

ALL INDIA COORDINATED RESEARCH PROJECT ON SUGARCANE AGRONOMY

ANNUAL REPORT

2016-17



DEPARTMENT OF AGRONOMY

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TECHNICAL REPORT

The following experiments related to Sugarcane Agronomy were allotted to the Pantnagar centre during 2016-17

S. No.	Experiment	Title
1.	AS-68 (a)	Impact of integrated application of organics and inorganics in improving soil health and sugarcane productivity (Plant cane spring).
2.	AS-68 (b)	Impact of integrated application of organics and inorganics in improving soil health and sugarcane productivity in ratoon II (Planted cane spring during 2014-15).
3.	AS-68 (c)	Impact of integrated application of organics and inorganics in improving soil health and sugarcane productivity in ratoon I (Planted cane spring 2015-16).
4.	AS-69	Use of plant growth regulators (PGRs) for enhanced yield and quality of sugarcane.
5.	AS-70	Scheduling irrigation with mulch under different sugarcane planting methods
6.	AS-71	Carbon sequestration assessment in sugarcane based cropping system
7.	AS-72 (a)	Agronomic performance of elite sugarcane genotypes (early maturing genotypes)
8.	AS-72 (b)	Agronomic performance of elite sugarcane genotypes (mid late maturing genotypes)

As per technical programme, all above experiments were conducted at the Norman E. Borlaug Crop Research Center of G.B. Pant University of Agriculture & Technology, Pantnagar during 2016-17. Pantnagar is situated at 29° N latitude and 79° E longitude and at an altitude of 243.8 m above the mean sea level in the foot hills of Himalayas (Shivalik Range) in *Tarai* region. The *Tarai* belt enjoys sub-humid tropical climate with hot summers and cold winter with minimum temperature in the range of 6.5 °C during 2016 in December (**Appendix-I**). Total rainfall received 2430.9 mm from March, 2016 to Feb., 2017. Maximum relative humidity ranges from 61.3% in May, 2016 to 95% in December, 2016. Sunshine period was 2.9 hrs/day in June/July, 2016 and 11.1 hrs/day in May, 2016 (**Appendix-I**). The physio-chemical properties of the experimental soil are given in (**Appendix-II**). The experimental soil was silty loam in texture, rich in organic carbon (1.05%), medium in available phosphorus (48.5- 49.0 kg P₂O₅/ha) and potassium (238- 242 kg K₂O/ha) with soil pH 7.4 to 7.6. Details of the experiment are given experiment wise separately.

PROJECT NO. AS-68 (a)

Title : Impact of integrated application of organics and inorganics in improving soil health and sugarcane productivity (Planted cane spring) (2016-17).

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

Year of start : 2014-15

Experiment under report : 2016-2017

Experimental site : N. E. Borlaug Crop Research Center of G.B. Pant University of Agriculture & Technology, Pantnagar

Cropping system : Sugarcane- Ratoon I- Ratoon II

Treatment details (Table 1)

Treatments	Sugarcane (plant crop)	Ratoon-I	Ratoon-II
T ₁	No organic + 50% RDF	Application of trash at 10 tonnes /ha + 50 % RDF	Application of trash at 10 tonnes /ha + 50 % RDF
T ₂	No organic + 100% RDF	Application of trash at 10 tonnes /ha + 100 % RDF	Application of trash at 10 tonnes /ha + 100 % RDF
T ₃	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)
T ₄	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)
T ₅	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)
T ₆	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)
T ₇	Application of FYM /compost @ 10 tonnes /ha + biofertilizer (<i>Azotobacter</i> / <i>Acetobacter</i> + <i>PSB</i>) + 50 % RDF	Application of FYM/Compost @ 10 tonnes/ha + biofertilizer (<i>Azotobacter</i> / <i>Acetobacter</i> + <i>PSB</i>) + 50 % RDF	Application of FYM /Compost @ 10 tonnes/ha + biofertilizer (<i>Azotobacter</i> <i>Acetobacter</i> + <i>PSB</i>) + 50% RDF
T ₈	Application of FYM/Compost @ 10 tonnes /ha + biofertilizer (<i>Azotobacter</i> / <i>Acetobacter</i> + <i>PSB</i>) + 100 % RDF	Application of FYM/Compost @ 10 tonnes/ha + biofertilizer (<i>Azotobacter</i> / <i>Acetobacter</i> + <i>PSB</i>) + 100 % RDF	Application of FYM/compost @ 10 tonnes/ha + biofertilizer (<i>Azotobacter</i> / <i>Acetobacter</i> + <i>PSB</i>) + 100 % RDF
T ₉	Application of FYM/Compost @ 10 tonnes /ha + biofertilizer (<i>Azotobacter</i> / <i>Acetobacter</i> + <i>PSB</i>) + soil test basis	Application of FYM/Compost @ 10 tonnes/ha + biofertilizer (<i>Azotobacter</i> / <i>Acetobacter</i> + <i>PSB</i>) + soil test basis (NPK application)	Application of FYM/Compost @ 10 tonnes/ha + biofertilizer (<i>Azotobacter</i> / <i>Acetobacter</i> + <i>PSB</i>) + soil test basis (NPK application)

Experimental details:-

Sugarcane variety	:	Co Pant 5224
Design	:	Randomized block design
Replications	:	3 (Three)
Treatment	:	9
Gross plot size	:	3.75 x 8.0 m= 30.0 m ²
Net plot size	:	2.25 x 8.0 m= 18.0 m ²
Spacing	:	75 cm
Planting date	:	19.2.2016
Harvesting date	:	10.2.2017

Sugarcane setts (3 budded) of variety Co Pant 5224 were planted in flat bed method after treated with carbendazin solution of 0.25% for 10 minutes to avoid fungal infection if any on Feb, 19, 2016. Soil of the experimental plots was silty clay loam, neutral in pH (7.6) and high in organic carbon (1.005%). Treatments were given as per technical programme. Recommended dose of fertilizer N, P and K were given 120:60: 40 kg/ha. Half of the N + full dose of phosphorus and potash were given as basal and remaining half of the N was given in two splits before onset of monsoon (last of the June). Crop was harvested on 10.2.2017.

Results:-

Germination% was recorded highest at 45 DAP in the treatment T₆- FYM@20t/ha + inorganic nutrient application based on soil test (rating chart) which was found significantly higher over rest of the treatments except T₄, T₅ and T₈. Highest cane yield (80.3 t/ha) was recorded in T₆ which was found significantly superior over rest of the treatments except T₅- FYM @20t/ha + 100% RDF (inorganic source). Higher yield in these treatments was the results of higher shoots, higher NMC, cane girth, cane length. Cane weight (individual cane) was similar in T₅ and T₆. Highest CCS yield (9.5 t/ha) was also recorded in the treatment T₆ which was at par to T₅. Higher CCS yield in these treatments was the result of higher cane yield and available sugar%. Lowest cane yield (67.0 t/ha) was recorded in T₁ (No organic + 50% RDF. However, cane yield was increased in rest of the treatments having different combinations of organic + inorganic or biofertilizer (Table 1).

Soil fertility:-

Higher organic carbon (1.101%) was recorded in the treatment T₆- FYM 20 t/ha + inorganic nutrient application based on soil test (rating chart) which was found significantly higher over those treatments in which organic matter (FYM/compost) or biofertilizers were not added (T₁, T₂ and T₃) over organic matter applied. Organic carbon% was lower in the treatments in which recommended dose of fertilizer

(120:60:40 kg NPK/ha were added). Availability of N, P, K, S, Zn, Mn and Fe was also improved in the treatment T₆ followed by the treatment T₄, T₅, which were significantly higher over rest of the treatments.

Uptake of nutrients (N, P and K) by the crop was also influenced by the application of FYM 20 t/ha + NPK applied as per soil test(chart) and found significantly higher over rest of the treatments except T₅. Initial values for organic carbon, available N, P, K and S were 1.005%, 221.6, 40.2, 224.7, 42.4 kg/ha. Available Zn, Mn and Fe were 1.75, 35.8 and 30.6 mg/kg soil (Table 2).

Summary:-

On the basis of the experimental results it was observed that highest cane yield (80.3 t/ha) was recorded from the treatment T₆- FYM 20 t/ha + inorganic nutrients N, P and K as per soil test (rating chart). The cane yield in treatment T₆ was recorded significantly higher over rest of the treatments except T₅- FYM 20 t/ha + R.D.F (100%). Higher cane yield in T₆ and T₅ was the result of good growth (shoot population), higher NMC, cane weight. Higher CCS yield 9.5 t/ha was recorded due to higher cane yield and higher sucrose % in these treatments.

Organic carbon % and availability of nutrients N, P, K, S, Zn, Mn and Fe was also increased in those treatments in which FYM was added. Some response of bio-fertilizer was also observed in improving the organic carbon and availability of nutrients N, P, K, S, Zn, Mn and Fe. Uptake of these nutrients was also improved in T₅ and T₆ (FYM + RDF inorganic 120:60:40 kg/ha) or application of nutrients on the basis of soil test.

Table:1 Growth, cane yield and juice quality of spring planted sugarcane influenced by various treatments of integrated nutrient management (Sugarcane planted spring 2016-17)

Treatments	Germination %		Shoot population (000/ha)				Shoot height (cm)	Cane yield (t/ha)	Millable cane (000/ha)	Cane girth (cm)	Cane length (cm)	Per cane weight (g)	Sucrose % at harvest	Available sugar (%)	CCS (t/ha)
	30 DAP	45 DAP	90 DAP	120 DAP	150 DAP	180 DAP	240 DAP								
T ₁ -No organic + 50% RDF	24.6	33.2	141.0	146.3	150.3	139.0	327.3	67.0	75.2	8.2	382.3	850.0	14.9	9.1	6.1
T ₂ -No organic + 100% RDF	26.8	33.5	147.0	152.0	156.3	146.3	331.0	75.7	75.7	8.3	387.7	860.0	15.2	9.3	6.4
T ₃ -No organic + soil test based recommendation	27.4	33.8	150.7	156.0	159.0	147.3	336.2	73.6	77.4	8.3	391.0	865.0	15.5	9.6	6.9
T ₄ -Application of FYM/Compost @ 20 tonnes /ha + 50 % RDF (inorganic source)	33.5	36.0	171.0	175.0	180.7	172.7	345.5	73.0	81.2	8.8	415.3	1080.0	17.3	11.3	3.2
T ₅ -Application of FYM /Compost @ 20 tonnes/ha + 100 % RDF (inorganic source)	36.3	37.2	188.3	193.3	198.3	189.7	353.6	79.6	84.4	9.5	438.7	1290.0	17.8	11.6	9.3
T ₆ -Application of FYM /Compost @ 20 tonnes/ha + inorganic nutrient application based on soil test (rating chart)	36.7	37.5	193.3	198.3	203.3	195.0	355.0	80.3	85.0	9.7	445.0	1290.0	18.0	11.8	9.5
T ₇ -Application of FYM /compost @ 10 tonnes /ha + biofertilizer (<i>Azotobacter/ Acetobacter</i> + <i>PSB</i>) + 50 % RDF	31.2	34.7	153.7	159.7	163.7	153.3	338.8	71.8	79.3	8.5	398.3	870.0	16.8	10.9	7.8
T ₈ -Application of FYM/Compost @ 10 tonnes /ha + biofertilizer (<i>Azotobacter/ Acetobacter</i> + <i>PSB</i>) + 100 % RDF	35.3	36.8	175.0	178.3	183.3	174.3	348.7	75.7	81.9	9.1	422.7	1100.0	17.5	11.5	8.4
T ₉ -Application of FYM/Compost @ 10 tonnes /ha + biofertilizer (<i>Azotobacter/ Acetobacter</i> + <i>PSB</i>) + soil test basis	31.6	35.3	168.7	173.7	178.0	166.7	341.3	76.7	80.0	8.6	406.3	950.0	17.0	11.0	8.3
SEm±	0.8	0.7	4.5	2.4	2.3	3.8	2.9	0.6	0.4	0.3	3.8	48.5	0.5	0.2	0.8
CD at 5 %	2.4	2.1	13.5	7.3	6.8	11.4	8.6	1.9	1.2	0.9	11.3	150.0	1.6	0.7	0.25

R.D.F:-120:60:40 kg NPK/ha

Table:2 Availability of different nutrients in soil after harvesting of sugarcane influenced by various treatments (Planted cane 2016-17)

Treatments	Nutrient uptake (kg/ha)			Organic carbon (%)	Avail. N (kg/ha)	Avail. P (kg/ha)	Avail. K (kg/ha)	Avail. S (kg/ha)	Avail. Zn (mg/kg)	Avail. Mn (mg/kg)	Avail. Fe (mg/kg)
	N	P	K								
T ₁ -No organic + 50% RDF	156.2	22.3	215.4	0.915	215.3	37.3	212.3	38.3	0.77	32.2	24.9
T ₂ -No organic + 100% RDF	170.4	24.77	222.3	0.918	218.7	38.6	217.4	39.4	0.81	32.5	25.0
T ₃ -No organic + soil test based recommendation	175.5	25.1	228.0	0.920	220.3	40.0	219.7	40.2	0.82	33.0	25.1
T ₄ -Application of FYM/Compost @ 20 tonnes /ha + 50 % RDF (inorganic source)	207.8	30.68	284.5	1.093	245.0	46.0	246.8	45.5	0.96	34.5	26.8
T ₅ -Application of FYM /Compost @ 20 tonnes/ha + 100 % RDF (inorganic source)	215.3	32.05	293.7	1.099	249.1	46.4	248.4	46.6	1.12	34.7	27.1
T ₆ -Application of FYM /Compost @ 20 tonnes/ha + in organic nutrient application based on soil test (rating chart)	220.7	32.54	295.6	1.101	250.4	46.8	249.5	47.0	1.18	34.8	27.5
T ₇ -Application of FYM /compost @ 10 tonnes /ha + biofertilizer (<i>Azotobacter Acetobacter</i> + <i>PSB</i>) + 50 % RDF	190.0	27.62	261.3	1.056	238.8	44.3	242.7	42.2	0.85	33.8	26.3
T ₈ -Application of FYM/Compost @ 10 tonnes /ha + biofertilizer (<i>Azotobacter/ Acetobacter</i> + <i>PSB</i>) + 100 % RDF	198.3	28.92	276.4	1.073	240.0	45.2	245.0	44.3	0.88	34.0	26.4
T ₉ -Application of FYM/Compost @ 10 tonnes /ha + biofertilizer (<i>Azotobacter/ Acetobacter</i> + <i>PSB</i>) + soil test basis	200.7	29.46	273.0	1.084	242.7	45.5	245.7	44.7	0.90	34.1	26.6
SEm±	3.1	1.2	3.8	0.004	2.0	0.8	1.7	1.3	0.02	0.3	0.3
CD at 5 %	9.4	3.7	11.4	0.011	6.1	2.3	5.0	3.9	0.07	1.0	1.0
Initial values				1.005	221.6	40.2	224.7	42.4	1.75	35.8	30.6

PROJECT NO. AS-68 (b)

Title : Impact of integrated application of organics and inorganics in improving soil health and sugarcane productivity in ratoon II (Planted cane spring during 2014-15).

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

Year of start : 2014-15

Experiment under report : 2016-2017

Experimental site : N. E. Borlaug Crop Research Center of G.B. Pant University of Agriculture & Technology, Pantnagar

Cropping system : Sugarcane- Ratoon I- Ratoon II

Treatment details (Table 1)

Treatments	Ratoon-II
T₁	Application of trash at 10 tonnes /ha + 50 % RDF
T₂	Application of trash at 10 tonnes /ha + 100 % RDF
T₃	Application of trash at 10 tonnes /ha + soil test basis (NPK application)
T₄	Application of FYM/ Compost @ 20 tonnes/ha + 50 % RDF (inorganic source)
T₅	Application of FYM /Compost @ 20 tonnes/ha + 100 % RDF (inorganic source)
T₆	Application of FYM /Compost @ 20 tonnes/ha + in organic nutrient application based on soil test (NPK application)
T₇	Application of FYM /Compost @ 10 tonnes/ha + biofertilizer (<i>Azotobacter Acetobacter</i> + <i>PSB</i>) + 50% RDF
T₈	Application of FYM/compost @ 10 tonnes/ha + biofertilizer (<i>Azotobacter /Acetobacter</i> + <i>PSB</i>) + 100 % RDF
T₉	Application of FYM/Compost @ 10 tonnes/ha + biofertilizer (<i>Azotobacter/Acetobacter</i> + <i>PSB</i>) + soil test basis (NPK application)

(b) Sugarcane Ratoon II (Planted cane 2014-15)

Experiment details:

Design : R.B.D

Variety : Co Pant 5224

Ratoon I : Planted cane 2014-15

Ratoon II : Planted cane 2014-15 and Ratoon II initiation initiation of Ratoon I

Treatment	:	09 (as mentioned in Table 1)
Replication	:	3
Date of ratooning	:	10.02.2016
Date of harvesting	:	22.12.2017
Plot Size	:	8.0 m x 3.75 m = 30 m ²

Ratoon II was initiated after harvesting of Ist ratoon (of planted cane 2014-15) on 10.02.2016. Sugarcane variety Co Pant 5224 was planted during 2014-15 in flat planting having 75 cm row spacing. Ratoon crop was raised as per recommended package and practices. Ratoon II was harvested on 22.12.2017.

Results:-

Cane yield was varied in different treatments and was recorded highest (54.69 t/ha) in Treatment 6- FYM @20 t/ha + soil based test of NPK/ha) which was significantly higher over rest of the treatments. Lowest cane yield was recorded (36.21 t/ha) in T₁- 50% R.D.F + 10 t trash. Higher cane yield in the treatment T₆ was the result of higher NMC (68.5, 000/ha), higher cane girth, length and weight of individual cane (880 g/cane). However, shoot population was highest (95,000/ha) in the Treatment 5 (FYM 20 t/ha + 100% RDF by inorganic source), though the number of clumps were almost similar in T₅ and T₆.

Commercial cane yield (CCS yield t/ha) was highest in the treatment T₅- FYM@ 20t/ha + 100% R.D.F. (inorganic sources) which was significantly higher over rest of the treatments (Table 3).

Uptake by crop:-

Uptake of N by sugarcane ratoon was highest (109.3 kg N/ha) in the Treatment T₅- FYM@20t/ha + 100% RDF (inorganic source) and uptake was significantly higher over rest of the treatments. Uptake of N was lowest in T₁-trash 10 t/ha + 50% RDF). Uptake of P was also higher in T₅ which was significantly higher over rest of the treatments except T₄ and T₆. However the uptake of K was higher in the treatment T₅ which was significantly higher over rest of the treatments except T₆. Uptake of N, P and K was lowest in T₁-Trash 10 t/ha + 50% R.D.F. (Table 4).

Soil health:-

Organic carbon in soil was recorded highest (1.06%) in the treatment T₆- FYM 20 t/ha + inorganic nutrients on soil test base which was significantly higher over rest of the treatment except T₄ and T₅. Organic carbon was lowest in T₁- 10 t trash + 50% R.D.F. However, organic carbon % was increased in all the treatments. Organic carbon was increased more in those plots in

which FYM was applied along with 100% RDF. Availability of N and P was more in the treatment T₆ whereas Potassium, Zn, Fe, Mn, S were more in T₅.

Summary:-

In Ratoon II highest cane yield (54.69 t/ha) was recorded in T₆- FYM@20t/ha + inorganic fertilizer on soil test based. Millable cane, cane girth, cane length and weight of individual cane were also higher in T₆. Commercial cane sugar was higher in T₅ which was significantly higher over rest of the treatments.

Uptake of N, P and K was higher in T₅. Phosphorus uptake was non-significant in T₄, T₅ and T₆. Whereas Potassium uptake was non-significant between T₅ and T₆.

Highest organic carbon 1.06% was recorded in T₆ followed by T₄ and T₅ (non-significant). Available N was highest in T₆ which was higher over rest of the treatments except T₄, T₅ and T₈. Potassium availability was higher in T₆ which was on par to T₄, T₅, T₈ and T₉. Lowest availability of N, P and K was recorded in T₁ (Table 4).

Table:3 Growth and cane yield of ratoon II influenced by integrated nutrient management (IInd ratoon of cane planted 2014-15)

Treatments	Clumps (000/ha)	Shoot population (000/ha)			Cane yield (t/ha)	Millable canes (000/ha)	Cane girth at harvest (cm)	Cane length (cm)	Per cane weight (g)	Sucrose % at harvest	CCS (t/ha)
		60 DAR	90 DAR	120 DAR							
T ₁ - Application of trash at 10 tonnes /ha + 50 % RDF	23.7	67.3	71.7	72.3	36.21	56.0	7.7	311.7	720.0	17.7	7.6
T ₂ - Application of trash at 10 tonnes /ha + 100 % RDF	24.3	69.7	72.7	75.0	41.33	59.7	7.8	338.0	733.3	19.1	7.8
T ₃ - Application of trash at 10 tonnes /ha + soil test basis (NPK application)	25.0	71.0	73.0	77.3	42.0	61.6	8.3	356.7	800.0	19.3	7.8
T ₄ - Application of FYM/ Compost @ 20 tonnes/ha + 50 % RDF (inorganic source)	27.0	76.0	80.0	89.0	48.03	67.6	9.2	374.0	833.3	20.5	8.1
T ₅ - Application of FYM /Compost @ 20 tonnes/ha + 100 % RDF (inorganic source)	28.7	77.7	83.0	95.0	50.4	68.5	9.3	374.7	880.0	20.5	8.8
T ₆ - Application of FYM /Compost @ 20 tonnes/ha + in organic nutrient application based on soil test (NPK application)	28.3	79.0	85.7	93.3	54.69	69.4	9.5	376.7	853.3	20.7	8.4
T ₇ - Application of FYM /Compost @ 10 tonnes/ha + biofertilizer (<i>Azotobacter</i> / <i>Acetobacter</i> + <i>PSB</i>) + 50 % RDF	26.3	74.7	75.0	80.0	42.19	62.0	8.4	360.7	786.7	18.9	7.9
T ₈ - Application of FYM/compost @ 10 tonnes/ha + biofertilizer (<i>Azotobacter</i> / <i>Acetobacter</i> + <i>PSB</i>) + 100 % RDF	26.7	75.3	77.7	84.7	47.79	63.5	8.7	372.0	600.0	19.8	8.0
T ₉ - Application of FYM/Compost @ 10 tonnes/ha + biofertilizer (<i>Azotobacter</i> / <i>Acetobacter</i> + <i>PSB</i>) + soil test basis (NPK application)	26.0	72.7	76.7	83.7	45.92	62.7	8.5	369.7	813.3	19.7	7.9
SEm±	0.81	0.77	1.16	0.87	1.15	1.35	0.39	7.76	51.81	0.44	0.09
CD at 5 %	2.4	2.3	3.5	2.6	3.4	4.08	1.19	23.48	17.13	1.34	0.27

Table:4 Effect of various treatments on availability of different nutrients and organic carbon and uptake of N, P and K influenced by various treatments (after harvest of ratoon II)

Treatments	Organic carbon (%)	Avail. N (kg/ha)	Avail. P (kg/ha)	Avail. K (kg/ha)	Avail.Zn (mg/kg soil)	Avail. Fe (mg/kg soil)	Avail. Mn (mg/kg soil)	Avail. S (mg/kg soil)	Uptake (Kg/ha)		
									N	P	K
T ₁ - Application of trash at 10 tonnes /ha + 50 % RDF	0.91	183.91	32.52	188.83	0.77	18.5	29.4	32.3	138.3	15.6	197.0
T ₂ - Application of trash at 10 tonnes /ha + 100 % RDF	0.93	185.12	33.16	186.74	0.81	18.6	30.9	33.7	149.4	16.3	207.7
T ₃ - Application of trash at 10 tonnes /ha + soil test basis (NPK application)	0.94	187.52	34.95	190.37	0.83	19.7	31.2	34.7	157.0	17.5	213.2
T ₄ - Application of FYM/ Compost @ 20 tonnes/ha + 50 % RDF (inorganic source)	1.04	202.07	41.90	202.28	0.92	23.1	33.4	40.7	180.3	23.8	238.7
T ₅ - Application of FYM /Compost @ 20 tonnes/ha + 100 % RDF (inorganic source)	1.05	204.95	42.46	210.04	1.03	26.0	35.1	42.3	187.3	25.2	247.0
T ₆ - Application of FYM / Compost @ 20 tonnes/ha + in organic nutrient application based on soil test (NPK application)	1.06	206.48	44.14	208.46	0.97	24.9	34.4	41.0	183.9	24.4	242.2
T ₇ - Application of FYM/Compost @ 10 tonnes/ha + biofertilizer (<i>Azotobacter/ Acetobacter</i> + <i>PSB</i>) + 50 % RDF	0.97	191.21	36.17	199.94	0.85	20.9	31.2	36.7	160.3	18.2	225.2
T ₈ - Application of FYM/ compost @ 10 tonnes/ha + biofertilizer (<i>Azotobacter/ Acetobacter</i> + <i>PSB</i>) + 100 % RDF	1.01	199.28	40.36	206.22	0.90	22.9	32.5	39.0	175.5	22.0	234.8
T ₉ - Application of FYM/ Compost @ 10 tonnes/ha + biofertilizer (<i>Azotobacter/ Acetobacter</i> + <i>PSB</i>) + soil test basis (NPK application)	1.01	192.43	38.05	204.68	0.86	21.8	32.1	36.0	168.4	20.9	230.1
SEm±	1.00	1.54	1.54	2.52	0.02	0.74	0.89	0.62	1.06	0.71	2.5
CD at 5 %	0.02	4.6	4.6	7.64	0.08	2.25	2.7	1.89	3.2	2.15	7.8

PROJECT NO. AS-68 (c)

Title : Impact of integrated application of organics and inorganics in improving soil health and sugarcane productivity in ratoon I (Planted cane spring 2015-16).

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

Year of start : 2014-15

Experiment under report : 2016-2017

Experimental site : N. E. Borlaug Crop Research Center of G.B. Pant University of Agriculture & Technology, Pantnagar

Cropping system : Sugarcane- Ratoon I- Ratoon II

Treatment details (Table 1)

Treatments	Ratoon-I
T₁	Application of trash at 10 tonnes /ha + 50 % RDF
T₂	Application of trash at 10 tonnes /ha + 100 % RDF
T₃	Application of trash at 10 tonnes /ha + soil test basis (NPK application)
T₄	Application of FYM/Compost @ 20 tonnes/ha + 50 % RDF (inorganic source)
T₅	Application of FYM/Compost @ 20 tonnes/ha + 100 % RDF (inorganic source)
T₆	Application of FYM/Compost @ 20 tonnes/ha + in organic nutrient application based on soil test (NPK application)
T₇	Application of FYM/Compost @ 10 tonnes/ha + biofertilizer (<i>Azotobacter/Acetobacter</i> + PSB) + 50 % RDF
T₈	Application of FYM/Compost @ 10 tonnes/ha + biofertilizer (<i>Azotobacter/Acetobacter</i> + PSB) + 100 % RDF
T₉	Application of FYM/Compost @ 10 tonnes/ha + biofertilizer (<i>Azotobacter/Acetobacter</i> + PSB) + soil test basis (NPK application)

Experimental details:

Variety : Co Pant 5224

Design : R.B.D

Replication : 3

Treatments : 9

Date of planting : 19.02.2015

Date of harvesting : 22.02.2016

(Ratooning) : 22.02.2016

Sugarcane Ratoon I (2016-17)-

Sugarcane planted during 2015-16 was harvested on 22.02.2016 and ratoon was started on 22.2.2016. Variety was Co Pant 5224 and the ratoon experiment was on the same sight on the same plot of the planted crop. Treatments etc. were as per technical programme. Soil of the experimental plot was silty clay loam. Crop was raised as per package and practices. Data related to crop growth and juice quality given in Table 5 and soil analysis in the Table 6.

Results:-

Highest cane yield (74.5 t/ha) was recorded in the treatment T₆-FYM@20t/ha + inorganic nutrient applied on soil test basis (NPK) which was significantly higher over rest of the treatments except T₈ and T₅. Higher cane yield in these treatments (T₅, T₆ and T₈) was the result of higher number of clumps/ha, shoot population, cane length, cane girth, NMC and individual cane weight. Higher cane length (407.4 cm) was recorded in the treatments T₆ which was significantly higher over rest of the treatments except T₈ and T₅. Shorter plants were recorded in T₁ which were significantly lower than T₄, T₅, T₆, T₇, T₈ and T₉ (Table 5).

Sucrose % was recorded lowest (14.1%) in the treatment T₁ and highest (17.3%) in the treatment T₅ followed by T₆. Available sugar and CCS yield were also higher in T₅ and T₆. Lowest CCS yield was recorded (5.5) in the treatment T₁- Trash@10 t/ha + 50% R.D.F (75 kg N + 30 kg P₂O₅ + 20 kg K₂O/ha).

Soil health and uptake of N, P and K

Uptake of N, P and K by plants was highest in the treatment T₆- FYM 20 t/ha and inorganic nutrients on soil test basis. Nitrogen, phosphorus and potash uptake was significantly higher in T₆ over rest of the treatments except T₅. Organic carbon % was significantly higher in T₄, T₅ and T₆ over rest of the treatments. Highest Zn availability was recorded in T₆ which was significantly higher over rest of the treatments. Availability of Mn, Fe and S was significantly higher in T₄, T₅ and T₆.

Summary:-

Highest cane yield was recorded in the treatment T₆-FYM 20 t/ha + inorganic nutrients applied on soil test basis. Higher shoot population, cane length and girth, NMC and individual cane weight were also higher in T₆ followed by T₅.

Uptake of N, P and K and availability of the major nutrients was recorded in the treatments in which FYM/compost was given along with RDF (100% on soil test basis).

Table:5 Effects of various treatments on growth and cane yield and quality of juice in Sugarcane ratoon (after ratoon-I harvest)

Treatments	Clump population (000/ha)	Shoot population (000/ha)			Cane length (cm)	Cane girth (cm)	Individual cane weight (g)	NMC (000/ha)	Cane yield (t/ha)	CCS (t/ha)	Sucrose % at harvest	Available sugar (%) at harvest
		120 DAR	150 DAR	180 DAR								
T ₁ -Application of trash at 10 tonnes /ha + 50 % RDF	13.8	134.3	137.0	132.3	330.2	7.8	748.6	63.8	62.9	5.5	14.1	8.7
T ₂ -Application of trash at 10 tonnes /ha + 100 % RDF	14.0	137.0	140.7	136.0	335.3	8.0	784.2	64.4	65.5	5.8	14.3	8.9
T ₃ -Application of trash at 10 tonnes /ha + soil test basis (NPK application)	14.2	139.3	143.3	138.7	337.7	8.0	786.3	66.6	67.6	6.6	15.2	9.7
T ₄ -Application of FYM/Compost @ 20 tonnes/ha + 50 % RDF (inorganic source)	15.8	145.7	150.0	145.3	381.4	8.4	998.7	70.0	69.8	7.3	16.2	10.5
T ₅ -Application of FYM/Compost @ 20 tonnes/ha + 100 % RDF (inorganic source)	17.8	155.7	161.3	157.7	400.2	9.2	1160.3	74.5	73.7	8.3	17.3	11.3
T ₆ -Application of FYM/Compost @ 20 tonnes/ha + in organic nutrient application based on soil test (NPK application)	18.1	158.3	165.3	158.3	407.4	9.0	1175.4	75.6	74.5	8.3	17.2	11.2
T ₇ -Application of FYM/Compost @ 10 tonnes/ha + biofertilizer (<i>Azotobacter/Acetobacter</i> + <i>PSB</i>) + 50 % RDF	15.0	140.7	146.3	140.7	372.6	8.3	803.6	68.3	68.3	7.0	15.8	10.2
T ₈ -Application of FYM/Compost @ 10 tonnes/ha + biofertilizer (<i>Azotobacter/Acetobacter</i> + <i>PSB</i>) + 100 % RDF	16.8	148.0	152.7	148.0	391.0	8.5	1032.5	71.1	70.6	7.5	16.5	10.7
T ₉ -Application of FYM/Compost @ 10 tonnes/ha + biofertilizer (<i>Azotobacter/Acetobacter</i> + <i>PSB</i>) + soil test basis (NPK application)	15.1	142.3	147.3	142.3	375.5	8.3	876.3	68.9	68.7	7.0	15.8	10.2
SEm±	0.9	3.5	3.9	3.5	8.5	0.3	5.8	2.2	1.3	0.2	0.3	0.3
CD at 5 %	2.7	10.4	11.7	10.6	25.4	0.9	17.3	6.5	3.9	0.7	1.0	0.8

R.D.F- 150: 60: 40 kg/ha

Table:6 Effects of various organic and inorganics on uptake of different nutrients in soil (after harvest of I ratoon 2016-17) of planted cane 2015-16

Treatments	Total uptake (kg/ha)			Organic carbon(%)	Avail. N (kg/ha)	Avail. P (kg/ha)	Avail. K (kg/ha)	Avail.Zn (kg/ha)	Avail. Mn (kg/ha)	Avail. Fe (kg/ha)	Avail. S (kg/ha)
	N	P	K								
T ₁ -Application of trash at 10 tonnes /ha + 50 % RDF	129.7	19.1	176.3	0.902	206.7	36.4	215.8	0.56	31.3	21.9	36.5
T ₂ -Application of trash at 10 tonnes /ha + 100 % RDF	140.0	20.6	186.6	0.905	209.3	37.3	216.5	0.72	33.9	24.8	38.2
T ₃ -Application of trash at 10 tonnes /ha + soil test basis (NPK application)	144.5	21.1	191.8	0.909	209.7	38.3	217.1	0.76	34.4	25.9	38.3
T ₄ -Application of FYM/Compost @ 20 tonnes/ha + 50 % RDF (inorganic source)	179.8	26.4	247.3	1.086	238.8	43.5	245.7	1.13	36.6	29.5	45.5
T ₅ -Application of FYM/Compost @ 20 tonnes/ha + 100 % RDF (inorganic source)	197.0	28.3	263.3	1.095	240.1	44.7	249.0	1.15	37.4	29.8	46.3
T ₆ -Application of FYM/Compost @ 20 tonnes/ha + in organic nutrient application based on soil test (NPK application)	201.6	29.1	270.3	1.096	242.6	45.8	250.6	1.25	37.7	29.9	46.7
T ₇ -Application of FYM/Compost @ 10 tonnes/ha + biofertilizer (<i>Azotobacter</i> / <i>Acetobacter</i> + <i>PSB</i>) + 50 % RDF	163.8	24	225.1	1.034	231.2	40.9	237.3	0.88	35.4	27.8	39.4
T ₈ -Application of FYM/Compost @ 10 tonnes/ha + biofertilizer (<i>Azotobacter</i> / <i>Acetobacter</i> + <i>PSB</i>) + 100 % RDF	176.6	26.2	242.3	1.058	233.3	41.1	240.6	0.95	35.5	28.4	42.3
T ₉ -Application of FYM/Compost @ 10 tonnes/ha + biofertilizer (<i>Azotobacter</i> / <i>Acetobacter</i> + <i>PSB</i>) + soil test basis (NPK application)	173.2	25.4	237.3	1.062	235.4	42.5	242.2	0.96	35.7	29.1	43.6
SEm±	3.2	0.5	3.5	0.005	0.9	0.8	1.1	0.01	0.13	0.4	0.4
CD at 5 %	9.7	1.4	10.4	0.014	2.7	2.3	3.2	0.03	0.37	1.3	1.1
Initial values				0.91	195.0	40.29	201.15				

PROJECT NO. AS-69

Title	:	Use of plant growth regulators (PGRs) for enhancing yield and quality of sugarcane
Objectives	:	(i) To accelerate rate and extent of sugarcane germination through the use of PGRs. (ii) To assess the effects of PGRs on sugarcane growth, yield and juice quality.
Year of start	:	2015-16
Year of completion	:	2017-18
Data under report	:	2016-17
Location of the experiment	:	N. E. Borlaug Crop Research Center of G. B. Pant University of Agriculture & Technology, Pantnagar

Treatment details :

- T₁- Conventional
- T₂- Overnight soaking of setts in water
- T₃- Overnight soaking of setts in 50 ppm ethephon
- T₄- Overnight soaking of setts in 100 ppm ethephon
- T₅- T₁ + GA₃ spray @ 35 ppm at 90, 120 and 150 DAP
- T₆- T₂ + GA₃ spray @ 35 ppm at 90, 120 and 150 DAP
- T₇- T₃ + GA₃ spray @ 35 ppm at 90, 120 and 150 DAP
- T₈- T₄ + GA₃ spray @ 35 ppm at 90, 120 and 150 DAP

Experimental details

Design	:	Randomized Block Design (R.B.D.)
Number of Treatments	:	8
Replication	:	3
No. of plots	:	24
Gross plot size	:	8.0 x 3.75 = 30 m ²
Net plot size	:	8.0 x 2.25 = 18 m ²
Row spacing	:	75 cm (5.0 rows/plot)
Method of planting	:	Flat bed
Variety	:	Co Pant 3220
Date of planting	:	22.03.2016
Date of harvesting	:	16.01.2017

Three budded setts of sugarcane variety Co Pant 3220 were planted on 22.03.2016 in flat bed planting at 75 cm apart row to row. Experiment was planted in Randomized block design and total 8 treatments were replicated thrice. Setts of the sugarcane were treated with either water or Ethephon as per treatment before planting and GA₃ was applied in standing crop as per treatments. The crop was nourished with recommended dose of N, P and K@ 120: 60: 40 kg/ha. Half dose of N + full dose of P and K were applied at the time of planting (basal) and remaining N was splitted in two parts and thus full dose of N was given upto 15 June (before onset of monsoon). All the cultural practices were adopted to raise the crop. Soil of the experimental plot was silty clay loam, rich in organic carbon, low in available N and high in Phosphorus and moderate in available K. Crop was harvested on January 16, 2017.

Results :-

Highest germination% (49.0%) was recorded at 50 DAP in the treatments T₄ and T₈ in which sugarcane setts were dipped in the Ethephone solution (100 ppm) overnight. Even germination % was hasten in the treatment of Ethephon 50 or 100 ppm soaking overnight from 10 DAP and enhanced in 20, 30 and 40 DAP. Germination % was also improved in the treatment water soaking of setts (overnight) at 20 DAP onwards. Lowest germination % and delayed was observed in conventional method (no treatment). Even at 50 DAP 45% higher germination was recorded in the treatment Ethephon@100 ppm overnight soaking over conventional. Though, the germination % was improved in 50 ppm Ethephon soaking (overnight) but was significantly lower than 100 ppm.

Highest cane yield (110.6 t/ha) was recorded in the treatment in which setts were soaked overnight in the solution of Ethephon 100 ppm + GA₃ spray@35 ppm at 90, 120 and 150 DAP. However, there was no significant difference in the treatment T₄ (only Ethephon 100 ppm soaking setts overnight) and T₈ (Ethephon 100 ppm fb GA₃@35 ppm applied at 90, 120 and 150 DAP) and in T₇ in which dose of Ethephon was 50% fb GA₃ 35 ppm at 90, 120 and 150 DAP. Higher cane yield was the result of higher and hasten germination of setts, resulted higher shoot population at all the stages of crop growth, cane girth, length of the stalk and ultimately heavier cane (higher cane weight). NMC were recorded in these treatments T₈, T₄ and T₇.

Commercial cane yield (CCS yield t/ha) was recorded highest (11.3) in treatment T₄ which was significantly higher over rest of the treatments except T₆, T₇ and T₈. Higher CCS yield was the result of higher cane yield, higher sucrose % in this treatment (Table 7).

Summary :-

Germination%, higher shoot population, higher NMC, higher cane weight, length of the cane were recorded in the treatment T₄ and T₈ of Ethephon soaking of setts @ 100 ppm which was triggered by GA₃ application 35 ppm applied at 90, 120 and 150 DAP. Germination % was also hastened and higher in sett soaking with water overnight. Though the cane yield was on par in 50 ppm or 100 ppm Ethephon setts soaking overnight.

Table:7 Germination %, growth, yield of cane and juice quality as influenced by various treatments

Treatments	Germination % (DAP)					No. of Shoots (000/ha) (DAP)				NMC (000/ha)	Cane length (cm)	Cane girth (cm)	Individual cane weight (g)	Cane yield (t/ha)	Sucrose %	CCS (t/ha)
	10	20	30	40	50	90	120	150	180							
T ₁ -Conventional (No treatments)	0.0	2.8	10.4	17.6	22.1	101.8	103.5	127.0	118.0	68.0	203.3	9.3	1000.0	81.2	15.9	8.3
T ₂ -Overnight soaking of setts in water	0.0	24.3	18.1	32.7	35.3	103.3	106.0	151.0	136.8	69.1	215.7	9.7	1300.0	84.1	16.3	9.0
T ₃ - Overnight soaking of setts in 50 ppm Ethephon	4.5	26.4	30.2	35.4	41.0	105.5	107.1	148.0	132.3	77.5	219.7	9.7	1366.7	94.0	16.4	9.6
T ₄ - Overnight soaking of setts in 100 ppm Ethephon	7.4	39.1	45.0	47.9	49.0	121.3	122.3	158.0	147.8	81.2	266.0	10.7	1400.0	109.3	16.7	11.3
T ₅ - T ₁ + GA ₃ spray @35 ppm 90, 120, 150 DAP	0.0	2.5	17.3	18.6	28.3	101.1	103.3	133.6	125.0	76.2	201.7	9.7	1083.0	83.0	16.4	8.9
T ₆ - T ₂ + GA ₃ spray @35 ppm 90, 120, 150 DAP	0.5	25.6	31.5	36.7	39.4	109.8	112.8	153.6	134.2	77.2	216.3	9.8	1233.3	95.0	16.6	10.2
T ₇ - T ₃ + GA ₃ spray @35 ppm 90, 120, 150 DAP	5.0	28.0	37.5	42.8	48.9	110.3	110.7	148.0	136.3	78.7	245.7	10.2	1400.0	102.5	16.4	10.8
T ₈ - T ₄ + GA ₃ spray @35 ppm 90, 120, 150 DAP	8.6	31.5	42.9	47.7	49.5	112.0	113.3	155.6	147.0	81.5	251.7	10.8	1500.0	110.6	16.9	10.5
SEm±	0.3	1.1	2.7	1.2	0.9	4.3	4.2	0.5	0.5	0.7	3.4	0.05	85.0	3.7	0.02	0.4
CD at 5 %	1.0	3.2	7.9	3.6	2.7	12.9	12.4	1.5	1.5	1.9	10.0	1.0	253.0	11.0	0.07	1.3

PROJECT NO. AS-70

Title : Scheduling irrigation with mulch under different sugarcane planting methods

Objective : To enhance crop and water productivity in sugarcane

Year of start : 2016-17

Year of completion : 2019-20

Location of the experiment : N. E. Borlaug Crop Research Center of G. B. Pant University of Agriculture & Technology, Pantnagar

Treatment (A) : **Combination of planting methods and mulch practices**

P₁: Conventional flat planting (75 cm row spacing) with organic mulching @ 6 t/ha (sugarcane trash/paddy straw/ any other available crop residue)

P₂: Conventional flat planting (75 cm row spacing) without mulch

P₃: Paired row trench planting (30: 120 cm row spacing) with organic mulching @ 6 t/ha

P₄: Paired row trench planting (30: 120 cm row spacing) without mulch

Treatment (B) : **Irrigation schedule (IW/CPE)**

I₁: 0.60

I₂: 0.80

I₃: 1.00

Irrigation water depth : 7.5 cm

Experimental details :

Experimental design : Strip plot design

Row : Planting methods mulch combination (4)

Column: Irrigation scheduling (3)

Replications : 3

Total plots : 36

Plot size : 4.5 x 8.0 m= 36.0 m²
Row spacing : Flat planting (conventional)-75 cm
Paired row planting- 30: 120 cm
Fertilizer application : 150 kg N + 60 kg P₂O₅ + 40 kg K₂O/ha
Sugarcane variety : Co Pant 5224
Date of planting : 5.3.2016
Date of harvesting : 11.01.2017
Total rainfall : 1185.6 mm

Soil properties :

1. Soil texture	:	Silty clay loam
2. Organic carbon (%)	:	1.1 (rich)
3. Available nitrogen (kg/ha)	:	240.76 (low)
4. Available phosphorus (kg/ha)	:	29.12 (high)
5. Available potassium (kg/ha)	:	265.2 (medium)
6. Soil pH (1:2.5, soil and water suspension)	:	7.53
7. Bulk density (g/cc)	:	1.32
8. Infiltration rate (cm/hr) for initial 45 minutes	:	2.3
9. Basic infiltration rate (cm/hr)	:	1.8

Three budded setts of sugarcane variety Co Pant 5224 were planted as per treatment (method of planting- flat bed, conventional at 75 cm and paired row planting 30: 120 cm). Setts were treated with 0.25% solution of carbendazim before planting to avoid fungal infection, if any. The crop was planted on 5.3.2016 and was harvested during 11.1.2017. Experiment was conducted in Strip plot design having method of planting and trash combination (4) in rows and irrigation scheduling (3) in columns. All the treatments were replicated three times. Soil of the experimental plots was silty clay loam rich in organic carbon (1.1%) and low in available N (240.76 kg/ha), high in available Phosphorus (29.12 kg/ha) and medium in available Potassium (265.2 kg/ha). Bulk density of the soil was 1.32 g/cc. Infiltration rate (cm/hr) for initial 45 minutes was 2.3 and basic infiltration rate (cm/hr) was 1.8. Soil of the experiment was neutral with pH (7.53). Total rainfall during the crop duration was 1185.6 mm. Total water was applied 1485.6 mm in the treatment of 1.0 IW/CPE including irrigation water (300 mm) + rainfall (1185.6) (Table 8).

Results:-

Germination % at 40 days after planting was highest (32.5%) in paired row planting (30: 90 cm) with trash which was significantly higher over rest of the treatments. Higher millable cane (88.2 000/ha), cane yield (86.2 t/ha), sucrose % (17.7) and CCS yield (t/ha) (14.3) were recorded in the same treatment (paired row planting with trash mulching). These parameters were influenced by higher number of shoots/ha since very beginning and maintained upto 180 DAP. Cane yield was significantly higher in this treatment (paired row planting + trash mulch) over rest of the treatments. Lowest NMC, cane yield, sucrose % and CCS yield (t/ha) were recorded in conventional planting (flat planting without trash mulching). Highest cane yield (83.8 t/ha) was recorded in 1.0 IW/CPE irrigation treatment which was significantly higher over either 0.8 or 0.6 IW/CPE. Higher cane yield in this treatment was the result of high NMC. However, sucrose % and CCS yield were non-significant in all the three irrigation treatments. Germination % was also not influenced by irrigation treatments (Table 8).

Summary:-

On the basis of present study it was observed that cane yield and NMC were significantly higher in the treatment of paired row planting (30: 120) + trash mulching and at 1.0 IW/CPE ratio. Sucrose% was not influenced due to planting method or trash management and irrigation methods, though the CCS yield was highest in the treatment of paired row planting + mulch and was significantly higher over rest of the treatments. Cane yield was statistically similar in treatment 0.8 or 1.0 IW/CPE but were significantly higher over 0.6 IW/CPE.

Table: 8(a) Effect of planting methods with or without mulch under different irrigation level on growth, yield and juice quality of spring planted Sugarcane

Treatment	Germination (40 DAP)	No of shoots (000/ha)			Milliable canes (000/ha)	Cane yield (t/ha)	Sucrose %	CCS (t/ha)
		120 DAP	150 DAP	180 DAP				
Planting method								
Flat planting with mulch	27.8	128.1	135.9	143.4	81.9	78.2	17.4	12.1
Flat planting without mulch	25.9	126.6	130.9	132.1	76.8	77.9	16.8	12.7
Paired row with mulch	32.5	129.7	143.9	148.1	88.4	86.7	17.7	14.9
Paired row without mulch	29.4	129.1	137.3	145.3	85.8	85.8	17.6	13.8
SEM _±	0.2	0.5	0.4	0.4	0.1	0.1	0.02	0.01
CD at 5%	2.1	NS	4.2	4.5	1.1	1.2	0.3	0.5
Irrigation level								
0.6 IW/CPE	28.2	126.8	135.9	141.3	82.4	80.8	17.3	12.4
0.8 IW/CPE	28.8	127.6	137.3	142.2	83.4	81.7	17.4	13.7
1.0 IW/CPE	29.7	130.7	137.8	143.2	83.8	83.9	17.5	14.1
S.Em _±	0.2	0.1	0.3	0.2	0.02	0.1	0.01	0.05
CD at 5%	NS	1.8	NS	NS	0.4	1.8	NS	0.7

Table: 8(b) Observation on water utilization

Method of planting	Irrigation water applied (mm)	Total rainfall (mm)	Total water applied (mm)	Water productivity (q/ha/cm)
Planting method				
Flat planting with mulch	250	1185.6	1435.6	5.4
Flat planting without mulch	250	1185.6	1435.6	5.3
Paired row with mulch	250	1185.6	1435.6	5.9
Paired row without mulch	250	1185.6	1435.6	5.8
Irrigation level				
0.6 IW/CPE	150	1185.6	1335.6	6.1
0.8 IW/CPE	225	1185.6	1410.6	5.7
1.0 IW/CPE	300	1185.6	1485.6	5.6

PROJECT NO. AS-71

Title	:	Carbon sequestration assessment in sugarcane based cropping system
Objectives	:	To improve the total soil organic carbon build-up and sustain crop yields
Year of start	:	2016-17
Duration	:	One cycle of 3 years rotation
Location of the experiment	:	N. E. Borlaug Crop Research Center of G. B. Pant University of Agriculture & Technology, Pantnagar
Treatment	:	8
Cropping system	:	

T₁- Rice-wheat-rice-wheat (residue retention without *Trichoderma*)

T₂- Rice-wheat-rice-wheat (residue retention with *Trichoderma*)

T₃- Sugarcane-ratoon (trash mulching without *Trichoderma*)-wheat

T₄- Sugarcane-ratoon (trash removal without *Trichoderma*)-wheat

T₅- Sugarcane-ratoon (trash mulching with *Trichoderma*)-wheat

T₆- Sugarcane-ratoon-wheat (trash incorporation through rotavator and *Trichoderma* incorporation before sowing of wheat)

T₇- Sugarcane-ratoon-wheat (zero tilled) without *Trichoderma*

T₈- Sugarcane-ratoon-wheat (zero tilled) with *Trichoderma*

Experimental details

Design	:	R.B.D
Replication	:	3
Variety	:	Co Pant 5224
Date of planting	:	22.02.2016
Date of harvesting	:	15.03.2017
Plot Size	:	6.0 m x 4.5 m = 27 m ²
Rice transplanting date	:	5.7.2016
Row to row distance	:	20 cm
Harvesting of rice	:	24.10.2016
Rice variety	:	HKR-47
Wheat variety	:	HD 2967
Row to row distance	:	23 cm

Sowing time (wheat) : 19.11.2017
 Harvesting time (wheat) : 3.5.2017
 Initial value of soil : Initial values of organic carbon (%), N, P and K (kg/ha) are given below

Depth of soil	Organic carbon (%)	N (kg/ha)	P (kg/ha)	K (kg/ha)
0-30 cm	0.988	228.6	30.5	216.3
30-60 cm	0.923	220.4	25.1	205.7
60-90 cm	0.885	206.8	20.7	188.2

Sugarcane setts three budded variety Co Pant 5224 were planted on 22.2.2016 by flat bed method at 75 cm apart row to row. Before planting, setts were dipped for 10 minutes in the solution of carbendazim@ 0.25%. Experiment was planned in Randomized block design having 8 treatments and all the treatments were replicated thrice. Soil of the experimental plot was silty clay loam, neutral in pH (7.2), rich in organic carbon (1.05%), low in available N, medium in Potassium and high in available Phosphorus. Recommended dose of NPK (120: 60: 40 kg/ha) was applied. Half dose of N and full dose of P and K was applied as basal and remaining half of the N was split into two and was applied within 90 days of crop planted (before onset of monsoon). Recommended package and practices were adopted to raise the crops (sugarcane, rice and wheat). Sugarcane was harvested on 15.3.2017. Observations were recorded as per technical programme.

Results:-

(i) Sugarcane

Sugarcane crop produced almost similar shoot population, NMC and cane yield in different treatments which were found non-significant to each other. Sucrose% and CCS yield were also found non-significant (Table 9).

ii) Rice

Rice crop variety HKR-47 was raised matured in 104 days after planting and produced 47.0 q/ha straw and 54.8 q/ha grain yield.

iii) Wheat

Wheat variety HD 2967 produced 48.6 q/ha grain yield and 46.2 q/ha straw, matured in 145 days.

Summary:-

Sugarcane crop produced almost similar cane yield and NMC in all the treatments and found non-significant. Sucrose% and CCS yield were also found non-significant. Rice variety HKR-47 produced 54.8 q/ha grain and 47.0 q/ha straw yield. Rice variety HD 2967 produced 48.6 q/ha grain and 46.2 q/ha straw yield. Initial values for N, P and K and organic carbon were also taken before planting of these crop and shown in Table at different depths (0-30, 30-60 and 60-90 cm).

PROJECT NO. AS-72(a)

Title	:	Agronomic performance of elite sugarcane genotypes (early maturing)
Objectives	:	To assess the performance of promising sugarcane genotypes of Advanced Varietal Trial (AVT)
Year of start	:	2016-17
Duration	:	One year
Location of the experiment	:	N. E. Borlaug Crop Research Center of G. B. Pant University of Agriculture & Technology, Pantnagar
Planting time	:	February-March
Design	:	R.B.D
Replication	:	3
Treatments	:	
Sugarcane genotypes	:	CoLK-11201, CoLK-11202, CoLK-11203, CoH-11262
Zonal check	:	CoJ 64, Co 0238/Co Pant 3220
Experimental details:		
Treatment	:	6
Replication	:	3
Date of planting	:	10.03.2016
Date of harvesting	:	9.03.2017
Plot size	:	6.0 x 6.0 m= 36 m ²
Net plot size	:	6 x 3.6 m= 21.6 m ²
Number of line	:	6
Spacing	:	120 cm
Fertilizer	:	125% of the recommended dose (120:60:40 kg NPK/ha)

Sugarcane 3 budded setts of different clones in question were planted at row distance of 120 cm and nourished with 125% of the RDF (120:60:40 kg NPK/ha). The setts were planted by flat bed method on 10.3.2016 and were harvested on 9.3.2017. Crop was raised as per package and practices of the crop. Weeds were removed by Atrazine applied @ 1.0 kg a.i/ha (PE) followed by interculture operations. Setts were treated with carbendazin solution 0.25% for 10 minutes before planting. Soil of the experimental plot was silty clay loam with normal/neutral pH (7.2).

Results:-

Among all the genotypes (6), cane yield was highest (102.9 t/ha) of the genotype CoH 11261, which was significantly higher over rest of the genotypes. The cane yield was significantly higher over national checks i.e. CoJ 64 (77.4 t/ha) and Co Pant 3220 (87.8 t/ha). Co 0238 could not be planted due to non-availability of seed from the breeder. Heavier cane with higher shoot population at different stages of crop growth were also recorded in the genotype Co H 11262 over rest of the genotypes. However, NMC were higher in national check (Co J 64) but there was no significant difference in between Co J 64 and CoH 11262. Higher sucrose % (17.9%) was also higher in genotype CoH11262 which were significantly higher over rest except Co Pant 3220. CCS yield was recorded highest (15.2 t/ha) in genotype Co H 11262 which was significantly higher over rest of the genotypes. Germination % was almost the same in Co H 11262, CoJ 64 and Co Pant 3220 which was significantly higher over rest of the genotypes i.e. CoLK 110201, CoLK 110202, CoLK 110203 (Table 10).

Summary:-

As per observations recorded genotype CoH 11262 performed better among all the genotypes tested with regard to cane yield, NMC, germination %, individual cane weight, sucrose % and commercial cane yield. Sucrose % was on par to Co Pant 3220.

Table:10 Agronomic performance of elite sugarcane genotypes

Treatments	Germination %	No. of Shoots (000/ha) (DAP)				Individual cane weight (g)	Millable cane (000/ha)	Cane yield (t/ha)	Sucrose % at Nov.	Sucrose % at Harvest	CCS (t/ha)
	45 DAP	60	90	120	150						
T ₁ - CoLK 110201	8.7	37.0	45.5	52.7	61.7	1000.0	40.7	46.3	17.3	17.1	6.8
T ₂ - CoLK 110202	6.7	35.4	46.9	49.8	50.9	1300.0	49.3	64.6	16.9	17.2	9.6
T ₃ - CoLK 110203	15.2	43.3	47.5	53.0	56.0	1100.0	47.3	43.0	17.3	17.4	6.3
T ₄ - CoH 11261	14.5	61.8	67.6	70.2	70.9	1566.0	70.1	102.9	17.6	17.9	15.2
T ₅ - CoJ 64	15.5	62.4	67.9	70.3	69.3	833.0	72.0	77.4	15.6	15.9	11.0
T ₆ - Co Pant 3220	15.2	57.0	64.5	66.1	68.0	1400.0	68.7	87.8	17.3	17.6	10.7
SEm±	1.4	2.9	1.5	1.9	2.6	68.0	2.8	2.2	0.2	0.09	0.30
CD at 5 %	4.4	9.1	4.8	5.8	8.2	214.0	8.8	6.8	0.6	0.30	0.96

PROJECT NO. AS-72(b)

Title : Agronomic performance of elite sugarcane genotypes (mid late maturing genotypes)

Objectives : To assess the performance of promising sugarcane genotypes of Advanced Varietal Trial (AVT)

Year of start : 2016-17

Duration : One year

Location of the experiment : N. E. Borlaug Crop Research Center of G. B. Pant University of Agriculture & Technology, Pantnagar

Planting time : February-March

Design : R.B.D

Replication : 3

Treatments :

Sugarcane genotypes : Co 11027, CoH 11263, CoLK-11204, CoLK-11206, CoPb 11214, CoS 11232

Zonal check : CoS 767, CoS 8436, CoPant 97222

Experiment was not conducted due to non-availability of seed material.

APPENDIX-I

Meteorological data of crop period Feb. 2016- Feb. 2017 at Pantnagar

Month	Date	Year	Metro. Week No. (2011)	Temperature(°C)		Relative Humidity(%)		Rainfall (mm)	No. of Rainy Days	Sunshine hrs.	Wind Velocity (km/hr.)	Evap. (mm)	
				Max.	Min.	Max.	Min.						
Jan-Feb	29-04	2016	5	22.2	6.8	96.0	48.0	0	0	4.8	5.3	1.9	
Feb	05-11	2016	6	23.3	8.3	93.0	46.0	0	0	5.4	3.7	2.4	
Feb	12-18	2016	7	26.4	9.4	82.0	32.0	0	0	6.8	5.5	3.1	
Feb	19-25	2016	8	26.4	11.8	87.0	44.0	2.5	0	4.6	6.3	2.9	
Feb-Mar	26-04	2016	9	28.8	12.1	88.0	37.0	0	0	7.4	3	3	
Mar	05-11	2016	10	30.4	13.4	86.0	37.0	0	0	8.4	6.1	4.2	
March	12-18	2016	11	29.1	13.5	83.0	37.0	0.9	1	7.1	7.7	4.7	
	19-25	2016	12	31.3	14.0	80.0	28.0	0	0	8.8	6.6	4.7	
Mar-Apr.	26-01	2016	13	33.7	16.0	78.4	32.3	0	0	7.0	5.1	4.8	
	April	02-08	2016	14	35.6	20.4	64.9	31.6	0	0	6.9	6.0	6.7
Apr-May	9-15	2016	15	37.3	17.2	63.7	28.9	0	0	10.4	8.8	8.9	
	16-22	2016	16	38.7	21.5	69.6	32.0	0	0	7.5	7.2	9.5	
	23-29	2016	17	38.9	16.9	71.0	26.7	0	0	11.1	9.2	12.5	
	30-06	2016	18	37.2	20.8	63.9	27.3	19.6	1	7.5	6.9	9.2	
	May	7-13	2016	19	33.9	22.4	72.7	42.9	39.2	2	3.9	5.5	5.8
May-June	14-20	2016	20	38.5	23.9	61.3	36.0	0	0	10.7	8.4	8.5	
	21-27	2016	21	33.9	22.8	72.9	48.0	41.4	4	8.3	8.8	7.4	
	28-03	2016	22	33.8	24.3	72.6	51.4	35.2	1	7.7	7.5	7.4	
	June	04-10	2016	23	35.3	26.6	68.7	55.1	17.4	2	6.0	8.4	6.6
	11-17	2016	24	35.5	25.8	77.4	52.9	40.8	3	6.5	7.1	6.5	
June-July	18-24	2016	25	32.9	26.0	84.6	65.0	66.2	4	6.3	5.9	4.7	
	25-01	2016	26	33.3	26.3	86.7	66.3	80.4	5	4.0	7.3	4.4	
	02-08	2016	27	30.7	25.9	90.1	77.0	72.2	5	2.0	6.4	3.4	
	9-15	2016	28	33.0	26.2	89.4	71.0	52.6	5	4.2	5.6	4.3	
	16-22	2016	29	32.0	25.5	91.4	74.3	119.2	4	2.8	5.9	4.6	
Jul-Aug.	23-29	2016	30	30.8	24.9	89.1	76.7	125.9	6	3.9	6.5	3.8	
	30-05	2016	31	31.7	25.7	86.1	71.4	151.8	4	5.5	7.1	5.0	
	August	06-12	2016	32	33.0	26.3	89.4	69.3	40.2	4	5.7	6.8	4.5
	13-19	2016	33	32.9	25.9	92.6	69.9	100.6	5	4.7	3.9	3.9	
	20-26	2016	34	33.1	26.3	87.0	67.7	2.4	2	7.8	4.7	4.4	
Aug-Sep.	27-02	2016	35	34.0	25.5	88.9	63.6	26.6	3	5.5	3.8	3.6	
	September	03-09	2016	36	32.7	25.3	91.0	68.9	2.4	1	6.2	6.2	4.6
October	10-16	2016	37	32.1	24.5	88.9	72.4	59.4	1	4.5	4.3	3.6	
	17-23	2016	38	32.7	24.2	89.9	65.9	76.6	1	5.9	3.6	3.2	
	24-30	2016	39	32.6	23.2	87.0	61.9	3.4	1	8.9	2.9	3.2	
	01-07	2016	40	32.7	24.9	88.0	65.4	0	0	3.9	2.4	3.0	
	08-14	2016	41	32.2	19.9	88.7	61.6	0	0	5.9	2.9	2.9	
Oct-Nov.	15-21	2016	42	31.6	17.2	80.0	48.7	0	0	7.7	2.3	2.8	
	22-28	2016	43	31.2	13.8	90.1	38.4	0	0	7.7	2.1	2.8	
	29-04	2016	44	30.4	13.5	84.9	38.6	0	0	7.9	1.9	2.6	
	November	05-11	2016	45	29.0	11.4	90.3	36.9	0	0	7.9	2.6	2.4
	12-18	2016	46	28.3	10.6	90.9	36.9	0	0	8.1	2.1	2.8	

	19-25	2016	47	26.6	9.8	93.4	38.1	0	0	7.3	2.2	1.9
Nov-Dec.	26-02	2016	48	26.1	11.3	92.6	46.6	0	0	4.2	2.6	1.8
December	03-09	2016	49	23.4	11.5	83.2	54.9	0	0	4.1	3.1	1.3
	10-16	2016	50	20.0	9.9	94.4	66.4	0	0	2.2	2.7	1.1
	17-23	2016	51	23.1	6.5	94.6	48.7	0	0	6.1	2.3	1.8
	24-31	2016	52	22.5	8.7	93.4	55.3	11.2	1	5.9	3.6	1.7
January	01-07	2017	1	22.6	9.3	92.1	52.9	0	0	6.3	3.6	1.8
	08-14	2017	2	18.2	4.3	92.7	52.1	0	0	6.2	4.3	1.4
	14-21	2017	3	19.2	7.0	95.3	58.6	0	0	4.5	4.9	1.3
	22-28	2017	4	22.6	8.5	92.3	55.3	0	0	5.3	4.7	1.8
Jan.-Feb.	29-04	2017	5	21.2	9.4	93	59.7	0	0	5.3	3.3	1.6
February	05-11	2017	6	23.2	8.5	92.1	46.6	0	0	5.9	5.3	1.9
	12-18	2017	7	25.2	9.3	90.6	48.7	0	0	7.1	2.8	1.6
	19-25	2017	8	26.9	10.4	91.6	44.6	0	0	7.2	5.3	2.8

APPENDIX-II

Details of different experiments

Experiments	Varieties	Planting date/ Ratoon initiation date	Date of harvesting	Fertilizer dose (kg/ha)
AS-68 (a)	Co Pant 5224	19.02.2016	10.02.2017	As per technical programme Recommended 120:60:40 kg NPK/ha as per treatments
AS-68 (b)	Co Pant 5224	10.02.2016	22.02.2017	As per technical programme Recommended 150:60:40 kg NPK/ha as per treatments
AS-68 (c)	Co Pant 5224	19.02.2015	22.02.2016	As per technical programme Recommended 150:60:40 kg NPK/ha as per treatments
AS-69	Co Pant 3220	22.03.2016	06.01.2017	Recommended 150:60:40 kg NPK/ha
AS-70	Co Pant 5224	05.03.2016	11.01.2017	Recommended 120:60:40 kg NPK/ha
AS-71	Co Pant 5224	22.02.2016	15.03.2017	Recommended 120:60:40 kg NPK/ha
Paddy and Wheat	HKR-47 HD-2967	5.07.2016 19.11.2016	24.10.2016 3.05.2017	Recommended 120:60:40 kg NPK/ha