

Research Article

Preformance of Autumn Planted Sugarcane Genotypes in Sodic Soil

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Abstract

A Field experiments was conducted to evaluate the autumn (Preseason) planted sugarcane genotypes in sodic soil during 2014-15 and 2017-18 at the Central Sugarcane Research Station, Padegaon. The treatments comprised of seven sugarcane genotypes viz., Co 86032, CoM 0265, Co 94012, CoC 671, MS 10001, CoVSI 434 and CoM 9057 replicated three times with randomized block design. The soil of experimental site was sodic having pH_e (8.80), EC_e (1.70 dS/m) and ESP (19.55%). The sugarcane variety CoM 0265 recorded significantly the highest cane yield (148.40 t/ha) however, it was found at par with variety MS 10001 (141.26 t/ha), CO 86032 (125.26 t/ha) and CoM 09057(121.98 t/ha). Variety MS 10001 (21.22 t/ha) recorded significantly highest CCS yield and found at par with sugarcane variety CoM 0265 (20.18t/ha). Growth and yield attributes viz., tillering ratio, millable height, number of internodes per plant and cane girth were significantly higher in genotype CoM 0265. CCS percentage (15.16%) was recorded significantly highest with CoM 9057 and found at par with all varieties except Co 86032 and CoM 0265. sugarcane variety CoM 0265 recorded significantly highest relative leaf water content (RLWC), SPAD., No. of green leaves.

Keywords: Sugarcane genotype, Sodic, RLWC, SPAD, CCS and Yield

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Introduction

Sugarcane is the most important cash crop of Maharashtra. Sugar industry plays a pivotal role in the socio-economic and educational development in the rural areas of the state. Maharashtra sugar industry has been under sugarcane is about 9.22 lakh ha. in Maharashtra with the sugarcane production of 950.65 lakh tons, n growing for the last 70 years without any impediments. During 2017-18, the area average productivity is 103.10 t/ha, average sugar recovery is 11.23 % and the sugar production is 106.77 lakh ton. The area under sugarcane in Maharashtra reached to the peak and there is very little or no more scope to increase the area. The productivity is stagnating around 85 t ha^{-1} i.e. 35 t acre^{-1} [1]. The number and crushing capacity of sugar factories was increasing year by year. In such situation, we have the only option to increase the sugarcane productivity by means of generating the improved technologies and varietal development considering the global warming and the climate change. The sugarcane productivity of the country is reducing day by day due to cluster of factors. The selection of suitable genotypes for sugarcane cultivation has prime importance and improve yield in the range of 28 to 60 per cent [2]. India is endowed with a diversity of soil resources having different prospects and limitations. Inceptisols occupy the largest area (95.8 M ha) followed by Entisols, Alfisols, Vertisols and Aridisols [3]. These combined with a wide variation in geomorphology, topography, climate including rainfall pattern, temperature, humidity and sunshine etc. provide a favourable environment for the growth of a variety of agricultural, horticultural, medicinal and forest crops. Over-exploitation and inappropriate practices due to swelling population, industrialization and urbanization with the quest for immediate gains to meet the growing demands without long term perspectives have, however, resulted in soil degradation by various processes at an alarming rate. The widespread twin problems of water logging and soil sodicity in most canal commands, particularly in arid and semi-arid regions threaten the sustainability of irrigated agriculture. In view of this present investigation was undertaken.

Materials and Methods

A field experiment was conducted at research farm of Central Sugarcane Research Station, Padegaon during spring season of years 2014-15 to 2017-18 (2 plant cane + 1 ratoon) to evaluate the of autumn (Preseason) planted sugarcane genotypes in sodic soil. The experiment was laid out with three replications. Seven sugarcane genotypes viz., Co 86032, CoM 0265, Co 94012, CoC 671, MS 10001, CoVSI 434 and CoM 9057 were tried as treatments. The soil of

experimental site was sodic in nature with pH_e (8.80), EC_e (1.70 dS/m) and ESP (19.55%). The plot size of 10 m x 7.2 m and 120 cm distance for ridges and furrows were kept for planting of sugarcane. The recommended cultural practices were adopted for raising sugarcane crop during spring season of all the years. 2 plant cane and one ratoon crop were studied. At the time of harvesting, five canes from each plots were randomly selected and recorded growth and yield attributes. The data pertaining to growth, yield and quality parameters were statistically analyzed as per the procedure laid out [4].

Results and Discussion

The pooled results with respect of Cane and CCS yield, biometric observation, and quality parameters are presented in Tables 1-4.

Cane and CCS yield

Data presented in Table 1 revealed that, sugarcane variety CoM 0265 recorded significantly the highest cane yield (148.40 t/ha) however, it was found at par with variety MS 10001 (141.26 t/ha), CO 86032 (125.26 t/ha) and CoM 09057(121.98t/ha). Variety MS 10001 (21.22 t/ha) recorded significantly highest CCS yield and found at par with sugarcane variety CoM 0265 (20.18t/ha). The higher cane yield was ascertained by the ability of genotypes to absorb the nutrient in sodic soil conditions. The yield of sugarcane genotype is the function of nutrient uptake from soil under prevailing soil conditions. The variations in cane yield among the sugarcane genotypes are associated with soil salinity. These neutral salts increase the osmotic potential of soil solution. The soil solution is the prime source of plant to absorb the nutrients from soil. However, because of higher osmotic potential of soil solution, the plant has exerted a more energy to absorb the nutrients. The matrix potential of soil is also enhanced by the salt content of soil may hinders the nutrient absorption. The potential of sugarcane genotypes to absorb the nutrients under salinity and sodicity of soil were varied, it is depends on genetic make up of individual genotypes. These mechanisms may affect the nutrient absorption and affect the cane yield. These observations are corroborated with the observations [5].

Table 1 Cane and CCS yield (t/ha) as affected by sugarcane varieties (Pooled Mean)

Treatment	Cane yield (t/ha)			Mean	CCS yield(t/ha)			Mean
	14-15	15-16	16-17		14-15	15-16	16-17	
V ₁ - Co 86032	133.62	129.96	112.20	125.26	18.33	19.10	15.59	17.67
V ₂ -CoM 0265	165.50	157.28	122.41	148.40	21.26	21.71	17.58	20.18
V ₃ - Co 94012	114.80	109.40	95.67	106.62	17.12	16.13	14.15	15.80
V ₄ - Co C 671	100.70	93.98	86.47	93.72	14.59	14.10	12.29	13.66
V ₅ - MS10001	159.70	152.38	111.70	141.26	22.54	24.05	17.06	21.22
V ₆ - Co VSI 434	73.71	68.66	61.60	67.99	10.24	9.78	9.13	9.72
V ₇ -CoM 9057	137.10	130.88	97.96	121.98	19.37	20.32	15.84	18.51
SE _±	6.27	5.75	4.23	11.73	0.97	0.84	0.56	0.63
CD at 5%	19.06	17.48	12.86	35.65	2.96	2.56	1.71	1.91

Biometric observation

Data presented in Table 2 revealed that, during first year the germination percentage (70.56%) recorded significantly highest with sugarcane variety CoM 09057. While it was at par with sugarcane variety CoVSI 434 (65.78 %) and Co 94012 (59.67%). During second year the germination percentage (87.00 %) recorded significantly highest with sugarcane variety MS 10001 than rest of the treatments. The stool count of ratoon (28703) recorded significantly highest with sugarcane variety Co 86032 and found at par with all the genotypes except CoC 671 and CoVSI 434. The significantly highest tillering ratio (2.16) was observed in CoM 0265 while it was on par with MS 10001 (2.14). CoM 0265 recorded significantly highest millable height (248.67 cm) and found on par with, MS 10001 (244.67cm) Co 86032 (230.33cm) and CoM 09057(230.00cm). The numbers of internodes per plant (25.67) were significantly highest in sugarcane variety CoM 0265. However, it was found at par with sugarcane variety MS 10001 (24.77). The girth (11.23 cm) was significantly highest with sugarcane variety MS 10001. It was found at par with sugarcane variety CoM 0265 (10.90 cm). Millable cane per hectare (88659/ha) was found significantly highest in sugarcane variety MS 10001. Weight per cane (1.81 kg/cane) was found significantly highest in sugarcane variety MS 10001 and found on par with CoM 0265 (1.69 kg/cane), CoC 671(1.73 kg/cane) and CoM 09057 (1.69 kg/cane). The variation in the germination percentage and other growth attributes of different sugarcane genotypes might be due to accumulation of soluble salts in the active root zone and potential or genetic ability of that genotypes to withstand

under saline/ sodic root zone. The higher osmotic potential at active root zone due to soluble salt accumulation requires exerting higher energy for absorption of nutrients and growth, similar results were also reported by [6].

Table 2 Biometric observation as affected by sugarcane varieties (Pooled Mean)

Treatments	Germination (%) Plant cane I	Germination (%) Plant cane II	Stool count / ha (Ratoon)	Tillering Ratio	Millable height (cm)	Girth (cm)	No. of I'nodes / Plant	Millable Cane (ha)	Wt/ Cane (kg)
V ₁ - Co 86032	46.89	68.33	28703	1.95	230.33	9.85	23.00	78869	1.60
V ₂ -CoM 0265	55.0	78.70	28587	2.16	248.67	10.90	25.67	88659	1.69
V ₃ - Co 94012	59.67	69.67	26620	1.80	182.67	10.23	18.80	70103	1.55
V ₄ - Co C 671	48.33	68.00	23032	1.73	177.00	9.80	17.67	54142	1.73
V ₅ - MS10001	56.44	87.00	28472	2.14	244.67	11.23	24.77	77870	1.81
V ₆ - Co VSI 434	65.78	78.00	23495	1.72	171.67	9.47	16.43	45686	1.49
V ₇ -CoM 9057	70.56	81.00	28071	2.02	230.0	10.57	23.10	72083	1.69
SE _±	4.01	1.69	1334	0.02	10.77	0.13	0.48	720	0.06
CD at 5%	12.18	5.15	4058	0.07	32.75	0.39	1.47	2191	0.20

Quality Parameters

Data presented in Table 3 revealed that the Brix (c) and sucrose (%) among the sugarcane varieties were found to be non significant. Purity (97.13%) was found significantly highest with var. CoM 9057 and MS 10001 found at par with Co 94012 (96.61%) and CoC 671 (96.57%). CCS percentage (15.16%) was recorded significantly highest with CoM 9057 and found at par with all varieties except Co 86032 and CoM 0265. The lower sucrose content might be because of salt induced stimulation of the sucrolytic activities of acid and neutral invertase activities [7]. This might be ascribed due to higher osmotic potential in soil soluble salts reflected lowering the root development thereby inhibiting the nutrient absorption. Similar, observations were recorded by [8].

Table 3 Quality parameters as affected by sugarcane varieties (Pooled Mean)

Treatment	Brix (c)	Sucrose %	Purity%	CCS%
V ₁ - Co 86032	21.30	19.92	93.42	14.12
V ₂ -CoM 0265	20.65	19.37	93.79	13.60
V ₃ - Co 94012	21.39	20.72	96.61	14.76
V ₄ - Co C 671	21.03	20.26	96.57	14.63
V ₅ - MS10001	21.13	20.56	97.13	15.09
V ₆ - Co VSI 434	20.90	20.01	95.10	14.34
V ₇ -CoM 9057	21.80	21.16	97.13	15.16
SE _±	0.33	0.36	0.50	0.30
CD at 5%	NS	NS	1.53	0.92

SPAD: (Soil-Plant Analysis Development)

Physiological observation

Data presented in Table 4 revealed that, sugarcane variety CoM 0265 recorded significantly highest relative leaf water content (RLWC) at 120 DAP (82.05) however it was on par with variety MS 10001(80.67). At 150 DAP relative leaf water content (RLWC) (85.60) recoded significantly highest in variety MS 10001 it was found on par with CoM 0265(83.98). SPAD values at 120 DAP was found significantly higher in MS 10001(61.97) and found at par with CoM 0265(59.33). At 150 DAP SPAD values (77.98) was found significantly highest in sugarcane variety MS 10001 while it was found on par with CoM 0265(76.79), Co 86032 (76.12) and CoM 09057 (74.68).At 120 DAP number of green leaves recorded significantly highest in sugarcane variety MS 10001 (9.34). At 150 DAP number of green leaves was significantly highest in variety MS 10001 (10.99). Significantly the least number of dry leaves at 120 DAP were recorded by variety MS 10001 (1.38) and found at par with Co 86032(1.39) CoM 0265(1.52), and CoM 09057 (1.52). At 150 DAP significantly least number of dry leaves were recorded with variety Co 86032(1.92) and found at par with) MS 10001 (2.23) and CoM 09057 (2.23). [5] observed the effects of salinity on biosynthesis of sucrose in the leaf and its translocation to stalk for storage. Salinity regulates the activity of sugar metabolizing enzymes in

number of crops. It was reduced the activity of sucrose synthesis and starch phosphorylase and enhanced those of acid and neutral invertase [7].

Soil properties

The mean data on soil properties at harvest are presented in **Table 5A-5B**.

Table 4 Relative leaf water content (RLWC), SPAD, No. of green leaves and No. of dry leaves as affected by sugarcane varieties (Ratoon)

Treatments	RLWC		SPAD		No. of green leaves		No. of dry leaves	
	120DAP	150DAP	120DAP	150DAP	120DAP	150DAP	120DAP	150DAP
V ₁ - Co 86032	75.50	80.83	56.74	76.12	8.20	9.48	1.39	1.92
V ₂ -CoM 0265	82.05	83.98	59.33	76.79	8.55	9.92	1.52	2.39
V ₃ - Co 94012	77.55	77.71	53.37	70.88	7.77	8.72	2.48	2.56
V ₄ - Co C 671	72.36	72.65	51.27	69.19	7.68	8.29	2.65	2.75
V ₅ - MS10001	80.67	85.60	61.97	77.98	9.34	10.99	1.38	2.23
V ₆ - Co VSI 434	73.33	70.35	51.85	70.93	7.31	7.81	2.50	2.68
V ₇ -CoM 9057	73.44	82.01	55.71	74.68	7.89	9.00	1.52	2.23
SE _±	1.08	0.96	0.82	1.14	0.15	0.24	0.23	0.14
CD at 5%	3.29	2.92	2.51	3.45	0.46	0.73	0.70	0.43

Table 5A Initial soil status

No.	Parameter	Quantity	Remark
1.	pH _e	8.80	Sodic
2.	EC _e (dS/m)	1.70	
3.	ESP (%)	19.55	
4.	CaCO ₃ (%)	10.83	
5.	Ca (me/l)	1.16	
6.	Mg (me/l)	1.52	
7.	Na (me/l)	5.38	
8.	K (me/l)	0.1	
9.	CO ₃ (me/l)	0.1	
10.	HCO ₃ (me/l)	3.60	
11.	Cl (me/l)	3.06	
12.	SO ₄ (me/l)	0.91	
13.	SAR)	4.65	
	Exchangeable Cations		
	Na (meq/l)	6.46	
	K (meq/l)	0.51	
	Ca (meq/l)	24.0	
	Mg (meq/l)	22.29	
	CEC (meq/100g)	33.04	

Table 5B Mean data on soil properties at harvest (Pooled mean)

Treatment	pH	EC (dsm ⁻¹)	O.C. (%)	N (kg ha ⁻¹)	P ₂ O ₅ (kg ha ⁻¹)	K ₂ O (kg ha ⁻¹)
Initial	8.80	1.70	0.37	205.33	15.33	297.00
V ₁ - Co 86032	8.80	1.70	0.37	205.33	15.33	297.00
V ₂ -CoM 0265	8.83	1.72	0.43	210.67	16.67	304.67
V ₃ - Co 94012	8.81	1.69	0.43	214.33	19.00	300.33
V ₄ - Co C 671	8.82	1.73	0.41	203.67	13.00	298.00
V ₅ - MS10001	8.85	1.74	0.40	210.33	15.00	308.00
V ₆ - Co VSI 434	8.82	1.72	0.48	201.33	18.00	301.00
V ₇ -Co 9057	8.80	1.72	0.43	212.00	21.00	294.33

Conclusion

The sugarcane variety CoM 0265 produced significantly higher cane yield followed by MS10001 and variety MS10001 recorded significantly highest CCS yield among all seven genotypes tested in sodic soil.

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Publication History

Received 04th Jan 2019
Revised 28th Jan 2019
Accepted 08th Feb 2019
Online 28th Feb 2019

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