PERFORMANCE OF SUGARCANE VARIETAL IMPACT ON CANE YIELD, JUICE QUALITY AND SUGAR RECOVERY IN TROPICAL ZONE OF INDIA.

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Abstract: Two promising sugarcane clones, 2000A240 (Early) and 2000A241 (Midlate) were evolved from 79A 28 x CoA 7602. They were tested against three standards each (Early and Midlate) for their performance in station yield trials from 2013-14 to 2014-15 in two plant and one ratoon crops. The test clone 2000A240 recorded significantly higher cane and sugar yields (111.32 and 16.43 t/ha) over the best standard CoA 92081 (107.67 and 15.55 t/ha). For per cent juice sucrose, the test clone 2000A240 recorded higher per cent juice sucrose (18.61) when compared to two standards Co 6907 (17.61) and CoA 99082 (17.92) and CoA 92081 (18.59 per cent). CCS per cent was also high in 2000A240 (14.79) when compared to best standard CoA 92081 (14.52). The promising midlate clone 2000241 mustered an average cane and CCS yields (100.46 and 14.43t/ha) when compared to best standard CoV 92102 (92.95 and 13.48 t/ha) when tested over two plants and one ratoon crop. For per cent juice sucrose and CCS per cent the test clone 2000A241 (19.61 and 14.39) registered higher mean values but were on par with the best standard CoV 92102 (19.60 and 14.34) respectively. The two elite clones 2000A240 and 2000A241 recorded maximum cane length (287.67 and 260.00 cm), cane diameter (2.46 and 2.73 cm) and single cane weight (1.23 and 1.34 kg) respectively when compared to early standards Co 6907 (233.33cm, 2.10 cm and 1.04 kg), CoA 92081 (251.17cm, 2.10cm and 1.13 kg), CoA 99082 (251.17 cm, 2.02cm and 1.06 kg) and midlate standards CoV 92102 (247.00cm, 2.46cm and 1.22 kg), Co 7219 (254.00 cm, 2.48cm and 1.17 kg) and Co 86249 (227.00 cm, 2.20cm and 1.09 kg) respectively. The new clones were resistant to red rot and smut under natural and artificially inoculated conditions. In view of the extraneous behavior of these two clones for their sucrose per cent, sugar and cane yields not only contributes for high sugar recovery and also a big incentive to sugar industries of Tropical zone of India comprising of the states of Andhra Pradesh, Telangana, Orissa and Tamilnadu.

Keywords: Sugarcane-sucrose rich clones- higher cane yield-high sugar recovery- Tropical zone of India

Introduction: Sugarcane is one of the important commercial crops of the tropical and sub tropical regions and is the main source of sugar in India. It is grown in an area of 53.05 lakh hectares producing 3668.00 lakh tonnes of cane with a productivity of 69.9 tons/ha (2015-16) in India while it is grown in an area of 1.10 lakh hectares producing 77.70 lakh tonnes of cane with a productivity of 71.00 t/ha in Andhra Pradesh.

The major constrains of cane production in Andhra Pradesh state include moisture stress during formative phase under assured and limited irrigated situations, water logged conditions during monsoon period, frequent occurrence of insect pests and diseases, extension of cane cultivation in rainfed areas, lodging of crop due to cyclonic storms in coastal areas and non-adoption of recommended package of practices including fertilization. Cane yield, CCS yield, juice sucrose per cent and commercial cane sugar per cent are the important criteria to evolve new sugarcane varieties coupled with tolerance to biotic stresses. The early maturing sugarcane varieties are chosen in the beginning of crushing season for higher sugar recoveries. Besides, the influence of season which is less pronounced on early maturing varieties and in late planted conditions, growing of early maturing clones facilitate recovery of higher sugar yields (Lakshmi Kantham, 1984). The early and midlate varieties should be planted in a ratio of 60:40 so that in late crushing season mid late varieties will help not only for cane productivity but also realization of high sugar production in sugar industry.

Midlate and late maturing varieties are recommended for crushing during February- March and March- May respectively in the interest of getting higher sugar recoveries at any period of crushing. Hence, there is a need to increase the productivity by adapting midlate varieties since most of the factory areas were occupied by early varieties and a very few midlate varieties were under cultivation might be one of the reasons for low productivity in the state. To meet requirement of both the farmers and industry, it is always better to have more number of varieties with different maturity period so that proper and effective varietal scheduling can be practiced to provide quality cane to the factories throughout the crushing period.

Materials and Methods: The clones, 2000A240 (Early) and 2000A241 (Midlate) developed from 79A28 x CoA 7602. They were tested in the station yield trials from 2013-14 to 2014-15 in two plants and one ratoon crop consequently under early and midlate groups at Regional Agricultural Research

Station, Anakapalle. Each clone was grown in eight rows of eight meters length. The experiments were laid out in Randomized Block Design with three replications. All the recommended package of practices were adopted for raising a good and healthy crop. Data were recorded on morphological characters, NMC at harvest, length of millable canes, single cane weight and diameter of cane, juice quality parameters (sucrose and CCS per cent) were determined as per the standard procedure (Meade and Chen, 1971). Cane yield was recorded at harvest on plot basis and expressed in tons/hectare, sugar yield was estimated based on cane yield and CCS per cent. Reaction to diseases *viz.,* red rot and smut both under natural and artificial conditions was recorded against the mixed inoculation of three predominant pathotypes (Cf 419, Cf 671 and Cf 997) of red rot in Andhra Pradesh; Statistical analysis of data was carried out as per Panse and Sukhatme (1978).

Results and Discussions: Mean data on the performance of 2000A240 and 2000A241 for NMC, Cane yield, CCS yield, juice sucrose per cent, ccs per cent, yield components and reaction to diseases are furnished in Table

Mean data on the performance of 2000A240 for cane yield and CCS yield in two plant and one ratoon crops were presented in Table 1. The early clone gave a mean cane and CCS yields (111.32 and 16.43 t/ha) when compared to standards Co 6907 (89.95 and 11.88 t/ha), CoA92081 (107.67 and 15.55 t/ha) and CoA 99082 (99.67 and 12.74 t/ha) respectively. The per cent increase for cane and CCS yields over three standards was 23.75 & 38.30; 3.39 & 5.66 and 11.69 & 28.96 respectively.

Mean data on the performance of 2000A240 for per cent juice sucrose and CCS per cent in two plant and one ratoon crops was presented in Table 2. The clone recorded a mean juice sucrose and CCS per cent (18.61 and 14.79) and was on par with the best standard CoA 92081 (18.59 and 14.52) but significantly superior over the two standards Co 6907 (17.61 and 13.30) and CoA 99082 (17.92 and 12.83) respectively. The per cent increase for percent juice sucrose and CCS per cent over Co 6907 (4.66 &11.20), CoA92081 (0.11 &1.86) and CoA 99082 (2.85 & 15.28) respectively.

Mean data on the performance of 2000A241 for cane yield and CCS yield in two plant and one ratoon crops were presented in Table 3. The midlate clone gave a mean cane and CCS yields (100.46 and 14.43 t/ha) when compared to standards CoV 92102 (92.95 and 13.48 t/ha), Co 7219 (87.31 and 12.27 t/ha) and Co 86249 (83.67 and 10.19 t/ha) respectively. The per cent increase for cane and CCS yields over the standard CoV 92102 was (8.08 &7.05), Co 7219 (15.06 &17.60) and Co86249 (20.07 & 41.61) respectively.

Mean data on the performance of 2000A241 for per cent juice sucrose and CCS per cent in two plant and one ratoon crops was presented in Table 4. The clone recorded a mean juice sucrose and CCS per cent (19.61& 14.39) and was on par with the best standard CoV 92102 (19.60&14.34) but significantly superior over the two standards Co 7219 (19.27& 14.06) and Co 86249 (18.09 and 12.25) respectively. The per cent increase for percent juice sucrose and CCS per cent over the standard CoV 92102 (0.05 &0.35), Co 7219 (1.76&2.35) and Co 86249 (8.40& 17.47) respectively.

Performance of 2000A240 and 2000A241 for yield components: Mean performance of 2000A240 and 2000A241 in two plant and one ratoon crops for yield components were presented in Table 5. The two clones 2000A240 and 2000A241 recorded maximum cane length (287.67 and 260.00 cm), cane diameter (2.46 and 2.73 cm) and single cane weight (1.23 and 1.34 kg) respectively when compared to early standards Co 6907 (233.33cm, 2.10 cm and 1.04 kg), CoA 92081 (251.17cm, 2.10cm and 1.13 kg), CoA 99082 (251.17 cm, 2.02cm and 1.06 kg) and midlate standards CoV 92102 (247.00cm, 2.46cm and 1.22 kg), Co 7219 (254.00 cm, 2.48cm and 1.17 kg) and Co 86249 (227.00 cm, 2.20cm and 1.09 kg) respectively.

Reaction of promising clones to major diseases: Reaction of 2000A240 and 2000A241 for red rot under natural and artificial conditions and for smut under artificial condition was evaluated and presented in Table 6. The clone 2000A240 showed resistant reaction both under nodal and plug methods of inoculation, while the standard Co 6907 showed susceptible reaction, while the two standards CoA 92081 and CoA 99082 recorded resistant reaction for red rot. Where as the midlate clone 2000A241 recorded resistant reaction while the standards CoV 92102 and Co 86249 were resistant for red rot both under nodal and plug methods of inoculation. The clones 2000A240 and 2000A241 noted resistant reaction for smut, where as the early standards Co 6907, 87A298, CoA 99082 and midlate standards Co 7219 were susceptible to smut while the midlate standards CoV 92102 and Co 86249 recorded resistant reaction.

Conclusion: There is a need to identify suitable and better performing early maturity with high sucrose sugar and cane yields in the state as early maturity varieties like Co 6907and CoA 99082 occupied a little area being cultivated in the state. Most promising clone i.e. CoA 92081 which was occupied in large area of about 60.00 per cent is being affected by smut in ratoons and hence sugar mills are not encouraging the variety. It is well known that early maturing sugar rich varieties are comparatively lower in their tonnage but they are ideal for early and later part of

planting and inclusion of such varieties would also help in high sugar recovery.

With regard to midlate varieties, a few midlate maturity clones are under farmers fields as well as in sugar factory operational areas. Hence to strengthen the varietal scheduling programme it would be necessary to have more number of varieties in the midlate group for high sugar production and high sugar recovery.

The two promising early and midlate clones 2000A240 and 2000A241 with erect non lodging growth habit desirable morphological characters, higher sugar yield, rich in sucrose, CCS per cent and resistant to red rot and smut. In view of the extraneous behavior of these two clones for their sucrose per cent, sugar and cane yields, not only contributes for high sugar recovery and also a big incentive to sugar industrial areas of the Tropical zone of India comprising of the states of Andhra Pradesh, Telangana, Orissa and Parts of Tamilnadu.

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2000A240 (CoA11323)

2000A241(CoA07322)

Table 1: Performance of 2000A240(Early) in station yield trials for cane yield and Sugar Yield (t/ha)

S. No	Clone	Cane yield			Mean	Per cent increase over checks for cane yield(t/ha)	Sugar yield(t/ha)			Mean	Per cent increase over checks for Sugar yield yield(t/ha)
		P1	P2	R			PI	P2	R		
1	2000A240	112.30	123.00	98.67	111.32		17.00	17.28	15.00	16.43	
	Standards										
1	Co 6907	96.85	98.00	75.00	89.95	**23.75**	11.88	12.96	10.86	11.88	**38.30**
2	CoA 92081	118.00	110.00	95.00	107.67	**3.39**	15.85	15.95	14.85	15.55	**5.66**
3	CoA 99082	109.00	102.00	88.00	99.67	**11.69**	12.86	13.50	11.85	12.74	**28.96**
	CD (0.05)	18.00	14.04	16.06	-		0.86	1.81	1.70		
	CV (%)	8.00	7.80	8.89	-		8.50	10.70	9.50		

Table 2: Performance of 2000A240(Early) in station yield trials for per cent juice sucrose and CCS per cent

S.No	Clone	Per Cent Juice Sucrose			Mean	Per cent increase over checks for per cent juice sucrose	CCS per cent			Mean	Per cent increase over checks for CCS per cent
		P1	P2	R			PI	P2	R		
1	2000A240	18.00	18.90	18.92	18.61		15.13	14.05	15.20	14.79	
	Standards										
1	Co 6907	17.50	17.58	17.76	17.61	**4.66**	12.21	13.22	14.48	13.30	**11.20**
2	CoA 92081	18.00	18.86	18.90	18.59	**0.11**	13.43	14.50	15.63	14.52	**1.86**
3	CoA 99082	17.80	17.95	18.00	17.92	**2.85**	11.80	13.23	13.47	12.83	**15.28**
	CD (0.05)	0.61	0.81	1.10	-		0.62	0.70	1.08		
	CV (%)	1.12	2.00	3.08	-		1.98	1.88	2.46		

Table 3: Performance of 2000A241(Midlate) in station yield trials for cane yield and Sugar Yield (t/ha)

S.No	Clone	Cane yield			Mean	Per cent increase over checks for cane yield(t/ha)	Sugar yield(t/ha)			Mean	Per cent increase over checks for Sugar yield yield(t/ha)
		P1	P2	R			PI	P2	R		
1	2000A241	101.41	110.00	90.00	100.46		14.54	15.50	13.26	14.43	
	Standards										

1	CoV 92102	98.85	100.00	80.00	92.95	**8.08**	14.07	14.60	11.76	13.48	**7.05**
2	Co 7219	94.94	95.00	72.00	87.31	**15.06**	13.37	13.28	10.16	12.27	**17.60**
3	Co 86249	95.00	88.00	68.00	83.67	**20.07**	11.20	10.60	8.78	10.19	**41.61**
	CD (0.05)	6.30	5.70	8.89	-		1.93	2.51	3.02	-	
	CV (%)	9.53	7.21	11.33	-		10.00	8.83	9.15	-	

Table 4: Performance of 2000A241(Midlate) in station yield trials for per cent juice sucrose and CCS

S.No	Clone	Cane yield			Mean	Per cent increase over checks for per juice sucrose (t/ha)	Sugar yield(t/ha)			Mean	Per cent increase over checks for CCS percent (t/ha)
		P1	P2	R			PI	P2	R		
1	2000A241	19.84	19.00	20.00	19.61		14.34	14.09	14.73	14.39	
	Standards										
1	CoV 92102	19.00	19.80	20.00	19.60	**0.05**	14.23	14.38	14.40	14.34	**0.35**
2	Co 7219	19.54	18.82	19.45	19.27	**1.76**	14.08	13.98	14.12	14.06	**2.35**
3	Co 86249	17.80	18.00	18.46	18.09	**8.40**	11.79	12.05	12.91	12.25	**17.47**
	CD (0.05)	0.61	1.70	0.89	-		0.81	0.61	1.92	-	
	CV (%)	1.18	2.34	1.35	-		2.11	1.19	3.03	-	

Table 5: Performance of 2000A240 and 2000A241 for Yield components

Stalk length (cm)					**Stalk Diameter (cm)**				**Single cane weight (Kg)**			
Clone	**I Plant**	**II Plant**	**Ratoon**	**Mean**	**I Plant**	**II Plant**	**Ratoon**	**Mean**	**I Plant**	**II Plant**	**Ratoon**	**Mean**
2000A240	292.00	310.00	261.00	287.67	2.49	2.55	2.35	2.46	1.33	1.27	1.09	1.23
Standards												
Co 6907	264.00	255.00	181.00	233.33	2.11	2.10	2.08	2.10	1.07	1.04	1.01	1.04
CoA 92081	250.00	274.50	229.00	251.17	2.23	1.92	2.15	2.10	1.23	1.06	1.09	1.13
CoA 99082	260.00	261.50	215.00	245.50	2.04	2.16	1.85	2.02	1.10	1.17	1.00	1.09
CD (0.05)	1.23	1.18	1.22	-	1.08	1.02	1.00	-	.089	1.05	1.08	-
CV (%)	4.50	5.11	4.28	-	4.86	3.22	4.54	-	3.02	4.22	5.03	-
Stalk length (cm)					**Stalk Diameter (cm)**				**Single cane weight (Kg)**			
Clone	**I Plant**	**II Plant**	**Ratoon**	**Mean**	**I Plant**	**II Plant**	**Ratoon**	**Mean**	**I Plant**	**II Plant**	**Ratoon**	**Mean**
2000A241	263.00	271.00	247.00	260.00	2.85	2.85	2.49	2.73	1.363	1.42	1.23	1.34
Standards												
CoV 92102	235.00	262.00	243.00	247.00	2.58	2.47	2.32	2.46	1.36	1.23	1.07	1.22
Co 7219	257.00	268.00	236.00	254.00	2.65	2.60	2.19	2.48	1.20	1.20	1.10	1.17
Co 86249	239.00	238.00	205.00	227.00	2.28	2.25	2.07	2.20	1.13	1.13	1.01	1.09
CD (0.05)	0.20	0.36	0.94	-	0.23	0.44	0.19	-	0.07	0.14	0.14	-
CV (%)	5.30	4.43	4.64	-	6.10	5.46	2.74	-	3.80	3.78	4.22	-

Table 6: Disease reaction of 2000A240(Early clone) and 2000A241 (Midlate clone) for major Diseases

S. No	Clone	Nodal method			Plug method			Smut
		Cf 419	Cf 671	Cf 997	Cf 419	Cf 671	Cf 997	
1	2000A240	R	R	R	R	R	R	R
	Standards							
1	Co 6907(C)	R	R	R	HS	HS	HS	HS
2	CoA 92081 (C)	R	R	R	R	R	R	HS
3	CoA 99082 (C)	R	R	R	R	R	R	S
S. No	Clone	Nodal method			Plug method			Smut
		Cf 419	Cf 671	Cf 997	Cf 419	Cf 671	Cf 997	
1	2000A241	R	R	R	R	R	R	R
	Standards							
1	CoV 92102	R	R	R	R	R	R	R
2	Co 7219	R	R	R	I	I	S	HS
3	Co 86249	R	R	R	R	R	R	S

I – Intermediate, R- Resistant, S- Susceptible, HS – Highly susceptible

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