	Sig

Table AS 70.11.2: Interaction effect between irrigation scheduling and planning methods on cane and sugar yield at Bethuadhari

Treatments	Cane yield (t/ha)			Sugar yield (t/ha)		
Planting method	Irrigation schedule(IW/CPE)					
	I_1	I_2	I_3	I_1	I_2	I_3
P_1	72.35	80.13	85.20	8.44	9.41	10.07
P_2	61.26	70.27	79.11	7.09	8.17	9.25
P_3	87.25	106.70	115.32	10.42	12.81	14.01
P_4	78.15	86.53	98.50	9.21	10.21	11.69
SEm(±)	1.87	3.19		0.40	0.70	
CD(P=0.05)	5.63	9.56		1.21	2.10	
	P X I	I X P		P X I	I X P	

Important Observations: The experiment was initiated during the year (2016-17) and was allotted to all the centres, however only 11 centres carried out the trial as per the technical programme. Salient findings are enumerated below:

- Planting of sugarcane in paired rows (120: 30) with mulching of trash (6 t/ha) in the inter-row spaces out yielded the conventional flat method with or without mulch at all the centres in north western, north central and north eastern zones. Being in the climatic region of high evaporative demand sugarcane crop responded up to 1.0 IW/CPE irrigation regime in the zones, however similar yields have been recorded with 0.8 IW/CPE ratio at many centres. Trash mulching could effectively save 20-26% irrigation water over no-mulching.

- Sugarcane crop in peninsular and east coast zones responded to furrow planting (120 cm) and skip furrow irrigation combined with the use of leguminous crop as green manure till 75 DAP, as a mulch during tillering and thereafter residue incorporation. As far irrigation regimes, IW/CPE ratio 1.0 was found to result in higher cane productivity, however it can be restricted to 0.8 for getting higher water use efficiency in these zones.

- Use of mulch in sub-tropical zones and green manuring followed by mulching and residue incorporation in tropical zones resulted in higher net return.

PROJECT NO.: AS 71

Title: Carbon sequestration assessment in sugarcane based cropping system

Objective : To improve the total soil organic carbon build-up and sustain crop yields

Year of start : 2016 – 2017

Locations : All centers

Duration : One cycle of 3 years crop rotation

Treatments (Cropping system) :

North West and North Central Zones

T_1 : Rice - Wheat – Rice – Wheat (residue retention without *Trichoderma*)

T_2 : Rice - Wheat – Rice – Wheat (residue retention with *Trichoderma*)

T_3 : Sugarcane – Ratoon (trash mulching without *Trichoderma*) - Wheat

T_4 : Sugarcane – Ratoon (trash removal without *Trichoderma*) - Wheat

T_5 : Sugarcane – Ratoon (trash mulching with *Trichoderma*) - Wheat

T_6 : Sugarcane – Ratoon - Wheat (trash incorporation through rotavator and *Trichoderma* incorporation before sowing of wheat)

T_7 : Sugarcane – Ratoon- Wheat (Zero tilled) without *Trichoderma*

T_8 : Sugarcane – Ratoon-Wheat (Zero tilled) with *Trichoderma*

Peninsular and East Coast Zones

T_1 : Soybean-wheat/maize/*toria*

T_2 : Sugarcane-Ratoon-cowpea/urd bean/moong bean

T_3-T_8 : Will be same as in North West and North Central Zones except wheat to be substituted by maize/*toria*/cowpea

Treatments : 8

Design : RBD

Replication : 3

Plot size : 6 rows of 6 meter length

Observations to be recorded :

Soil parameters

1. Initial and final soil fertility status (0-30, 30-60 and 60-90 cm soil depths) as well as physical parameters (bulk density, infiltration rate, WHC)

2. Total soil organic carbon before start of the experiment and after harvest of every crop

Rice – Wheat/ Maize/*Toria*:

1. Germination count
2. No. of tillers at 30, 60 & 90 DAS
3. Days to maturity
4. Straw and grain yield

Sugarcane:

1. Germination at 35 & 45 DAP
2. Periodic tiller population 90, 120, 180 DAP/DAR
3. Plant height at 90, 120, 180 DAP/DAR
4. Growth parameters i.e., NMC, cane length, diameter and cane wt.
5. Juice quality (Brix, pol % and purity %)
6. Cane and sugar yields (t/ha)

Note:
All other trash management treatments will be same for both the regions.
Trichodermaviride solid based culture (10^7cfu/g)

The experiment will be conducted in permanent field layout.

Planting season: February – March

SUMMARY OF RESULTS OBTAINED DURING LAST YEAR (2017-18)

The trial was initiated during 2016-17 with allocation to all the centres. In all 15 centres conducted the trial in accordance with the approved technical programme. Centre wise summary of findings for the year 2017-18 are being given here under:

NORTH WEST ZONE

1. FARIDKOT

During 2017-18 wheat yield was significantly higher when sown after rice. The wheat following sugarcane was significantly better in T7 and T8 than T3 and T4. Sugarcane yield was better in T3, and T7 where trash was incorporated and was significantly higher than T4, T6 and T8 where trash was removed. Cane equivalent yield was also higher in T3, T5 and T7 than other treatments.

2. KOTA

Based on the two year study of soil properties, it can be concluded that soybean-wheat -moongbean (residue retention with Trichoderma) treatment was found better with respect to significantly enhancement in OC, infiltration rate, bulk density, WHC and Nutrient status of soil over T3 and T4 treatments. Whereas in case of ratoon T6 recorded significantly higher germination, tillers, plant height, cane diameter, cane weight, cane yield as well as juice quality parameters over rest of treatments.

3. KAPURTHALA

Cane equivalent yield was significantly higher in T3 that was at par with cane yield in treatments T5, T6 and T7 but it was significantly higher than the yield under remaining treatments.

4. LUCKNOW

Ratoon crop yielded 109.8 t/ha in sugarcane based cropping system. Higher wheat yield (46.9 q/ha) was recorded in sugarcane based cropping system just after harvest of ratoon crop as compared to 35.9 q/ha in rice-wheat system. Residue retention with Trichoderma in wheat improved the wheat yield by 11.2% in rice-wheat based cropping system. However, trash mulching with Trichoderma in ratoon crop improved the cane yield by 9.5% as compared to mulching without Trichoderma.

5. PANTNAGAR

Highest cane yield and wheat yield in ratoon recorded in T5 – Trash mulching with Trichoderma. Sucrose % in ratoon at harvest was not influenced by trash mulching or removal. There was no significant difference in organic carbon build up in any of the treatment however highest organic carbon % was recorded in T5 – sugarcane-ratoon (trash mulching with Trichoderma) – wheat.

6. UCHANI

Higher cane equivalent yield was recorded in Sugarcane plant- ratoon-wheat cropping system as compared to Rice- wheat cropping system. Highest cane equivalent yield of 115.4, 115.0 and 110.0 t/ha was recorded in treatment T7 (sugarcane – Ratoon-Wheat (ZT) without Trichoderma, T5 (sugarcane – Ratoon (trash mulch with Trichoderma) – Wheat) and T3 (sugarcane – Ratoon (trash mulch without

Trichoderma) – Wheat). Physical properties of soil were adversely affected in treatment T1 and T2 after harvest of puddled transplanted rice. The bulk density increased from 1.63 (initial) to 1.72 g/cc after harvest of rice crop. The bulk density and WHC improved after rice residue retention in wheat crop through happy seeder machine in treatment T1 and T2. Sugarcane proved superior in maintaining soil physical properties in comparison to puddled transplanted rice- wheat rotation.

PENINSULAR ZONE

7. PADEGAON

During 2017-18 soybean grain yield recorded in treatment T1 was 10.6 q/ha and T2 11.6 q/ha while wheat grain yield was recorded in T1 was 29.39 q/ha and T2 was 31.01 q/ha. Mean sugarcane ratoon yield was observed to be 72.9 t/ha to 100.8 t/ha.

8. NAVSARI

NMC (111430/ha) was recorded significantly higher with treatment T5 over T7 and remained at par with T3. Cane length and cane diameter at harvest was failed to show any significant effect due to different treatments. Single Cane weight was recorded significantly highest with treatment T5 and remained at par with T3, T6 and T7. Significantly highest Cane yield (121.17 t/ha) was noticed with treatment T5 over T7 and remained at par T3. CCS yield was not significantly influenced due to different treatments.

9. MANDYA

In the second year sugarcane was ratooned in T2 to T7 treatment and soybean-maize was grown in T1 treatment. All the sugarcane treatments recorded on par yield and yield attributing parameters and in soybean-maize treatment soybean yield was 16.5 q/ha and maize yield was 85.0 q/ha (Table AS 71.9.1). Soil chemical parameters viz., soil pH, EC, OC, BD and soil available N, P2O5 and K2O content after the harvest of ratoon crop were not influenced significantly due to different cropping systems.

10. THIRUVALLA

Sugarcane-Ratoon (trash mulching with Trichoderma)-cowpea recorded the maximum cane length (260.68 cm), cane diameter (2.47 cm), single cane weight (1.70 kg) etc. and resulted in significantly higher cane and sugar yield (77.17 and 8.23 t/ha respectively) followed by T6 - Sugarcane-ratoon-cowpea(trash incorporation through rotavator and Trichoderma incorporation before sowing of cowpea) which recorded the values of 254.33 cm, 2.41 cm, 1.65 kg and 69.65 and 6.81 t/ha respectively for the said parameters.

11. POWARKHEDA

The significantly highest Sugarcane equivalent yield (246.32 t/ha) was obtained with sugarcane- ratoon (trash mulching with Trichoderma) - wheat followed by Sugarcane-Ratoon (trash mulching without Trichoderma)- Wheat (241.71 t/ha) cropping systems. Among these treatment the equivalent yield recorded at par. The equivalent yield recorded Sugarcane- Ratoon- Wheat (Zero tilled with Trichoderma) (240.49 t/ha), Sugarcane- Ratoon - Wheat (trash incorporation through rotavator and Trichoderma incorporation before sowing of Wheat) (238.11 t/ha), Sugarcane- Ratoon (trash removal without Trichoderma)- Wheat (237.83 t/ha), Sugarcane- Ratoon-Wheat

(Zero tilled without Trichoderma) (237.39 t/ha), Sugarcane-Ratoon- Moong bean (236.32 t/ha), Soybean- Wheat (100.51 t/ha). The highest net return (Rs.132951/ha) and B:Cratio(1:1.30) was recorded under Sugarcane-Ratoon (trash mulching with Trichoderma)- Wheat cropping system then other sugarcane cropping system.

EAST COAST ZONE

12. ANAKAPALLE

Studies on carbon sequestration assessment in sugarcane based cropping system indicated that there is no significant variation in yield and quality of sugarcane ratoon crop in T2 to T8 treatments.

13. CUDDALORE

Sugarcane – Ratoon (trash mulching with Trichoderma) – Maize recorded significantly higher number of millable cane (145600/ha), cane length (286.5 cm) cane diameter (2.14 cm) and individual cane weight (1.71 kg) of sugarcane. The treatment (T5) Sugarcane – Ratoon (trash mulching with Trichoderma) – Maize has significantly recorded the highest cane yield (145.2 t/ha) and sugar yield (17.89 t/ha) and it was on par with Sugarcane – Ratoon – Maize (trash incorporation through rotavator and Trichoderma incorporation before planting of Maize) cropping sequence (142.2 t/ha and 17.16 t/ha respectively).

14. NAYAGARH

In the second year cowpea and sesame crop was grown along with ratoon crop to compare with sugarcane based cropping system. The observations on growth parameters and yield and yield attributes were analysed. The ratoon crop with trash mulching with Trichoderma produced highest number of net millable canes (90700/ha), cane (94.14 t/ha) and CCS yield (11.34 t/ha).

NORTH CENTRAL ZONE

15. PUSA

Data on growth, yield attributes, ratoon yield and quality of sugarcane and yield of rice, wheat system and organic carbon content on post-harvest soil indicated that none of treatments except straws yield of wheat could establish significant effect in improving the growth, yield, quality and organic carbon content. However, comparatively higher ratoon cane yield (82.0 t/ha) was obtained with sugarcane-ratoon-wheat (trash incorporation through rotavator and Trichoderma incorporation before sowing of wheat) (T6). Comparatively higher grain (3.73 and 3.91 t/ha) and straw yield (4.80 and 5.40 t/ha) of rice and wheat, respectively was obtained with rice-wheat-rice-wheat (residue retention with Trichoderma cropping system (T2).

IMPORTANT OBSERVATIONS:

- In the north-west zone use of sugarcane trash as mulch with or without Trichoderma inoculation in the ratoon crop resulted in highest sugarcane equivalent yield and brought about palpable improvement in soil health indicators.

- Trash mulching along with the use of Trichoderma in ratoon crop yielded in highest cane equivalent yield of the system comprising sugarcane- ratoon- cowpea/ greengram crops in peninsular and east-coast zones.

- For north central zone ratavator operation after ratoon harvest followed by spray of Trichoderma resulted in highest cane equivalent yield in sugarcane –ratoon – wheat cropping system.

CURRENT YEAR (2018-19) REPORT

NORTH WEST ZONE

1. FARIDKOT

The experiment was started with planting of sugarcane during 2016 and the effect of various treatments has been applied and their effect studied in ratoon crops. The yield of rice and wheat was at par in both the treatments. Sugarcane yield from plant crop was also at par in all treatments.Sugarcane (variety CoJ 88) was planted on 22.03.2016 and harvested on 16.03.2017. The initial soil status stood as pH: 8.6, EC: 0.30 dsm-1, OC= 0.30%, P =13.0 kg/ha, K= 750 kg/ha. Sugarcane plant crop yilded 94.6 t/ha whereas rice and wheat yield was recorded to be 7.8 and 5.6 & 7.9 and 5.7 t/ha in treatments T1 and T2, respectively.

During 2017-18 wheat yield was significantly higher when sown after rice. The wheat following sugarcane was significantly better in T7 and T8 than T3 and T4. Sugarcane yield was better in T3, and T7 where trash was incorporated and was significantly higher than T4, T6 and T8 where trash was removed. Cane equivalent yield was also higher in T3, T5 and T7 than other treatments (**Table AS 71.1.1**).

Table AS 71.1.1: Sowing and planitng dated of various crops in the systemat Faridkot

Year	Crop	Variety	Date of Planting, Ratooning	Date of Harvesting
2016-17	Sugarcane	CoJ 88	22.03.2016	16.03.2017
	Rice	PR 124	24.06.2016	19.10.2016
	Wheat	PBW 725	11.11.2016	22.04.2017
2017-18	Sugarcane (Ratoon)	CoJ 88	17.03.2017	20.12.2017
	Rice	PR 124	27.06.2017	18.10.2017
	Wheat	Unnat PBW 343	24.11.2017	27.04.2018
	Wheat after sugarcane	PBW 658	24.12.2017	27.04.2018

Table AS 71.1.2: Yield performance of variosu crops in the system at Faridkot

Treatment	Yield (t/ha)			
	Rice	Wheat	Sugarcane	Cane Eq. Yield
T1	7.7	5.9	-	70.4
T2	7.9	6.6	-	75.1
T3	-	3.4	91.8	109.6
T4	-	3.4	77.4	95.2
T5	-	3.8	88.8	108.7
T6	-	4.0	74.1	95.1
T7	-	4.2	93.7	115.7
T8	-	4.4	74.8	97.9
CD (5%)	-	0.7	13.5	

Crop price used for calculating cane eqyuivalent yield: Rice (Rs/q) 1590; Wheat(Rs/q) 1625; Sugarcane(Rs/q) 310.

2. KOTA

A field experiment was planted on 8th March, 2016 to improve the total soil organic carbon build-up and sustain crop yields. Sugarcane variety CoPb09181 was planted at 75 cm row distance. The highest sugarcane equivalent yield (62.40 t/ha) was recorded with the Soybean-wheat –moongbean (residue retention with Trichoderma) treatment than T1.The soybean equivalent yield (52.89 q/ha), mean crop grain yield in *kharif, rabi* and summer season were also recorded in the same cropping system. Higher germination percent in *kharif* and *rabi* and tillers/plant in rabi were observed in Soybean-wheat –moongbean (residue retention without Trichoderma), while number of branches /plant in kharif and summer was recorded in soybean-wheat –moongbean (residue retention with Trichoderma) treatment (**Table AS 71.2.1**).

During the year 2017-18 ratoon was initiated on 10th March, 2017. Among the cropping systems, highest sugarcane ratoon shoot count at 35 and 45 DARI, tiller population at 90 DAR and 180 DAR (90930 and171130), plant height at 120, 180 and at harvest (140.8,179.8 and 251.8 cm), cane diameter (3.47 cm), NMC (145100), cane weight (836.87 g), cane yield (93.80 t/ha) was recorded with the Sugarcane – Ratoon - Moong bean (trash incorporation through rotavator and Trichoderma incorporation before sowing of Moong bean) treatment . Quality parameters were also recorded highest in the same cropping system (**Table AS 72.2.2**).

Significant increase in soil organic carbon (0.52 %) was recorded under Soybean-Wheat –Moong bean (residue retention with Trichoderma) treatment over T3 and T4 treatment and at par with rest. The highest infiltration rate (4.64 mm/hr) was recorded under Soybean-Wheat –Moongbean (residue retention with Trichoderma) treatment over all the other treatments, except T1. Soil pH was not influenced by different cropping system, whereas WHC (47.27 %) of soil influenced significantly by Soybean-Wheat –Moongbean (residue retention with Trichoderma) treatment over T3 and T4 and on par with rest of treatments of cropping system during the second

(Ratoon) year. Bulk density (1.44 mg/m2) of soil reduced significantly with application of T2 treatment over T1, T3, T4 and T6 treatments and at par with rest. Significantly higher available N (339.00 kg/ha) in soil was obtained with T2 treatment over T3 and T4 treatments and at par with rest of treatments. Whereas higher available P (25.20kg/ha) was noted with T2 which was significantly superior over all the treatments except T1 treatments. Available K (328.77 kg/ha) in soil also increased significantly with T2 over T3 and T4 treatments and at par with rest of treatments.

Summary: Based on the three years study of soil properties, it can be concluded that Soybean-Wheat –Moong bean-wheat (residue retention with Trichoderma) (T2) treatment was found better with respect to significant enhancement in OC, infiltration rate, bulk density, WHC and Nutrient status of soil over T3 and T4 treatments. Whereas, in case of ratoon of sugarcane different treatment was noted that with T6 treatment also significantly higher in respect germination, tillers, plant height, cane diameter, cane weight, cane yield as well as in cane quality parameters with rest of treatments. Similarly, wheat succeeding ratoon also recorded higher germination (84.378%), no. of tillers at 90 DAS (9.97 thousand /ha), grain yield (56.83 q/ha) and straw yield (84.67 q/ha) under T6 treatment, which was significantly higher over sugarcane- ratoon-moong/wheat cropping system. In case of soil properties and nutrients status of soil with T6 treatment was found superior over rest of sugarcane-ratoon- wheat/ moong cropping systems with or without Trichoderma and trash mulching & trash removal treatment, by recording organic carbon (0.52 %), WHC (47.07%), bulk density (1.44 Mg/m3), N (332 kg/ha), P (24.10 kg /ha) and K (324.33 kg /ha).

Table AS 71.2.1: Performance of crops in rotation at Kota

Cropping system	Mean crop grain yield (q/ha)			Mean crop straw yield (q/ha)			Soybeanequ. yield (q/ha)
	Kharif	Rabi	Summer	Kharif	Rabi	Summer	
T_1 **:** Soybean - Wheat – Mungbean (Residue retention without Trichoderma)	17.2	40.1	8.8	29.5	63.0	19.8	51.7
T_2**:**Soybean-Wheat – Mungbean (Residue retention with Trichoderma)	17.4	40.8	9.2	30.4	62.2	20.5	52.8

Table AS 71.2.2: Yield performance of different crops under various systems at Kota

Treatment	Cane yield (t/ha)	Sucrose (%)	CCS (%)	CCS yield (t/ha)
T_1**:** Soybean-Wheat - Soybean –Wheat (residue retention without *Trichoderma*)/ sugarcane equivalent yield in system	62.50*	-	-	-
T_2 **:** Soybean-Wheat - Soybean -Wheat (residue retention with *Trichoderma*)	62.70*	-	-	-

/sugarcane equivalent yield in system				
T_3:Sugarcane – Ratoon (trash mulching without *Trichoderma*) – Moong bean	91.67	17.98	12.39	11.36
T_4 : Sugarcane – Ratoon (trash removal without *Trichoderma*) - Moong bean	90.83	16.97	11.64	10.58
T_5 : Sugarcane – Ratoon (trash mulching with *Trichoderma*) - Moong bean	93.00	18.28	12.61	11.73
T_6 : Sugarcane – Ratoon - Moong bean (trash incorporation through rotavator and *Trichoderma* incorporation before sowing of Moong bean)	93.80	18.35	12.66	11.87
T_7 : Sugarcane – Ratoon- Moong bean (Zero tilled) without *Trichoderma*	92.07	18.10	12.48	11.49
T_8 :Sugarcane – Ratoon- Moong bean (Zero tilled) with *Trichoderma*	93.03	18.08	12.46	11.58
SEm ±	1.51	0.30	0.22	0.25
CD (P=0.05)	4.57	0.92	0.68	0.76

Table AS 71.2.3: Influence of different cropping systems on soil properties at the of the system at Kota

Treatment	Soil OC(%)	Soil pH	WHC (%)	Bulk density (Mg/m^3)	Nutrient status of soil (kg/ha) after harvest		
	At harvest				N	P	K
T_1 : Soybean-Wheat - Soybean – Wheat (residue retention without *Trichoderma*)	0.517	8.21	46.73	1.44	334.6	24.50	326.6
T_2 : Soybean-Wheat - Soybean - Wheat (residue retention with *Trichoderma*)	0.523	8.19	47.20	1.43	338.3	25.13	328.6
T_3 :Sugarcane – Ratoon (trash mulching without *Trichoderma*) – Moong bean	0.493	8.21	45.80	1.45	325.0	21.50	302.3
T_4: Sugarcane – Ratoon (trash removal without *Trichoderma*) - Moong bean	0.483	8.22	45.63	1.45	314.0	21.40	299.3
T_5 : Sugarcane – Ratoon (trash mulching with *Trichoderma*) - Moong bean	0.507	8.19	46.70	1.44	329.0	23.50	321.6
T_6: Sugarcane – Ratoon - Moong bean (trash incorporation through rotavator and *Trichoderma* incorporation before sowing of Moong bean)	0.517	8.19	46.73	1.44	331.6	23.60	324.3
T_7 : Sugarcane – Ratoon- Moong bean (Zero tilled) without *Trichoderma*	0.507	8.20	46.37	1.45	327.6	23.30	319.0

T_8 **:**Sugarcane – Ratoon- Moong bean (Zero tilled) with *Trichoderma*	0.503	8.19	46.83	1.44	328.0	23.50	320.0
SEm ±	0.01	0.02	0.32	0.003	3.79	0.39	6.25
CD (P=0.05)	0.02	NS	0.97	0.011	11.50	1.19	18.96
CV	2.26	4.72	1.20	0.42	2.00	2.91	3.41
Initial	0.50	8.22	46.50	1.45	355	25.30	325

3. LUCKNOW

Sugarcane (CoPk05191) was planted in the experiment by 18th Feb 2016. The experimental soil was silt loam with pH 7.42 and organic carbon 0.42%, low in available nitrogen (270 kg/ha), medium in available phosphorus (36 kg/ha) and medium in available potassium (310 kg/ha). During the first year (2016-17) rice-wheat cropping system recorded grain yield of rice 4.22 t and wheat 4.57 t/ha. However sugarcane plant crop yielded to the tune of 107 to 119 t/ha in different sugarcane based cropping system (T3-T8). Residue retention with Trichoderma in wheat improved the wheat yield by 7%.

During 2017-18 soil analysis of experimental field revealed that rice-wheat cropping system recorded mean organic carbon 0.36% as compared to sugarcane based cropping system (0.43%) in 0-30 cm depth of soil. It subsequently decreased in 30-60 cm depth and recorded 0.24 and 0.29 % SOC, respectively. Mean available nutrient status in soil decreased as compared to initial status of soil. During second year of experimentation, rice-wheat cropping system recorded grain yield of rice and wheat in tune of 41.6 and 35.9 q/ha respectively (**Table AS 71.3.1**). Ratoon crop yielded 109.8 t/ha in sugarcane based cropping system.Higher wheat yield (46.9 q/ha) was recorded in sugarcane based cropping system just after harvest of ratoon crop as compared to 35.9 q/ha in rice-wheat system. Residue retention with Trichoderma in wheat improved the wheat yield by 11.2% in rice-wheat based cropping system. However, trash mulching with Trichoderma in ratoon crop improved the cane yield by 9.5% as compared to mulching without Trichoderma.

During the year 2018-19 it was found that Sugarcane - ratoon-wheat system recorded higher total soil organic carbon (0.45%) than the Rice-Wheat system (0.39%) at 0-30 cm depth as compared to initial SOC value of 0.32%. The mean SOC value improved 40.6% in Sugarcane -ratoon-wheat system than 21.8% in rice-wheat system from the initial SOC due to high addition of crop residua in the system. It further subsequently decreased in 30-60 cm depth. Mean available nutrient status in soil decreased as compared to initial status of soil. The conformity experiment was laid out in randomized block design with eight treatments and three replications under rice-wheat and sugarcane-ratoon-wheat systems with same objective to improve the total soil organic carbon build-up and sustain crop yields during 2018-19 with same technical programme.

Table AS 71.3.1: performance of different crops under various systems at Lucknow

Cropping System	2016-17		2017-18	
	Rice (q/ha)	Wheat (q/ha)	Rice (q/ha)	Wheat (q/ha)
T1: Rice – Wheat – Rice – Wheat (residue retention without *Trichoderma*)	41.7	44.2	42.4	34.01
T2: Rice – Wheat – Rice – Wheat (residue retention with *Trichoderma*)	42.8	47.3	40.8	37.8
Mean	42.3	45.8	41.6	35.9
Sugarcane-Wheat				
	Plant yield (t/ha)		Ratoon yield (t/ha)	Wheat yield (q/ha)
T3: Sugarcane – Ratoon (Trash mulching without *Trichoderma*) – Wheat	110		110	48.7
T4: Sugarcane – Ratoon (Trash removal without *Trichoderma*) – Wheat	116		107.5	45.8
T5: Sugarcane – Ratoon (Trash mulching with *Trichoderma*) – Wheat	107		120.5	49.8
T6 : Sugarcane – Ratoon – Wheat (Trash incorporation through rotavator and *Trichoderma* incorporation before sowing of wheat)	119		103.3	46.7
T7:Sugarcane – Ratoon – Wheat (Zero tilled) without *Trichoderma*	107		109.1	43.8
T8: Sugarcane – Ratoon – Wheat (Zero tilled) with t*richoderma*	113		108.7	46.5
Mean	112		109.8	46.9

Table AS 71.3.2: Influence of various treatments on SOC status at the end of cropping systems at Lucknow

		First year				**Second year**			
Cropping system	**Initial status**	After Rice- I		After Wheat-I		After Rice- I		After Wheat-I	
		Yield (q/ha)	%OC	Yield (q/ha)	%OC	Yield (q/ha)	%OC	Yield (q/ha)	%OC
T_1 -Rice-Wheat-Rice-Wheat (residue retention **without***Trichoderma*)	0.32	41.7	0.33	44.2	0.35	40.8	o.36	34.0	0.37
T_2 -Rice-Wheat-Rice-Wheat (residue retention **with** *Trichoderma*)		42.8	0.34	47.3	0.37	42.4	0.39	37.8	0.41
	Initial status	**First year**				**Second year**			
		After sugarcane (Plant)				After Ratoon		After Wheat	
		Yield (t/ha)		%OC		Yield (t/ha)	%OC	Yield (q/ha)	%OC
T_3-Sugarcane-Ratoon (Trash mulching **without***Trichoderma*)-	0.32	110		0.36		110	0.43	48.7	0.46

Wheat							
T_4 - Sugarcane-Ratoon (Trash removal **without***Trichoderma*)-Wheat		116	0.35	108	0.36	45.8	0.42
T_5 - Sugarcane-Ratoon (Trash mulching **with***Trichoderma*)-Wheat		107	0.35	121	0.46	49.8	0.48
T_6 - Sugarcane-Ratoon (Trash incorporation through rotavator and *Trichoderma* incorporation before sowing of wheat)		119	0.36	103	0.46	46.7	0.49
T_7 - Sugarcane-Ratoon-wheat (Zero tilled) **without***Trichoderma*		107	0.34	109	0.37	43.8	0.42
T_8 - Sugarcane-Ratoon-wheat (Zero tilled) **with** *Trichoderma*		113	0.34	109	0.38	46.5	0.43

4. UCHANI

During 2016-17grain yield of rice and sugarcane yield of plant crop was not affected due to different treatments, as no treatment was applied in rice and sugarcane plant crop. Numerically higher grain yield of wheat was recorded in T2 treatment (Rice—wheat rotation) where residue was retained with Trichoderma inoculation as compared to T1 treatment where residue was retained without Trichoderma. Physical properties of soil were adversely affected in treatment T1 and T2 after harvest of puddled transplanted rice. The bulk density increased from 1.64 (initial) to 1.72 g/cc after harvest of rice crop. The bulk density and WHC improved after rice residue retention in wheat crop through happy seeder machine in treatment T1 and T2.

Sugarcane variety CoH 167 (mid maturing) was planted during spring season on March15, 2016 and was harvested on March 10, 2017 to take ratoon crop. Soil sampling was undertaken just after harvesting of plant crop of sugarcane. The treatments have been applied in ratoon crop as per technical programme. In rice –wheat cropping system treatments (T1 and T2), non-scented rice variety HKR 47 was transplanted on July 5, 2016 and fertilized with 150-60-60 NPK kg/ha. Rests of the inputs were applied in rice crop as per state recommendation. The rice crop was harvested on October 20, 2016. After harvesting of rice crop, the soil sampling was undertaken for measuring the required parameters in this experiment. Wheat variety HD 2967 was sown on November 5, 2016 by Happy Seeder in full residue load after harvesting of rice crop. The wheat was fertilized with 150-60-60 NPK kg/ha. Wheat crop was harvested on April 15, 2017 in first year of experimentation. Soil sampling was again done after harvesting of wheat crop in treatment T1 and T2. The ratoon crop was harvested on December 15, 2017. Second crop of wheat was harvested on April 20, 2018.

Paddy and wheat grain yield in T2 (Rice-Wheat- Rice-Wheat (residue retention with Trichoderma) treatment was comparatively higher as compared to T1 (Rice-Wheat-Rice-Wheat (residue retention without Trichoderma) treatment (**Table AS 71.4.1**). Highest wheat grain yield was recorded in rice-wheat cropping system (T1 and T2) treatments due to timely sowing of wheat in these treatments. Wheat yield levels were comparatively lower in wheat sown after ratoon harvest. Higher cane yield were recorded in the treatment ((T3, T5, T7) where trash mulching/Trichoderma was applied. Higher cane equivalent yield was recorded in Sugarcane plant- ratoon-wheat cropping system as compared to Rice- wheat cropping system. Highest cane equivalent yield of 115.4, 115.0 and 110.0 t/ha was recorded in treatment T7 (sugarcane – Ratoon- Wheat (ZT) without Trichoderma, T5(Sugarcane – Ratoon (trash mulch with Trichoderma) – Wheat) and T3 (sugarcane – Ratoon (trash mulch without Trichoderma) – Wheat).

Physical properties of soil were adversely affected in treatment T1 and T2 after harvest of puddled transplanted rice. The bulk density increased from 1.63 (initial) to 1.72 g/cc after harvest of rice crop. The bulk density and WHC improved after rice residue retention in wheat crop through happy seeder machine in treatment T1 and T2. Sugarcane proved superior in maintaining soil physical properties in comparison to puddled transplanted rice- wheat rotation. No changes were recorded in pH, EC and soil texture (**Table AS 71.4.2**).

Summary: Higher cane equivalent yield was recorded in Sugarcane plant- ratoon-wheat cropping system as compared to Rice- wheat cropping system. Highest cane equivalent yield of 115.4, 115.0 and 110.0 t/ha was recorded in treatment T7 (sugarcane – Ratoon- Wheat (ZT) without Trichoderma, T5 (sugarcane – Ratoon (trash mulch with Trichoderma) – Wheat) and T3 (sugarcane – Ratoon (trash mulch without Trichoderma) – Wheat). Physical properties of soil were adversely affected in treatment T1 and T2 after harvest of puddled transplanted rice. The bulk density increased from 1.63 (initial) to 1.72 g/cc after harvest of rice crop. The bulk density and WHC improved after rice residue retention in wheat crop through happy seeder machine in treatment T1 and T2. Sugarcane proved superior in maintaining soil physical properties in comparison to puddled transplanted rice- wheat rotation.

Table AS 71.4.1: Performance of different crops under various systems at Uchani

Cropping system		Paddy grain yield (t/ha)	Wheat Grain yield (t/ha)	Cane yield (t/ha)	Cane equivalent yield (t/ha)
T1	Rice-Wheat-Rice-Wheat (residue retention without *Trichoderma*)	6.65	5.84	-	64.3
T2	Rice-Wheat- Rice-Wheat (residue retention with *Trichoderma*)	6.83	6.08	-	66.5
T3	S.cane (Spring) – Ratoon (trash mulch without *Trichoderma*) – Wheat	-	4.62	85.5	110.0
T4	S.cane (Spring) – Ratoon (trash removal without *Trichoderma*) – Wheat	-	4.65	79.5	104.2
T5	Sugarcane (Spring) – Ratoon (trash mulch with *Trichoderma*) – Wheat	-	4.81	89.4	115.0

T6	Sugarcane (Spring) – Ratoon – Wheat (trash incorporation through rotavator&*Trichoincorporation* before sowing of wheat)	-	5.10	77.8	104.9
T7	Sugarcane (Spring)– Ratoon- Wheat (ZT) without *Trichoderma*	-	5.32	87.1	115.4
T8	Sugarcane (Spring)– Ratoon- Wheat (ZT) with *Trichoderma*	-	5.41	77.5	106.2
	CD at 5%		0.63	5.6	

Table AS 71.4.2: Influence of various treatments on soil properties at the end of cropping systems at Uchani

Treatment	Bulk density (g/cc)	Infiltration rate (mm/day)	Water holding capacity	pH	EC	OC	Available nutrients (kg/ha)	
							P	K
T1: Rice-Wheat-Rice-Wheat (residue retention without *Trichoderma*)	1.67	3.58	28.3	7.8	0.4	0.41	12.3	180
T2: Rice-Wheat- Rice-Wheat (residue retention with *Trichoderma*)	1.67	3.62	28.6	7.8	0.4	0.41	12.6	176
T3: Sugarcane – Ratoon (trash mulch without *Tricho*) - Wheat	1.65	3.62	29.6	7.8	0.4	0.42	12.5	178
T4: Sugarcane– Ratoon (trash removal without *Tricho*) - Wheat	1.65	3.62	29.7	7.8	0.4	0.42	12.5	178
T5: Sugarcane – Ratoon (trash mulch with *Tricho*) - Wheat	1.65	3.62	29.6	7.8	0.4	0.41	12.4	177
T6: Sugarcane – Ratoon - Wheat (trash incorporation through rotavator&*Trichoincorporation* before sowing of wheat)	1.65	3.62	29.6	7.8	0.4	0.42	12.5	177
T7: Sugarcane – Ratoon-Wheat (ZT) without *Trichoderma*	1.65	3.62	29.6	7.8	0.4	0.41	12.4	178
T8: Sugarcane – Ratoon-Wheat (ZT) without *Trichoderma*	1.65	3.62	29.5	7.8	0.4	0.41	12.5	179
Initial status	1.63	3.64	30	7.8	0.4	0.39	12.1	186

PENINSULAR ZONE

5. MANDYA

In first year, sugarcane was raised in T2 to T7 treatment and soybean-maize was grown in T1 treatment. All the sugarcane treatments recorded on par yield and yield attributing parameters; and in soybean-maize treatment, soybean yield was 18.23 q/ha and maize yield was 88.0 q/ha.

In the second year sugarcane was ratooned in T2 to T7 treatment and soybean-maize was grown in T1 treatment. All the sugarcane treatments recorded on par yield and yield attributing parameters and in soybean-maize treatment soybean yield was 16.5 q/ha and maize yield was 85.0 q/ha (**Table AS 71.5.1**). In the third year Cowpea was sown in T2 to T7 treatment and soybean-maize was grown in T1 treatment. The Cowpea yield was significantly higher in Sugarcane Ratoon – Cowpea (trash mulching with Trichoderma) (15.13 q/ha) but it was at par with sugarcane - ratoon- (trash mulching with Trichoderma) – Cowpea (15.01 q/ha).In soybean-maize treatment soybean yield was 16.3 q/ha and maize yield was 86.2 q/ha. The soil physico - chemical parameters were not influenced significantly as compared to initial values. However, the trash incorporation treatments recorded significant improvement in soil physical and chemical properties as compare to trash burning / removal treatments (Table AS 71.5.2).Soil chemical parameters viz., soil pH, EC, OC, BD and soil available N, P_2O_5 and K_2O content after the harvest of ratoon crop were not influenced significantly due to different cropping systems.

Table AS 71.5.1: Performance of sugarcane ratoon under various systems at Mandya

Treatment	Single cane weight (kg)	Cane length (m)	Cane girth (cm)	No. of internodes	Millable cane ('000/ha)	Cane yield (t/ha)	CCS (t/ha)
T_1	-	-	-	-	-	-	-
T_2	2.06	2.27	3.30	22.65	75.39	162.63	21.43
T_3	2.15	2.42	3.63	24.14	79.46	170.20	23.05
T_4	2.04	2.24	3.30	22.76	74.96	161.13	22.73
T_5	2.18	2.53	3.80	24.50	80.47	172.33	23.53
T_6	2.05	2.30	3.37	22.95	74.83	161.83	22.92
T_7	2.01	2.20	3.33	22.77	74.44	159.53	22.46
T_8	2.06	2.22	3.37	22.70	75.95	163.07	21.73
S.Em.±	0.05	0.06	0.07	0.30	3.44	6.12	0.88
CD@5%	NS	NS	NS	NS	NS	NS	NS

Table AS 71.5.2: Influence of various treatments on soil properties at the end of the cropping systems at Mandya

Treatment	Germination (%)	Seed yield (q/ha)	pH	EC (dS/m)	OC (%)	BD (Mg/m^3)	Soil Available Nutrients (kg/ha)		
							N	P_2O_5	K_2O
T_1	-	-	7.5	2.58	0.385	1.35	272.5	35.4	148.9
T_2	83.04	13.48	7.6	2.59	0.382	1.38	288.9	44.2	156.6
T_3	78.85	10.63	7.5	2.75	0.387	1.42	286.2	41.2	153.3
T_4	84.46	14.30	7.5	2.62	0.380	1.41	274.5	37.52	147.8
T_5	81.64	15.01	7.5	2.78	0.384	1.39	287.8	45.62	154.2
T_6	83.90	15.13	7.5	2.76	0.392	1.43	298.7	48.96	165.8
T_7	77.57	12.33	7.6	2.85	0.398	1.45	302.5	50.12	168.9
T_8	80.40	13.05	7.5	2.89	0.408	1.46	306.8	52.1	170.5
S.Em.±	0.49	0.31	0.24	0.08	0.10	0.18	7.12	1.32	8.45
CD @ 5%	1.52	0.95	NS	NS	NS	NS	NS	NS	NS

6. PUNE

The field experiment was conducted to assess the carbon sequestration under different cropping sequences. The project is initiated in 2016-17. The data with respect to initial soil analysis, cane yield and soil analysis at harvest is presented in Table 1 to 10. The experiment was conducted on moderately alkaline, deep, medium black soil having moderate in nitrogen, high phosphorus and moderately high potash. The soil was calcareous in nature and sufficient in sulphur and micronutrient content.During the first year (2016-17), soybean-wheat cropping system recorded grain yield of soybean (32.23 q/ha) and wheat (30.51 q/ha) whereas grain yield obtained in 2018-19 for soybean crop (30.51 q/ha) and wheat (22.8 q/ha). First year sugarcane was planted in the field having organic carbon 0.93% and harvested, the cane yield was in the range of 119.5 to 121.90 t/ha with an average of 120.80 t/ha in different sugarcane based cropping system (T2-T8) whereas in the ratoon crop cane yield was in the range of 94.6 to 107.5 t/ha in different sugarcane based cropping system (**Table AS 71.6.1**). The trash mulching with *Trichoderma* in ratoon crop improved cane yield by 8.9 t/ha, as compared to mulching without *Trichoderma*. Residue retention with *trichoderma* in wheat recorded maximum grain yield (25.8 t/ha).

The organic carbon content ranged from 0.88 – 0.98% at 0-30 cm depth whereas it was 0.77 – 0.90 % organic carbon in 30-60 cm depth. The data showed that organic carbon was higher in almost all the treatments of trash mulching sugarcane plant cane and ratoon crop as compare to initial soil analysis at 0-30cm and 30 -60cm depth. Organic carbon content sustained in sugarcane - ratoon – wheat (trash incorporation through rotavator and *trichoderma* incorporation before sowing of wheat) cropping sequence as compared to other cropping sequences (**Table AS 71.6.2**).

Summary: The project is initiated to assess the carbon sequestration under different cropping sequences. The results concluded that the trash mulching with Trichoderma in ratoon crop improved cane yield by 8.9 t/ha as compared to mulching without Trichoderma whereas residue retention with Trichoderma in wheat recorded maximum grain yield (25.8 t/ha) in plantcane-Ratoon-Wheat cropping sequence.

Table AS 71.6.1: Performance of different component crops of the various systems at Pune

Cropping system	2017-18		2018-19	
	Soybean (q/ha)	Wheat (q/ha)	Soybean (q/ha)	Wheat (q/ha)
T1- Soybean - Wheat	32.23	23.4	30.51	22.8
Sugarcane - Wheat				
	Plant yield (t/ha)	**Ratoon yield (t/ha)**	**Cowpea yield (q/ha)**	
T2- Sugarcane- Ratoon- Cowpea	129.00	98.6	21.7	
	Plant yield	**Ratoon yield**	**Wheat yield**	
T3 – Sugarcane – Ratoon (trash mulching without*trichoderma*) - Wheat	134.0	102.9	21.5	
T4 - Sugarcane – Ratoon (trash removal without T*richoderma*) - Wheat	145.1	101.2	23.8	
T5- Sugarcane –Ratoon (Trash mulching with *Trichoderma*) - Wheat	150.2	107.5	24.5	
T6- Sugarcane–Ratoon – Wheat (trash incorporation through rotavator and T*richoderma* incorporation before sowing of wheat)	149.2	103.4	25.8	
T7 – Sugarcane–Ratoon–wheat (Zero tilled) without*Trichoderma*	142.1	105.5	22.5	
T8 - Sugarcane – Ratoon – wheat (Zero tilled) with *Trichoderma*	143.6	104.7	21.8	
Mean	144.0	104.2	23.3	

Table AS 71.6.2: Influence of various treatments on SOC content at the end of cropping systems at Pune

Cropping system	**Soybean**		**Wheat**			
	Organic carbon (%)					
	0-30 cm	30-60 cm	0-30 cm		30-60 cm	
T1 – Soybean- wheat	0.96	0.90	0.88		0.85	
	Sugarcane		**Ratoon**		**Cowpea**	
T2 - Sugarcane – Ratoon - Cowpea	0.98	0.82	0.99	0.87	0.90	0.88
	Plant cane		**Ratoon**		**Wheat**	
T3 - Sugarcane – Ratoon (trash mulching without *Trichoderma*) – Wheat	0.89	0.77	0.95	0.81	0.91	0.89
T4 - Sugarcane – Ratoon (trash removal without *Trichoderma*) – Wheat	0.94	0.87	0.87	0.72	0.81	0.78
T5 - Sugarcane – Ratoon (trash mulching with *Trichoderma*) – Wheat	0.94	0.89	1.01	0.84	0.94	0.91
T6 - Sugarcane – Ratoon– Wheat (trash incorporation through rotavator and *Trichoderma* incorporation before sowing of wheat)	0.95	0.83	1.02	0.93	0.98	0.94
T7 – Sugarcane – Ratoon – Wheat (Zero tilled) without *Trichoderma*	0.96	0.77	0.89	0.69	0.85	0.84
T8 – Sugarcane – Ratoon – Wheat (Zero tilled) with *Trichoderma*	0.88	0.84	0.90	0.78	0.88	0.86
Mean	0.93	0.83	0.94	0.80	0.90	0.87

EAST COAST ZONE

7. NAYAGARH

Sugarcane (CoOr 10346) was planted during 2016-17. Initial soil organic carbon was calculated by taking observations of organic carbon (%) and bulk density at different depths. In the first treatment cowpea (1.7 q/ha) and sesame (5.42 q/ha) were grown to compare with sugarcane based cropping system. The observations on growth parameters and yield and yield attributes were analyzed but there were no significant differences among the treatments.In the second year cowpea and sesame crop was grown along with ratoon crop to compare with sugarcane based cropping system (**Table AS 71.7.1**). The observations on growth parameters and yield and yield attributes were analyzed. The ratoon crop with trash mulching with Trichoderma produced highest number of net millable canes (90700/ha), cane (94.14 t/ha) and CCS yield (11.34 t/ha).Total soil organic carbon was found to be better with treatment T5 (sugarcane – ratoon (trash mulching with Trichoderma) – cowpea) compared to other treatments. Highest cowpea yield (185.78 kg/ha) was obtained when cowpea was grown after trash incorporation through rotavator and Trichoderma incorporation before sowing of cowpea (**Table AS 71.7.2**).

Table AS 71.7.1: Performance of sugarcane under various systems at Nayagarh

Treatment	Germination % at 45 DAR	No of tillers (000/ha) 180 DAR	NMC (000/ha)	Cane yield (t/ha)	Juice Brix %	CCS %	CCS yield (t/ha)
T_2	52.05	82.01	82.793	85.29	19.367	11.617	9.904
T_3	54.33	84.80	85.180	88.52	20.050	11.773	10.416
T_4	51.42	81.72	82.960	86.52	19.450	11.540	9.982
T_5	58.71	89.57	90.700	94.14	20.220	12.047	11.346
T_6	53.37	83.80	84.217	87.05	18.820	11.243	9.776
T_7	53.86	82.65	82.947	85.90	19.657	11.413	9.811
T_8	54.96	80.47	81.783	84.87	19.440	11.577	9.826
Sem±	1.11	1.61	1.528	1.723	0.430	0.259	0.283
CD at 5 %	3.41	4.96	4.707	5.30	NS	NS	0.871

Table AS 71.7.2: Influence of treatments on SOC and other bulk density at the end of cropping systems at Nayagarh

Treatment	**0-30 cm**			**30-60 cm**			**60-90 cm**			**Total SOC**
	OC %	**B.D**	**SOC**	**OC %**	**B.D**	**SOC**	**OC%**	**B.D**	**SOC**	
T_1	0.43	1.35	17.41	0.37	1.46	16.20	0.30	1.52	13.68	47.30
T_2	0.48	1.36	19.58	0.44	1.45	19.14	0.36	1.50	16.2	54.92
T_3	0.48	1.35	19.44	0.43	1.45	18.70	0.37	1.53	16.983	55.12
T_4	0.49	1.40	20.58	0.42	1.45	18.27	0.34	1.50	15.3	54.15
T_5	0.52	1.43	22.30	0.48	1.52	21.88	0.38	1.64	18.696	62.89
T_6	0.52	1.41	21.99	0.47	1.49	21.00	0.36	1.62	17.496	60.50
T_7	0.52	1.42	22.15	0.43	1.50	19.35	0.33	1.60	15.84	57.34
T_8	0.53	1.43	22.73	0.47	1.51	21.29	0.38	1.62	18.468	62.49

NORTH CENTRAL ZONE

8. PUSA

During 2016-17 data on growth, yield attributes, yield and organic carbon content on post-harvest soil and quality of sugarcane as affected by different treatments have been recorded. Data revealed that comparatively higher grain (3.98 and 4.22 t/ha) and straw (5.17 and 5.74 t/ha) of rice and wheat, respectively was obtained with rice-wheat-rice- wheat (residue retention with Trichoderma) cropping system (T2). However, sugarcane (88.5 t/ha) and sugar (10.73 t/ha) yield was obtained in other treatments.

During 2017-18 data on growth, yield attributes, ratoon yield and quality of sugarcane and yield of rice, wheat system and organic carbon content on post-harvest soil indicated that none of treatments except straw yield of wheat could establish significant effect in improving the growth, yield, quality and organic carbon content (**Table AS 71.8.1**). However, comparatively higher ratoon cane yield (82.0 t/ha) was obtained with sugarcane-ratoon-wheat (trash incorporation through rotavator and Trichoderma incorporation before sowing of wheat) (T6). Comparatively higher grain (3.73 and 3.91 t/ha) and straw yield (4.80 and 5.40 t/ha) of rice and wheat, respectively was obtained with rice-wheat-rice-wheat (residue retention with Trichoderma cropping system (T2).

Table AS 71.8.1: **Performance of different crops under various systems at Pusa**

Treatment	Tiller count ($\times 10^3$/ha) at 120 DAP	Plant height (cm) at 240 DAP	Cane length (cm) at harvest	Cane dia. (cm)	NMC ($\times 10^3$/ha)	Single cane weight (g)	Cane yield (t/ha)	Rice		Wheat	
								Grain yield (t/ha)	Straw yield (t/ha)	Grain yield (t/ha)	Straw yield (t/ha)
Cropping system											
T_1Rice- Wheat-Rice- Wheat (residue retention without *Trichoderma*)	-	-	-	-	-	-	-	3.62	4.70	3.71	5.23
T_2Rice- Wheat-Rice- Wheat (residue retention with *Trichoderma*)	-	-	-	-	-	-	-	3.73	4.80	3.91	5.40
T_3Sugarcane-Ratoon- (trash mulching without *Trichoderma*) - Wheat	231.4	275	252	2.05	144.6	524	75.3	-	-	3.17	4.02
T_4Sugarcane-Ratoon- (trash removal without *Trichoderma*) - Wheat	243.7	273	248	2.03	147.7	509	75.2	-	-	3.23	4.10
T_5Sugarcane-Ratoon- (trash mulching with *Trichoderma*) - Wheat	228.3	271	246	2.06	142.7	521	74.0	-	-	3.09	3.98

T_6Sugarcane-Ratoon- Wheat (trash incorporation through rotavator and *Trichoderma incorporation before sowing of wheat*)	260.4	279	256	1.95	157.8	531	82.0	-	-	3.00	3.88
T_7Sugarcane – Ratoon- Wheat (Zero tilled) without *Trichoderma*	256.4	278	254	2.02	155.4	524	79.3	-	-	2.96	3.82
T_8Sugarcane – Ratoon- Wheat (Zero tilled) with *Trichoderma*	247.8	276	253	2.00	150.2	522	76.5	-	-	3.46	4.39
SEm (±)	18.79	21.12	21.29	0.144	9.73	35.30	4.92	-	-	0.177	0.219
CD (P=0.05)	NS	NS	NS	NS	NS	NS	NS	-	-	NS	0.66
CV (%)	13.3	13.3	14.7	12..4	11.3	11.7	11.1	-	-	9.2	8.8

PROJECT NO.: AS 72

Title: Agronomic performance of elite sugarcane genotypes

Objective	**:**	To assess the performanceof promising sugarcane genotypes of Advanced Varietal Trial (AVT)
Year of start	**:**	2016-2017
Duration	**:**	One year
Locations	**:**	All centres where post of Agronomist has been provided as well as any voluntary center.
Planting time	**:**	North West, North Central & North East Zones: February-March Peninsular & East Coast Zones: Ist fortnight of January
Treatments	**:**	
1. Genotypes	**:**	Please see varieties and checks of the Centre's zone (listed below)
2. Agronomy	**:**	**Spacing :** Wider spacing for all the entries 1. 90 cm and120 cm for North West, North Central, North East and East Coast Zones. 2. 120 cm and 150 cm for the Peninsular Zone. **Fertilizer levels**: 125% of the recommended dose of NPK for the zone
Design	**:**	RBD
Replication	**:**	2 or 3
Plot size	**:**	North West, North Central, North East and East Coast Zones: 5 rows of 6 m length. Peninsular Zone: 4 rows of 6 m length.

Note: 1. Seed material of the test varieties may please be obtained from concerned breeder of the center.

2. Separate trials to be laid out for early and mid-late maturity groups along with zonal checks.

Observations to be recorded	**:**	i) Initial soil fertility status for available NPK, soil texture, physico-chemical properties of the soil. ii) Data on germination, no. of millable canes, cane yield, Pol (%), CCS (t/ha).

List of varieties (zone-wise) for the Experiment AS 72 during 2018-19

I. North West Zone (AVT II Plant)

Early maturing varieties (3):	Co 13034, CoPb 13181, CoS 13231
Zonal Check (3):	CoJ 64, Co 0238 and Co 05009
Mid-late maturing varieties (5):	Co 13035, CoH 13263, CoLk 13204, CoPant 13224, CoPb 13182
Zonal Check (4):	CoS 767, CoS 8436, CoPant 97222 and Co 05011

II. North Central & North East Zones (AVT II Plant)

Early maturing varieties (3):	CoP 13437, CoSe 13451, CoSe 13452
Zonal Check (3):	CoLk 94184, CoSe 95422, CoSe 01421
Mid-late maturing varieties:	No entries proposed

III. Peninsular Zone (AVT II Plant)

Proposed varieties (8):	Co 12007, Co 12008, Co 12009, Co 12012, Co 12019, Co 12024, CoM 12085 and VSI 12121
Zonal Check (3):	Co 86032, CoC 671 and CoSnk 05103

IV. East Coast Zone (AVT II Plant)

Early maturing varieties (3):	Co 13023, CoA 14321, CoC 14336
Zonal Check (3):	CoA 92081, CoC 01061 and CoOr 03151
Mid-late maturing varieties (6):	Co 13028, Co 13029, Co 13031, CoA 14323, CoC 14337 and PI 14377
Zonal Check (3):	CoV 92102, Co 86249 and Co 06030

Note : Varieties other than listed above should not be included or substituted.

SUMMARY OF RESULTS OBTAINED DURING LAST YEAR (2017-18)

The trial was initiated during 2016-17 with allocation to all the centres. In all 21 centres conducted the trial in accordance with the approved technical programme. Centre wise high lights of the findings are enumerated below.

Best performing genotypes across the centres located in different zones are listed herewith:

Sl. No.	Zone	Early genotypes	Mid-late genotypes	Spacing
1	**North Western**	CoPant 12221, CoLk 12203, Co 12027, Co 12026	CoPant 12226, CoPb 12211, CoS 12232, Co 12029, CoLk 12205, CoH 12263,	At almost all the centres cane yield at 90 cm spacing was significantly superior over that of 120 cm.
2	**Peninsular**	Co 11001, CoM 11081, CoM 11082, CoM 11084	Co 11005, CoM 11085, Co 11012, Co 11019, CoM 11086, Co 11007	Except Thiruvalla all the centres used only 150 cm spacing.
3	**East Coast**	CoC 13336, CoA 13323, CoA 13322	CoOr 13346	No variation in inter-row spacing
4	**North Central**	CoSe 12451, CoLk 12207	CoSe 12453, CoLk 09204	Significant yield improvement at closer spacing (90 cm).
5	**North Eastern**	All genotypes performed similar and below the performance of check varieties.	All genotypes performed similar and below the performance of check varieties except CoLk 09204.	Significant yield improvement at closer spacing (90 cm).

CURRENT YEAR (2018-19) REPORT
NORTH WESTERN ZONE

1. FARIDKOT

Early

The experiment was carried out with initial soil status: pH: 8.2, EC: 0.21 dsm-1, OC= 0.57 %, P =26.2 kg/ha, K= 450 kg/ha, with six genotypes at 90 am 120 cm spacing and by applying 125% of recommended N (150 kg/ha). The yield was at par at 90 cm and 120 cm spacing (**Table AS 72.1.1a& b**). The number of shoots and millable canes were better at 90 cm spacing but single cane weight was better at 120 cm spacing. Although interaction between spacing and genotypes was non- significant but yield of CoPb13181, Co 238 and Co 5009 was higher at wider spacing than at 90 cm spacing. The highest cane yield was of CoPb 13181 (134.4 t/ha) followed by Co 5009 (110.6 t/ha).

Table AS 72.1.1a: Performance of early maturing genotypes at different row spacing at Faridkot

Spacing/ Genotype	Germination (%)	No. of Shoots ('000/ha)	NMC ('000/ha)	Cane length (cm)	Cane diameter (cm)	Single cane wt. (g)	Sucrose (%)
Spacing							
90 cm	33.5	130.1	91.7	242	2.73	1350	17.83
120 cm	34.7	107.0	83.9	259	2.75	1557	17.71
CD (5%)	NS	16.4	4.1	NS	NS	200	NS
Genotypes							
Co 13034	31.9	110.3	73.0	252	3.12	1783	18.08
CoPb 13181	34.9	141.3	107.2	252	2.52	1435	17.27
CoS 13231	36.6	111.1	96.7	272	2.55	1218	18.40
CoJ 64	33.8	111.3	81.5	231	2.64	1232	17.90
Co 238	32.8	122.1	75.5	218	2.93	1447	17.54
Co 5009	34.3	115.1	92.9	275	2.69	1605	17.43
CD (5%)	NS	NS	7.1	35	0.3	346	0.57

Table AS 72.1.1 b: Growth performance of early maturing genotypes at Faridkot

Spacing/Genotypes	**90 cm**	**120 cm**	**Mean**
Co 13034	107.8	92.7	100.3
CoPb 13181	133.3	135.4	134.4
CoS 13231	102.8	95.1	99.0
CoJ 64	74.1	75.4	74.8
Co 238	87.5	94.1	90.8
Co 5009	106.9	114.2	110.6
Mean	102.1	101.2	
CD (5%)	Row spacing	Genotypes	Interaction
	NS	11.6	NS

Mid-late

The experiment was conducted by planting nine genotypes at 90 am 120 cm spacing and by applying 125% of recommended N. Cane yield was significantly better at 90 cm

spacing than 120 cm spacing (**Table AS 72.1.2 a & b**). The number of shoots and millable canes were better at 90 cm spacing. The highest cane yield was of CoH 13263 (141.6 t/ha) which was at par with CoPb 13182 (131.3 t/ha), Co 05011 (128.4 t/ha) and Co 13035 (125.1 t/ha).

Table AS 72.1.2 a: Cane yield of mid-late maturing genotypes at Faridkot

Spacing/ Genotype	Germination (%)	No. of Shoots ('000/ha)	NMC ('000/ha)	Cane length (cm)	Cane diameter (cm)	Single cane wt. (g)	Sucrose (%)
Spacing							
90 cm	27.6	140.6	105.8	248	2.86	1444	14.90
120 cm	28.2	111.5	86.2	229	2.87	1492	15.22
CD (5%)	NS	11.2	6.6	13	NS	NS	0.27
Genotype							
Co 13035	25.6	135.3	94.3	255	3.01	1692	15.00
CoH 13263	31.7	158.3	119.9	227	2.97	1482	15.51
CoPant 13224	30.4	127.3	88.4	273	2.94	1673	15.58
CoPb 13182	28.6	114.4	85.4	250	3.05	1918	15.91
CoLk 13204	26.6	109.7	90.9	223	25	1111	12.68
CoS 767	25.3	122.9	95.2	238	262	1242	15.65
CoS 8436	27.4	113.2	89.1	198	2.87	1202	15.70
CoPant 97222	26.3	112.1	85.6	241	2.98	1468	15.59
Co05011	29.4	141.3	112.1	239	2.86	1424	13.99
CD (5%)	NS	23.7	14.1	28	0.22	156	0.58

Table AS 72.1.2 b: Growth and quality performance of different mid-late genotypes at Faridkot

Spacing/Genotypes	**90 cm**	**120 cm**	**Mean**
Co 13035	140.1	110.1	125.1
CoH 13263	143.0	140.3	141.6
CoPant 13224	135.5	109.1	122.3
CoPb 13182	130.0	132.5	131.3
CoLk 13204	113.0	89.2	101.1
CoS 767	105.1	97.6	101.4
CoS 8436	118.9	81.7	100.3
CoPant 97222	141.7	97.6	119.7
Co05011	147.3	109.4	128.4
Mean	130.5	107.5	
CD (5%)	Row spacing	Genotypes	Interaction
	9.6	20.4	NS

2. KOTA

Early

The experiments crop was planted in spring on 06.03.2018 and harvested in 17.03.2019.The experimental field was applied with 125% of the recommended dose of NPK (250:75:50 kg/ha)). A perusal of data showed that at closer spacing (90 cm), genotype Co 13034 recorded significantly higher germination (49.13 %), single cane length (237.50 cm), cane yield (94.40t/ha), single cane weight (1070.00 gm) and number of millable canes (88.97 thousand/ ha). Similarly Co 13034 recorded

significantly higher CCS yield (11.99 t/ha) however it was at par with genotypesCoPb 13181, CoS 13231. Brix (21.50 %), sucrose (19.00 %), CCS (13.14 %) recorded with Co 13034 were significantly superior over zonal checks and at par with Co 13181, and CoS 13231 genotypes. There was no significant effect of spacing (**Table AS 72.2.1**).

Mid-late

Performance of mid-late maturing genotypes at 90 cm row spacing (**Table AS 72.2.2**) showed that among genotypes CoH 13263 recorded significantly higher germination (49.40 %), cane length (224.50 cm), single cane weight (1109.50 gm), tillers (141.35 thousand/ ha) and number of millable cane (92.70 thousand/ ha). However, cane yield recorded maximum with Co 13035 genotype which was significantly higher over rest of genotypes and zonal checks.

At 120 row spacing genotypeCoH 13263 recorded significantly higher germination (49.50 %), no. of tillers (141.70 thousand/ha) and cane length (224.9 cm) over zonal checks and at par with Co 13035 and CoPb 09181 genotypes. Similarly Co 13263 recorded maximum and significantly higher Brix (21.30 %), Sucrose (18.79%), CCS (12.99%) and CCS yield (12.03 t/ha) over, CoS 767 (zc), CoS 8436(zc), CoPant 97222(zc) and Co 05011(zc) and at par with Co 13035, CoLk 13204, CoPant 13224 and CoPb 09181 genotypes.

Table AS 72.2.1: Performance of early genotypes of sugarcane at Kota

Treatment	**Germination 45 DAP (%)**	**Tillers 180 DAP (000/ha)**	**Cane length (cm)**	**Millable cane (000/ ha)**	**Single cane weight (g)**	**Cane yield (t/ha)**	**Sucrose (%)**	**CCS yield (t/ha)**
Varieties								
Co 13034	49.13	143.00	237.50	88.97	1070.00	94.40	19.00	11.99
CoPb 13181	45.40	136.73	216.57	85.70	850.00	89.80	17.45	10.77
CoS 13231	45.80	134.83	223.63	86.87	876.73	91.20	18.28	10.47
CoJ 64 (zc)	44.30	133.20	222.20	81.90	812.67	80.50	16.22	8.94
Co 0238 (zc)	45.20	128.43	218.77	84.37	883.33	87.50	17.08	10.22
Co 05009 (zc)	45.00	137.97	229.03	83.43	983.50	85.20	16.84	9.84
SEm ±	1.14	3.08	8.29	2.53	24.23	25.12	0.59	0.53
CD (P=0.05)	3.60	9.70	26.15	7.98	76.39	79.20	1.85	1.67
CV	4.32	3.93	6.40	5.14	4.60	49.38	5.81	8.87

Table AS 72.2.2: Performance of mid-late genotypes at Kota

Treatment	Germination 45 DAP (%)	Tillers (000/ha)	Cane length (cm)	Millable cane (000/ ha)	Single cane weight (g)	Cane yield (t/ha)	Sucrose (%)	CCS yield (t/ha)
Varieties								
Co 13035	47.40	141.20	223.50	91.40	1008.50	92.90	17.87	11.43
CoH 13263	49.40	141.35	224.50	92.70	1109.50	92.60	18.59	11.89
CoLK 13204	45.90	136.30	218.10	88.50	924.50	88.00	16.42	9.86
CoPant 13224	46.90	136.60	221.30	84.70	950.05	88.30	16.63	10.06
CoPb 09181	48.30	137.90	219.50	85.50	985.00	90.20	17.45	10.82
CoS 767 (zc)	44.40	135.10	215.35	83.50	784.00	81.80	16.27	9.11
CoS 8436 (zc)	42.50	133.70	209.30	85.90	810.00	78.80	16.22	8.76

CoPant 97222(zc)	45.50	134.80	213.90	87.60	814.80	80.10	16.01	8.77
Co 05011 (zc)	44.60	134.40	222.20	82.30	810.30	79.60	15.39	8.34
SEm ±	1.88	2.30	4.99	2.62	15.22	3.52	0.58	0.61
CD (P=0.05)	6.12	7.48	16.26	8.55	49.63	11.47	1.88	2.00
CV	5.75	2.37	3.22	4.27	2.36	5.79	4.87	8.78

3. LUCKNOW

Early

The data presented in **Table AS 72.3.1** showed that germination % was significantly higher in Co0238 over CoS13231 and CoJ64. The two spacing did not have significant effect on germination. Similarly significantly higher (20.48 %) tillers were obtained in the genotype Co0238 sown at 90 cm over CoS13231 sown at same distance. But shoot and NMC count ('000/ha) were significantly higher in the genotype CoS13231 sown at 90 cm row spacing in comparison to the rest of the genotypes sown at both the spacing. The shoot and NMC count were significantly lower at 120 cm spacing compared to 90 cm spacing in all the three genotypes. Significantly higher cane yield (104.0 t / ha) was reported in Co0238 sown at 90 cm over CoS13231 and CoJ64 sown at same spacing. Further, the genotype CoS13231 and Co0238 gave significantly lower cane yield at 120 cm row spacing. Cane length, cane girth, cane weight were higher in Co0238 than remaining two genotypes.

In general higher values of different quality parameters were recorded at 10 months stage over 8 months stage. But corrected brix, sucrose % and purity coefficient measured at 8 and 10 months stage did not differ in any of the genotypes sown at different spacing. CCS % and CCS yield (t/ ha) at 8 and 10 months stage also showed the similar pattern as it was reported in other quality parameters.

Mid-late

Growth and yield of the different genotypes showed wide variations (**Table AS 72.3.2**). The germination ranged from 12.51 to 33.04 % for different genotypes. Higher germination was obtained in the genotype CoLk13204 (33.04), CoH13263 (29.39) while lower germination (12.51) was recorded in genotypeCoPant97222. Similar was the trend recorded in number of the tillers/ha. The genotypes CoLk13204 and CoH13263 were also superior in number of shoots and NMC count over all the genotypes. The lowest shoot number (88.44 thousand/ha was recorded in CoPb13182 shown at 120 cm spacing. The genotype CoLk13204 gave highest yield (84.76 ton/ha) sown at 90 cm spacing followed by the same genotype sown at 120 cm spacing (68.49 ton/ha). The higher yield in CoLk13204 was mainly attributed to its higher NMC/ha. Brix varied from 17.3 to 21.07 at 10 months stage and 18.87 to 20.72 at 12 months stage in different genotypes. The sucrose content at 10 months stage ranged from 14.13 % to 18.48 % and higher sucrose containing genotypes were CoH13263, Co13035, and CoPb13182. While the genotype CoLk13204 showed lowest sucrose content among all genotypes at both the stages. The CCS % and CCS yield (t/ha) at 10 months stage was lower in comparison to these values recorded at 12 months stage in different genotypes. At 12 months stage, higher CCS % containing genotypes were Co13035,CoH13263, CoLk13204, Co Pant97222 and CoPb13182, while lower CCS % was recorded in CoS767 sown at 90 cm and CoLk13204 sown at 120 cm spacing.

All most all the genotypes included in this trial showed significant reduction in different growth, yield attributes and yield at wider (120 cm) spacing in comparison to the 90 cm row spacing. There were 13.66 and 8.33 % lower cane and CCS yield respectively at 120 cm spacing over 90 cm. CCS (t/ha) at 10 and 12 months stage was higher in CoLk13204 sown at 90 cm apart than other genotypes tested. At 12 months stage CoLk 13204 sown at 90 cm row distance gave significantly higher CCS(t/ha) over its 120 cm row distance. CoLk13204 proved superiority at both the distances over the other genotypes.

Table AS 72.3.1: Performance of early genotypes at Lucknow

Treatment	Germination %	Tiller count (000/ha) at 120 DAP	Tiller count (000/ha) at 150 DAP	Shoot count/plot-(000/ha)	NMC count/plot-(000/ha)	Cane yield ((t/ha)	Cane Length (cm)	Cane girth (cm)
	Mean	Mean	Mean	Mean	Mean	Mean	Mean	Mean
CoS13231 at 90 cm	26.33	128.73	153.13	153.76	97.63	85.76	171.00	1.73
CoS13231 at 120 cm	25.66	98.33	121.10	119.90	71.56	69.13	166.66	1.53
Co 0238	36.43	155.10	156.43	132.06	79.26	104.00	174.66	2.33
Co 0238	37.56	127.46	128.90	104.90	73.10	82.80	179.00	1.90
CoJ 64	25.43	105.03	126.53	122.66	66.53	71.76	160.33	1.86
CoJ 64	27.03	78.86	92.56	104.03	63.06	63.60	159.00	1.63
C.D.	4.19	11.03	13.51	10.38	8.73	15.11	NS	0.24
SE(m)	1.36	3.60	4.41	3.39	2.85	4.93	4.82	0.07
C.V.	7.75	4.96	5.58	4.77	6.18	10.22	5.00	7.18

Table AS 72.3.2: Performance of mid-late genotypes at Lucknow

Treatment	Germination (%)	tillers (000/ ha)	shoot (000/h a)	NMC (000/ha)	yield (t/ha)	cane length (cm)	cane diameter (mm)	per cane wt. (kg)
Co13035 at 90	24.33	111.25	100.17	57.59	37.64	154.66	22.72	0.683
Co13035 at 120	22.29	101.62	95.95	54.88	29.47	163.33	23.65	0.61
CoH13263 at 90	25.84	168.09	136.25	86.96	48.57	145.33	23.36	0.60
CoH13263 at 120	29.39	157.53	118.98	71.01	40.39	132.33	23.06	0.597
CoLk13204 at 90	29.39	168.02	113.3	114.79	84.76	162.2	23.38	0.72
CoLk13204 at 120	33.04	178.42	126.57	127.55	68.49	159.6	23.1	0.63
CoPant 13224 at 90	21.22	110.57	101.42	58.43	38.63	154.33	23.93	0.607
CoPant 13224 at 120	20.07	105.54	92.62	61.187	35.08	139.33	23.49	0.77
CoPb 13182 at 90	18.64	112.62	91.96	68.55	37.98	161.06	24.39	0.787
CoPb 13182 at 120	20.6	112.36	88.44	71.05	42.30	188.66	23.30	0.85
CoS767 at 90	21.4	129.9	134.09	83.18	41.8	156.66	21.28	0.597
CoS767 at 120	23.88	129.53	122.3	80.36	27.95	165.00	19.77	0.547
CoPant 97222 at 90	17.58	96.41	127.52	57.7	45.58	160.33	23.51	0.79
CoPant 97222 at 120	12.51	80.75	94.05	44.73	39.50	159.66	24.20	0.82
Co 05011 at 90	22.82	147.93	142.70	84.50	46.77	126.66	22.11	0.573
Co 05011 at 120	24.77	148.37	144.51	91.22	45.34	137.33	22.65	0.603
C.D.	4.33	13.57	12.67	13.87	7.85	28.34	2.58	NS

4. SHAHJAHANPUR

The soil of experimental field was low in organic carbon (0.32%) and phosphorus (13.20 kg/ha) and medium in potash (151 kg/ha) with pH 7.14. Early and mid–late genotypes were planted on 15.03.2018. Crop of early genotypes was harvested on 18.01.2019 and mid –late genotypes on 25.01.2019.

Early

Experimental results of early genotypes (**Table AS 72.4.1**) revealed that standard genotype Co 0238 produced significantly higher cane yield (105.10 t/ha) followed by genotype CoS13231 (77.40 t/ha). Regarding spacing significantly higher cane yield (82.20 t/ha) was recorded with 90 cm row spacing than that of 120 cm (67.90 t/ha). CCS% in cane at harvest was found significantly higher in Co13034 (12.36) followed by Co0238 (12.03).

Mid-late

Among mid–late genotypes (**Table AS 72.4.2**) Co13035 produced significantly higher cane yield (82.55 t/ha) at par with CoPant13224 (82.00 t/ha). Regarding spacing, significantly higher cane yield (79.93 t/ha) was recorded with 90 cm row spacing than that of 120 cm row spacing. CCS% in cane at harvest was observed significantly higher in genotype Co 13035 (11.51) followed by CoPb 13182 (11.23).

Summary: In early group, standard genotype Co 0238 produced significantly higher cane yield (105.10 t/ha) followed by CoS 13231 (77.40 t/ha). Co13035 produced significantly higher cane yield (82.55 t/ha) at par with CoPant 13224 (82.00 t/ha) in mid–late group. Regarding spacing significantly higher cane yield were obtained in early and mid-late genotype at 90 cm row spacing.

Table AS 72.4.1: Performance of early maturing genotypes at Shahjahanpur

Treatment	Germination (%)	Shoots (000/ha)	NMC (000/ha)	Cane yield (t/ha)	CCS (%)
Genotypes					
Co13034	40.70	157.27	111.78	70.60	12.36
CoPb13181	49.20	217.04	133.51	69.50	11.72
CoS13231	57.00	190.23	130.47	77.40	11.94
CoJ64	53.40	163.15	139.89	62.40	12.01
Co0238	41.90	151.32	104.78	105.10	12.02
Co05009	35.20	133.70	72.61	65.60	11.80
SE±	0.88	2.40	3.78	2.91	0.09
CD at 5%	1.82	4.99	7.85	6.03	0.02
Spacing					
90 cm	45.60	194.30	132.32	82.20	11.89
120 cm	46.90	141.97	99.46	67.90	12.01
SE±	0.51	1.39	2.18	1.68	0.06
CD at 5%	1.05	2.88	4.53	3.48	NS

Table AS 72.4.2: Performance of mid-late genotypes at Shahjahanpur

Treatment	Germination (%)	Shoots (000/ha)	NMC (000/ha)	Cane yield (t/ha)	CCS (%)
Genotypes					
Co13035	38.70	164.64	93.88	82.55	11.51
CoH13263	48.50	183.05	95.20	76.45	10.71
CoLk13204	54.50	232.01	118.12	78.65	09.26
CoPant13224	46.10	154.38	94.82	82.00	11.00
CoPb13182	43.70	170.33	91.72	73.15	11.23
CoS767	40.20	179.23	113.51	70.15	10.88
CoS8436	32.10	125.06	96.06	64.50	11.01
CoPant97222	38.30	148.67	97.35	66.50	11.15
Co 05011	35.30	162.53	95.27	70.05	10.72
SE±	**3.90**	**20.66**	**11.14**	**0.83**	**0.16**
CD at 5%	**7.92**	**41.98**	**22.63**	**1.69**	**0.32**
Spacing					
S_1 - 90 cm	42.30	194.64	108.17	79.93	10.83
S_2 - 120 cm	41.60	151.16	90.93	68.57	10.85
SE±	**1.84**	**9.74**	**5.25**	**0.39**	**0.08**
CD at 5%	**NS**	**19.79**	**10.67**	**0.80**	**NS**

5. UCHANI

All the genotypes were planted at 90 cm and 120 cm with 125 % of recommended dose of NPK i.e. 187.5+ 62.5+62.5 NPK kg/ha in randomized block design with three replications during spring season on March 6, 2018. Separate trials were conducted for early and mid-late varieties. The soil of the experimental field was sandy loam in texture with pH 7.8, EC 0.4 dSm^{-1}, organic carbon 0.39%, available P 11.8 kg/ha and available K 192 kg/ha. The crop was irrigated at 8-10 days interval during pre-monsoon season and 15-20 days interval during post monsoon seasons. The crop was harvested on March 05, 2019.

Early

Germination per cent recorded at 45 days after planting was not affected significantly due to different spacing. Tillers, NMC cane yield and sugar yield were affected significantly due to different spacing. Significantly higher number of tillers, NMC and cane yield were recorded at 90 cm spacing as compared to 120 cm spacing whereas, cane weight was significantly higher at 120 cm spacing as compared to 90 cm spacing. CCS per cent was not affected significantly due to different spacing.

Genotypes differed significantly in terms of germination percent, tillers, cane weight and cane yield. Varieties CoPb 13181, CoS 13231, CoJ 64, Co 0238 and Co 05009 being at par recorded significantly higher germination as compared to Co 13034. Genotypes Co 13034, Co 05009 and CoS 13231 produced the lowest number of tillers in the month of June. All the genotypes were at par for number of millable canes counted at harvest. Highest and lowest cane weight and cane yield was recorded in variety Co 0238 (1006 g, 85.8t/ha) and CoS 13231 (792 g, 68.7 t/ha), respectively. Varieties Co 0238 and Co 05009 being at par produced significantly higher can yield in comparison to rest of the varieties. Interaction was not found significant (**Table AS 72.5.1**).

Mid-late

Germination was not affected significantly due to different row spacing. However, tillers, NMC, Cane yield and sugar yield were affected significantly. Conspicuously higher number of tillers, NMC, cane yield and sugar yield was recorded at 90 cm spacing as compared to 120 cm spacing whereas, cane weight was significantly higher at 120 cm.

Genotypes differed significantly in terms of germination percent, tillers, millable canes, cane weight and cane yield. CoPb 13182, CoPant 13224, CoH 13263 and CoLk 13204 being at par recorded significantly higher germination in comparison to rest of the varieties. Lowest germination was recorded in Co 05011 and Co 13035. Lowest number of tillers were observed in CoS 8436. Genotypes Co 05011, CoPant 97222, CoS 767, CoPb 13182, CoPant 13224 and Co 13035 were at par in terms of tillers recorded in the month of June. Significantly highest numbers of millable canes were recorded in CoLk 13204. Lowest number of millable canes were recorded in CoPb 13182. GenotypesCoPant 13224, Co 13035 and CoH 13263 being at par produced significantly highest cane weight. Lowest cane weight was recorded in variety CoS 767. CoH 13263, CoLk 13204, Co 13035 and CoPant 13224 being at par recorded significantly highest cane yield. Varieties CoS 8436, CoPb 13182, CoS 767 and CoPant 97222 being at par produced the lowest cane yield. Interaction was not found significant (**Table AS 72.5.2**).

Summary: Germination was not affected significantly due to different spacing. Significantly higher number of tillers, number of millable canes, cane yield and sugar yield were recorded at 90 cm spacing as compared to 120 cm spacing irrespective of the maturity group. Cane weight was significantly better at 120 cm as compared to 90 cm spacing. Among early maturing varieties, highest and lowest and cane yield was recorded in variety Co 0238 (85.8 t/ha) and CoS 13231 (68.7 t/ha), respectively. Among mid maturing entries, CoH 13263, CoLk 13204, Co 13035 and CoPant 13224 being at par recorded significantly highest cane yield. Interaction was not found significant.

Table AS 72.5.1: Performance of early maturing genotypes at Uchani

Treatment	Germination (%)	Tillers (000/ha)	NMC (000/ha)	Cane weight (g)	Cane yield (t/ha)
Spacing					
90 cm	51.5	128.5	98.4	867	81.5
120 cm	51.7	105.1	83.3	956	76.1
CD at5%	NS	3.6	4.1	27	2.9
Varieties					
Co 13034	47.3	110.9	88.5	959	80.8
CoPb 13181	53.4	120.6	91.6	924	80.5
CoS 13231	52.2	113.5	90.8	792	68.7
CoJ 64	53.2	123.3	95.6	830	75.4
Co 0238	53.8	117.8	89.7	1006	85.8
Co 05009	49.7	115.0	89.2	957	81.5
CD at 5%	3.8	6.2	NS	47	4.9

Table AS 72.5.2: Performance of mid-late maturing genotypes at Uchani

Treatments	Germination (%)	Tillers (000/ha)	NMC (000/ha)	Cane weight (g)	Cane yield (t/ha)
Spacing					
90 cm	47.6	135.2	102.2	965	86.2
120 cm	48.6	117.3	92.4	1026	83.2
CD at5%	NS	4.4	4.0	21	2.5
Varieties					
Co 13035	43.1	133.6	103.2	1062	96.3
CoH 13263	51.6	147.1	112.9	1027	101
CoLk 13204	50.4	153.4	123.4	916	98.9
CoPant 13224	52.5	128.9	105.3	1046	96.0
CoPb 13182	52.3	127.7	93.0	922	75.0
CoS 767	41.2	130.9	95.0	939	78.0
CoS 8436	46.6	108.7	98.0	853	72.9
Co Pant 97222	51.3	136.3	105.5	848	78.0
Co 05011	43.8	126.3	97.3	996	84.7
CD at 5%	2.8	9.3	8.6	45	5.3

PENINSULAR ZONE

6. PUNE

Sugarcane was planted on 18.01.2018 and harvested on 01.02.2019. In early group, genotype CoM11084 showed highest germination (80.17 %) and number of millable canes (0.89 lakh/ha), tillering at 90 & 120 DAP (1.02 & 1.26 lakh/ha). Single cane weight (1.43 kg) was higher in Co11001,maximum cane girth (9.40 cm) and total plant height (288.99 cm) were obtained in genotype Co 11004 and internodes (26.61) in Co85004. While in mid-late group, maximum tillering at 90 & 120 DAP (1.03 & 1.18 lakh/ha) and NMC (0.80 lakh/ha) were obtained in genotype CoM11085. Maximum germination percentage (81.50%), number of internode (28.70), total cane height (332.30 cm), single cane wt. (1.78 kg) and cane girth (11.07) was recorded in Co 11007.

The cane yield (t/ha) presented in **Table AS 72.6.1** was significantly affected due to various genotypes. The highest cane yield in early group of genotypes (117.32 t/ha) was obtained in genotype Co 11001 and mid-late genotype Co 11012 with 129.20 t/ha which was more than the checksCoC 671 and Co 86032.Sugar yield (t/ha) was also obtained significantly more (17.38 t/ha) in early genotype CoM 11081 which was more than the check variety CoC 671 (11.43 t/ha). Whereas, Co 11012 a mid-late genotype yielded maximum sugar yield of 18.38 t/hawhich was less than the check variety Co99004 (19.29 t/ha).The juice quality parameters measured in terms of Brix, Sucrose (%) and CCS % differed significantly for genotypes. In early group, maximum Brix (22.44) was found in CoC671 whereas, CCS % (14.80) and sucrose (20.18%) was found in Co11004. Among mid-late genotypesCoM11086 recorded highest Brix (21.80), CCS (14.86%) and Sucrose (20.58%).Benefit cost ratio was affected due to various genotypes. It was maximum (1:2.55) in early genotype Co 11001 and found maximum of 1: 2.81 in mid-late genotype Co 11012.

Summary: The results of the plant crop indicated that for the early genotypes tillering (1.02 & 1.26 lakh/ha) at 90 & 120 DAP, single cane weight (1.43 kg), cane yield (117.32 t/ha) and B:C ratio (1:2.55) was highest in Co11001.The mid-late genotype CoM11085 performed better in tillering at 90 & 120 DAP (1.03 & 1.18 lakh/ha) and NMC (0.80 lakh/ha) while cane yield (129.20 t/ha), CCS yield (18.38 t/ha), B:C ratio (1:2.81) was higher in Co11012.Whereas, CoM11086 showed superior juice quality.

Table AS 72.6.1: Performance of genotypes at Pune

Treat. No.	Treatment	Cane yield (t/ha)	CCS yield (t/ha)	B:C ratio	NMC at harvest (Lakh/ha)	Cane length at 12 MAP (cm)	Wt. per cane (kg)	Tillering at 90 DAP (Lakh/ha)
V_1	Co11001	117.32	14.93	2.55	0.81	192.92	1.43	1.02
V_2	Co11004	56.71	8.37	1.23	0.60	288.99	0.95	0.85
V_3	CoM11081	111.67	17.38	2.43	0.64	203.30	0.91	1.01
V_4	CoM11082	73.81	12.22	1.60	0.56	274.53	1.24	0.81
V_5	CoM11084	102.70	14.29	2.23	0.89	233.70	1.16	1.01
V_6	Co85004	84.09	11.76	1.83	0.82	285.36	1.01	0.95
V_7	Co94008	77.96	10.92	1.69	0.81	260.63	1.27	0.89
V_8	CoC671	78.14	11.43	1.70	0.84	211.52	1.23	0.89
V_9	Co11005	84.59	11.75	1.84	0.69	226.21	1.23	0.80
V_{10}	Co11007	98.35	13.03	2.14	0.70	332.30	1.78	0.80
V_{11}	Co11012	129.20	18.38	2.81	0.72	240.54	1.58	0.92
V_{12}	Co11019	95.98	13.17	2.08	0.72	301.30	1.34	0.88
V_{13}	CoM11085	119.64	16.58	2.60	0.80	257.92	1.33	1.03
V_{14}	CoM11086	116.10	16.52	2.52	0.70	295.65	1.46	0.97
V_{15}	Co86032	108.04	15.06	2.35	0.79	261.03	1.37	0.99
V_{16}	Co99004	108.00	19.29	2.35	0.72	264.95	1.44	0.80
SEM±		9.22	1.43	0.20	0.04	8.16	0.09	0.08
CD @ 5%		26.51	4.13	0.57	0.13	23.45	0.27	0.25
CV%		16.45	17.75	16.45	12.08	5.56	12.68	21.97

7. MANDYA

A field experiment was planted on 25.1.2018 and harvested on 02.02.2019 to assess the performance of promising sugarcane genotypes of Advanced Varietal Trial under optimum agronomic management practices and wide row spacing of 150 cm. Among the genotypes, Co 12009 was found superior with respect to cane yield (122.29 t/ha) as compared to others. But, was on par with CoM12085 (109.25 t/ha) and VSI12121 (108.4 t/ha). This increased cane yield was due to enhanced yield parameters viz., single cane weight, cane length, cane girth, inter-nodal length, number of internodes and number of millable cane/ha. Quality parameters viz., sucrose % and CCS% did not vary significantly for the genotypes (**Table AS 72.7.1**).

Table AS 72.7.1: Performance of early genotypes at Mandya

Treatment	Cane yield (t/ha)	Single cane weight (kg)	Millable cane ('000/ha)	Sucrose %	Purity %	CCS %	CCS (t/ha)
Co12007	91.79	1.17	82.39	19.31	94.87	13.81	12.67
Co12008	76.66	1.26	91.42	20.87	92.21	14.75	11.35
Co12009	122.29	1.63	104.05	19.04	91.50	13.39	16.38
Co12012	75.57	1.26	101.52	19.43	93.87	13.96	10.53
Co12019	66.50	1.08	87.94	19.50	92.07	14.13	9.40
Co12024	74.64	1.16	67.86	18.26	95.03	12.88	9.61
CoM12085	109.25	2.16	64.87	19.28	92.31	13.57	14.85
VSI12121	108.40	1.66	80.60	19.77	93.47	14.06	15.24
Co86032	94.18	1.27	67.21	18.32	92.58	13.02	12.27
CoC671	81.18	1.29	94.44	19.83	93.73	14.02	11.42
CoSnk05103	69.02	1.09	99.65	18.67	94.96	13.48	9.31
S.Em.±	3.95	0.10	3.25	0.24	0.61	0.22	0.64
CD@5%	11.65	0.31	9.58	0.70	1.80	0.64	1.88

8. SANKESHWAR

Early

There was significant difference among the early genotypes tested for yield and yield attributes. Significantly higher cane yield (92.11 t/ha) was recorded in Co 12007 on par with CoC 671(87.95 t/ha). The lowest cane yield (76.81 t/ha) was recorded in Co 12008. The lowest NMC was recorded in CoC 671(49,780/ha) and the highest was recorded in Co 12007 (68,140/ha). The cane girth was highest in CoC 671(3.09 cm) and was lowest in Co 12007 (2.29 cm). Juice brix did not differ significantly among the early genotypes tested. However, rest of the quality parameters differed significantly. The higher Pol(21.44%) was recorded in CoC 671. The CCS% and juice purity was highest in Co12008 (**Table AS 72.8.1**).

Mid-late

Significantly higher cane yield (121.43 t/ha) and CCS yield (15.18 t/ha) was recorded in Co 12009 and was on par with Co12012 (115.42 t/ha). The lowest cane yield (106.33 t/ha) was recorded in VSI 12121. The highest NMC (122280/ha) was recorded in Co 12009 and lowest NMC (57550/ha) was recorded in CoM 12085. Cane girth was highest in CoM 12085 (3.08 cm) and was lowest in Co 12012 (2.16 cm). Single cane weight was highest in CoM 12085 (2.16 kg) and was lowest in Co 12019 (0.97 kg).Significant differences were noticed among all mid late genotypes for all the quality parameters tested. The highest values were recorded in Co 12009 for brix (24.92) and Pol (19.32%) for CCS (%) in VSI 12121 and purity (%) in CoM 12085 (**Table AS 72.8.1**).

Table AS 72.8.1: Growth performance of elite genotypes at Sankeshwar

Treatment	Germination (%) 30 DAP	Cane yield (t/ha)	NMC (000/ha)	Cane length(cm)	Cane girth (cm)	Single cane weight (kg)	CCS Yield (t/ha)
Co 12007	48.12	92.11	68.14	2.22	2.84	1.37	12.35
Co 12008	50.89	76.81	53.20	2.23	2.86	1.45	12.00
CoC 671 (C)	53.44	87.95	49.78	2.35	3.09	1.78	13.18
CoSnk 05103 (C)	65.58	78.99	46.59	2.52	2.94	1.70	10.46
Co 12009	51.82	121.43	74.53	3.21	2.63	1.77	15.18
Co 12012	60.26	115.42	122.28	2.56	2.16	1.03	11.78
Co 12019	58.30	103.46	108.51	1.78	2.56	0.97	13.46
Co 12024	47.54	110.22	88.17	2.15	2.65	1.35	12.96
CoM 12085	66.86	112.61	57.55	2.34	3.08	2.16	15.44
VSI 12121	54.02	106.33	69.10	2.32	2.60	1.67	13.91
Co 99004	51.59	107.08	84.50	2.24	2.59	1.46	13.75
Co 86032 (C)	53.79	109.13	76.54	2.19	2.61	1.51	13.85
Mean	**55.18**	**101.79**	**74.91**	**2.34**	**2.72**	**1.52**	**13.19**
Sem ±	**2.41**	**2.44**	**10.85**	**0.18**	**0.12**	**0.18**	**0.66**
CD 5%	**7.07**	**7.15**	**31.83**	**0.53**	**0.35**	**0.54**	**1.94**

9. COIMBATORE

Experiment was initiated during February 2018. The experiment was laid out in split plot design with two replications. In all 11 elites sugarcane genotypes Co 12007, Co 12008, Co 12009, Co 12012, Co 12019, Co 12024, Co 86032, CoC 671, CoM 12085, CoSnk 05103, VSI 12121 with 125 % RDF were planted with two spacing (120 and 150 cm). Cane yield differences were non-significant (**Table AS 72.9.1**) for two row spacing wherein planting sugarcane at 120 cm row spacing recorded higher cane yield (137.09 t/ha) than 150 cm row spacing (120.71 t/ha). Data were recorded on growth, juice quality, cane yield and yield attributes. In the plant crop the NMC (000/ha) showed significant difference due to varieties, wherein, promising early genotype Co 12012 (129460 NMC/ha) recorded significantly higher NMC than the check varieties Co 86032 (89670 NMC/ha) and CoC 671(76700 NMC/ha).

Juice quality (Brix, sucrose, purity and CCS percent) was studied by collecting cane samples at harvest. Juice Brix, Sucrose%, Purity % and CCS % at harvest showed significant varietal difference (**Table AS 72.9.2**). In the plant crop CoC 671 recorded significantly highest mean brix of 22.37 than other elite sugarcane genotypes. Amongst the 11 elite sugarcane genotypes VSI 12121 and Co 12012 was found more promising and recorded marginally higher CCS yield of 22.91 and 20.85 t/ha than the check entries CoC 671(20.41t/ha) and Co 86032 (18.59 t/ha).

Table AS 72.9.1: Growth performance of evaluated genotypes at Coimbatore

Particulars	Cane length (cm)	Cane girth (mm)	No of internodes	SCW (kg)	NMC (000/ha)	Cane yield (t/ha)
Spacing						
120 cm	228.86	28.97	25.02	1.39	103.27	137.09
150 cm	241.97	29.95	26.90	1.58	84.59	120.71

SEd	9.61	0.75	0.72	0.04	4.15	2.36
CD	NS	NS	NS	NS	NS	NS
Varieties						
Co 12007	236.67	26.92	25.16	1.32	92.72	106.85
Co 12008	219.16	30.52	25.33	1.24	83.05	97.03
Co 12009	264.167	33.83	24.83	1.86	80.99	142.57
Co 12012	242.49	25.68	26.83	1.29	129.46	164.94
Co 12019	172.08	27.23	25.08	0.98	103.01	111.75
Co 12024	215.00	30.17	30.58	1.38	89.18	117.68
VSI 12121	281.66	31.21	26.25	2.06	100.48	154.07
COM 12085	287.08	32.72	28.50	2.20	67.03	125.12
Co Snk 05103	224.58	26.02	21.74	0.90	120.96	134.80
Co 86032	227.91	30.47	25.41	1.54	89.67	136.43
CoC 671	218.74	29.32	25.91	1.59	76.70	127.85
Se d	15.94	1.48	2.070	0.18	9.04	16.21
CD	33.26	3.10	4.319	0.38	18.86	33.81
Interaction (V*S)						
SEd	22.55	2.10	2.92	0.25	12.79	16.19
CD	NS	NS	NS	NS	NS	NS

Table AS 72.9.2: Quality performance of evaluated genotypes at Coimbatore

	Brix	Sucrose %	Purity %	CSS %	CCS yield (t/ha)
Spacing					
120 cm	20.53	19.58	95.32	14.02	19.11
150 cm	20.42	19.58	95.79	14.05	16.96
Se d	0.068	0.20	0.69	0.19	0.04
CD	NS	NS	NS	NS	0.57
Varieties					
Co 12007	20.02	19.46	97.22	14.05	15.02
Co 12008	22.17	21.13	95.30	15.12	14.71
Co 12009	20.22	19.22	95.01	13.74	19.68
Co 12012	19.57	18.01	92.01	12.70	20.85
Co 12019	20.32	19.17	94.31	13.66	15.40
Co 12024	19.52	19.18	98.27	13.90	16.17
VSI 12121	21.32	20.64	96.82	14.87	22.91
COM 12085	20.89	20.37	97.52	14.71	18.41
Co Snk 05103	18.87	17.14	90.84	12.00	16.22
Co 86032	19.97	19.03	95.30	13.62	18.59
CoC 671	22.37	22.05	98.55	16.00	20.41
Se d	0.62	0.65	1.16	0.50	1.93
CD	1.29	1.36	2.43	1.05	4.03
Interaction (V*S)					
Se d	0.88	0.92	3.44	0.71	2.73
CD	**NS**	**NS**	**NS**	**NS**	NS

EAST COAST ZONE

10. NAYAGARH

Six mid-late maturing genotypes from AVT namely Co 13028, Co 13029, Co 13031, CoA 14323, CoC 14337 and PI 14377 along with three standard checks i.e. CoV 92102, Co 86249 and Co 06030 were evaluated on red laterite soil of the

experimental farm of Sugarcane Research Station, Nayagarh. Soil was acidic (pH 5.33) in reaction with electrical conductivity of 0.206 dSm^{-1}. Available N content was in lower range (155 kg/ha), but the soil was medium in available P (19.6 kg/ha) and (K 164 kg/ha) content. Analysis of variance suggested that there is significant variations among the genotypes with respect to germination %, number of tillers at 180 days and number of millable canes ('000/ha). The genotype PI 14377 with 90 cm spacing produced the highest average cane yield of 106.54 t/ha with application of 125 % RD of fertilizer (**Table AS 72.10.1**).

Table AS 72.10.1: Performance of mid-late genotypes at Nayagarh

Treatment		Germination % at 45 DAP	No of tillers (000/ha) at 180 DAP	NMC (000/ha)	Cane yield (t/ha)	Sucrose (%)	CCS (%)
T_1	Co 13028 (90 cm)	53.80	82.33	83.60	90.89	16.80	11.20
T_2	Co 13029 (90 cm)	51.33	82.90	83.86	91.17	17.00	11.04
T_3	Co 13031(90 cm)	55.27	82.43	83.84	93.73	17.50	11.60
T_4	CoA 14323(90 cm)	49.97	83.10	84.14	92.36	17.80	11.03
T_5	CoC 14337(90 cm)	46.83	78.93	81.89	92.05	16.60	11.58
T_6	PI 14377(90 cm)	59.77	89.10	92.34	106.54	18.55	11.90
T_7	CoV 92102(90 cm)	55.43	87.33	89.41	100.77	17.50	11.23
T_8	Co 86249(90 cm)	53.30	84.93	90.11	102.97	18.20	11.62
T_9	Co 06030(90 cm)	51.27	83.28	85.46	97.68	17.65	11.25
T_{10}	Co 13028(120 cm)	55.65	80.13	81.32	88.45	16.67	11.56
T_{11}	Co 13029(120 cm)	53.48	80.90	80.88	87.79	17.30	11.36
T_{12}	Co 13031(120 cm)	58.22	79.43	81.24	90.73	16.80	11.67
T_{13}	CoA 14323(120 cm)	53.47	81.70	82.56	90.76	17.37	11.93
T_{14}	CoC 14337(120 cm)	48.86	75.93	78.29	86.25	17.20	11.72
T_{15}	PI 14377(120 cm)	60.46	86.75	88.11	97.84	17.20	12.04
T_{16}	CoV 92102(120 cm)	57.35	84.36	85.95	96.46	17.33	11.80
T_{17}	Co 86249(120 cm)	55.12	87.39	89.76	99.47	17.20	11.84
T_{18}	Co 06030(120 cm)	52.35	78.98	82.36	93.63	17.57	11.25
SEm±		2.763	1.342	1.276	1.504	0.359	0.294
CD at 5 %		7.433	4.072	3.869	4.563	NS	NS

NORTH CENTRAL ZONE

11. PUSA

Early

An examination of data indicates that 90 cm row spacing recorded significantly higher plant population (178800/ha), millable canes (123700/ha) and cane yield (101.3 t/ha). Though, marked variation in single cane weight (897.7 g/plant) was obtained due to 120 cm row spacing. Row spacing did not exert significant impact on sucrose content juice.125 % recommended dose of fertilizer significantly increased the plant population (171100 /ha), millable canes (116500 /ha), single cane weight (899.4 g/plant) and cane yield (100.1 t/ha). Though, sucrose content juice remained unaffected due to fertility levels.

The maximum plant population (169700/ha) and millable canes (114900/ha) were obtained with the genotype CoP 13437 which was statistically comparable to CoSe 13451 and CoLk 94184 in respect to plant population and CoSe 13451 in case of millable canes. However, significantly higher single cane weight (1063.3 g/plot) and cane yield (105.6 t/ha) was noted due to the genotype CoSe 95422. Though, sucrose content juice did not varied significantly due to different genotypes (**Table AS 72.11.1**).

Table AS 72.11.1: **Performance of early genotypes at Pusa**

Treatment	Germination (%)	Plant population ($\times 10^3$/ha)	Millable canes ($\times 10^3$/ha)	Single cane weight (g)	Cane yield (t/ha)	Sucrose (%) in juice
Row spacing (cm)						
90 cm	33.34	178.8	123.7	847.6	101.3	18.37
120 cm	33.99	131.4	91.5	897.7	77.3	18.38
SEm±	0.66	2.30	1.48	12.3	1.38	0.066
CD (P=0.05)	NS	6.4	4.1	34.1	3.8	NS
Fertility level (% RDF)						
F_1 – 100 % RDF	33.02	139.1	98.7	845.9	78.5	18.48
F_2 – 125 % RDF	34.31	171.1	116.5	899.4	100.1	18.27
SEm±	0.66	2.30	1.48	12.3	13.38	0.066
CD (P=0.05)	NS	6.4	4.1	34.1	3.8	NS
Early promising genotypes						
CoP 13437	32.2	169.7	114.9	930.8	102.7	18.29
CoSe 13451	32.6	161.6	109.4	910.0	96.1	18.38
CoSe 13452	33.9	134.5	102.6	805.0	78.1	18.27
CoLk 94184	33.2	161.0	106.9	610.3	62.3	18.63
CoSe 95422	34.0	155.5	105.2	1063.3	105.6	18.27
CoSe 01421	36.2	148.1	106.4	916.5	91.0	18.40
SEm±	1.13	3.99	2.57	21.3	2.39	0.11
CD (P=0.05)	NS	11.1	7.1	59.1	6.6	NS
CV (%)	11.7	8.9	8.3	8.5	9.3	2.15

12. SEORAHI

Early

The experimental field was medium in organic carbon (0.740 per cent), medium in available phosphorus (22.13 kg/ha) and low in potash (58.40 kg/ha) with pH 8.07. Sugarcane crop was planted on 8th March 2018 and harvested on 29th March 2019. CoSe 13452 genotype obtained significantly higher germination per cent (43.24), shoot population (154.67 thousand per ha) and NMC (89.64 thousand per ha) over check i.e. CoSe 01421 but significantly more cane yield was recorded in this genotype over all the zonal checks. Cane yield of CoSe 13451genotype was recorded significantly higher as compared to zonal checks i.e. CoLk 94184 and CoSe 01421. Lower germination per cent and shoot population was recorded in genotype CoP 13437 over zonal checks but effect on NMC was significantly higher as compared to zonal check CoSe 01421 (139800/ha). Performance of genotype CoP 13437 on cane yield was found significantly higher against zonal checks viz. CoLk 94184 and CoSe 01421. Effect of row spacing on shoot population, NMC and cane yield was found significantly higher in the treatment of 90 cm row spacing. This treatment produced significantly higher

shoot population (161.97 thousand per ha), NMC (102.58 thousand per ha) and cane yield (80.99 t/ha) over 120 cm row spacing but sucrose per cent was significantly higher in 120 cm (12.95 per cent) row spacing. Effect of fertility on germination and sucrose per cent was non-significant but significantly higher shoot population (149.00 thousand per ha), NMC (93.03 thousand per ha) and cane yield (76.89 t/ha) were obtained in F2 fertility treatment (**Table AS 72.12.1**).

Table AS 72.12.1: Performance of early genotypes at Seorahi

Treatment	Germination %	Shoot count (000/ha)	NMC (000/ha)	Cane Yield (t/ha)	Sucrose %
Genotypes					
V_1-CoP 13437	39.80	130.16	85.42	74.84	19.56
V_2-CoSe13451	41.08	132.47	86.16	76.82	19.72
V_3- CoSe13452	43.24	154.67	89.07	80.25	20.24
V_4- CoLk 94184	45.00	150.19	99.07	70.56	19.69
V_5- CoSe 95422	49.61	166.83	107.43	73.36	20.06
V_6- CoSe 01421	40.98	136.35	82.64	68.73	19.39
SEm±	1.78	2.34	1.38	1.56	0.19
CD(P=0.05)	**5.06**	**6.74**	**3.92**	**4.46**	**0.54**
Fertility Levels					
F_1	42.45	141.23	90.24	71.32	19. 68
F_2	44.12	149.00	93.03	76.87	19.88
SEm±	1.03	1.37	0.79	0.91	0.11
CD(P=0.05)	**NS**	**3.89**	**2.26**	**2.57**	**NS**
Row spacing					
S_1-90 cm	43.01	161.97	102.58	80.99	19.58
S_2-120 cm	43.56	128.26	80.69	67.19	19.97
SEm±	1.03	1.37	0.79	0.91	0.11
CD(P=0.05)	**NS**	**3.89**	**2.26**	**2.57**	**0.31**

PROJECT NO.: AS 73

Title: Assessment of climate change impact on sugarcane productivity

Objective : To assess long term variability in weather parameters and the change of sugarcane production.

Year of start : 2018-2019

Duration : One year

Locations : All centres where post of Agronomist has been provided as well as any voluntary centre.

Methodology : Long term daily weather data (30 years or more) is to be collected from nearest meteorological station for following parameters.

1. Daily maximum temperature
2. Daily minimum temp.
3. Daily relative humidity morning
4. Daily RH noon
5. Daily rainfall
6. Daily wind velocity
7. Daily evaporation
8. Daily BSSH (Bright Sun Shine Hours)

Analysis for means and general trends of weather over the years has to be performed by the stations at the following intervals.

1. Weekly
2. Monthly, seasonal
3. Annual
4. Decadal

Daily weather data and analyzed data is to be submitted to P.I. in soft format using MS and excel sheets along with following:

1. Representative cane yield for corresponding years
2. Representative sucrose content for corresponding years
3. Soil data
4. Plant data (Biometric)
5. Lat long information including elevation

Current year (2018-19) Report

The project was initiated during this year and was allocated to the centres where agronomists are posted in the scheme. Only two centres Lucknow and Nayagarh submitted a report presented here under:

1. LUCKNOW

The study was conducted with the weather data recorded at agro-meteorology observatory of ICAR-Indian Institute of Sugarcane Research, Lucknow. Under the study two long-term normal (30 years average) were studied. The first normal was for the period of 1956 to 1985 and the second normal was for the period of 1986 to 2015. The study revealed that 87% of the total annual rainfall was recorded during the monsoon season (June to September) while 9.4 and 3.6 % rainfall was recorded during the post monsoon (October to February) and pre monsoon (March to May), respectively. The weekly rainfall occurrence probability study revealed that standard metrological week 26 to 37 recorded more than 50% of probabilities of going wet. Rainfall declined in all the months except four non rainy season months (January, February, April and December) in comparison of the two normal. The maximum rainfall decline was recorded in the month of August (84.2 mm). The decrease in August month rainfall was reflected in increase of minimum and maximum temperature by 0.31 and 0.7 ^{o}C as compared to the first normal. The time series data of weather attributes were studied from 1956 to 2018 by Man-Kendall trend test on monthly, seasonal and annual basis. Study showed significant increasing trend in minimum temperature during the months of February, March and December (**Table AS 73.1.1**).

The seasonal minimum temperature showed significantly increasing trend in summer and winter season which was also reflected by increase in average annual minimum temperature (0.01^{o}C). The maximum temperature showed significantly decreasing trend in the month of January and May at the rate of 0.33, 0.29 and 0.17 ^{o}C decade^{-1}, respectively. Whereas, month of August showed significantly increasing trend (0.14 ^{o}C decade^{-1}). Winter season maximum temperature decreased significantly. The minimum temperature during the winter season recorded significantly increasing trend. The morning relative humidity showed significantly increasing trend from the month of January to July and October to November. The increasing trend was also found in the afternoon relative humidity, during the month of January to March, July and October to December. The average annual R.H. of morning and afternoon recorded Sen's slope of 0.12 and 0.10. The significantly decreasing trend was recorded in monsoon and total annual rainfall at the rate of 31.76 and 28.97 mm decade^{-1}, respectively. The monthly rainfall of August showed significantly negative trend (19.3 mm decade^{-1}). Reduction in rainfall during the month of August resulted by significantly decreasing trend in total number of rainy days of the month. The highest average monthly evaporation was recorded during the month of April (8.36 mm day^{-1}) and the lowest was recorded during the month of December (1.61 mm day^{-1}). The significant reduction in an average evaporation was recorded during the month of January to May, July and from October to December. However, increasing trend in evaporation was found during the month of August. This trend was also reflected in seasonal and annual trend. The maximum wind speed was recorded during the month of April (4.86 km hr^{-1}) and minimum during the month of November (1.47 km hr^{-1}). Wind speed showed significantly negative trend during the month of January, April to May, July to September and in November. The

season and annual study of wind speed also showed significantly negative trend in all the seasons and at annual level. It was found that the highest BSS hours were recorded during the month of May (9.29 hrs. day^{-1}) and lowest during August (5.50 hrs. day^{-1}). Significantly negative trend was recorded during the months from January to March, July and November to December.

Summary: The long term (1956-2018) weather parameters viz. temperature (minimum and maximum), relative humidity (morning and afternoon), rainfall, evaporation, wind speed and bright sun shine hours were studies to assess the climate change impact on sugarcane productivity at ICAR- Indian Institute of Sugarcane research, Lucknow. The results revealed that all the studied weather parameters showed significant trend either increasing or decreasing at monthly, seasonal or on annual level. Rainfall is one of the important weather parameter which showed decreasing pattern at the rate of 28.97 mm decade^{-1}.

Table AS 73.1.1: Average monthly weather parameters trend at ICAR-IISR, Lucknow (During 1956 to 2018)

Parameters	Months/Sig & DC	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
T min. (°C)	Mean	7.29	10.13	14.75	20.48	24.54	26.38	25.90	25.50	24.06	18.55	11.87	7.71
	Significance	NS	**	**	NS	NS	NS	NS	NS	NS	NS	NS	*
	Decadal change	-	0.33	0.29	-	-	-	-	-	-	-	-	0.17
T max. (°C)	Mean	21.76	25.51	31.39	37.06	39.47	37.83	33.61	32.86	32.86	32.31	28.52	23.84
	Significance	**	NS	NS	NS	**	NS	NS	**	NS	NS	NS	NS
	Decadal change	-0.41	-	-	-	-0.28	-	-	0.14	-	-	-	-
R.H. 7:30 hrs. (%)	Mean	92.00	85.33	72.49	53.64	55.82	69.68	86.81	89.88	89.61	88.63	90.21	92.73
	Significance	*	**	**	**	**	**	**	NS	NS	**	**	NS
	Decadal change	0.58	1.96	1.67	1.39	2.75	1.90	0.67			1.15	1.00	0.58
R.H. 14:30 hrs. (%)	Mean	48.68	39.65	28.34	22.24	28.89	45.50	70.91	73.21	66.68	48.90	39.07	48.68
	Significance	**	**	**	NS	**	NS	NS	NS	NS	NS	NS	*
	Decadal change	2.25	2.24	1.37	-	2.02	-	-	-	-	-	-	1.32
Rainfall (mm)	Mean	16.2	15.0	8.0	5.3	21.3	110.3	265.8	267.0	186.0	42.2	4.2	8.5
	Significance	NS	NS	NS	NS	NS	NS	NS	*	NS	NS	NS	NS
	Decadal change	-	-	-	-	-	-	-	-19.3	-	-	-	-
Evaporation[1] (mm/day)	Mean	1.72	3.10	5.46	8.33	8.36	6.82	3.94	3.51	3.40	3.02	2.21	1.61
	Significance	**	**	*	**	**	0.30	*	0.07	*	0.18	**	**
	Decadal change	-0.45	-0.25	-0.37	-0.76	-0.73	-	0.27	-	0.16	-	-0.33	-0.27
Wind speed[1] (km/hr)	Mean	2.70	3.61	4.73	4.86	4.14	3.92	3.43	2.89	2.70	1.58	1.47	1.77
	Significance	**	NS	NS	**	**	NS	**	**	*	NS	*	NS
	Decadal change	-0.38	-	-	-0.38	0.54	-	-0.67	-0.42	-0.21	-	-0.13	-
BSS (hrs./day)	Mean	7.28	8.22	8.67	9.07	9.29	7.28	5.61	5.50	6.76	8.18	8.24	7.43
	Significance	**	**	**	NS	NS	NS	*	NS	NS	NS	**	**
	Decadal change	-0.42	-0.25	-0.22	-	-	-	-0.24	-	-	-	-0.28	-0.40

Note: 1 Average of 1989-2018, NS- Non Significant,*Significant at P=0.05 and **Significant at P=0.01.

2. NAYAGARH

Nayagarh located in the east-coast zone experiences annual temperature ranging from 22.1 as minimum to 33.05 ^{o}C as maximum. The average annual rainfall for the last 21 years stand at 1576.2 mm with a variation from 1031 to 2129.9 mm showing wide inter-annual variability in the rainfall.

Table AS 73.2.1: Descriptive analysis of annual weather parameters observed at Nayagarh During 1998 to 2018

Weather Parameters	First Year	Last Year	No of years	Mini-mum	Maxi-mum	Mean	SD	CV (%)	Skew-ness
Tmin. (^{o}C)	1998	2018	21	21.49	23.04	22.21	0.43	1.93	0.09
Tmax. (^{o}C)	1998	2018	21	32.50	33.80	33.05	0.36	1.10	0.53
Total Rainfall (mm)	1998	2018	21	1031.0	2129.9	1576.2	313.8	19.91	0.28
R.H. I (%)	1998	2018	21	86.40	93.16	90.91	1.42	1.56	-1.55
R.H. II (%)	1998	2018	21	48.93	61.37	57.22	2.75	4.81	-1.09
BSS (Hrs.)	1998	2018	17	5.57	7.30	6.62	0.52	7.80	-0.61

PROJECT NO.: AS 74

Title: Evaluation of sugarcane varieties for drought tolerance

Objective : Identification of drought tolerant varieties suitable for specific agro-climatic condition.

Year of start : 2018-2019

Duration : Long term (Based on 2-years crop performance)

Locations : All centres where post of Agronomist has been provided as well as any voluntary centre.

Planting time : North West, North Central & North East Zones: February-March

Peninsular & East Coast Zones: Ist fortnight of January

Treatments :

(a) Newly released varieties:

- Early maturing (3)
- Mid-late maturing (3)

(b) Irrigation regimes: 2

- IW/CPE ratio 1.0
- IW/CPE ratio 0.3

Total no. of treatments: 12

Design : Strip plot design

Replication : 3

Plot size : North West, North Central, North East and East Coast Zones: 8 rows of 8 m length.
Peninsular Zone: 8 rows of 8 m length.

Methodology : All the irrigation regimes would be applied 50 days after planting

in the main season crop of the region.

Observations to :

i) Root dry weight at 50, 100, 150 and 200 DAP.

ii) Relative leaf water content 24 hrs before and after each irrigation 50 DAP onwards.

iii) Soil moisture content before and after each irrigation.

iv) Leaf area index and specific leaf weight at 50, 100, 150 and 200 DAP.

v) Dry matter accumulation at 50, 100, 150, 200 and at harvest.

vi) Monthly tiller count and other plant biometric data.

vii) Yield attribute and cane yield

viii) Juice quality at 10 and 12 months stages including juice extraction percentage.

Protocol for determination of:

1. Relative leaf water content
2. Leaf area index (LAI) and specific leaf weight

CURRENT YEAR (2018-19) REPORT

The project was initiated during this year. In all 09 centres conducted the trial and centre wise report are presented here under:

NORTH WEST ZONE

1. FARIDKOT

Well-watered (I1) crop gave significantly higher cane yield (**Table AS 74.1.1**) than water stressed crop (I2). The yield reduction varied from 6.3 percent (CoPb 92) to 24.4 percent (CoPb 93). During the crop season there was about 462 mm rainfall and most of it was up to September.

Table AS 74.1.1: **Performance of different genotypes under water stress at Faridkot**

Irrigation regime/ Genotype	I1	I2	Mean
CoPb 92	112.0	104.9	108.5
Co 118	84.0	76.0	80.0
CoJ 64	102.7	92.0	97.4
CoPb 91	137.3	109.8	123.6
CoPb 93	129.3	97.8	113.6
CoPb 94	140.4	129.7	135.1
Mean	117.6	101.7	
CD (5%)	Irrigation regimes	Genotypes	Interaction
	14.9	8.9	NS

2. KOTA

The field experiment was planted on 3rd March, 2018 at ARS, Kota to evaluate sugarcane varieties for drought tolerance and water productivity. Early maturing varieties namely V1- CoPk 05191, V2- Co 0238, V3- Co 5009 and mid-late maturing V4-Co 05011, V5-CoH 9264 & V6-CoS 8436 were planted at 75 cm row distance, keeping 3 budded 4 setts per meter row length. Significant variation in germination and tiller population from 90 DAP till harvest stage was observed for CoPk 05191 in early maturing group and CoS 8436 under mid-late maturing verities. Germination and tiller population recorded higher under I1 irrigation regime.Root dry weight at 100 and 150 DAP was recorded highest with CoPk 05191 and at 50 DAP & 200 DAP (0.40 gm & 207.88 gm) with Co 5009 in early maturing variety. While, highest root dry weight recorded at 50 DAP (0.41 gm), 100 DAP (0.76 gm) and at 150 DAP (168.90gm), (207.33gm) with V6–CoS 8436 treatment in mid-late maturing group. Whereas, highest dry matter recorded with Co 0238 variety at 100 DAP (51.6 gm/plant), 150 DAP(132.4

gm/plant), & at harvest (335.3 gm/plant) in early maturing group and maximum dry matter accumulation with CoH 9264 at 50 DAP(40.5 gm/plant) & 150 DAP (134.9 gm/plant), at 100 DAP CoS 8436 (49.9 gm/plant), Co 05011 at 200 DAP (222.1 gm/plant) & at harvest (235.0 gm/plant) in mid-late maturing varieties. Maximum leaf area index recoded with Co 0238 in early maturing group and CoS 8436 in mid-late maturing group at different stages. However, higher root dry weight, highest dry matter of plant and leaf area index recorded with I1 irrigation regime over I2 irrigation regime.

Data presented in table **AS 74.2.1** revealed that significantly higher NMC (130 thousand/ha), cane length (251.2 cm), cane yield (87 t/ha), juice extraction at 10 month (47 %) and at 12 month (50 %) were obtained with CoPk 05191 over other varieties under early maturing group. Whereas, highest NMC (127 thousand / ha), single cane weight (941 gm) cane yield (87 t/ha), juice extraction at 10 month (41 %) and at 12 month (43 %) were obtained with the CoS 8436, cane length (235.4 cm) with CoH 9264, cane diameter (3.2 cm) with Co 05011 variety. However, I1 irrigation regime recorded higher NMC (124.72 000/ha), cane length (245.867 cm), cane diameter (2.928) single cane weight (936.50 gm), cane yield (85.39 t/ha) and juice extraction at 10 month (42.17%) & at 12 month (44.72 %) over I2 irrigation regime.The effect of irrigation regimes on quality parameters of early and mid-late maturing varieties showed highest Brix (20.03 %), Sucrose (17.5 %), Purity (87.3 %), CCS (12.0 %) and CCS yield (10.5 t/ha) with V1- CoPk 05191 at 10 moth and Brix (20.1 %), Sucrose (18.6 %), Purity (88.1 %), CCS (12.6 %) and CCS yield (11.2 t/ha) with V1- CoPk 05191 at 12 moth in early maturing varieties group under I1 irrigation regime. However, in mid-late maturing group under I1 regime highest Brix (19.88 %), Sucrose (17.3 %), Purity (87.1 %), CCS (11.9 %) and CCS yield (9.4 t/ha) with V6- CoS 8436 at 10 moth and Brix (20.77 %), Sucrose (18.2 %), Purity (87.8 %), CCS (12.6 %) and CCS yield (9.9 t/ha) with V6- CoS 8436 at 12 month.

Data revealed that there were differences in cost of cultivation, GR, NR owing to production cost. The higher GR (239708.33 Rs/ha) and NR (131160.00 Rs/ha) and B: C ratio (2.21) recorded with CoPk 05191in early maturing group. However, highest Gross return (221833.33 Rs/ha), net return (113285.00 Rs/ha) and B: C ratio (2.04) with Co 05011 variety among mid-late varieties. The higher GR (234834.72Rs/ha) and NR (125138.06 Rs/ha) and B: C ratio (1:2.14) recorded with I1 (I/W CPE ratio 1.0) irrigation regime over I2 (I/W CPE ratio 0.3) irrigation regime.

Irrigation regimes had significant impact on growth and yield attributes. Significantly higher germination tiller population, plant height NMC and cane weight recorded at an IW: CPE ratio of 1.0 over IW: CPE ratio of 0.30 was due to sufficient moisture availability during the critical period. The higher cane yield and quality parameters were recorded at IW: CPE ratio of 1.0 over IW: CPE ratio of 0.3. Since cane yield is the result of additive and complementary effect of plant growth and yield attributing characters and the growth and yield attributes had better expression at optimum irrigation owing to adequate quantity and balanced proportion of water supply during the crop growth stages.

Summary: CoPk 05191 was found better with respect to number of tillers, plant height, millable canes, cane yield, brix, CCS yield(t/ha) resulting in significantly higher net return over other varieties under early maturing group and CoS 8436 variety in

respect of germination, growth, juice extraction and quality parameters but in respect to cane length, cane diameter, cane yield Co 05011 performed best under mid-late group.The higher GR (239708.33 Rs/ha) and NR (131160.00 Rs/ha) and B:C ratio (2.21) recorded with CoPk 05191 in early maturing group and with Co 05011in mid-late group with gross return (221833.33 Rs /ha), net return (113285.00 Rs /ha) and B:C ratio (2.04). The higher GR (234834.72Rs/ha) and NR (125138.06 Rs/ha) and B: C ratio (1:2.14) was recorded with I1 (I/W CPE ratio 1.0) irrigation regime over I2 (I/W CPE ratio 0.3) irrigation regime.

Table AS 74.2.1: Effect of irrigation regime of performance of varieties at Kota

Treatment	Cane length (cm)	Cane diameter (cm)	NMC (000/ ha)	Cane weight (g)	Cane yield (t/ha)	Juice Extraction (%)	
						10 month	12 month
Variety							
Early							
V_1 : CoPk 5191	251.2	2.1	130.17	850	87.17	47	50
V_2 : Co 0238	240.6	3.1	119.67	1051	81.52	43	48
V_3 : Co 5009	237.4	3.3	118.83	902	84.83	39	42
Mid-late							
V4 : Co 05011	242.0	3.2	123.92	937	80.67	38	40
V5 : CoH 9264	235.4	2.6	118.67	882	79.59	39	41
V_6 : CoS 8436	234.5	2.7	126.50	941	78.67	41	43
SEm ±	2.435	0.193	6.939	42.630	2.958	2.567	2.548
CD (P=0.05)	7.671	0.609	21.859	134.300	9.318	8.088	8.028
CV	2.484	16.747	13.823	11.264	8.828	15.308	14.222
B. Irrigation schedule (IW/CPE)							
I_1 : 1.0	245.867	2.928	124.72	936.50	85.39	42.17	44.72
I_2 : 0.3	234.478	2.728	121.19	917.50	78.75	40.00	43.06
SEm ±	1.717	0.038	3.956	10.001	1.672	1.161	0.988
CD (P=0.05)	10.446	0.231	24.073	60.849	10.175	7.062	6.014
CV	3.033	5.684	13.651	4.577	8.644	11.986	9.554

3. LUCKNOW

The experimental soil was sandy loam with pH 8.15, low in organic carbon (0.27%) and available nitrogen (199.12 kg ha^{-1}) and medium in available P_2O_5 (22.23 kg ha^{-1}), high in available K_2O (199.21 kg ha^{-1}) and EC was 0.16.This experiment was laid out on 4th April 2018 in strip plot design with three replications. Sugarcane crop was irrigated 8 times in treatment IW/CPE ratio 1.0 (IS 1.0), and three times in IW/CPE ratio 0.3 (IS 0.3). Crop was irrigated 7.5 cm in depth in each time of irrigation. Well distributed 1321.7 mm rainfall was received during the crop duration in 47 rainy days. Sugarcane crop at IW/CPE ratio 1.0 was irrigated 5 times whereas IW/CPE ratio 0.3 was irrigated only once between end of rainstill harvest of sugarcane.

Difference in root dry weight at 50 & 150 DAP was found non-significant due to irrigation regimes. Among the varieties, root dry weight production was recorded significant and maximum root dry weight (482.93 kg/ha) was produced with variety CoPk 05191 followed by CoLk 94184. Between irrigation treatments I1 recorded

significantly superior root dry weight and total dry weight production at 100 and 200 DAPover I2. Total dry matter production at harvest was highest with Co 0238 followed by CoPk 05191. Numerically higher number of millable canes(97.54 thousand/ha) was produced with treatment I1 over I2. Among the varieties production of NMC was recorded non- significant, whereas CoPk 05191 was recorded maximum NMC (95.28 thousand/ha) followed by Co 0238. Among the varieties, maximum cane length 207.68 cm was recorded with CoS 08279 which was at par with CoPk 05191 (206.65cm). Maximum cane girth 24.00 mm was recorded with Co 0238 followed by CoPk 05191 (23.26 mm).The highest average cane weight (709g) was recorded with variety CoPk 05191 foll0wed by CoLk 94184. Interaction effect of irrigation regime with sugarcane varieties was recorded significant for average cane weight and yield of sugarcane. Sugarcane yield 76.79 t/ha was recorded significantly high with Co 0238 under I1 but the mean yield of variety CoPk 05191 was highest. Reduction in average cane weight due to moisture stress was minimum (5.56 %) in CoPk 05191 followed by CoLk 94184 (7.6 %). However, minimum reduction in sugarcane yield owing to moisture stress(13.7%)was recorded with CoPk 05191 followed by CoLk 11206 which was at par with CoLk 94184.Quality parameters of sugarcane recorded at 10 & 12 months crop stage revealed that I1 recorded significantly higher juice extraction percentage at both the stages. Among the varieties juice extraction percentage differed non-significantly. Irrigation schedule recorded non-significant effect on ^{0}brix and sucrose content at both the crop stages. Maximum production 8.97 and 9.18 t/ha of CCS was recorded with variety CoPk 05191 during 10 and 12 months crop stages, respectively.

Summary: Among the six varieties of sugarcane, CoPK 05191 produced highest NMC, cane length, cane girth, sugarcane yield, juice extraction percentage, CCS t/ha, which may be due to production of higher root dry weight, LAI and average cane weight. Minimum reduction in sugarcane yield (13.7%)due to moisture stress was found with CoPk 05191 followed by CoLk 11206 which was at par with CoLk 94184 (18.38%).

Table AS 74.3.1: Interaction and main effect of irrigation regimes and varieties on root dry weight and total dry matter accumulation at Lucknow

Treatments	Root dry wt. kg/ha				Total dry weight kg/ha				
	50 DAP	100 DAP	150 DAP	200 DAP	50 DAP	100 DAP	150 DAP	200 DAP	At harvest
A. Irrigation schedule									
IS1.0	57.89	97.07	293.23	492.75	593.25	1204.39	4762.09	18468.78	35729.06
IS0.3	57.75	91.85	287.30	459.69	591.06	1119.49	4472.99	17125.56	30834.06
CD at 5%	**NS**	**3.07**	**NS**	**21.69**	**NS**	**NS**	**187.9**	**517.9**	**1782.93**
B. Verities									
Co Lk 94184	58.40	96.38	292.77	480.78	597.14	1153.98	4589.34	17920.96	33081.74
Co Pk 05191	58.41	96.64	294.17	482.93	601.81	1236.47	4805.81	18182.99	34638.53
Co 0238	57.72	94.17	293.39	480.54	644.80	1234.71	4799.44	18170.19	34725.91
Co Lk 9204	57.72	92.16	284.03	460.99	570.45	1096.70	4467.15	17253.07	31900.03
Co Lk 11206	57.15	93.89	289.11	477.81	568.08	1150.82	4576.87	17743.13	33383.37
CoS 08279	57.51	93.52	288.13	474.29	570.65	1098.94	4466.65	17512.68	31959.79
CD at 5%	**NS**	**NS**	**NS**	**8.37**	**37.91**	**81.69**	**180.95**	**NS**	**1930.92**

Table AS 74.3.2: **Influence of varieties and irrigation regime on cane yield at Lucknow**

Treatment	**IS 1.0**	**IS 0.30**	**Mean**
Co Lk 94184	69.60	58.80	**64.20**
Co Pk 05191	71.98	63.31	**67.65**
Co 0238	76.79	55.23	**66.01**
Co Lk 9204	67.54	53.38	**60.46**
Co Lk 11206	67.80	57.92	**62.86**
CoS 08279	66.97	55.10	**61.03**
Mean	**70.11**	**57.29**	
Factor A- CD at 5%	**4.00**		
Factor B- CD at 5%	**4.38**		
Factor AxB- CD at 5%	**5.38**		

Table AS 74.3.3: Effect of varieties and irrigation regime on juice quality at Lucknow

Variety	Juice quality at 10 months				Juice quality at 12 months			
	Juice extraction %	^{0}Brix	Pol%	CCS t/ha	Juice extraction %	^{0}Brix	Pol %	CCS t/ha
A. Irrigation schedule								
IS1.0	62.26	20.63	18.60	9.11	61.30	21.49	18.64	8.94
IS0.3	58.21	20.38	18.33	7.32	56.86	21.84	19.01	7.49
CD at 5%	**3.11**	**NS**	**NS**	**0.61**	**3.50**	**NS**	**NS**	**0.57**
B. Varieties								
Co Lk 94184	60.14	19.96	17.87	8.01	58.91	21.73	18.81	8.26
Co Pk 05191	60.78	21.05	18.98	8.97	60.03	22.44	19.70	9.18
Co 0238	60.20	21.07	19.12	8.84	58.86	19.74	17.34	7.87
Co Lk 9204	59.78	20.22	18.32	7.74	58.53	21.81	18.38	7.49
Co Lk 11206	60.43	19.88	17.75	7.75	59.25	21.88	19.01	8.20
CoS 08279	60.07	20.85	18.74	7.97	58.89	22.38	19.72	8.30
CD at 5%	**NS**	**0.86**	**0.90**	**0.90**	**NS**	**1.37**	**1.39**	**0.86**

4. SHAHJAHANPUR

The soil of experimental field was low in organic carbon (0.32%) and phosphorus (13.20 kg/ha) and medium in potash (151.20kg/ha) with pH 7.14. Experimental sugarcane plant crop was planted on 16.03.2018 and harvested on 12.03.2019.Experimental data (Table AS 74.4.1) indicated that variety CoLk 94184 gave significantly higher number of shoots (173957/ha) at 150 DAP, millable canes (137499/ha) and cane yield (92.80t/ha) followed by CoSe 11453 with cane yield of 88.20 t/ha. IW/CPE ratio 1.0 produced significantly higher cane yield of 85.75 t/ha than that of IW/CPE ratio 0.3. CCS% was not affected significantly with various varieties and IW/CPE ratio.

Summary: Genotype CoLk 94184 produced significantly higher cane yield (92.80t/ha) followed by CoSe 11453 with cane yield of 88.20 t/ha. IW/CPE ratio 1.0 recorded significantly higher cane yield of 85.75 t/ha.

Table AS 74.4.1: Effect of irrigation regimes and varieties on sugarcane at Shahjahanpur

Treatment	Germination (%)	Shoots (000/ha)			NMC (000/ha)	Cane (yield t/ha)	CCS (%)
		90 DAP	120 DAP	150 DAP			
A - Varieties							
V_1 - UP 05125	46.65	119.27	136.28	151.68	118.46	72.20	11.81
V_2 - CoS 13231	45.00	123.50	143.52	157.12	128.88	67.40	11.70
V_3 - CoLk 94184	44.55	147.80	158.56	173.96	137.50	92.80	11.26
V_4 - CoS 08279	44.20	116.20	134.20	148.67	116.26	86.40	11.75
V_5 - CoS 9232	43.85	109.61	128.70	138.08	106.08	82.80	12.17
V_6 - CoSe 11453	44.70	135.59	137.44	149.65	117.82	88.20	11.56
SE±	**0.93**	**2.47**	**2.83**	**3.45**	**2.95**	**2.45**	**0.87**
CD at 5%	**1.95**	**5.19**	**6.06**	**7.25**	**6.19**	**5.16**	**NS**
B – Irrigation regimes							
I_1-IW/CP 1.0	44.38	133.18	146.74	153.59	124.32	85.75	11.70
I_1-IW/CPE 0.3	44.68	116.61	132.83	145.80	117.34	77.47	11.68
SE±	**0.09**	**0.80**	**1.02**	**1.16**	**0.28**	**0.52**	**0.38**
CD at 5%	**NS**	**3.45**	**4.39**	**4.98**	**1.21**	**2.25**	**NS**

5. UCHANI

Six entries (3 from early and 3 from mid late) were planted at 75 cm spacing on March 20, 2018 in spring season. These entries were evaluated at two irrigation regimes i.e. at 1.0 and 0.3 IW/CPE ratios. The crop was fertilized with 150-60-60 NPK kg/ha. The soil of the experimental field was sandy loam in texture with bulk density of 1.65 g/cm^3, infiltration rate 1.70 mm/hr (basic), low in organic carbon (0.37) medium in available phosphorus (11.7 kg/ha) and medium in available K (173kg/ha). Pan evaporation rate readings were recorded from pan evaporimeter installed at the farm. Average pan evaporation rate values were 4.2, 6.4, 7.7 and 7.7 mm/day for the month of March, April, May and June 2018 (pre-monsoon period), respectively. Highest values of pan evaporation rate were recorded in the month of May and June 2018. Soil moisture per cent (on volume basis) before each irrigation in 1.0 and 0.3 IW/CPE treatments recorded during pre-monsoon period was 12.5-13.9 % and 5.0-5.4 %, respectively. The crop was irrigated as per treatments up to June end. The crop was irrigated as per requirement during post monsoon period. The crop received 1374 mm total rainfall during the crop season out of which 317 mm during pre-monsoon, 985 during monsoon (July 2018, 2017 to September 2018) and 71.2 mm during post monsoon (October 2018 to March 2019). Maximum rainfall of 549 mm and 310.5 was recorded during the month of July and September 2018. No rainfall was received in October 2018 and November 2018 months. Monthly average maximum temperature of 29.4,35.4,38.6 and 36.3 0C was recorded during March, April, May and June 2018 (Pre-monsoon period), respectively. Maximum monthly average temperature values ranges from 38.6 oC (May 2018) to 18.4 oC (January 2019) during crop season. Minimum monthly average temperature values ranges from 26.0 oC (June and July 2018) to 5.7 oC (December 2018) during the crop growth season. Total evaporation

during the crop season was recorded as 1586.7 mm. The crop was harvested on March 8, 2019.

Varieties differed significantly in terms of germination, tillers, millable canes, cane weight and cane yield. Varieties Co 0238 (56.6 %) and Co 0118 (55.4%) being at par recorded significantly higher germination among all the varieties. Variety CoH 160 recorded highest number of tillers and millable canes among all the varieties. Varieties Co 0238, CoH 167, CoH 119 and CoH 5011 were at par in terms of millable canes. Highest cane weight was recorded in variety CoH 119 followed by Co 0238, Co 0118, CoH 167, Co 5011 and lowest in CoH 160. Variety CoH 119 in mid late and Co 0238 in early being at par produced significantly higher cane yield as compared to variety CoH 167, Co 0118, Co 5011 and CoH and later being at par with each other (**Table AS 74.5.1**).

There were no significant differences in terms of germination, growth, yield and yield attributing characters between 1.0 and 0.3 IW/CPE ratios due to frequent rainfall during pre-monsoon period. Total irrigation water applied during pre-monsoon season of 22.5 and 15.0 cm was calculated at 1.0 and 0.3 IW/CPE schedule, respectively. During post monsoon, 60 cm irrigation water was applied in both the irrigation levels. Total (pre+ post monsoon) irrigation water of 82.5, and 75 cm was applied at 1.0 and 0.3 IW/CPE irrigation schedule, respectively. Total (Irrigation+ rainfall) water was calculated as 219.9 and 212.4 at 1.0 and 0.3 IW/CPE irrigation schedule, respectively. Among early varieties Co 0238 (12.97 kg) and CoH 119 (12.99 kg) among mid late varieties produced the highest yield of cane produced/1000 litres of irrigation at irrigation schedule of 0.3 IW/CPE ratio (**Table AS 74.5.2**).

Summary: No significant differences in terms of growth and yield were observed between 1.0 and 0.3 IW/CPE ratios due to frequent rains during pre-monsoon period. Variety CoH 119 (96.9 t/ha) in mid late and Co 0238(96.2 t/ha) in early group being at par produced significantly higher cane yield as compared to variety CoH 167 (90.5 t/ha), Co 0118 (88.4 t/ha), Co 5011 (91.6 t/ha) and CoH 160 (91.4 t/ha) and later four being at par with each other. Among early varieties Co 0238 (12.97 kg) and CoH 119 (12.99 kg) among mid late varieties produced the highest yield of cane produced/1000 litres of irrigation at irrigation schedule of 0.3 IW/CPE ratio. Total irrigation water applied during pre-monsoon season was calculated 22.5 and 15.0 cm at 1.0 and 0.3 IW/CPE schedule, respectively. Total (pre+ post monsoon) irrigation water of 82.5, and 75 cm was applied at 1.0 and 0.3 IW/CPE irrigation schedule, respectively. Total (Irrigation+ rainfall) water was calculated as 219.9 and 212.4 at 1.0 and 0.3 IW/CPE irrigation schedule, respectively.

Table AS 74.5.1: **Influence of irrigation regimes and varieties on cane growth and yield at Uchani**

Treatment	Germination (%)	Tillers (000/ha) 120 DAP	NMC (000/ha)	Cane wt. (g)	Cane yield (t/ha)
Variety					
CoH 167(ML**)**	42.2	158.0	113.0	822	90.5
CoH 119 (ML**)**	42.9	158.6	111.6	892	96.9

Co 5011(ML)	42.7	158.6	116.1	810	91.6
CoH 160 (Eary)	48.0	190.6	130.4	719	91.4
Co 0238 (Eary)	56.6	172.8	114.9	864	96.2
Co 0118 (Eary)	55.4	158.5	108.3	825	88.4
CD at 5%	2.0	7.2	5.3	35	5.0
Irrigation schedule (IW/CPE)					
1.0	47.7	164.8	114.9	819	91.8
0.3	47.5	167.5	116.5	825	93.2
CD at 5%	NS	NS	NS	NS	NS

Table AS 74.5.2: **Water productivity of different varieties at Uchani**

Variety	IW/ CPE	No. of irrigation	Total Pre-monsoon irrigation (cm)	Post monsoon irrigation (cm)	Total irrigation (cm)	Total rainfall (cm)	Total water (cm)	Cane yield (t/ha)	Cane produced per 1000 litres of irrigation water (kg)
CoH 167	1.0	2	22.5	60	82.5	137.4	219.9	89.6	10.86
CoH 119	1.0	2	22.5	60	82.5	137.4	219.9	96.4	11.68
Co 5011	1.0	2	22.5	60	82.5	137.4	219.9	91.0	11.03
CoH 160	1.0	2	22.5	60	82.5	137.4	219.9	89.8	10.89
Co 0238	1.0	2	22.5	60	82.5	137.4	219.9	95.1	11.53
Co 0118	1.0	2	22.5	60	82.5	137.4	219.9	85.5	10.36
CoH 167	0.3	1	15.0	60	75	137.4	212.4	91.3	12.18
CoH 119	0.3	1	15.0	60	75	137.4	212.4	97.4	12.99
Co 5011	0.3	1	15.0	60	75	137.4	212.4	92.2	12.29
Co H 160	0.3	1	15.0	60	75	137.4	212.4	92.9	12.39
Co 0238	0.3	1	15.0	60	75	137.4	212.4	97.3	12.97
Co 0118	0.3	1	15.0	60	75	137.4	212.4	88.2	11.76

PENINSULAR ZONE

6. SANKESHWAR

The cane yield differed significantly due to influence of irrigation regimes and genotypes. Among mid-late genotypes Co 86032 recorded significantly higher cane yield (157.47 t/ha) than SNK 09227 and SNK 09268. In early genotypes SNK 088789 recorded higher yield (133.71 t/ha) over SNK 07680 and CoC 671. Similar trend was noticed with NMC, Cane girth, Single cane weight, CCS yield and quality parameters. Foe irrigation regimes, IW/CPE ratio 1.0 recorded significantly higher cane yield

(143.54 t/ha) compared to IW/CPE ratio 0.3 (124.04 t/ha). Similar trend was noticed with yield attributes except NMC and quality parameters.

The combined effect of genotypes and irrigation regimes on yield and yield attributes differed significantly. Among the mid-late genotypes Co 86032 with IW/CPE ratio 1.0 recorded significantly higher cane yield (164.40 t/ha) which was on par with SNK 09227 with IW/CPE ratio 1.0. Early variety SNK 088789 recorded higher cane yield (141.04 t/ha) with IW/CPE ratio 1.0 compared to other varieties. At IW/CPE ratio 0.3 the mid-late genotype SNK 09227 performed better (135.27 t/ha) as compared to Co 86032 and SNK 09268. In early genotypes SNK 088789 performed better than CoC 671 and SNK 07680. Similar trend was noticed with NMC, Cane girth, Single cane weight, and CCS yield and quality parameters.

Summary: At IW/CPE ratio 0.3, genotypes SNK 09227 (mid-late) and SNK 088789 (early) performed better than rest of the genotypes.

Table AS 74.6.1: Sugarcane growth and yield as influenced due to irrigation regimes and varieties

Treatment	Germination 30 DAP (%)	Cane yield (t/ha)	NMC (000/ha)	Cane girth (cm)	Plant height at harvest (cm)	Single cane weight (kg)	CCS yield (t/ha)
Irrigation regimes							
I1: IW/CPE ratio 1	63.18	143.54	84.78	2.95	261	1.95	19.07
I2:IW/CPE ratio 0.3	62.89	124.04	74.25	2.56	239	1.48	16.47
S.Em±	0.05	0.98	3.17	0.02	3.6	0.05	0.35
CD 5%	NS	5.97	NS	0.15	NS	0.30	2.14
Varieties							
V1:Co 86032 (Midlate)	63.06	157.47	82.69	2.90	265	1.96	20.62
V2:SNK 09227 (Midlate)	64.13	149.25	94.54	2.77	242	1.62	19.11
V3:SNK 09268 (Midlate)	58.24	126.00	66.11	2.86	263	1.93	16.09
V4:SNK 07680 (Early)	64.51	120.80	74.07	2.70	245	1.64	15.26
V5:SNK 088789 (Early)	71.32	133.71	79.90	2.53	277	1.72	17.44
V6:CoC 671 (Early)	56.96	115.51	79.78	2.78	209	1.45	18.07
S.Em±	0.90	1.76	2.28	0.03	2.9	0.04	0.42
CD 5%	2.84	5.55	7.20	0.10	9.3	0.13	1.32
Interaction (I X V)							
I1V1	63.13	164.90	94.05	3.18	280	2.31	21.33
I1V2	64.35	163.22	103.97	3.01	252	1.92	20.69
I1V3	58.53	134.93	69.63	3.04	275	2.16	16.82
I1V4	64.72	132.25	75.76	2.84	259	1.84	17.77
I1V5	71.18	141.04	88.35	2.73	287	1.98	17.91
I1V6	57.17	124.90	76.93	2.89	212	1.52	19.89
I2V1	62.99	130.04	71.33	2.62	250	1.60	17.24
I2V2	63.91	135.27	85.10	2.53	232	1.31	17.53
I2V3	57.95	117.08	62.60	2.69	251	1.69	15.36
I2V4	64.29	109.35	72.37	2.56	231	1.45	12.76
I2V5	71.47	126.38	71.46	2.32	266	1.46	16.97
I2V6	56.74	106.12	82.63	2.66	206	1.38	16.26
S.Em±	0.10	2.93	5.03	0.07	7.5	0.09	0.64
CD 5%	0.397	10.19	21.73	0.24	28.6	0.36	2.58

NORTH CENTRAL ZONE

7. PUSA

Varieties had significant variation on growth, yield attributes, cane yield and most of the quality parameters of sugarcane. Higher growth and yield attributes were recorded under CoP 2061 except cane diameter and single cane weight (**Table AS 74.7.1**). Hence, CoP 2061 gave highest cane yield (91.6 t/ha) which was statistically comparable to CoP 16437 (85.0 t/ha) and CoP 9437 (81.3 t/ha). Though, higher brix, pol and juice recovery at 10 and 12 months stage were obtained from CoP 16437. Among irrigation regimes significantly higher plant population (156400/ha), plant height (303 cm), LAI (3.63), millable canes (107400/ha), single cane weight (960.8 g/plot) and cane yield (94.0 t/ha) were obtained with IW: CPE ratio 1.00. The number of irrigation was 4 & 1 at IW: CPE ratios 1.00 and 0.30, respectively. The total water applied on the basis of depth (7.5 cm) and number of irrigations was 30 and 7.5 cm at IW: CPE ratios of 1.00 & 0.30, respectively.

Summary: It can be concluded those sugarcane varieties, CoP 2061, CoP 16437 and CoP 9437 when irrigated at IW: CPE ratio 1.00 are better for higher productivity under Bihar condition.

Table AS 74.7.1: **Growth and yield performance of sugarcane varieties at varying irrigation regimes at Pusa**

Varieties	Plant population (× 10^3/ha)	Plant height (cm) at 240 DAP	Cane diameter (cm)	LAI	Millable canes (×10^3/ha)	Single cane weight (g)	Cane yield (t/ha)
CoP 16437	104.2	289	2.80	3.63	80.2	1069.5	85.0
CoP 112	118.5	287	2.48	2.95	88.7	770.5	67.5
BO 153	159.6	240	2.10	3.32	112.6	656.5	72.4
CoP 2061	194.9	293	2.28	3.70	130.2	712.5	91.6
BO 154	135.7	283	2.37	3.25	97.3	747.0	71.7
CoP 9437	123.8	263	2.56	3.05	92.5	881.5	81.3
SEm (±)	6.0	10.3	0.10	0.15	3.67	37.77	3.28
CD (P=0.05)	18.9	32.0	0.31	0.46	11.6	119.0	10.3
CV (%)	10.5	9.1	9.8	10.8	9.0	11.5	10.3
Irrigation regimes (IW/CPE)							
I_1 :1.00	156.4	303	2.48	3.63	107.4	960.8	94.0
I_2 : 0.30	122.5	248	2.38	3.00	93.1	704.7	62.5
SEm (±)	3.15	7.7	0.05	0.08	1.67	23.00	1.66
CD (P=0.05)	19.2	47.0	NS	0.46	10.1	40.0	10.1
CV (%)	9.6	11.8	8.5	9.62	7.1	12.1	9.0

Table AS 74.7.2: Influence of irrigation regimes and varieties on quality parameters at Pusa

Treatment	Brix (%)		Pol (%)		Purity (%)	
	10^{th} month	12^{th} month	10^{th}month	12^{th} month	10^{th} month	12^{th} month
Variety						
CoP 16437	20.72	21.47	18.20	18.77	87.87	87.42
CoP 112	20.25	20.68	17.88	18.23	88.28	88.12
BO 153	19.67	19.87	17.34	17.70	88.13	89.07

CoP 2061	19.05	19.42	16.64	16.97	87.33	87.35
BO 154	19.63	19.92	17.34	17.73	88.35	89.03
CoP 9437	20.17	20.25	17.89	18.03	88.78	89.05
SEm (±)	0.27	0.12	0.24	0.12	0.51	0.31
CD (P=0.05)	0.86	0.37	0.76	0.38	NS	0.98
CV (%)	3.36	1.40	3.38	1.63	1.42	0.86
Irrigation regimes (IW/CPE)						
I_1 : 1.00	20.09	20.44	17.73	18.05	88.27	88.31
I_2 : 0.30	19.74	20.09	17.37	17.76	87.98	88.37
SEm (±)	0.15	0.11	0.11	0.07	0.32	0.23
CD (P=0.05)	NS	NS	NS	NS	NS	NS
CV (%)	3.29	2.36	2.73	1.59	1.54	1.10

8. BETHUADHARI

The field experiment was planted on 16.3.2018 with early maturing(3): V1-CoLk 94184, V2 -CoSe 95422, V3 -BO 130 and mid – late maturing(3): V4 - BO 91, V5 -CoP 06436, V6 -CoP 9301 varieties for their performance at varying irrigation regimes. Moisture stress (IW:CPE 0.3) caused significant reduction in cane yield across the varieties (**Table AS 74.8.1**). Among the varieties CoLk 94184 performed best with highest yield (94.28 t/ha) followed by BO 91 (90.8 t/ha). These two varieties were found to be most resilient against moisture stress with least reduction in cane yield (**Table AS 74.8.2**).

Table AS 74.8.1: Influence of irrigation regimes and varieties on sugarcane yield and quality at Bethuadhari

Treatment	°Brix at 10 months	Brix at 12 months	Sucrose (%) 10 months	Sucrose (%) 12 months	Cane yield (t/ha)	CCS (%)	CCS (t/ha)
Irrigation schedule (IW/CPE)							
I_1	17.87	18.23	16.85	17.22	81.27	11.66	9.51
I_2	17.18	17.63	16.06	16.46	72.09	9.40	6.72
SEm(±)	-	0.22	-	0.44	2.12	0.59	0.77
CD at 5%	NS	0.65	NS	1.32	6.37	1.77	2.32
Varieties							
V_1	18.54	18.53	17.38	17.40	94.28	11.32	10.21
V_2	17.71	17.72	16.83	16.82	72.95	10.55	7.74
V_3	17.46	17.51	16.44	16.46	68.65	9.93	6.91
V_4	18.11	19.10	16.95	17.74	90.80	11.64	10.57
V_5	17.05	17.62	15.06	16.63	68.81	10.13	7.01
V_6	16.28	17.10	15.27	16.01	64.62	9.58	6.25
SEm(±)	-	0.36	-	0.35	3.22	0.35	0.32
CD(P=0.05)	NS	1.07	NS	1.05	9.65	1.05	1.87
CV	7.58	5.95	8.23	6.54	6.23	7.65	6.48
Interaction	NS	Sig	NS	Sig	Sig	NS	Sig

Table AS 74.8.2: **Effect of interaction between varieties and irrigation regimes on cane yield at Bethuadhari**

Treatments	Brix (%) 12 month		Sucrose (%) 12 month		Cane yield (t/ha)		CCS (t/ha)	
Varieties	Irrigation schedule(IW/CPE)							
	I_1	I_2	I_1	I_2	I_1	I_2	I_1	I_2
V_1	19.10	17.96	17.95	16.85	101.75	86.81	12.40	8.03
V_2	18.20	17.25	17.32	16.33	76.75	69.15	9.17	6.32
V_3	17.75	17.27	16.85	16.07	75.25	62.05	8.57	5.25
V_4	19.15	19.05	18.01	17.47	92.45	89.15	11.18	9.97
V_5	18.01	17.23	17.14	16.12	72.40	65.22	8.14	5.85
V_6	17.19	17.01	16.07	15.95	69.05	60.19	7.63	4.88
SEm(±)	0.34	0.37	0.18	0.32	5.38	3.65	0.42	0.65
CD(P=0.05)	1.01	1.12	0.53	0.95	16.15	10.95	1.25	1.95
	V X I	I X V	V X I	I X V	V X I	I X V	V X I	I X V

EAST COAST ZONE

9. NAYAGARH

The experiment was laid out on 4.1.2018 in strip plot design with three early maturing varieties (CoOr 03151, CoOr 03152, CoOr 05346) and three mid-late maturing varieties(CoOr 04151, CoOr 10346, Co 86249) with two irrigation regimes i.e. IW/CPE ratio 1.0 and IW/CPE ratio 0.3 to evaluate the drought tolerance capacity of the varieties. Among early maturing varieties, CoOr 03151 with IW/CPE ratio 0.3 recorded significantly different growth and yield parameters compared to other varieties CoOr 03152, CoOr 05346. Similarly among mid-late maturing varieties, CoOr 04151 with IW/CPE ratio 0.3 recorded significantly different growth and yield parameters compared to other varieties CoOr 10346, Co 86249. So this is possibly due to better drought tolerant capacity of these two varieties compared to other varieties (Table AS 74.9.1).

Table AS 74.9.1: Influence of irrigation regimes and varieties on growth and yield of sugarcane at Nayagarh

Treatments	Germination % at 45 DAP	No of tillers (000/ha) at 120 DAP	NMC (000/ha)	Cane yield (t/ha)	Juice Brix %	CCS %	CCS yield (t/ha)
Irrigation schedule							
I_1	53.05	85.86	88.15	100.28	21.30	12.10	12.13
I_2	51.40	75.57	77.44	87.74	21.29	11.86	10.40
Sem+	0.451	0.372	0.367	0.622	0.492	0.247	0.277
CD at 5 %	NS	2.261	2.231	3.783	NS	NS	1.686
Variety							
V_1	52.32	84.43	86.30	97.70	21.28	12.11	11.82
V_2	52.99	80.88	82.45	92.24	21.74	11.86	11.04
V_3	50.90	79.79	81.95	93.30	21.93	11.90	11.10
V_4	53.73	81.33	83.06	97.47	21.51	11.62	11.36
V_5	53.82	79.40	81.96	91.31	20.87	12.19	11.12
V_6	49.58	78.46	81.04	91.36	20.44	12.19	11.15
SEm+	1.37	1.061	0.974	1.072	0.508	0.204	0.227
CD at 5 %	NS	3.128	2.873	3.161	NS	NS	NS

Table AS 74.9.2: Influence of interaction between irrigation regimes and varieties on cane yield at Nayagarh

	V_1	V_2	V_3	V_4	V_5	V_6	**Mean**
I_1	103.58	99.65	99.74	103.79	98.20	96.74	100.28
I_2	91.82	86.23	86.85	91.15	84.43	85.98	87.74
	Irrigation	**Variety**	**I within V**	**V within I**			
Sem	0.622	1.072	1.517	1.516			
CD 5%	3.783	3.161	5.273	4.470			

Treatment	Relative Water content(Before irrigation)	Relative Water content(Before irrigation)	Specific leaf weight (g/cm^2)
Irrigation schedule			
I_1	90.00	91.511	0.418
I_2	76.186	83.71	0.385
Variety			
V_1	85.5	90.48	0.375
V_2	80.635	84.925	0.368
V_3	81.21	85.9	0.372
V_4	86.355	90.77	0.384
V_5	82.14	861	0.370
V_6	82.73	87.18	0.371

IMPORTANT OBSERVATIONS:

- Moisture stress during pre-monsoon growth phase brought about significant reduction in cane yield across all the zones. The loss in yield ranged within 20 to 35 % in different sugarcane growing zones.
- Sugarcane varieties found resilient against moisture stress in different sugarcane growing zones are:

Zone	**Early maturing**	**Mid-late maturing**
North West	CoPb 92, CoPk 05191, CoLk 94184	CoPb 94, Co 05011, CoLk 11206, CoSe 11453, CoH 119
Peninsular	SNK 088789	Co 86032
North central	CoP 16437, CoLk 94184	CoP 2061, BO 91
East coast	CoOr 03151	CoOr 04151

SUMMARY OF THE ACHIEVEMENTS FOR THE YEAR 2018-19

A look on advancements in sugarcane research, its production scenario and the transfer of technology to the stake holders during the recent past evinces encouraging trends and new challenges. On the research front development of new high yielding high sugar varieties supported with suitable production and protection technologies made sugar sector viable on one hand and left ample scope for diversification on the other. During the year 2018-19 as per the latest estimates sugar production is expected to touch an all-time high level of 33-35 million tonnes with record sugarcane production of more than 400 million tonnes produced from 5.43 million hectares. The largest sugarcane and sugar producing state of Uttar Pradesh is estimated to produce about 12 million tonnes of sugar by crushing comparatively less cane with a high recovery of 11.48%. The increased production and sugar recovery have provided scope for diverting sugarcane juice, B-heavy molasses and other substrates for the production of ethanol to be used as bio-fuel for automobiles. With the development of high biomass producing sugarcane cultivars it is required to develop suitable production technologies for enough anchorage to roots to hold the crop from lodging, enhanced water and nutrient use efficiency in view of price escalation of these resources, technologies for bringing in resilience against adverse impacts of climate change and micro and macro level crop and product diversification to enhance the income of sugarcane growers. For the year 2018-19 the trials under Crop Production discipline of AICRP on Sugarcane were designed and carried out to develop recommendations for addressing these issues. These were concentrated on aspects such as agronomic evaluation of promising genotypes for their performance potential under variable inter-row spacing and enhanced fertility level, integrated nutrient management schedule for sugarcane production system to ensure soil health and crop productivity, carbon sequestration potential of sugarcane based cropping systems impacting soil health, raising water productivity in sugarcane system through mulching and water application regimes and also to assess the water productivity and drought tolerance potential of newly released varieties of sugarcane. Most of the centres carried out these trials in the true research spirit and reported the results as per the prescribed format. However, Akola faced the constraints like scarcity of irrigation water and could not conduct the trials. A summary table showing no. of centres allotted, conducted and not conducted the stipulated experiments during 2018-19 is given in Appendix I. The experiment wise summary of the results are presented below:

AS 68: Impact of integrated application of organics and inorganics in improving soil health and sugarcane productivity

The trial initiated during the year 20104-15 with allotment to all the centres. However, during the year 2018-19 only 08 centres carried out the trial.

NORTH WEST ZONE

1. FARIDKOT

Ratoon cane yield (91.5 t/ha) was the highest with application of FYM/Compost @ 20 tonnes / ha + inorganic nutrient based on soil test (T6) which was significantly higher than all treatments except no organic + soil test based recommendation T3 (83.3 t/ha) and T5 (88.1 t/ha). These treatments also have the residual effect of FYM applied to plant crop. Same trend was there for CCS t/ha.

2. LUCKNOW

In the first ratoon crop the highest rate of sprouting (93.4%) was observed under the treatment of only organic matter application along with FYM. Highest number of tillers (180.2 thousand/ha at 120 days after planting), shoot count (175.6 thousand/ha at 180 DAP), number of millable canes (120.5 thousand/ha), cane yield (84.20 t/ha) and sugar yield (10.55 t/ha) were recorded under the treatment where application of FYM @ 20t/ha was done along with soil test (rating chart) based inorganic fertilizer recommendations.

3. SHAHJAHANPUR

Sugarcane ratoon with application of FYM @ 10 tonnes/ ha + bio-fertilizers (Azotobacter + PSB) + inorganic nutrients on soil test basis (NPK) produced significantly higher cane yield (99.20 t/ha) than that of other treatments.

4. UCHANI

FYM 20 t/ ha + 100% RDF through inorganic source (T6) and FYM @ 10 t/ ha + biofertilizer (Azotobacter/ Acetobacter + PSB) + soil test basis (T9) were found best and at par treatments in terms of number of tillers (18.4, 142.9 thousands/ha), millable canes (119.1, 116.5 thousands/ha) and ratoon cane yield (96.6, 94.0 t/ha) and sugar yield as compared to rest of the treatments.

PENINSULAR ZONE

5. SANKESHWAR

The yield and yield attributes recorded in first ratoon cane indicated significant differences among the treatments. Application of trash at 10 tonnes/ha along with soil test based nutrients application recorded highest cane yield (100.41 t/ha), number of millable canes (80680/ha) and CCS yield (13.65 t/ha).

EAST COAST ZONE

6. NAYAGARH

Results obtained from first ratoon crop indicated that application of FYM/Compost @ 10t/ha + (Azotobacter + PSB) +100% RDF (T8) and Application of FYM/Compost @ 10t/ha + Azotobacter + PSB + Soil test based (NPK) fertilizer application (T9) recorded higher percentage of germination at 45 DAR i.e. 43.70 and 46.89%, respectively. These treatments subsequently performed better than other treatment combinations leading to higher yield parameters and cane yield.

NORTH CENTRAL ZONE

7. SEORAHI

Sugarcane ratoon with application of FYM@ 10 t/ha + bio-fertilizers (Azotobacter + PSB) + soil test basis NPK application treatment produced significantly higher clump population (34.92 thousand/ha), NMC (107.54 thousand/ha) and cane yield (83.99 t/ha) as compared to other treatments except the treatment T8.

8. PUSA

Integrated application of nutrients was found effective in improving soil fertility and cane yield. The application of fertilizers on soil test basis along with organics @ 20

t/ha was found suitable for boosting cane yield and maintaining soil fertility in calcareous soils of Bihar.

IMPORTANT OBSERVATIONS:

The experiment was carried out at 08 stations out of allotted 24. Following salient points emerged from findings:

- Combined application of organic and inorganic sources of nutrients was found conspicuously better over the use of fertilizers alone across the centres located in different agro-climatic conditions.
- Sugarcane trash used as mulch in ratoon crops has little contribution as a source of nutrients as organic amendments like FYM or compost recorded significant improvement in cane and sugar yield over that with trash mulching under the use of recommended dose of fertilizers across the locations.
- Use of organic sources of nutrients in plant ratoon system brings about substantial enhancement of soil health parameters in most of the sugarcane growing soils.

AS 70: Scheduling irrigation with mulch under different sugarcane planting methods

The trial was initiated during 2016-17 and was allocated to all the centres. In all 11 centres carried out the trial as per common technical programme for the year. Centre wise summary of findings are given below.

NORTH WEST ZONE

1. FARIDKOT

Among the planting methods paired row trench planting with trash mulching recorded significantly higher cane yield(99.7 t/ha) than all othermethods of planting. Trash mulching resulted in significantly higher cane yield than without trash mulching irrespective of planting methods. Apparent water productivity (AWP) and Total water productivity (TWP) were significantly higher in paired row trench planting than conventional planting. Among irrigation schedules AWP decreased successively with increase in water input from 0.6 to 1.0 IW/CPE.

2. KOTA

Based on the three years of study, it can be concluded that paired row trench planting (30:120 cm row spacing) with organic mulching of sugarcane trash @ 6 t/ha was found better with respect to number of tillers, plant height, millable canes, cane yield, cane diameter, cane weight, brix, CCS yield (t/ha) and water use efficiency. However, irrigation water at IW: CPE ratio of 0.80 was found economical in sugarcane yield when compared with 0.60 and 1.00 IW: CPE ratios. Maximum WUE was recorded at IW: CPE ratio of 0.80 which was significantly higher over IW: CPE ratio of 1.00.Significant enhancement in economics with each successive increase in irrigation regimes from 0.60 to 0.80 IW: CPE ratio was proportionally more than the increase in irrigation water i.e. IW: CPE ratio of 1.00.

3. LUCKNOW

Paired-row trench planting (30:120cm row spacing) with trash mulching (75.19 t/ha) being at par with conventional flat method of planting along with trash mulching (74.22 t/ha) resulted in significantly higher cane yield than that of conventional flat method of planting with no trash mulching (63.42 t/ha). The trash application led to higher sugarcane yields, irrespective of irrigation scheduling. The higher cane yield (73.86 t/ha) under irrigation schedule at 0.8 IW: CPE might be attributed better initial crop growth, higher number of millable cane (92.27 x 000/ha) owing to optimum irrigation frequency with trash mulching at the time of crop establishment. Water use efficiency was found highest under paired-row trench planting with trash mulching (0.432 t/ha- cm) followed by conventional flat method of planting with trash mulching (0.427 t/ha-cm).

4. SHAHJAHANPUR

Paired row trench planting (120:30 cm row spacing) with organic mulch @ 6 t/ha produced higher cane yield (89.07 t/ha) and maximum water use efficiency (1090.20 kg/ha cm). Irrigation schedule at 1.00 IW/CPE ratio (I3) produced significantly higher cane yield (90.05 t/ha) with minimum water use efficiency (1050.25).

5. UCHANI

No significant differences in growth yield and yield attributing characters were observed among all the irrigation regimes due to frequent rains during pre-monsoon period. Sugarcane yield (95.2 t/ha) was significantly higher under paired-row trench planting with trash mulching than conventional flat method of planting along with trash mulching (82.2 t/ha) followed by paired-row trench planting with no mulching (88.6 t/ha) and conventional flat method of planting with no mulching (75.5 t/ha). Interaction between method of planting and irrigation levels was found non-significant. Highest yield of cane produced/1000 litres of irrigation (13.72 and 13.29 kg) water was recorded in paired row trench planting at 0.6 IW/CPE and 0.8 IW/CPE irrigation schedule with trash mulching.

PENINSULAR ZONE

6. MANDYA

Among the planting methods, 120 cm row spaced furrow planting with *dhaincha* green manure sown 30 DAP and mulching at 75 DAP recorded significantly higher cane yield (161.0 t/ha) as compared to others. However, it was at par with 120 cm row spaced furrow planting with alternate skip furrow irrigation after earthing up + *dhaincha* green manure mulching (155.2 t/ha). Among the irrigation schedules, IW/CPE ratio of 1.0 recorded significantly higher yield (170.8 t/ha) as compared to IW/CPE ratio of 0.60 (131.8 t/ha). Among the interactions, significantly higher cane yield was observed in P2I3 (180.5 t/ha). However, it was on par with P4I3 (170.6 t/ha) and P1I3 (168.1 t/ha). Scheduling of irrigation at IW/CPE ratio of 0.6 consumed lowest amount of irrigation water (1725mm) and saved 18% of irrigation water. While, the highest amount of irrigation water was consumed by IW/CPE ratio of 1.0 (2095 mm).

7. PUNE

The furrow planting of 120 cm spacing with sun hemp green manure mulching and irrigation schedule of 1.00 IW/CPE was found superior for cane yields, however it was at par with cane yield recorded in 120 cm row spaced furrow planting with alternate skip furrow irrigation after earthing up with sun hemp green manure mulching. The highest water use efficiency was recorded in furrow planting of 120 cm row spacing with alternate skip furrow irrigation after earthing up with sun hemp green manure mulching.

EAST COAST ZONE

8. NAYAGARH

Furrow planting (120 cm row spacing) with alternate skip furrow irrigation after earthing-up + brown mulching method produced higher NMC and cane yield of 90944/ha and 100.35 t/ha, respectively which is closely followed by furrow planting (120 cm row spacing) with brown mulching (NMC and cane yield 90919/ha and 99.906 t/ha, respectively). Irrigating the crop at IW/CPE ratio of 1.0 produced highest NMC and sugarcane yield of 91922/ha and 105.48 t/ha, respectively which is significantly different from irrigating the crop at IW/CPE ratio of 0.6 (NMC and cane yield 85558/ha and 92.19 t/ha, respectively). Planting method x irrigation schedule interaction was found not significant.

NORTH CENTRAL ZONE

9. PUSA

The highest plant population (216100/ha), cane length (333.7 cm), millable canes (143200/ha) and cane yield (104.5 t/ha) were noticed under paired row trench planting (30: 120 cm) with trash mulching @ 6 t/ha (P3) being statistically comparable to paired row trench planting (30: 120 cm) without trash mulching (P4). However, brix, pol and purity percent were found to be non-significant. The number of irrigation was 6, 5 and 3 at IW: CPE ratios 1.00, 0.80 and 0.60, respectively. The total water applied on the basis of depth (7.5 cm) and number of irrigations was 45, 37.5 and 22.5 cm at IW: CPE ratios of 1.00, 0.80 and 0.60, respectively

10. SEORAHI

Paired row trench planting (120:30 cm row spacing) with organic mulch @ 6t/ha gave significantly higher germination, shoot population, NMC and cane yield over conventional flat planting (75 cm row spacing) with organic mulch @ 6t/ha and conventional flat planting (75 cm row spacing) without mulch. Among different irrigation scheduling treatments IW/CPE ratio 1.0 gave significantly higher performance. Cane yield and sucrose per cent increased with increase in the IW/CPE ratio. Sucrose per cent was not affected significantly with different treatments of planting methods and irrigation schedules.

NORTH EASTERN ZONE

11. BETHUADHARI

Results indicated that the highest cane yield (103.09 t/ha) was obtained with the trench planting (30:120 cm row spacing) with organic mulching @ 6 t/ha followed by that of trench planting without mulching. Among irrigation scheduling treatments keeping IW: CP ratio one brought about highest cane yield (94.53 t/ha) significantly better over the other two IW: CP ratio. Interaction between planning methods and irrigation scheduling was found significant for cane yield being highest (115.32 t/ha) at IW: CP ratio 1.0 when planted in trenches with mulching.

Important Observations: The experiment was initiated during the year (2016-17) and was allotted to all the centres, however only 11 centres carried out the trial as per the technical programme. Salient findings are enumerated below:

- Planting of sugarcane in paired rows (120: 30) with mulching of trash (6 t/ha) in the inter-row spaces out yielded the conventional flat method with or without mulch at all the centres in north western, north central and north eastern zones. Being in the climatic region of high evaporative demand sugarcane crop responded up to 1.0 IW/CPE irrigation regime in the zones, however similar yields have been recorded with 0.8 IW/CPE ratio at many centres. Trash mulching could effectively save 20-26% irrigation water over no-mulching.
- Sugarcane crop in peninsular and east coast zones responded to furrow planting (120 cm) and skip furrow irrigation combined with the use of leguminous crop as green manure till 75 DAP, as a mulch during tillering and thereafter residue incorporation. As far irrigation regimes, IW/CPE ratio 1.0 was found to result in higher cane productivity, however it can be restricted to 0.8 for getting higher water use efficiency in these zones.
- Use of mulch in sub-tropical zones and green manuring followed by mulching and residue incorporation resulted in higher net return.

AS 71: Carbon sequestration assessment in sugarcane based cropping system

The trial was initiated during 2016-17 with allocation to all the centres. In all 08 centres conducted the trial during 2018-19 in accordance with the approved technical programme.

NORTH WEST ZONE

1. FARIDKOT

The highest cane equivalent yield of the system was obtained with sugarcane plant-ratoon- zero tilled wheat without Trichoderma inoculation (115.7 t/ha) followed by plant-ratoon –wheat with trash mulching in ratoon irrespective of Trichoderma inoculation (109.6 and 108.7 t/ha).

2. KOTA

Based on the three years study of soil properties, it can be concluded that Soybean-Wheat –Moong bean-wheat (residue retention with Trichoderma) (T2) treatment was found better with respect to significant enhancement in OC, infiltration rate, bulk density, WHC and Nutrient status of soil over T3 and T4 treatments.

Whereas, in case of ratoon of sugarcane different treatment was noted that with T6 treatment also significantly higher in respect germination, tillers, plant height, cane diameter, cane weight, cane yield as well as in cane quality parameters with rest of treatments. Similarly, wheat succeeding ratoon also recorded higher germination (84.378%), no. of tillers at 90 DAS (9.97 thousand /ha), grain yield (56.83 q/ha) and straw yield (84.67 q/ha) under T6 treatment, which was significantly higher over sugarcane- ratoon-moong/wheat cropping system. In case of soil properties and nutrients status of soil with T6 treatment was found superior over rest of sugarcane-ratoon- wheat/ moong cropping systems with or without Trichoderma and trash mulching & trash removal treatment, by recording organic carbon (0.52 %), WHC (47.07%), bulk density (1.44 Mg/m3), N (332 kg/ha), P (24.10 kg /ha) and K (324.33 kg /ha).

3. LUCKNOW

During the year 2018-19 it was found that Sugarcane - ratoon-wheat system recorded higher total soil organic carbon (0.45%) than the Rice-Wheat system (0.39%) at 0-30 cm depth as compared to initial SOC value of 0.32%. The mean SOC value improved 40.6% in Sugarcane -ratoon-wheat system than 21.8% in rice-wheat system from the initial SOC due to high addition of crop residua in the system. It further subsequently decreased in 30-60 cm depth. Mean available nutrient status in soil decreased as compared to initial status of soil. The conformity experiment was laid out in randomized block design with eight treatments and three replications under rice-wheat and sugarcane-ratoon-wheat systems with same objective to improve the total soil organic carbon build-up and sustain crop yields during 2018-19 with same technical programme.

4. UCHANI

Higher cane equivalent yield was recorded in sugarcane plant- ratoon-wheat cropping system as compared to rice- wheat cropping system. Highest cane equivalent yield of 115.4, 115.0 and 110.0 t/ha was recorded in treatment T7 (sugarcane – Ratoon-Wheat (ZT) without Trichoderma, T5 (sugarcane – Ratoon (trash mulch with Trichoderma) – Wheat) and T3 (sugarcane – Ratoon (trash mulch without Trichoderma) – Wheat). Physical properties of soil were adversely affected in treatment T1 and T2 after harvest of puddled transplanted rice. The bulk density increased from 1.63 (initial) to 1.72 g/cc after harvest of rice crop. The bulk density and WHC improved after rice residue retention in wheat crop through happy seeder machine in treatment T1 and T2. Sugarcane proved superior in maintaining soil physical properties in comparison to puddled transplanted rice- wheat rotation.

PENINSULAR ZONE

5. MANDYA

In the third year Cowpea was sown in T2 to T7 treatment and soybean-maize was grown in T1 treatment. The Cowpea yield was significantly higher in Sugarcane Ratoon – Cowpea (trash mulching with Trichoderma) (15.13 q/ha) but it was at par with sugarcane - ratoon- (trash mulching with Trichoderma) – Cowpea (15.01 q/ha). In soybean-maize treatment soybean yield was 16.3 q/ha and maize yield was 86.2 q/ha. The soil physico - chemical parameters were not influenced significantly as compared to initial values. However, the trash incorporation treatments recorded significant

improvement in soil physical and chemical properties as compare to trash burning / removal treatments. Soil chemical parameters viz., soil pH, EC, OC, BD and soil available N, P_2O_5 and K_2O content after the harvest of ratoon crop were not influenced significantly due to different cropping systems.

6. PUNE

The project is initiated to assess the carbon sequestration under different cropping sequences. The results concluded that the trash mulching with Trichoderma in ratoon crop improved cane yield by 8.9 t/ha as compared to mulching without Trichoderma whereas residue retention with Trichoderma in wheat recorded maximum grain yield (25.8 t/ha) in plant cane-Ratoon-Wheat cropping sequence..

EAST COAST ZONE

7. NAYAGARH

The ratoon crop with trash mulching with Trichoderma produced highest number of net millable canes (90700/ha), cane (94.14 t/ha) and CCS yield (11.34 t/ha). Total soil organic carbon was found to be better with treatment T5 (sugarcane – ratoon (trash mulching with Trichoderma) – cowpea) compared to other treatments. Highest cowpea yield (185.78 kg/ha) was obtained when cowpea was grown after trash incorporation through rotavator and Trichoderma incorporation before sowing of cowpea.

NORTH CENTRAL ZONE

8. PUSA

Data on growth, yield attributes, ratoon yield and quality of sugarcane and yield of rice, wheat system and organic carbon content on post-harvest soil indicated that none of treatments except straw yield of wheat could establish significant effect in improving the growth, yield, quality and organic carbon content. However, comparatively higher ratoon cane yield (82.0 t/ha) was obtained with sugarcane-ratoon-wheat (trash incorporation through rotavator and Trichoderma incorporation before sowing of wheat) (T6). Comparatively higher grain (3.73 and 3.91 t/ha) and straw yield (4.80 and 5.40 t/ha) of rice and wheat, respectively was obtained with rice-wheat-rice-wheat (residue retention with Trichoderma cropping system (T2).

IMPORTANT OBSERVATIONS:

- In the north-west zone use of sugarcane trash as mulch with or without Trichoderma inoculation in the ratoon crop resulted in highest sugarcane equivalent yield and brought about palpable improvement in soil health indicators.
- Trash mulching along with the use of Trichoderma in ratoon crop yielded in highest cane equivalent yield of the system comprising sugarcane- ratoon-cowpea/ greengram crops in peninsular and east-coast zones.
- For north central zone ratavator operation after ratoon harvest followed by spray of Trichoderma resulted in highest cane equivalent yield in sugarcane –ratoon – wheat cropping system.

AS-72: Agronomic performance of elite sugarcane genotypes

The trial was initiated during 2016-17 and was allotted to all the centres. During the year (2018-19) 12 centres reported the results. Centre wise summary of findings for the year 2017-18 are given below:

NORTH WEST ZONE

1. FARIDKOT

Among early genotypes cane yield was at par at 90 and 120 cm spacing. The number of shoots and millable canes were better at 90 cm spacing but single cane weight was better at 120 cm spacing. The highest cane yield was of CoPb 13181 (134.4 t/ha) followed by Co 5009 (110.6 t/ha). For mid-late genotypes cane yield was significantly better at 90 cm spacing than 120 cm spacing. The number of shoots and millable canes were better at 90 cm spacing. The highest cane yield was of CoH 13263 (141.6 t/ha) which was at par with CoPb 13182 (131.3 t/ha), Co 05011 (128.4 t/ha) and Co 13035 (125.1 t/ha).

2. KOTA

For early maturing genotypes at closer spacing (90 cm), genotype Co 13034 recorded significantly higher germination (49.13 %), single cane length (237.50 cm), cane yield (94.40t/ha), single cane weight (1070.00 gm) and number of millable canes (88.97 thousand/ ha). There was no significant effect of spacing. Mid-late maturing genotype Co 13035 recorded the highest cane yield significantly higher over rest of genotypes and zonal checks.

3. LUCKNOW

The shoot and NMC count for early genotypes were significantly lower at 120 cm spacing compared to 90 cm spacing in all the three genotypes. Significantly higher cane yield (104.0 t/ha) was reported in Co 0238 sown at 90 cm over CoS 13231 and CoJ 64. Further, the genotype CoS 13231 and Co 0238 gave significantly lower cane yield at 120 cm row spacing. Cane length, cane girth, cane weight were higher in Co 0238 than remaining two genotypes. Among mid-late genotypes CoLk 13204 gave highest cane yield (84.76 ton/ha) sown at 90 cm spacing followed by the same genotype sown at 120 cm spacing (68.49 ton/ha). The higher yield in CoLk 13204 was mainly attributed to its higher NMC/ha. Brix varied from 17.3 to 21.07 at 10 months stage and 18.87 to 20.72 at 12 months stage in different genotypes.

4. SHAHJAHANPUR

Early genotypes revealed that Co 0238 produced significantly higher cane yield (105.10 t/ha) followed by genotype CoS13231 (77.40 t/ha). Regarding spacing significantly higher cane yield (82.20 t/ha) was recorded with 90 cm row spacing than that of 120 cm (67.90 t/ha). CCS% in cane at harvest was found significantly higher in Co13034 (12.36) followed by Co0238 (12.03).Co13035 produced significantly higher cane yield (82.55 t/ha) at par with CoPant 13224 (82.00 t/ha) in mid–late group. Regarding spacing significantly higher cane yield were obtained in early and mid-late genotype at 90 cm row spacing.

5. UCHANI

Germination was not affected significantly due to different spacing. Significantly higher number of tillers, number of millable canes, cane yield and sugar yield were recorded at 90 cm spacing as compared to 120 cm spacing irrespective of the maturity group. Cane weight was significantly better at 120 cm as compared to 90 cm spacing. Among early maturing varieties, highest and lowest and cane yield was recorded in variety Co 0238 (85.8 t/ha) and CoS 13231 (68.7 t/ha), respectively. Among mid maturing entries, CoH 13263, CoLk 13204, Co 13035 and CoPant 13224 being at par recorded significantly highest cane yield. Interaction was not found significant.

PENINSULAR ZONE

6. PUNE

The results of the plant crop indicated that for the early genotypes tillering (1.02 & 1.26 lakh/ha) at 90 & 120 DAP, single cane weight (1.43 kg), cane yield (117.32 t/ha) and B:C ratio (1:2.55) was highest in Co11001.The mid-late genotype CoM 11085 performed better in tillering at 90 & 120 DAP (1.03 & 1.18 lakh/ha) and NMC (0.80 lakh/ha) while cane yield (129.20 t/ha), CCS yield (18.38 t/ha), B:C ratio (1:2.81) was higher in Co11012.Whereas, CoM11086 showed superior juice quality.

7. MANDYA

Among the genotypes, Co 12009 found superior with respect to cane yield (122.29 t/ha) as compared to others. But, was on par with CoM12085 (109.25 t/ha) and VSI 12121 (108.4 t/ha). This increased cane yield was due to enhanced yield parameters viz., single cane weight, cane length, cane girth, inter-nodal length, number of internodes and number of millable cane/ha. Quality parameters viz., sucrose % and CCS% did not vary significantly for the genotypes.

8. SANKESHWAR

There was significant difference among the early genotypes tested for yield and yield attributes. Significantly higher cane yield (92.11 t/ha) was recorded in Co 12007 on par with CoC 671(87.95 t/ha). The lowest cane yield (76.81 t/ha) was recorded in Co 12008. The lowest NMC was recorded in CoC 671(49,780/ha) and the highest was recorded in Co 12007 (68,140/ha). For mid-late genotypes significantly higher cane yield (121.43 t/ha) and CCS yield (15.18 t/ha) was recorded in Co 12009 and was on par with Co12012 (115.42 t/ha). The lowest cane yield (106.33 t/ha) was recorded in VSI 12121. The highest NMC (122280/ha) was recorded in Co 12009 and lowest NMC (57550/ha) was recorded in CoM 12085.

9. COIMBATORE

Cane yield differences were non-significant for two row spacing wherein planting sugarcane at 120 cm row spacing recorded higher cane yield (137.09 t/ha) than 150 cm row spacing (120.71 t/ha). In the plant crop the NMC (000/ha) showed significant difference due to varieties, wherein, promising early genotype Co 12012 (129460 NMC/ha) recorded significantly higher NMC than the check varieties Co 86032 (89670 NMC/ha) and CoC 671(76700 NMC/ha).Juice Brix, Sucrose (%), Purity (%) and CCS (%) at harvest showed significant varietal difference. In the plant crop CoC 671 recorded significantly highest mean brix of 22.37 than other elite sugarcane

genotypes. Amongst the 11 elite sugarcane genotypes VSI 12121 and Co 12012 was found more promising and recorded marginally higher CCS yield of 22.91 and 20.85 t/ha than the check entries CoC 671(20.41t/ha) and Co 86032 (18.59 t/ha).

EAST COAST ZONE

10. NAYAGARH

Findings suggested significant variations among the genotypes with respect to germination %, number of tillers at 180 days and number of millable canes ('000/ha). The genotype PI 14377 with 90 cm spacing produced the highest average cane yield of 106.54 t/ha with application of 125 % RD of fertilizer.

NORTH CENTRAL ZONE

11. PUSA

Performance of early genotypes indicates that 90 cm row spacing recorded significantly higher plant population (178800 /ha), millable canes (123700 /ha) and cane yield (101.3 t/ha). Though, marked variation in single cane weight (897.7 g/plant) was obtained due to 120 cm row spacing. Row spacing did not exert significant impact on sucrose content juice.125 % recommended dose of fertilizer significantly increased the plant population (171100 /ha), millable canes (116500 /ha), single cane weight (899.4 g/plant) and cane yield (100.1 t/ha). Though, sucrose content juice remained unaffected due to fertility levels.

12. SEORAHI

In the early group CoSe 13452 genotype obtained significantly higher germination per cent (43.24), shoot population (154.67 thousand per ha) and NMC (89.64 thousand per ha) over check i.e. CoSe 01421 but significantly more cane yield was recorded in this genotype over all the zonal checks. Cane yield of CoSe 13451genotype was recorded significantly higher as compared to zonal checks i.e. CoLk 94184 and CoSe 01421.Effect of row spacing on shoot population, NMC and cane yield was found significantly higher in the treatment of 90 cm row spacing.

IMPORTANT OBSERVATIONS:

Best performing genotypes across the centres located in different zones are listed herewith:

Sl. No.	Zone	Early genotypes	Mid-late genotypes	Spacing
1	**North Western**	Co 13034, CoPb 13181, CoS 13231	CoH 13263, Co 13035, CoLk 13204	At all the centres cane yield at 90 cm spacing was significantly superior over that of 120 cm.
2	**Peninsular**	Co 12009, Co 12012, CoM 12085, VSI 12121		Wider spacing was found to yield lower yield.
3	**East Coast**	No entries	PI 14377, CoC 13031	No variation in yield due to row spacing
4	**North Central**	CoSe 13451, CoP 13437, CoSe 13452	No entries	Significant yield improvement at closer spacing (90 cm).

AS- 73: Assessment of climate change impact on sugarcane productivity

The trial was initiated during 2018-19 and was allotted to the centres equipped with meteorological observatory. During the year only 03 centres reported. Centre wise summary of findings for the year are given below:

1. LUCKNOW

The long term (1956-2018) weather parameters viz. temperature (minimum and maximum), relative humidity (morning and afternoon), rainfall, evaporation, wind speed and bright sun shine hours were studies to assess the climate change impact on sugarcane productivity at ICAR- Indian Institute of Sugarcane research, Lucknow. The results revealed that all the studied weather parameters showed significant trend either increasing or decreasing at monthly, seasonal or on annual level. Rainfall is one of the important weather parameter which showed decreasing pattern at the rate of 28.97 mm decade^{-1}.

2. NAYAGARH

Nayagarh located in the east-coast zone experiences annual temperature ranging from 22.1 as minimum to 33.05 oC as maximum. The average annual rainfall for the last 21 years stand at 1576.2 mm with a variation from 1031 to 2129.9 mm showing wide inter-annual variability in the rainfall.

AS – 74: Evaluation of sugarcane varieties for drought tolerance

The trial was initiated during 2018-19 and was allotted to all the willing centres. During the year only 09 centres reported. Centre wise summary of findings for the year are given below:

NORTH WEST ZONE

1. FARIDKOT

Well-watered (I1) crop gave significantly higher cane yield than water stressed crop (I2). The yield reduction varied from 6.3 percent (CoPb 92) to 24.4 percent (CoPb 93). During the crop season there was about 462 mm rainfall and most of it was up to September.

2. KOTA

CoPk 05191 was found better with respect to number of tillers, plant height, millable canes, cane yield, brix, CCS yield (t/ha) resulting in significantly higher net return over other varieties under early maturing group and CoS 8436 variety in respect of germination, growth, juice extraction and quality parameters but in respect to cane length, cane diameter, cane yield Co 05011 performed best under mid-late group. The higher GR (239708.33 Rs/ha) and NR (131160.00 Rs/ha) and B:C ratio (2.21) recorded with CoPk 05191 in early maturing group and with Co 05011 in mid-late group with gross return (221833.33 Rs /ha), net return (113285.00 Rs /ha) and B:C ratio (2.04). The higher GR (234834.72Rs/ha) and NR (125138.06 Rs/ha) and B: C ratio (1:2.14)

was recorded with I1 (I/W CPE ratio 1.0) irrigation regime over I2 (I/W CPE ratio 0.3) irrigation regime.

3. LUCKNOW

Among the six varieties of sugarcane, CoPK 05191 produced highest NMC, cane length, cane girth, sugarcane yield, juice extraction percentage, CCS t/ha, which may be due to production of higher root dry weight, LAI and average cane weight. Minimum reduction in sugarcane yield (13.7%) due to moisture stress was found with CoPk 05191 followed by CoLk 11206 which was at par with CoLk 94184 (18.38%).

4. SHAHJAHANPUR

Genotype CoLk 94184 produced significantly higher cane yield (92.80t/ha) followed by CoSe 11453 with cane yield of 88.20 t/ha. IW/CPE ratio 1.0 recorded significantly higher cane yield of 85.75 t/ha.

5. UCHANI

No significant differences in terms of growth and yield were observed between 1.0 and 0.3 IW/CPE ratios due to frequent rains during pre-monsoon period. Variety CoH 119 (96.9 t/ha) in mid late and Co 0238(96.2 t/ha) in early group being at par produced significantly higher cane yield as compared to variety CoH 167 (90.5 t/ha), Co 0118 (88.4 t/ha), Co 5011 (91.6 t/ha) and CoH 160 (91.4 t/ha) and later four being at par with each other. Among early varieties Co 0238 (12.97 kg) and CoH 119 (12.99 kg) among mid late varieties produced the highest yield of cane produced/1000 litres of irrigation at irrigation schedule of 0.3 IW/CPE ratio. Total irrigation water applied during pre-monsoon season was calculated 22.5 and 15.0 cm at 1.0 and 0.3 IW/CPE schedule, respectively. Total (pre+ post monsoon) irrigation water of 82.5, and 75 cm was applied at 1.0 and 0.3 IW/CPE irrigation schedule, respectively. Total (Irrigation+ rainfall) water was calculated as 219.9 and 212.4 at 1.0 and 0.3 IW/CPE irrigation schedule, respectively.

PENINSULAR ZONE

6. SANKESHWAR

At IW/CPE ratio 0.3, genotypes SNK 09227 (mid-late) and SNK 088789 (early) performed better than rest of the genotypes.The cane yield differed significantly due to influence of irrigation regimes and genotypes. Among mid-late genotypes Co 86032 recorded significantly higher cane yield (157.47 t/ha) than SNK 09227 and SNK 09268. In early genotypes SNK 088789 recorded higher yield (133.71 t/ha) over SNK 07680 and CoC 671.

NORTH CENTRAL ZONE

7. PUSA

It can be concluded that sugarcane varieties, CoP 2061, CoP 16437 and CoP 9437 when irrigated at IW: CPE ratio 1.00 are better for higher productivity under Bihar condition.

8. BETHUADHARI

Moisture stress (IW: CPE 0.3) caused significant reduction in cane yield across the varieties. Among the varieties CoLk 94184 performed best with highest yield

(94.28 t/ha) followed by BO 91 (90.8 t/ha). These two varieties were found to be most resilient against moisture stress with least reduction in cane yield.

EAST COAST ZONE

9. NAYAGARH

Among early maturing varieties, CoOr 03151 with IW/CPE ratio 0.3 recorded significantly different growth and yield parameters compared to other varieties CoOr 03152, CoOr 05346. Similarly among mid-late maturing varieties, CoOr 04151 with IW/CPE ratio 0.3 recorded significantly different growth and yield parameters compared to other varieties CoOr 10346, Co 86249. So this is possibly due to better drought tolerant capacity of these two varieties compared to other varieties.

IMPORTANT OBSERVATIONS:

- Moisture stress during pre-monsoon growth phase brought about significant reduction in cane yield across all the zones. The loss in yield ranged within 20 to 35 % in different sugarcane growing zones.
- Sugarcane varieties found resilient against moisture stress in different sugarcane growing zones are:

Zone	Early maturing	Mid-late maturing
North West	CoPb 92, CoPk 05191, CoLk 94184	CoPb 94, Co 05011, CoLk 11206, CoSe 11453, CoH 119
Peninsular	SNK 088789	Co 86032
North central	CoP 16437, CoLk 94184	CoP 2061, BO 91
East coast	CoOr 03151	CoOr 04151

COMMENTS

- Most of the participating centres have reported the results and other required information like initial soil fertility level, date of planting and harvest and weather conditions as per the suggested format. This need to be regularly followed and may be made more systematic.
- Use of organics in nutrient management schedule for sugarcane has shown its potential as reflected from the results obtained under the trial AS 68 for plant – ratoon system. Addition of 20 t/ha FYM/ compost along with inorganic fertilizers applied on the basis of soil test, soil test crop response for targeted yield or on the basis of general recommendation for the region has shown positive effect on sugarcane growth and yield both in plant and ratoon crops. Response of bio-fertilizers (*Azotobacter*/ *Acetobacter*/ *Azospirillum*/ PSB) was more pronounced in peninsular zone.
- Planting of sugarcane in paired rows (120: 30) with mulching of trash (6 t/ha) in the inter-row spaces out yielded the conventional flat method with or without mulch at all the centres in north western, north central and north eastern zones. Being in the climatic region of high evaporative demand sugarcane crop responded up to 1.0 IW/CPE irrigation regime in the zones, however similar

yields have been recorded with 0.8 IW/CPE ratio at many centres. Trash mulching could effectively save 20-26% irrigation water over no-mulching.

- Sugarcane crop in peninsular and east coast zones responded to furrow planting (120 cm) and skip furrow irrigation combined with the use of leguminous crop as green manure till 75 DAP, as a mulch during tillering and thereafter residue incorporation. As far irrigation regimes, IW/CPE ratio 1.0 was found to result in higher cane productivity, however it can be restricted to 0.8 for getting higher water use efficiency in these zones.
- Use of mulch in sub-tropical zones and green manuring followed by mulching and residue incorporation resulted in tropical zones resulted in higher net return.
- Evaluation of AVT genotypes at wider row distance and high fertility levels showed significant loss of yield at wider planting across all the zones. Wider row distance however, helped enhancing single cane weight at many stations.
- Long term weather data (provided by 03 centres only) indicated continuous reduction in rainfall in the north- west zone combined with conspicuous rise in minimum temperature.
- Water efficient varieties belonging to early and mid-late maturity groups were identified for different zones.
- All the centres are requested to give meaningful summary of different trials by making it more informative and true representative of the findings.

SUGGESTIONS

- The crop performance, in general, must be given in light of prevailing climatic condition particularly with reference to sucrose content & flowering behaviour.
- The treatments as decided should not be modified/ deleted.
- One or two pages of research highlights of all the experiments conducted at the centre must be enclosed with the annual report.
- Summary must be clear, to the point and self-explanatory.

ACKNOWLEDGEMENT

The hard work, sincerity and scientific rigour on the part of investigators at respective centres in implementation of different trials included in this report are acknowledged and put on record that without the same it was not possible to come out with the findings having country wide applicability. All round support and guidance received from Project Coordinator is duly acknowledged. Facilities and official provisions extended by Director, Indian Institute of Sugarcane Research, Lucknow for effective and timely implementation of various trials are sincerely recorded and acknowledged. The group humbly record its indebtedness to Indian Council of Agricultural Research, New Delhi for providing all required facilities, manpower and guidance in the course of implementation of the programme.

Annexure I

Details of Experiments allotted to and conducted by different Centres during 2018-19

Sl. No.	Centre	Experiment allotted						Experiments conducted					
1	Faridkot*	AS 68	AS70	AS71	AS72	AS73	AS74	AS68	AS70	AS71	AS72	AS73	AS74
2	Kota*	AS68	AS70	AS71	AS72	AS73	AS74	-	AS70	AS71	AS72	-	AS74
3	Lucknow	AS68	AS70	AS71	AS72	AS73	AS74	AS68	AS70	AS71	AS72	AS73	AS74
4	Kapurthala	AS68	AS70	AS71	AS72	AS73	AS74	-	-	-	-	-	-
5	Pantnagar	AS68	AS70	AS71	AS72	AS73	AS74	-	-	-	-	-	-
6	Shahjahanpur	AS68	AS70	AS71	AS72	AS73	AS74	AS68	AS70	-	AS72	-	AS74
7	Sriganganagar	AS68	AS70	AS71	AS72	AS73	AS74	-	-	-	-	-	-
8	Uchani	AS68	AS70	AS71	AS72	AS73	AS74	AS68	AS70	AS71	AS72	-	AS74
9	Akola	AS68	AS70	AS71	AS72	AS73	AS74	-	-	-	-	-	-
10	Coimbatore	AS68	AS70	AS71	AS72	AS73	AS74	-	-	-	AS72	-	-
11	Kolhapur	AS68	AS70	AS71	AS72	AS73	AS74	-	-	-	-	-	-
12	Mandya	AS68	AS70	AS71	AS72	AS73	AS74	-	AS70	AS71	AS72	-	-
13	Navsari	AS68	AS70	AS71	AS72	AS73	AS74	-	-	-	-	-	-
14	Padegaon	AS68	AS70	AS71	AS72	AS73	AS74	-	-	-	-	-	-
15	Powarkheda	AS68	AS70	AS71	AS72	AS73	AS74	-	-	-	-	-	-
16	Pune	AS68	AS70	AS71	AS72	AS73	AS74	-	AS70	AS71	AS72	-	-
17	Sankeshwar	AS68	AS70	AS71	AS72	AS73	AS74	AS68	-	-	AS72	-	AS74
18	Thiruvalla	AS68	AS70	AS71	AS72	AS73	AS74	-	-	-	-	-	-
19	Anakapalle	AS68	AS70	AS71	AS72	AS73	AS74	-	-	-	-	-	-
20	Cuddalore	AS68	AS70	AS71	AS72	AS73	AS74	-	-	-	-	-	-
21	Nayagarh	AS68	AS70	AS71	AS72	AS73	AS74	AS68	AS70	AS71	AS72	AS73	AS74
22	Pusa	AS68	AS70	AS71	AS72	AS73	AS74	AS68	AS70	AS71	AS72	-	AS74
23	Seorahi	AS68	AS70	AS71	AS72	AS73	AS74	AS68	AS70	-	AS72	-	-
24	Bethuadhari*	AS68	AS70	AS71	AS72	AS73	AS74	-	AS70	-	-	-	AS74
25	Buralikson	AS68	AS70	AS71	AS72	AS73	AS74	-	-	-	-	-	-