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Evaluation of Early Maturing Clones for Yield and Juice Quality in Sugarcane (*Saccharum officinarum* L.)

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ABSTRACT: A field experiment was conducted to evaluate the performance of three elite sugarcane clones (CoA 17321, CoA 17323 and CoC17336) and three standards (CoA 92081, CoC 01061 and CoOr 03151) at Regional Agricultural Research Station under AICRP at Regional Agricultural Research Station, Anakapalle in RBD with four replications during 2020-21 and 2021-22. The data on yield components, yield and quality parameters *viz*., Number of millable canes ('000/ha), Cane Yield (t/ha), CCS yield (t/ha), Brix (%), Sucrose (%), CCS (%), Purity (%), Pol % cane, Extraction percent, Fibre percent and yield components *viz*., single cane weight (kg), Cane length (cm) and cane girth (cm) was collected. The mean data over two plant (Plant I and II) and ratoon was analysed. The results revealed that the clone CoA 17321 recorded highest mean number of millable canes ('000/ha) of 109.40, mean cane yield (t/ha) of 120.47 and CCS yield (t/ha) of 15.16, significantly out yielded the best standard CoC 01061, recorded mean number of millable canes, cane yield and CCS yield (114.86, 99.80 and 11.94) respectively. Regarding quality parameters the same entry, CoA 17321 has recorded highest brix % (19.31), sucrose % (17.90), CCS % (12.56) and purity% (92.68) and is significantly superior to the standards CoC 01061 (19.29, 17.18, 11.92 and 89.03 respectively). Regarding Pol % cane the clone CoA 17321 has recorded highest mean pol % cane (13.55), Extraction % (50.79) and fibre percent (14.28). The clone recorded highest singe cane weight of 1.12 kg, cane length of 236.23cm and cane girth of 2.41cm.
The clone was found to be resistant to all races of Red rot under nodal method which indicates its field level tolerance. Based on the results obtained the clone CoA 17321 can be recommended for commercial cultivation in Andhra Pradesh for increased productivity.

Keywords: Brix, NMC, Cane Yield, Purity per cent, Red rot and Sucrose per cent.

INTRODUCTION

Sugarcane (*Saccharum officinarum* L.) is one of the most important industrial crop in India and second largest sugar producing country next to Brazil producing about 430.50 million tons of cane from an area of 5.09 million hectares with average productivity of 8.44 tons/ha. About 5 million farmers are involved in the cultivation of sugarcane and sugar industry contributes significantly to the rural economy by providing employment for nearly 4% of the rural population directly or indirectly. The sugar production depends on the sucrose content and yield of the variety. Plant Breeding exploits genetic variability for developing superior crop varieties. Creation of genetic variation and isolation of plant (s) having desirable combination of characters from the natural or the created variation are the two major steps in any crop improvement programme (Bonato *et al.*, 2006). Most of commercial varieties of sugarcane in India were developed either through bi-parental mating or through poly cross method or from general collection of open pollinated fluff.

Sugarcane crop experiences various types of biotic and abiotic stress, which effect the productivity (Nair, 2010). The production potential of the varieties is declining year by year due to its susceptibility to Red rot and Smut. Sugarcane accounts for more than 70% of the cost of production of sugar and hence the efficiency of sugar industry is mainly dependent upon the availability of improved sugarcane varieties with better juice quality and tolerance to biotic and abiotic stresses. Development of sustainable hybrids superior to the existing varieties assumes importance in Andhra Pradesh for high cane and sugar production. This was also possible by development of new, well adapted varieties and efficient crop production and crop protection technologies. Continuous research on selection and identification of promising new sugarcane clones for a particular agro-climatic situation through experimental field trial will be one of the appropriate approach for realizing sustainable sugarcane productivity without affecting the agro ecological balance. Keeping the above factors in view, the present investigation was programmed to spot out a suitable early season sugarcane clone for the recommendation in Andhra Pradesh.

MATERIALS AND METHODS

Field experiments were conducted at Regional Agricultural Research AICRP, Anakapalle, Acharya N.

G. Ranga Agricultural University. A set of three new promising sugarcane clones (CoA 17321, CoA 17323 *and CoC* 17336*)* against three standards (CoA 92081, CoC 01061 and CoOr 03151) were tested during two seasons 2020-21 and 2021-22 with two plant and one ratoon crop. The experiments were laid out in Randomized Block Design with three replications. The soils of the experimental site were sandy loams with clay base. All recommended package of practices were followed. Harvesting of the crop was done at the age of 10^{th} month.

Observations on yield components, yield and quality parameters *viz*., Number of millable canes ('000/ha), Cane Yield (t/ha), CCS yield (t/ha), Brix (%), Sucrose (%), CCS (%), Purity (%,), Pol% cane, Extraction percent, Fibre percent and yield components *viz*., single cane weight (kg), Cane length (cm) and cane girth (cm) were collected. Data on Millable cane population and cane yield were recorded at harvest. Cane samples were drawn at the time of harvest from each plot and crushed in a small power crusher and juice was analysed for brix (%), sucrose (%) and purity (%) as per the standard methods suggested by Meade and Chen (1977). The CCS% was worked based on the formula (Sucrose × 1.022) – (Brix × 0.292). The data collected on the above parameters was statistically analysed as per the procedure suggested by Panse and Sukhatme (1978) and presented in the Tables. Red rot reaction of this clone was evaluated under natural and artificial conditions with predominant red rot causing pathotypes CF 04, CF05 and CF 06 by nodal and plug method of inoculation. Smut reaction was also evaluated by standard procedure.

RESULTS AND DISCUSSION

The data on number of millable canes, cane yield and CCS yield were presented in Table 1. The results revealed that, among three test clones studied, the clone CoA 17321 recorded highest mean number of millable canes ('000/ha) of 109.40, mean cane yield (t/ha) of 120.47 and CCS yield (t/ha) was 15.16, significantly out yielded the best standard best standard CoC01061, recorded mean number of millable canes, cane yield and CCS yield (114.86, 99.80 and 11.94) respectively. The maximum number of millable cane production was obtained with this entry might have positively reflected upon cane yield. The data were in accordance with the findings of Manickam *et al*. (2004); Parusuram *et al*. (2011); Parihar (2020); Masri *et al*. (2022).

Regarding quality parameters the same entry, CoA 17321 has recorded highest Brix % (19.31), sucrose % (17.90), CCS % (12.56) and purity% (92.68) (table 2) and is significantly superior to the best standards CoC 01061 (19.29, 17.18, 11.92 and 89.03 respectively). Maximum cane yield and commercial cane sugar percent obtained with this entry might have combinedly resulted in increased sugar yield. The data were in accordance with the findings of Hogarth (1987); Berding *et al.* (2004); Parihar. (2020); Masri *et al.* (2022).

Regarding Pol % cane the clone CoA 17321 has recorded highest mean pol % cane (13.55), Extraction % (50.79) and fibre percent (14.28) presented in Table 3 and is superior over the best standards CoC 01061 (12.78, 46.72 and 15.54 respectively). As the pol percent in the cane represents the quantity of sugar in the sugar solution the sugar yield from the test clone may be high. The fibre percent in the clone also in medium range results in high juice extraction and less susceptible of lodging of the cane. High extraction percent nearly 50 per cent indicates the clone can be recommended for juice extraction for beverage.

The clone CoA 17321 recorded highest singe cane weight of 1.126 kg, cane length of 236.23cm and cane girth of 2.41cm (Table 4) while the standard CoC 01061 recorded 0.866 kg, 189.78 cm and 2.27 cm respectively. Higher cane length of the test clone, high single cane weight and higher cane girth resulted in the increased cane yield. The results were in accordance with Parihar (2020); Masri *et al*. (2022).

The clone, CoA 17321was found to be resistant to all races of Red rot under nodal method (Annual report 2014-15) indicating its field tolerance to the disease (Table 5) (Kishore Varma *et al*., 2020). It also recorded Moderate susceptibility to Smut and Wilt diseases. It has recorded resistant reaction to Yellow leaf disease at field level under natural conditions (Matsuoka *et al*., 1999). Based on the results obtained the clone CoA 17321 can be recommended for commercial cultivation in Andhra Pradesh.

Table 1: Mean performance of different early Sugarcane clones for Yield over two plant and one ratoon crops in AICRP yield trials, (2020-21 & 2021 –22).

Sr. No.	Clone No.	Number of millable canes ('000/ha)				Cane yield (t/ha)				CCS yield (t/ha)			
		Plant I	Plant II	Ratoon	Mean	Plant I	Plant II	Ratoon	Mean	Plant I	Plant II	Ratoon	Mean
1	**CoA17321**	100.54	122.28	105.38	109.40	119.55	129.81	112.04	120.47	14.86	17.15	13.46	15.16
2	**CoA 17323**	84.57	85.56	68.69	79.61	105.83	74.96	81.12	87.30	12.28	9.14	9.32	10.25
3	**CoC17336**	89.43	85.44	83.80	86.22	111.33	86.00	82.27	93.20	11.86	10.73	8.51	10.37
4	**CoA92081**	108.18	93.89	69.21	90.43	119.76	91.45	87.57	99.59	13.71	11.27	10.60	11.86
5	**CoC01061**	125.77	126.39	92.42	114.86	113.04	113.67	72.70	99.80	13.55	13.75	8.51	11.94
6	**CoOr 03151**	107.56	105.09	76.91	96.52	135.26	96.27	77.59	103.04	14.99	10.34	8.85	11.39
	Mean	102.68	103.11	82.74	96.18	117.46	98.69	85.55	100.57	13.54	12.06	9.88	11.83
	SE (m)	5.55	7.26	7.03		6.02	7.45	7.58		0.74	0.89	0.90	
	CD	16.72	21.87	21.19		18.14	22.45	22.85		2.23	2.69	2.71	
	CV	10.81	10.78	10.93		10.25	10.94	11.81		10.91	10.90	12.39	

Table 2: Mean performance of different early Sugarcane clones for Juice quality traits over two plant and one ratoon crops in AICRP yield trials, (2020-21 & 2021-22).

Sr. No.	Clone No.	Brix (%)				Sucrose (%)				CCS %				Purity %			
		Plant I	Plant II	Ratoon	Mean	Plant I	Plant II	Ratoon	Mean	Plant I	Plant II	Ratoon	Mean	Plant I	Plant II	Ratoon	Mean
1	**CoA17321**	19.26	19.43	19.25	19.31	17.69	18.76	17.26	17.90	12.45	13.21	12.01	12.56	91.84	96.55	89.65	92.68
2	**CoA 17323**	18.63	19.71	18.16	18.83	16.73	17.56	16.43	16.91	11.66	12.19	11.49	11.78	89.79	89.09	90.48	89.79
3	**CoC17336**	17.74	19.51	16.88	18.04	15.45	17.78	14.95	16.06	10.61	12.47	10.35	11.14	87.30	91.13	88.58	89.00
4	**CoA92081**	18.41	19.68	18.92	19.00	16.48	17.68	17.25	17.14	11.47	12.32	12.11	11.97	89.53	89.83	91.18	90.18
5	**CoC01061**	19.14	19.67	19.07	19.29	17.16	17.46	16.91	17.18	11.95	12.10	11.71	11.92	89.67	88.76	88.65	89.03
6	**CoOr 03151**	18.02	17.47	17.93	17.81	16.00	15.5	16.28	15.93	11.09	10.74	11.40	11.08	88.79	88.72	90.82	89.44
	Mean	18.53	19.25	18.37	18.72	16.59	17.46	16.51	16.85	11.54	12.17	11.51	11.74	89.49	90.68	89.89	90.02
	SE (m)	0.43	0.53	0.30		0.38	0.46	0.28		0.31	0.33	0.21		1.45	0.69	2.03	
	CD	1.29	1.59	0.91		1.13	1.40	0.85		0.91	0.98	0.63		4.38	2.07	6.12	
	CV	4.61	4.78	2.84		4.54	4.67	3.01		5.25	4.68	3.23		3.25	1.32	3.83	

Table 3: Mean performance of different early Sugarcane clones for quality parameters over two plant and one ratoon crops in AICRP yield trials, (2020-21 & 2021-22).

Sr. No.	Clone No.	Pol % cane (10 m)				Extraction % (10 m)				Fibre % (10 m)			
		Plant I	Plant II	Ratoon	Mean	Plant I	Plant II	Ratoon	Mean	Plant I	Plant II	Ratoon	Mean
1	**CoA17321**	13.59	13.97	13.08	13.55	52.29	50.72	49.36	50.79	13.18	15.48	14.18	14.28
2	**CoA 17323**	12.78	12.91	12.27	12.65	49.91	41.65	50.45	47.34	13.63	16.43	15.32	15.13
3	**CoC17336**	11.57	12.93	12.06	12.19	50.30	43.15	46.72	46.72	15.13	17.23	9.328	13.90
4	**CoA92081**	12.17	13.16	13.85	13.06	52.03	41.48	45.49	46.33	16.13	15.56	9.72	13.80
5	**CoC01061**	12.58	12.59	13.17	12.78	55.90	40.97	43.29	46.72	16.68	17.87	12.08	15.54
6	**CoOr 03151**	12.18	11.48	13.21	12.29	50.59	42.79	54.17	49.18	13.95	15.92	14.98	14.95
	Mean	12.48	12.84	12.77	12.70	51.84	43.46	48.25	47.85	14.78	16.41	12.60	14.60
	SE (m)	0.38	0.34	0.27		2.65	2.26	0.83		1.17	0.43	0.41	
	CD	1.16	1.01	0.84		8.00	6.81	2.50		3.54	1.30	1.23	
	CV	6.16	3.43	8.17		10.24	7.09	2.57		15.88	4.84	4.57	

Table 4: Mean performance of different early Sugarcane clones for yield components over two plant and one ratoon crops in AICRP yield trials, (2020-21 & 2021-22).

Sr. No.	Clone No.	Cane length (cm)				Cane girth (cm)				Single cane weight (kg)			
		Plant I	Plant II	Ratoon	Mean	Plant I	Plant II	Ratoon	Mean	Plant I	Plant II	Ratoon	Mean
1	**CoA17321**	229.83	205.54	273.33	236.23	2.30	2.16	2.77	2.41	1.264	1.054	1.06	1.126
2	**CoA 17323**	229.00	198.67	208.33	212.00	2.64	2.21	2.83	2.56	1.251	0.909	1.03	1.063
3	**CoC17336**	217.92	285.00	288.33	263.75	2.42	2.09	2.70	2.40	1.246	0.976	0.93	1.051
4	**CoA92081**	222.50	215.00	231.67	223.06	1.94	2.79	2.86	2.53	1.115	1.001	1.03	1.049
5	**CoC01061**	229.33	168.33	171.67	189.78	2.29	2.44	2.08	2.27	0.897	0.900	0.80	0.866
6	**CoOr 03151**	229.50	216.67	220.00	222.06	2.42	2.40	3.34	2.72	1.256	1.018	1.01	1.095
	Mean	226.35	214.87	248.89	230.04	2.33	2.35	2.76	2.48	1.17	0.98	0.98	1.043
	SE (m)	4.61	5.27	8.03		0.10	0.08	0.08		0.05	0.05	0.04	
	CD	13.88	15.89	24.19		0.31	0.25	0.25		0.16	0.14	0.13	
	CV	4.07	3.79	6.10		8.81	6.99	7.23		9.28	7.74	7.16	

Table 5: Reaction to different diseases at Regional Agricultural Research Station, Anakapalle.

Sr. No.	Clone No.	Red Rot						Smut	Wilt	YLD
		Nodal			Plug Method					
		CF04	CF05	CF06	CF04	CF05	CF06			
1	**CoA17321**	R	R	R	R	R	R	MS	MS	R
2	**CoA 17323**	R	R	R	R	R	R	HS	MS	R
3	**CoC17336**	R	R	R	R	R	R	S	MS	MR
4	**STANDARDS**									
5	**CoA92081**	R	R	R	R	R	R	HS	MS	R
6	**CoC01061**	S	S	S	MR	MR	MR	MR	MS	MS
7	**CoOr 03151**	R	R	R	MR	MR	MR	S	MR	MR

Source: Annual repot 2020-21 and 2021-22, Regional Agricultural Research AICRP, Anakapalle

CONCLUSIONS

The promising clone CoA 17321 recorded highest NMC, Cane Yield, single cane weight, CCS yield sucrose per cent and purity per cent over the best standards and can be recommended for commercial cultivation in Andhra Pradesh for increased productivity.

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