

Sugarcane Clones with High Physiological Efficiency for Moisture Stress Conditions

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ABSTRACT

Fourteen pre release sugarcane clones were tested against sugarcane variety Co 6907 for their suitability to early planted conditions (December / January planting) under moisture stress / drought at Regional Agricultural Research Station, Anakapalle during 2015-16 & 2016-17. Among fourteen pre release clones tested sugarcane clones 2006A 223 (71.04 t/ha) and 2000A 225 (69.8 t/ha), 2003A 255 (69.32 t/ha), 2009A 107 (66.72 t/ha) and 2007A 81 (69.65 t/ha) and CoC 01061 (65.29 t/ha) recorded higher cane yield and on par with standard. All these clones are significantly on par with each other and tolerance to red rot and smut diseases, whereas Co 6907 is susceptible to smut disease. These clones also recorded significantly low SLA on par with standard Co 6907 which indicates more photosynthetic assimilates per unit area. SPAD / SCMR values at 120 DAP under stress conditions (Summer). Sugarcane clones 2000A 225, 2003A 225, 2006A 223, 2009A 107, CoC 01061 and 2007A 81 recorded significantly higher SPAD values with standard Co 6907. The ancillary data denoting stress tolerance like sheath moisture per cent, root spread area, total bio mass production per stool under stress and physiological parameters like leaf proline content & SOD activity under stress conditions is also high in sugarcane clones 2000A 225, 2003A 255, 2006A 223, 2009A 107, 2007A 81 and CoC 01061 over standard Co 6907. Based on two years of finding sugarcane clones 2000A 225, 2009A 107, 2007A 81, 2006A 223, 2003A 255 and CoC 01061 were found to suitable for drought/ soil moisture stress condition of cane cultivation based on cane yield, ancillary data and physiological traits in relation to moisture stress tolerance.

Key words: Moisture stress / drought / limited irrigations, SPAD / SCMR, leaf proline, SOD (super oxide dismutase) activity, cane yield, per cent juice sucrose, root spread area, Number of millable canes and Fibre percent.

INTRODUCTION

Sugarcane is grown under soil moisture stress / drought conditions in sizeable area under early planting (December – January) in North

Coastal districts in addition to rainfed cane cultivation. Nearly 40-50% of cane cultivation of North Coastal zone is under moisture stress conditions /rainfed cane cultivation.

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The crop experiences moisture stress at all crop growth stages. Moisture stress affects germination, cane length, cane diameter, single cane weight, cane elongation, biomass production, NMC, cane yields under early planted rainfed conditions. (Raja Rajeswari et al., 2003 & 2009) The cane yields obtained are ranged from 40 - 45 t/ha under moisture stress conditions. SPAD /SCMR values, SOD values and carbon isotope discrimination values indices of moisture stress tolerance in field conditions. High values of SPAD and other ancillary parameters with cane yield of sugarcane was recorded high under moisture stress conditions (Sujatha & Jhansi, 2016). Present study was conducted involving 14 pre release clones including the standard Co 6907 to identify a high yielding clone coupled with tolerance to suitable for early planted conditions (December / January) under moisture stress. Planting early with 2 or 3 life irrigations and leaving to soil moisture stress conditions with trash mulching is also a practice in some of the parts of North Coastal zone.

MATERIALS AND METHODS

Fourteen promising pre release clones were studied with Co 6907 under early planted moisture stress conditions at Regional Agricultural Research Station, Anakapalle during 2015-16 & 2016-17. The design adopted was RBD with 2 replications. Each clone was planted in six rows of eight meters length with spacing of 80 cms between rows. Date of planting was in the month of January 2015 and 2016. Trash mulching @ 3t/ha was done at 3rd day after planting. Management of early shoot borer and white fly was carried out by spraying Monochrotophos @ 1.6ml/lt and biologically controlled with using *Trichocards*. A fertilizer dose of 112 kg N + 100 kg P₂O₅ + 120 Kg K₂O / ha was adopted. Nitrogen was applied into two equal splits at 45 and 90 DAP and P&K was applied as basal. Detrashing and spreading on dried leaves was carried out in between two rows to conserve soil moisture after cessation of rains. Data was recorded on cane yield, per cent juice sucrose,

ancillary data (Meade & Chen, 1971) and NMC at harvest, SCMR values at 120 DAP, leaf proline and SOD at 120 DAP were recorded adopting standard procedures (Dhopte & Manuel Livera, 1989).

RESULTS AND DISCUSSION

The pooled analysed data of 2015-16 and 2016-17 on cane yield, yield components other quality parameters with ancillary data are given in Table 1. The results obtained are presented on character wise.

Shoot population: The data on tiller production at formative stage under stress varied from 92.77 000/ha (2006A 223) to 137.53 000/ha (CoC 0102). Among 14 sugarcane clones tested CoC 01061 recorded significantly higher tiller production over standard Co 6907 (106.98 000/ha).

Number of Millable canes: Number of millable canes were high in sugarcane clone CoC 01061 (111.45 000/ha) followed by 2004A 55 (92.86 000/ha) which is on par with standard Co 6907 (84.89 000/ha).

Per cent juice sucrose: The cane quality in terms of per cent juice sucrose was ranged from 16.98% (2007A 126) to 21.18% (CoC 01061). Sugarcane clone CoC 01061 (21.18) recorded higher per cent juice sucrose over other clones tested and on par with the check Co 6907 (19.2%).

Specific leaf area (Cm² /g): The parameter indicating assimilation of photosynthates in leaf is SLA (cm²/g). It is ranged from 100.20 cm²/g (2001A 70) to 208.40 cm²/g (2004A 65). The SLA of sugarcane clones 2000A 225 (115.47 cm²/g), 2003A 255 (114.69 cm²/g), 2006A 223 (110.68 cm²/g), 2009A 107 (107.67) and 2007A 81 recorded low SLA over other clones tested and standard Co 6907 (118.67 cm²/g) which indicated more photosynthetic assimilates per unit area under stress conditions.

Root spread area: Among 14 sugarcane clones tested the root spread area at 120 DAP (stress conditions) ranged from 813 cm² (2009A 107) to 2137.2 cm² (CoC 01061). Sugarcane clones 2000A 225 (1366.5 cm²), 2009A 223 (1541.85 cm²), 2007A 130

(1532.85 cm²) and 2001A 63 (1136.65 cm²) recorded higher root spread area over other clones tested. The standard Co 6907 recorded a root spread area of 1082 cm².

Total bio mass production per stool (g/stool): The dry meter production at 120 DAP (under stress) in sugarcane clones tested is ranged from 912 g/stool (2007A 22) to 2589.95 g/stool (2007A 81). The dry meter production at 120 DAP at formative stage (under stress) was high in 2007A 81 (2589.95 g/stool) followed 2001A 63 (1997.3 g/stool), 2007A 130 (1740.25 g/stool), 2000A 225 (1507.25 g/stool) and by 2001A 70 (1319.8 g/stool) which are significantly superior over standard Co 6907 (1079.7 g/stool).

Sheath moisture per cent: Per cent moisture in sheath which is an important trait for moisture stress studies was ranged from 68 per cent (CoC 01061) to 71.75 per cent (2006A 223). Higher sheath moisture per cent under stress was recorded in sugarcane clones 2007A 161(71.95) followed by 2006A 223 (71.75%) which are on par with standard Co 6907 (69.45 %).

Leaf proline (μ moles /g fresh weight): Leaf proline content which is an important physiological drought tolerance denoting trait ranged from 72.2 moles /g fresh weight (2007A 126) to 172.69 μ moles /g fresh weight (2003 A 255). High leaf proline content recorded in 2003A 255 (172.69 μ moles /g fresh weight) followed by CoC 01061(151.99 moles /g fresh weight), 2001A 63 (136.83 μ moles /g fresh weight) which area superior over standard Co 6907 (116.9 % moles /g fresh weight).

Super oxide dismutase (SOD) activity (OD min./g): It is a prominent enzymatic Physiological triat in relation to moisture stress tolerance. It is ranged from 0.16 OD min./g (2007A 22) to 0.45 OD min./g (2004A 47). SOD activity was high in 2001A 227 (0.45 OD min./g) and 2001A 70 (0.44 OD min./g)

followed by 2001A 223 (0.44 OD min./g) and CoC 01061 (0.41 OD min./g) which indicates drought tolerance nature of sugarcane clones under moisture stress conditions.

SPAD / SCMR values: The values of SPAD / SCMR of sugarcane clones tested are ranged from 28.6 (Co 6907) to 38.0 (2003A 255). The SPAD / SCMR values of sugarcane clones 2000A 225 (37).25, 2007A 22 (36.05), 2006A 223 (35.20) are superior to the standard Co 6907 (28.95).

SPAD recovery: SPAD recovery at 180 DAP after on set of monsoon, the per cent SPAD recovery is ranged from 6.94% (2003A 255) to 152.4 (2006A 223). Highest SPAD recovery was in sugarcane clone 2006A 223 (152.4) followed by 2000A 225 (99.13%). The SPAD recovery percent of standard Co 6907 is at 78.71 per cent.

Fibre per cent: The fibre percent of sugarcane clones ranged from 11.36 % (2007A 81) to 16.72 (2007A 22). Highest fibre percent was recorded in 2007A 22 (16.72%) followed by 2001A 70 (15.77%) and CoC 01061 (14.50%). The fibre percent of standard Co 6907 is at 13.43%.

Cane yield: Among 14 sugarcane clones tested cane yield was high in 2006A 223 (71.04 t/ha) and 2003A 255 (69.32 t/ha) which are significantly onpar with check Co 6907 (69.22 t/ha) followed by sugarcane clones 2007A 81 (69.65 t/ha), 2000A 225 (69.0 t/ha), 2000A 107 (66.72 t/ha), CoC 01061 (65.29 t/ha), 2000A 241 (64.9 t/ha) and 2004A 55 (64.35 t/ha) recorded higher cane yield over other clones tested and on par with the check Co 6907 (66.22 t/ha).

Similar type of findings on performance of sugarcane clones under stress situation and moisture stress conditions of sugarcane was also studied and reported by Raja Rajeswari et al. (2009), Mukunda Rao et al. (2017) and Sujatha and Jhansi, 2016.

Table1: Cane yield, Yield attributed and physiological parameters of sugarcane clones under soil moisture stress / drought conditions under early planting (December / January) – Pooled data of 2015-16 & 2016-17

Sugarcane variety	Root spread area/stool (Cm ²) at 150 DAP	% Leaf sheath moisture (at 120 DAP)	SPAD / SCMR values (at 120 DAP)	SPAD recovery at 180 DAP (%)	Total biomass / stool (g) (at 150 DAP)	SLA (Cm ² / g.) (at 120 DAP)	Shoot population (000'/ha) (at 150 DAP)	NMC (000'/ha)	Cane yield (t/ha)	Sucrose (%)	Fibre (%)	Leaf proline (at 120 DAP)	SOD (OD min./g.) (at 120 DAP)
2004 A 55	879.00	70.20	32.70	44.34	1431.95	208.40	121.41	92.86	64.35	19.57	12.31	93.60	0.36
2000 A 225	1366.15	65.95	37.25	99.13	1507.25	115.47	105.43	86.47	69.81	20.68	10.80	169.03	0.44
2003 A 255	1032.15	69.60	38.00	6.94	1413.25	114.69	104.83	85.44	69.32	20.09	11.87	172.69	0.39
2006 A 223	1541.85	71.75	35.20	152.41	1224.10	110.68	92.77	76.62	71.04	19.98	12.29	124.59	0.41
Co 6907 (C)	1082.00	69.45	28.55	78.71	1079.70	118.67	106.98	84.89	66.22	19.86	13.43	116.90	0.39
2007 A 126	705.85	66.90	29.90	83.77	1251.10	127.08	103.55	82.85	65.23	16.98	13.00	72.22	0.30
2007 A 161	597.50	71.95	30.10	25.09	1006.45	137.51	111.15	81.81	62.66	18.58	11.44	126.25	0.38
2001 A 63	1136.65	68.80	31.60	15.06	1997.30	130.21	98.87	78.50	63.58	19.49	11.67	136.83	0.41
2009 A 107	813.00	70.45	37.70	21.63	1343.55	107.67	110.26	83.39	66.72	19.28	11.29	89.78	0.45
2007 A 130	1532.85	70.75	29.45	13.00	1740.25	134.54	99.81	78.54	65.82	18.38	12.67	123.15	0.41
2007 A 22	569.15	70.75	36.15	13.02	912.40	129.78	108.31	86.20	63.77	18.09	16.72	110.24	0.16
2001 A 70	1069.00	70.85	34.00	48.24	1319.80	100.20	108.39	84.91	62.50	19.85	15.77	171.81	0.44
2007 A 81	869.85	68.25	31.95	42.91	2589.95	119.66	111.46	92.63	69.65	20.15	11.36	101.29	0.34
Co C 0161	2137.15	68.00	31.15	4.59	1186.68	126.68	137.53	111.45	65.29	21.18	14.50	151.99	0.41
SEm±	97.30	1.22	0.85	-	151.00	9.52	5.14	5.09	2.27	0.74	0.92	4.16	
CD (0.05)	291.57	3.73	2.55	-	461.65	29.08	15.32	15.12	6.83	2.28	2.81	12.54	

CONCLUSIONS

Under early planted stress conditions, sugarcane clones 2009A 107, 2006A 223, 2000A 225, 2003A 255 and CoC 01061 are found suitable for cane cultivation compared to Co 6907 under moisture stress situations based on physiological efficiency, cane yield and quality parameters in relation to ancillary yield parameters and stress tolerance traits.

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