Biological Forum – An International Journal



13(4): 292-296(2021)

ISSN No. (Print): 0975-1130 ISSN No. (Online): 2249-3239

Sugarcane Clones Suitable for Moisture Stress/Drought Conditions under Early Planting (December/January)

Mukunda Rao Ch^{1*}, Rao P.S.¹, Charumathi M.², Bharathalakshmi M.³ and Jamuna P.⁴ ¹Principal Scientist, Department of Crop Physiology, ANGRAU, RARS, Anakapalle-531001, (Andhra Pradesh), India. ²Principal Scientist, Department of Plant Breeding, ANGRAU, RARS, Anakapalle-531001, (Andhra Pradesh), India. ³Associate Director of Research, (RARS ×) RARS, ANGRAU, RARS, Anakapalle-531001, (Andhra Pradesh), India. ⁴Principal Scientist, Department of Soil Science, ANGRAU, RARS, Anakapalle-531001, (Andhra Pradesh), India.

> (Corresponding author: Mukunda Rao Ch*) (Received 09 August 2021, Accepted 18 October, 2021) (Published by Research Trend, Website: www.researchtrend.net)

ABSTRACT: Fifteen 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 2018-19 and 2019-20. Sugarcane clones tolerance to moisture stress is need of the hour as sugarcane yields are drastically reducing due to moisture stress/drought. A field experiments were conducted with stress and non stress treatments for evaluation of sugarcane clones tolerance to soil moisture stress/drought. Among fifteen pre release clones tested sugarcane clones 2009A 107 (80.2 t/ha), 2006A 223 (79.50 t/ha), 2009A 252 (76.42 t/ha), 2011A 313 (72.64 t/ha) and 2011A 252 (71.48 t/ha) recorded higher cane yield over other clones tested. The standards 87A 298 and 83V 15 recorded a cane yield of 71.08 t/ha and 58.13 t/ha which are lower than the superior clones. These clones also recorded significantly low SLA which indicates more photosynthetic assimilates per unit area. SPAD/SCMR values at 120 DAP under stress conditions (Summer). These sugarcane clones also recorded significantly higher SPAD/SCMR values with standard 87A 298. 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 is also high in these sugarcane clones. Based on two years findings, sugarcane clones 2009A 107, 2006A 223, 2009A 252, 2011A 313 and 2011A 252 were found to be 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. The drought tolerance efficiency per cent was high in 2009A 107 (95.37%) followed by 2009A 252 (86.39%) and 2011A 252 (84.92%) over other clones tested. The standards 87A 298 and 83V 15 recorded a drought tolerance efficiency per cent of 85.38 and 84.53 respectively.

Keywords: Moisture stress/drought/limited irrigations, SPAD/SCMR, leaf proline, cane yield, per cent juice sucrose, root spread area, Number of millable canes and Fibre per cent.

INTRODUCTION

On industrial scale over 103 countries are producing white sugar using sugarcane and sugar beet as raw material. (FAO STAT, 2018). In India UP, Karnataka and Maharashtra are the three states accounted for more than 80% of Indian sugar production (Bhakshiram 2021). AP stands 11th position in area and production and 10th position in productivity in the country (Anonymous 2021a). 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. 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 and cane yields under early planted rainfed conditions (Raja Rajeswari et al. 2003 and 2009). The relative water content (RWC) of sugarcane leaves of susceptible varieties to drought is lower than the tolerance once (Rayes et al. 2021). An abiotic or biotic stress in growing phase in the period of rapid growth, cane drastically reduces the yield as well as affects the potential for re growth and longevity of sugarcane crop (Manimekalai et al., 2021). The cane yields obtained are ranged from 40 - 45 t/ha under moisture stress conditions of Andhra Pradesh. SPAD/SCMR values, SOD values and carbon isotope discrimination values indices of moisture stress tolerance in field conditions (Mukunda Rao et al., 2021a). High values of SPAD and other ancillary parameters with cane yield of sugarcane were recorded high under moisture stress conditions (Sujatha and Jhansi, 2016; Mukunda Rao et al. 2017). Under drought management sugarcane variety also plays an important role along with other management practices to mitigate the yield loss to some extent (Mukunda Rao et al., 2021b).

In A.P., sugarcane varieties 87 A 298 and 2003 V 46 are the leading varieties occupying considerable area of

Rao et al.,

sugarcane which were released nearly 15 years back. Now due to degeneration of existing good varieties there is a dire need of ample number of new sugarcane varieties especially with drought tolerance and higher cane yield and quality. Abiotic stresses which are common factors lowering yields of AP. Under this circumstances this study was initiated with 15 pre releasing sugarcane clones under an objective to identify sugarcane clones tolerance to moisture stress/drought during crop season.

MATERIAL AND METHODS

Fifteen promising pre release clones were studied with 87A 298 as check variety under early planted moisture stress conditions at Regional Agricultural Research Station, Anakapalle during 2018-19 and 2019-20. 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 2018 and 2019. Moisture stress I₀ treatment was imposed by withholding irrigation from March, 15th except two life irrigations at 10 DAP and 40 DAP till harvesting of sugarcane, where as check I₁ (Normal) treatment was imposed by need based monthly one irrigation from planting to harvesting of cane. Trash mulching @ 3 t/ha was done at 3rd day after planting. Soils are of light to medium texture with low to medium N and medium P and K nutrient status. Crop was raised by following all good management practices. 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 \times) P and K was applied as basal. Detrashing and spreading of 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 and Chen, 1971) and NMC at harvest, SCMR values at 120 DAP and leaf proline at 120 DAP were recorded by adopting standard procedures (Dhopte and Manuel Livera, 1989), duly following soil moisture data at formative stage during summer months. Statistical analysis was carried out by methods given by Panse and Sukhatme (1978).

RESULT AND DISCUSSION

The analyzed data of 2018-19 and 2019-20 on cane yield, yield components and other quality parameters with ancillary day are given in Table 1. The results obtained are presented on character wise. The rainfall data during crop growth period of 2018-19 and 2019-20 is given in Fig. 1 and 2.

Table 1: Performance of sugarcane clones under limited irrigated conditions (Early planting).

Sugarcan	e	Tiller population (000'/ha) (at 120 DAP)			SPAD / SCMR values (at 120 DAP/ stress)			SLA at 120 DAP (cm ²)			Percent leaf sheath moisture at 120 DAP			ure L	Leaf proline (µ moles) at 120 DAP		
variety	1	L _o	I ₁	Mean	I ₀	I ₁	Mean	I ₀	I ₁	Mean	I ₀	I ₁	Me	ean	I ₀	I_1	Mean
2011A 175	5 70	.62	75.58	72.60	36.0	47.3	41.65	134.82	131.94	133.38	69.30	68.07	7 68.	.69 12	26.94	81.0	103.97
2011A 252	2 59	.40	75.68	67.54	35.9	37.3	36.60	112.67	151.07	131.87	70.76	71.34	4 71.	.05 14	18.03	95.72	121.87
2011A 260	0 64	.57	72.27	68.42	39.9	42.1	41.00	140.17	176.35	158.26	68.95	70.58	8 69.	.77 12	21.69	77.63	99.66
2011A 262	2 70	.51	78.43	74.47	47.4	51.1	49.25	76.44	158.47	117.46	72.76	76.33	3 74.	.55 9	5.63	71.25	83.44
2006A 102	2 11	7.04	119.57	118.31	44.2	39.4	41.80	107.45	127.35	117.40	53.45	73.08	3 63.	.07 9	0.85	68.81	79.83
2006A 223	3 74	.14	89.98	82.06	40.2	37.7	38.95	124.33	208.49	166.41	72.73	73.09	9 72.	.91 7	9.13	64.78	71.96
2009A 107	7 57	.92	65.56	61.77	40.2	45.7	42.95	98.75	147.48	123.12	68.61	72.19	9 70.	.40 12	9.38	73.13	101.26
2010A 229	9 71	.06	79.55	75.31	45.8	31.3	38.55	120.19	139.63	138.41	70.98	74.63	3 72.	.81 12	29.85	80.44	105.15
87A298 (C	C) 79	.64	86.35	82.99	26.2	31.1	28.65	108.15	148.09	128.11	67.09	70.03	3 68.	.56 14	8.97	88.13	118.55
2009A 252	2 61	.05	78.76	69.91	42.3	45.1	43.70	88.61	145.11	116.86	69.32	76.03	3 72.	.68 10	07.72	71.16	89.44
2011A 222	2 85	.91	100.87	93.39	43.1	40.7	41.90	130.15	153.55	142.10	67.58	71.82	2 69.	.70 5	9.07	52.69	55.88
2011A 319	9 75	.46	75.06	73.26	37.8	40.8	39.30	136.05	165.23	150.65	71.94	73.90	5 74.	.94 11	5.22	67.88	91.55
2011A 313	3 91	.41	93.94	92.68	33.5	40.6	37.05	136.57	178.17	157.37	70.72	72.31	1 71.	.52 9	2.44	61.88	77.16
2011A 294	4 90	.20	107.03	98.62	34.0	34.5	34.25	113.34	120.88	117.08	72.50	74.72	2 73.	.64 6	7.13	53.07	60.10
83V 15 (C	C) 88	.22	90.64	89.43	41.93	47.2	44.59	148.02	150.46	149.24	71.55	72.10) 71.	.83 12	25.94	80.07	102.76
Mean	77	.14	85.68		39.23	40.79		118.3	153.48		69.22	72.69	Ð	10	9.17	72.49	
	SE	lm±	CD (0.05)		SEm±	CD (0.05)		SEm±	CD (0.05)		SEm±	CD (0.05)	S	Em±	CD (0.05)	
I	1.	27	3.68		0.47	1.30		2.68	8.39		0.30	0.92		2	2.45	7.08	
V	3.	49	10.09		1.29	3.73		4.16	12.34		0.42	1.18		e	5.70	19.39	
$I \times V$	N	IS	-		1.52	5.28		NS	-		NS	-		1	0.48	27.43	
														1	Root stru	cture stud	y
		umber of millable canes at harvest (000 ha)						Drought Sucrose (%) Delerance ciency (%			Fibre (%)			Root spread area/stool (Cm ²) at 120 Total biomass stool (g) (at 12			
Sugarcane variety	Numbe at h	r of milla arvest (0	able canes 00 ha)	с	ane yield (1	t/ha)	Drought tolerance efficiency (%	s.	Sucrose (%)	F	ibre (%)		Root s area/ (Cm ²)	pread stool at 120	Total b stool (g	iomass /) (at 120
Sugarcane variety	Numbe at h	r of milla arvest (0 I ₁	able canes 00 ha) Mean	C	ane yield (1	t/ha) Mean	Drought tolerance efficiency (%	5 I0	Sucrose (%) Mean	F I ₀	Fibre (%)	Mean	Root s area/ (Cm ²) D/	pread stool at 120 AP	Total b stool (g D	iomass /) (at 120 AP)
Sugarcane variety 2011A 175	Numbe at h I ₀ 59.83	r of milla arvest (0 <u>I₁</u> 62.25	able canes 00 ha) Mean 61.04	C I ₀ 59.85	ane yield (1	t/ha) Mean 69.13	Drought tolerance efficiency (% 76.32	5 I ₀ 16.48	Sucrose (%) <u>Mean</u> 18.09	H I 13.24	Tibre (%) <u>I₁</u> 10.76	Mean 12.00	Root s area/ (Cm ²) DA 943	pread stool at 120 AP .33	Total b stool (g D/ 73	iomass /) (at 120 AP)
Sugarcane variety 2011A 175 2011A 252	Numbe at h <u>I₀</u> 59.83 54.45	r of milla arvest (0 <u>I₁</u> <u>62.25</u> 53.92	ble canes 00 ha) Mean 61.04 54.19	C I ₀ 59.85 65.65	ane yield (1 <u>I1</u> <u>78.41</u> 77.30	Mean 69.13 71.48	Drought tolerance efficiency (% 76.32 84.92	I ₀ I6.48 16.61	Sucrose (% I1 19.71 16.55) <u>Mean</u> 18.09 16.58	I ₀ 13.24 15.76	I1 10.76 9.07	Mean 12.00 12.42	Root s area/ (Cm ²) DA 943 744	pread stool at 120 AP .33 .00	Total b stool (g DA 73 88	iomass /) (at 120 AP) 22.8 7.30
Sugarcane variety 2011A 175 2011A 252 2011A 260	Numbe at h 59.83 54.45 50.79	r of milla arvest (0 <u>I1</u> <u>62.25</u> <u>53.92</u> <u>57.74</u>	Mean 61.04 54.26	C <u>I0</u> <u>59.85</u> <u>65.65</u> <u>50.34</u>	I 1 78.41 77.30 75.20	Mean 69.13 71.48 62.77	Drought tolerance efficiency (% 76.32 84.92 66.94	I ₀ 16.48 16.61 16.67	Sucrose (% I ₁ 19.71 16.55 18.66) Mean 18.09 16.58 17.66	I ₀ 13.24 15.76 14.88	I ₁ 10.76 9.07 13.36	Mean 12.00 12.42 14.12	Root s area/ (Cm ²) D/ 943 744 1460	pread stool at 120 AP 	Total b stool (g D/ 73 88 57-	iomass /) (at 120 AP) 32.8 7.30 4.50
Sugarcane variety 2011A 175 2011A 252 2011A 260 2011A 262	Numbe at h 59.83 54.45 50.79 46.63	r of milla arvest (0 <u>I1</u> <u>62.25</u> <u>53.92</u> <u>57.74</u> <u>55.14</u>	Mean 61.04 54.19 54.26 50.89	I ₀ 59.85 65.65 50.34 56.20	I 1 78.41 77.30 75.20 78.10	Mean 69.13 71.48 62.77 67.15	Drought tolerance efficiency (% 76.32 84.92 66.94 71.95	I ₀ I6.48 I6.61 16.67 14.84	Sucrose (% 11 19.71 16.55 18.66 13.52) Mean 18.09 16.58 17.66 14.18	I ₀ 13.24 15.76 14.88 16.70	I1 10.76 9.07 13.36 11.64	Mean 12.00 12.42 14.12 14.17	Root s area/ (Cm ²) DA 943 744 1460 805	pread stool at 120 AP 	Total b stool (g D/ 73 88 88 57 58	iomass /) (at 120 AP) 22.8 7.30 4.50 9.90
Sugarcane variety 2011A 175 2011A 252 2011A 260 2011A 262 2006A 102	Numbe at h 59.83 54.45 50.79 46.63 52.53	r of milla arvest (0 <u>I1</u> <u>62.25</u> <u>53.92</u> <u>57.74</u> <u>55.14</u> <u>56.35</u>	Mean 61.04 54.19 54.26 50.89 54.44	C I ₀ 59.85 65.65 5 0.34 5 6.20 4 6.52	I 1 78.41 77.30 75.20 78.10 58.90	Mean 69.13 71.48 62.77 67.15 52.71	Drought tolerance efficiency (% 76.32 84.92 66.94 71.95 78.98	I 0 16.48 16.61 16.67 14.84 12.86	I ₁ 19.71 16.55 18.66 13.52 15.50) Mean 18.09 16.58 17.66 14.18 14.18	I ₀ 13.24 15.76 14.88 16.70 14.69	I1 10.76 9.07 13.36 11.64 14.78	Mean 12.00 12.42 14.12 14.17 14.73	Root s area/ (Cm ²) D4 943 744 1460 805 985	pread stool at 120 AP 	Total b stool (g D/ 73 88 88 57 58 103	iomass /) (at 120 AP) 22.8 7.30 4.50 9.90 44.50
Sugarcane variety 2011A 175 2011A 252 2011A 260 2011A 262 2006A 102 2006A 223	Numbe at h 59.83 54.45 50.79 46.63 52.53 54.62	r of milla arvest (0 53.92 57.74 55.14 56.35 62.43	Mean 61.04 54.19 54.26 50.89 54.44 58.53	C I ₀ 59.85 65.65 50.34 56.20 46.52 66.00	I 1 78.41 77.30 75.20 78.10 58.90 93.0	Mean 69.13 71.48 62.77 67.15 52.71 79.50	Drought tolerance efficiency (% 76.32 84.92 66.94 71.95 78.98 70.96	Ic.48 16.61 16.67 14.84 12.86 19.74	I 1 19.71 16.55 18.66 13.52 15.50 17.68) Mean 18.09 16.58 17.66 14.18 14.18 14.18 18.71	I0 I3.24 15.76 14.88 16.70 14.69 16.27 16.27	I1 10.76 9.07 13.36 11.64 14.78 12.68	Mean 12.00 12.42 14.12 14.17 14.73 14.48	Root s area/ (Cm ²) D4 943 744 1460 805 985 1104	pread stool at 120 AP 	Total b stool (g D/ 73 88 88 57 58 103 70	iomass /) (at 120 AP) 22.8 7.30 4.50 9.90 44.50 2.40
Sugarcane variety 2011A 175 2011A 252 2011A 260 2011A 260 2006A 102 2006A 223 2009A 107	Numbe at h 59.83 54.45 50.79 46.63 52.53 54.62 51.84	r of milla arvest (0 53.92 57.74 55.14 56.35 62.43 55.56	Mean 61.04 54.19 54.26 50.89 54.44 58.53 53.70	C 10 59.85 65.65 50.34 56.20 46.52 66.00 78.32	I1 78.41 75.20 78.10 58.90 93.0 82.12	Mean 69.13 71.48 62.77 67.15 52.71 79.50 80.22	Drought tolerance efficiency (% 76.32 84.92 66.94 71.95 78.98 70.96 95.37	Io Io 16.48 16.61 16.67 14.84 12.86 19.74 16.79 16.79	I1 19.71 16.55 18.66 13.52 15.50 17.68 17.34	Mean 18.09 16.58 17.66 14.18 14.18 14.18 18.71 17.06	I0 13.24 15.76 14.88 16.70 14.69 16.27 12.59	I1 10.76 9.07 13.36 11.64 14.78 12.68 12.75	Mean 12.00 12.42 14.12 14.17 14.73 14.48 12.67	Root s area/ (Cm ²) D/ 943 744 1460 805 985 1104 1490	pread stool at 120 AP 	Total b stool (g D/ 73 88 57 58 103 70 120	iomass /) (at 120 AP) 22.8 7.30 4.50 9.90 44.50 2.40 88.50
Sugarcane variety 2011A 175 2011A 252 2011A 260 2011A 260 2006A 102 2006A 102 2009A 107 2010A 229	Numbe at h 59.83 54.45 50.79 46.63 52.53 54.62 51.84 51.67	I1 62.25 53.92 57.74 55.14 56.35 62.43 55.56	Mean 61.04 54.19 54.26 50.89 54.44 58.53 53.70 54.12	C 59.85 65.65 50.34 56.20 46.52 66.00 78.32 56.40	I1 78.41 77.30 75.20 78.10 58.90 93.0 82.12 66.60	 Mean 69.13 71.48 62.77 67.15 52.71 79.50 80.22 61.50 	Drought tolerance efficiency (% 76.32 84.92 66.94 71.95 78.98 70.96 95.37 84.68	Io Io 16.48 16.61 16.67 14.84 12.86 19.74 16.79 12.59	I1 19.71 16.55 18.66 13.52 15.50 17.68 17.34 14.15 14.15	Mean 18.09 16.58 17.66 14.18 14.18 14.18 18.71 17.06 13.37	I0 I3.24 15.76 14.88 16.70 14.69 16.27 12.59 15.95 15.95	I1 10.76 9.07 13.36 11.64 14.78 12.68 12.75 14.20	Mean 12.00 12.42 14.12 14.73 14.73 14.48 12.67 15.08	Root s area/ (Cm ²) D/ 943 744 1466 805 985 110 1492 1709	(c) nucl pread stool at 120 AP .33 .00 5.67 .83 .33 4.00 3.33 9.33	Total b stool (g D2 73 88 57 58 103 70 120 153	iomass /) (at 120 AP) 22.8 7.30 4.50 9.90 44.50 2.40 88.50 66.70
Sugarcane variety 2011A 175 2011A 252 2011A 252 2011A 262 2006A 102 2006A 102 2006A 223 2009A 107 2010A 229 87A298(C)	Numbe at h 59.83 54.45 50.79 46.63 52.53 54.62 51.84 51.67 51.14	r of milla arvest (0 53.92 57.74 55.14 56.35 62.43 55.56 56.06 65.89	Mean 61.04 54.19 54.26 50.89 54.44 58.53 53.70 54.12 58.52	Logical Content of Con	I1 78.41 77.30 75.20 78.10 58.90 93.0 82.12 66.60 66.10	Mean 69.13 71.48 62.77 67.15 52.71 79.50 80.22 61.50 61.22	Drought tolerance efficiency (% 76.32 84.92 66.94 71.95 78.98 70.96 95.37 84.68 85.38	Ic.48 16.61 16.67 14.84 12.86 19.74 16.79 12.59 17.73	I1 19.71 16.55 18.66 13.52 15.50 17.68 17.34 14.15 17.78	Mean 18.09 16.58 17.66 14.18 14.18 14.18 18.71 17.06 13.37 17.75	I₀ 13.24 15.76 14.88 16.70 14.69 16.27 12.59 15.95 18.04	I1 10.76 9.07 13.36 11.64 14.78 12.68 12.75 14.20 13.21	Mean 12.00 12.42 14.12 14.17 14.73 14.48 12.67 15.08 15.63	Root s area/ (Cm ²) DA 943 744 1466 8055 9855 1100 1492 1709 1083	Control pread stool at 120 AP .33 .00 5.67 .83 .33 4.00 3.33 9.33 5.67	Total b stool (g D/ 73 88 57 58 103 700 120 153 94	iomass /) (at 120 AP) 22.8 7.30 4.50 9.90 44.50 2.40 88.50 66.70 3.10
Sugarcane variety 2011A 175 2011A 252 2011A 260 2011A 260 2006A 102 2006A 102 2006A 223 2009A 107 2010A 229 87A298(C) 2009A 252	Numbe at h 59.83 54.45 50.79 46.63 52.53 54.62 51.84 51.67 51.14 54.79	r of milla arvest (0 53.92 57.74 55.14 56.35 62.43 55.56 56.06 65.89 63.82	Mean 61.04 54.19 54.26 50.89 54.44 58.53 53.70 54.12 58.52 59.31	C <u>I</u> ₀ <u>59.85</u> <u>65.65</u> <u>50.34</u> <u>56.20</u> <u>46.52</u> <u>66.00</u> <u>78.32</u> <u>56.44</u> <u>70.84</u>	I1 78.41 77.30 75.20 78.10 58.90 93.0 82.12 66.60 66.10 82.00 82.00	Mean 69.13 71.48 62.77 67.15 52.71 79.50 80.22 61.50 61.22 76.42	Drought tolerance efficiency (% 76.32 84.92 66.94 71.95 78.98 70.96 95.37 84.68 85.38 86.39	I0 I6.48 16.61 16.67 14.84 12.86 19.74 16.79 16.259 17.73 16.67 16.67	I1 19.71 16.55 18.66 13.52 15.50 17.68 17.34 14.15 17.78 19.33 19.33	Mean 18.09 16.58 17.66 14.18 14.18 14.18 14.18 17.06 13.37 17.75 18.00	I I 13.24 15.76 14.88 16.70 14.69 16.27 15.95 15.95 18.04 16.43	I1 10.76 9.07 13.36 11.64 14.78 12.75 14.20 13.21 10.14	Mean 12.00 12.42 14.12 14.17 14.73 14.67 15.08 13.29	Root s area/ (Cm ²) 943 744 1466 805 9855 9855 9109 1499 1709 1088	(c)nue pread stool at 120 AP	Total b stool (g D2 73 88 57: 58: 103 70: 120: 155: 94:	iomass /) (at 120 AP) 22.8 7.30 4.50 9.90 44.50 2.40 8.850 66.70 3.10 8.50
Sugarcane variety 2011A 175 2011A 252 2011A 252 2011A 262 2006A 102 2006A 223 2009A 102 2009A 252 2010A 229 2010A 222 2011A 201 201 201 201 201 201 201 201 201 201	Numbe at h 59.83 54.45 50.79 46.63 52.53 54.62 51.84 51.62 51.14 54.79 43.85	r of milla arvest (0 <u>I</u> <u>62.25</u> 53.92 57.74 55.14 56.35 <u>62.43</u> 55.56 <u>55.56</u> <u>65.89</u> 63.82 52.88	Mean 61.04 54.12 54.26 50.89 54.44 58.53 53.70 54.22 59.31 48.36	C 59.85 65.65 50.34 56.20 46.52 66.00 78.32 56.40 56.44 56.44 56.44 56.40	I1 78.41 77.30 75.20 78.10 58.90 93.0 82.12 66.60 66.60 66.80 58.00	Mean 69.13 71.48 62.77 67.15 52.71 79.50 80.22 61.50 61.52 76.42 50.02	Drought tolerance efficiency (% 76.32 84.92 66.94 71.95 78.98 70.96 95.37 84.68 85.38 86.39 72.50	Io Io 16.48 16.61 16.64 16.67 14.84 12.86 19.74 16.79 12.59 17.73 16.67 18.51	I1 19.71 16.55 18.66 13.52 15.50 17.68 17.34 14.15 17.78 19.33 15.50	Mean 18.09 16.58 17.66 14.18 14.18 14.18 17.06 13.37 17.75 18.00 17.00	I0 13.24 15.76 14.88 16.70 14.69 16.27 12.59 15.95 18.04 16.43 17.31	I1 10.76 9.07 13.36 11.64 14.78 12.68 12.75 14.20 13.21 10.14	Mean 12.00 12.42 14.12 14.17 14.73 14.67 15.08 15.53	Root s area/ (Cm ²) DA 943 943 943 943 943 945 985 985 985 985 985 985 985 985 985 98	Control pread stool at 120 AP .33 .00 5.67 .83 .33 .33 .33 .33 .33 .33 .33 .00 .67 .67 .67	Total b stool (g D2 73 88 103 58 103	iomass /) (at 120 AP) 22.8 4.50 9.90 44.50 2.40 88.50 66.70 3.10 88.50 88.50
Sugarcane variety 2011A 175 2011A 252 2011A 262 2006A 102 2006A 223 2009A 107 2010A 229 87A298(C) 2009A 252 2011A 319	Numbe at h 59.83 54.45 50.79 46.63 52.53 54.62 51.84 51.67 51.14 54.79 43.85 54.62	r of milla arvest (0 <u>I</u> <u>62.25</u> 53.92 57.74 55.14 56.35 <u>62.43</u> 55.66 <u>65.89</u> <u>63.82</u> 52.88 <u>60.52</u>	Mean 61.04 54.19 54.26 50.89 54.44 58.53 53.70 54.12 58.52 59.31 48.36 57.57	C <u>I</u> ₀ <u>59.85</u> <u>50.34</u> <u>56.20</u> <u>46.52</u> <u>66.00</u> <u>78.32</u> <u>56.40</u> <u>56.44</u> <u>56.44</u> <u>70.84</u> <u>42.05</u> <u>52.16</u>	I1 78.41 78.41 77.30 75.20 78.10 58.90 93.0 93.0 82.12 66.60 66.10 82.00 58.00 90.00 90.00	Mean 69.13 71.48 62.77 67.15 52.71 79.50 80.22 61.50 61.22 76.42 50.02 71.08	Drought tolerance efficiency (% 76.32 84.92 66.94 71.95 78.98 70.96 95.37 84.68 85.38 86.39 72.50 57.96	Io Io 16.48 16.61 16.67 14.84 12.86 19.74 16.79 12.59 17.73 16.67 18.51 18.50	I1 19.71 16.55 18.66 13.52 15.50 17.68 17.34 14.15 17.78 19.33 15.50 11.94	Mean 18.09 16.58 17.66 14.18 14.18 18.71 17.06 13.37 17.75 18.00 17.00 15.22	I0 13.24 15.76 14.88 16.70 14.69 16.27 12.59 15.95 18.04 16.43 17.31 14.55	I1 10.76 9.07 13.36 11.64 14.78 12.68 12.75 14.20 13.31 10.14 13.74	Mean 12.00 14.12 14.17 14.73 14.48 12.67 15.08 13.29 15.53 13.92	Root s area/ (Cm ²) D/ 943 744 1466 8055 9855 1100 1499 1700 1088 1088 1088 154	Control pread stool at 120 AP .33 .00 5.67 .83 .33 0.33 5.67 .67 1.67 1.33	Total b stool (g D2 73 88 57% 578 103 70 120 94 833 755 113	iomass /) (at 120 AP) 22.8 4.50 9.90 44.50 2.40 8.50 8.50 8.50 8.50 41.50
Sugarcane variety 2011A 175 2011A 252 2011A 252 2011A 262 2006A 102 2006A 223 2009A 102 2009A 225 2011A 222 2011A 319 2011A 313	Numbe at h 59.83 54.45 50.79 46.63 52.53 54.62 51.84 51.67 51.14 54.79 43.85 54.62 47.85	r of milla arvest (0 62.25 53.92 57.74 55.14 56.35 62.43 55.06 65.89 63.82 52.88 60.52 53.40	Mean 61.04 54.19 54.26 50.89 54.44 58.53 53.70 54.12 58.52 58.52 59.31 48.36 57.57 55.63 55.63	C I ₀ 59.85 65.65 50.34 56.20 46.52 66.00 78.32 56.40 78.32 56.44 42.05 52.16 49.28	I1 78.11 78.11 77.30 75.20 78.10 58.90 93.0 82.12 66.60 66.60 68.200 58.00 90.00 96.00 96.00	Mean 69.13 71.48 62.77 67.15 52.71 79.50 80.22 61.50 61.22 76.42 50.02 71.08 72.64	Drought tolerance efficiency (% 76.32 84.92 66.94 71.95 78.98 70.96 95.37 84.68 85.38 86.39 72.50 57.96 51.33	Ie Ie 16.48 16.61 16.67 14.84 12.86 19.74 16.79 12.59 17.73 16.67 18.51 18.50 17.60 17.60	I1 I9.71 19.71 16.55 18.66 13.52 15.50 17.68 17.34 14.15 19.50 15.50 11.94 18.55	Mean 18.09 16.58 17.66 14.18 14.18 17.06 13.37 17.75 18.00 17.00 15.22 18.07	I0 13.24 15.76 14.88 16.70 14.69 16.27 12.59 15.95 18.04 16.43 17.31 14.55 18.13	I1 10.76 9.07 13.36 11.64 14.78 12.68 12.75 14.20 13.21 10.14 13.74 13.28 15.46	Mean 12.00 12.42 14.12 14.17 14.73 14.48 12.67 15.03 13.29 15.53 13.92 16.80	Root s area/ (Cm ²) DA 943 744 943 744 1466 8055 985 110 149: 170% 108 154 152:	Condition pread stool at 120 AP	Total b storal b <td< td=""><td>iomass /) (at 120 AP) 22.8 7.30 4.50 9.90 44.50 2.40 88.50 66.70 3.10 8.50 8.50 11.50 8.10</td></td<>	iomass /) (at 120 AP) 22.8 7.30 4.50 9.90 44.50 2.40 88.50 66.70 3.10 8.50 8.50 11.50 8.10
Sugarcane variety 2011A 175 2011A 252 2011A 260 2006A 102 2006A 102 2006A 223 2009A 107 2010A 229 2010A 229 2011A 252 2011A 252 2011A 313 2011A 294	Numbe at h 59.83 54.45 50.79 46.63 52.53 54.62 51.84 51.67 51.14 54.79 43.85 54.62 43.85 54.62 47.85	r of milla arvest (0 1, 62.25 53.92 57.74 55.14 56.35 62.43 55.56 62.43 55.56 62.43 55.56 62.88 63.82 52.88 60.52 53.40 58.78	Mean 61.04 54.26 50.89 54.41 54.26 50.89 54.41 58.53 53.70 54.12 58.51 59.31 48.36 57.57 55.63 51.58	C I ₀ 59.85 65.65 50.34 56.20 46.52 66.00 78.32 56.40 78.32 56.44 42.05 52.16 49.28 51.84	Ii 78.41 77.30 75.20 78.10 58.90 93.0 82.12 66.60 66.10 82.00 58.00 90.00 96.00 63.40 63.40	Mean 69.13 71.48 62.77 67.15 52.71 79.50 80.22 61.50 61.22 76.42 50.02 71.08 72.64 57.62	Drought tolerance efficiency (% 76.32 84.92 66.94 71.95 78.98 70.96 95.37 84.68 85.38 86.39 72.50 57.96 51.33 81.76	I₀ I₀ 16.48 16.61 16.61 16.67 14.84 12.86 19.74 16.79 12.59 17.73 16.67 18.51 18.50 17.60 17.91 17.91	I1 19.71 16.55 18.66 13.52 15.50 17.34 14.15 17.78 19.33 15.50 11.94 18.55 19.45	Mean 18.09 16.58 17.66 14.18 14.18 14.18 13.37 17.75 18.00 17.00 15.22 18.07 18.68	Io Io 13.24 15.76 14.88 16.70 14.68 16.27 15.95 18.04 16.43 17.31 14.55 18.13 16.72 16.72	Ii 10.76 9.07 13.36 11.64 14.78 12.68 12.75 14.20 13.31 10.14 13.74 13.28 15.46 15.27	Mean 12.00 12.42 14.12 14.17 14.73 14.48 12.67 15.08 13.29 15.53 13.92 16.80 15.99	Root s area/ (Cm ²) D4 943 944 1460 805 985 1100 1492 1700 1088 1084 154 1522 104	Onder pread stool at 120 AP .33 .00 5.67 .83 .33 .00 5.67 .667 .33 .00 .33 .00 .33 .00 .33 .00 .33 .00 .33 .00 .33 .03 .67 .67 .67 .1.33	Total b stress) Total b strong b Dz 72 88 57-7 103 103 103 700 120 94 833 755 113 113 766 73'	iomass /) (at 120 AP) 12.8 7.30 4.50 9.90 44.50 2.40 18.50 16.70 3.10 8.50 8.50 11.50 8.10 9.20
Sugarcane variety 2011A 175 2011A 250 2011A 260 2006A 102 2006A 102 2006A 223 2009A 107 2010A 229 87A298(C) 87A298(C) 2009A 252 2011A 313 2011A 313 2011A 294 83V 15 (C)	Numbe at h 59.83 54.45 50.79 46.63 52.53 54.62 51.84 51.67 51.14 54.79 43.85 54.62 47.85 44.37 54.79	r of milla arvest (0 62.25 53.92 57.74 55.14 56.35 55.66 56.06 65.89 63.82 52.88 60.52 53.40 58.78 63.82	bible canes 00 ha) Mean 61.04 54.19 54.26 50.89 54.24 58.53 53.70 54.12 58.52 59.31 48.36 57.57 55.63 51.58 59.31	C I ₀ 59.85 65.65 50.34 56.20 66.00 78.32 56.44 70.84 42.05 52.16 52.16 52.16 52.18 49.28 51.84 53.26	I1 78.41 77.30 75.20 78.11 77.30 75.20 78.10 78.90 93.0 82.12 66.60 66.610 82.00 58.00 90.00 90.00 96.00 63.40 63.00	Mean 69.13 71.48 62.77 67.15 52.71 79.50 80.22 61.50 61.22 76.42 50.02 71.08 72.64 55.62 58.13	Drought tolerance efficiency (% 76.32 84.92 71.95 78.98 70.96 95.37 84.68 85.38 86.39 72.50 57.96 51.33 81.76 84.53	Io Io Io.48 16.61 16.67 14.84 12.86 19.74 16.79 12.59 17.73 16.67 18.50 18.50 17.60 17.91 17.51 17.51	I1 19.71 16.55 18.66 13.52 15.50 17.68 17.34 14.15 17.78 19.33 15.50 11.94 18.55 19.45 19.45 19.45 19.45	Mean 18.09 16.58 17.66 14.18 18.71 17.06 13.37 18.00 17.00 15.22 18.07 18.68 18.68 18.70	Io Io 13.24 15.76 14.88 16.70 14.69 16.27 12.59 15.95 18.04 16.43 17.31 14.55 18.13 16.72 13.55 13.55	I1 10.76 9.07 13.36 11.64 14.78 12.68 12.75 14.20 13.21 10.14 13.74 13.25 15.46 15.27 13.39	Mean 12.00 12.42 14.12 14.17 14.73 14.48 12.67 15.08 15.63 13.29 15.53 13.92 16.80 15.99 13.47	Root s area/ area/ (Cm ²) DA 9433 744 1466 805 9855 1100 1088 154 2155 1522 1522 1044 1434	Condensity pread stool at 120 AP .33 .00 5.67 .83 .33 .00 5.67 .83 .33 .00 5.67 .83 .33 .33 .33 .33 .33 .33 .33 .33 .33 .33 .33 .33 .33 .33 .67 .67 .33 .33 .67 .33 .33 .33 .60	Total b stoal (g D/ 73 88 57. 57. 103 70. 120 75: 75: 75: 75: 75: 75: 76: 773: 80:	iomass /) (at 120 AP) i2.8 7.30 4.50 9.90 2.40 8.50 6.70 3.10 8.50 11.50 8.10 9.20 5.20
Sugarcane variety 2011A 175 2011A 250 2011A 260 2006A 102 2006A 223 2009A 272 2010A 229 87A298(C) 2001A 212 2011A 319 2011A 313 2011A 294 83V 15 (C) Mean	Numbe at h 59.83 54.45 50.79 46.63 52.53 54.62 51.84 51.67 51.14 54.79 43.85 54.62 47.85 44.37 54.79 51.58	r of milla arvest (0 1, 62.25 53.92 57.74 55.14 56.35 62.43 55.56 62.43 55.56 62.43 55.06 65.89 63.82 52.88 60.52 53.40 58.78 63.82 58.62	Mean 61.04 54.26 54.26 54.26 54.26 54.26 54.26 54.26 54.26 54.26 54.26 54.26 54.26 54.26 54.21 58.52 59.31	C 59.85 50.34 56.25 50.34 46.52 56.40 56.44 42.05 52.16 49.28 51.84 53.86 53.84 53.86 56.37	Ii 78.41 77.30 75.20 75.20 78.10 58.90 93.0 82.12 66.60 66.60 58.00 90.00 58.00 96.00 63.40 63.40 63.40 63.20 75.21	Mean 69.13 71.48 62.77 67.15 52.71 79.50 80.22 61.50 61.22 76.42 50.02 71.08 72.64 57.62 58.13	Drought tolerance efficiency (% 76.32 84.92 66.94 71.95 78.98 70.96 95.37 84.68 85.38 85.38 85.38 72.50 57.96 51.33 81.76 84.53 74.95	I0 I0 16.48 16.61 16.67 14.84 12.86 19.74 16.79 12.59 17.73 16.67 18.51 18.50 17.60 17.91 17.51 16.73	I1 19.71 16.55 18.66 13.52 15.50 17.68 17.34 14.15 17.33 15.50 11.94 18.55 19.45 19.45 19.45 17.04 17.04	Mean 18.09 16.58 17.66 14.18 14.18 14.18 17.06 13.37 17.75 18.00 17.00 15.22 18.07 18.68 18.70	I0 13.24 15.76 14.88 16.70 14.69 15.95 15.95 18.04 16.43 17.31 14.55 18.13 16.72 13.55 15.65	I1 10.76 9.07 13.36 11.64 14.78 12.68 12.75 14.28 13.21 10.14 13.74 13.28 15.46 15.27 13.39 12.91	Mean 12.00 12.42 14.12 14.73 14.48 12.67 15.08 15.63 13.29 15.53 13.92 16.80 15.99 13.47	Root s area/ area/(Cm²) D/ D/ D/ 9433 744 1466 805 9855 1104 1492 1709 1084 1084 154: 2153 152: 1024 104: 1436	Condet pread stool at 120 AP .33 .00 5.67 .83 .33 .03 .33 .67 .1.33 .000	Total b stol (g) 73 88 102 73 88 103 70 72 152 152 152 94 833 75: 76: 73: 80:	iomass /) (at 120 AP) 22.8 7.30 4.50 9.90 2.40 88.50 66.70 3.10 88.50 11.50 8.10 9.20 5.20
Sugarcane variety 2011A 175 2011A 250 2011A 260 2006A 102 2006A 102 2006A 223 2009A 107 2010A 229 87A298(C) 2009A 252 2011A 319 2011A 313 2011A 344 83V 15 (C) Mean	Numbe at h 59.83 54.45 50.79 46.63 52.53 54.62 51.84 51.67 51.14 54.79 43.85 54.62 47.85 54.62 47.85 54.79 51.58 SEm±	r of milla arvest (0 <u>I</u> 1 <u>62.25</u> <u>53.92</u> <u>57.74</u> <u>55.14</u> <u>55.14</u> <u>56.35</u> <u>62.43</u> <u>55.66</u> <u>65.89</u> <u>63.82</u> <u>52.88</u> <u>60.52</u> <u>53.40</u> <u>58.78</u> <u>63.82</u> <u>58.62</u> <u>CD</u> (0.05)	Mean 61.04 54.26 50.89 54.26 50.89 54.44 58.53 53.70 54.26 57.57 55.63 51.58 59.31	C 59.85 65.65 50.34 56.20 46.52 66.00 78.32 56.40 56.44 42.05 52.16 49.28 51.84 53.26 56.37 SEm±	Ii 78.41 77.30 75.20 78.10 58.90 93.0 82.12 66.60 66.10 66.60 58.00 90.00 96.00 96.00 63.40 63.40 63.40 75.21 CD	Mean 69.13 71.48 62.77 67.15 52.71 79.50 80.22 61.50 61.50 61.50 61.60 71.08 72.64 57.62 58.13	Drought tolerance efficiency (% 76.32 84.92 66.94 71.95 78.98 70.96 95.37 84.68 85.38 86.39 72.50 57.96 51.33 81.76 84.53 74.95	Io Io 16.48 16.61 16.77 14.84 12.86 19.74 16.77 14.84 12.59 17.73 16.67 18.51 18.50 17.60 17.751 16.73 SEm± 16.73	I1 19.71 16.55 18.66 13.52 15.50 17.68 17.34 14.15 17.73 15.50 11.94 18.55 19.45 19.49 19.33 15.50 11.94 18.55 19.45 19.45 19.69 17.04 CD (0.05) 10.95	Mean 18.09 16.58 17.66 14.18 14.18 14.18 14.18 17.06 13.37 17.75 18.00 17.00 15.22 18.07 18.68 18.70	Io 13.24 15.76 14.88 16.70 14.69 12.59 15.95 18.04 16.27 18.15 18.15 18.55 15.65 SEm±	I1 10.76 9.07 13.36 11.64 14.78 12.75 14.20 13.74 13.74 13.28 15.26 15.27 13.39 12.91 CD (0.05)	Mean 12.00 12.42 14.12 14.73 14.48 12.67 15.08 15.63 13.29 13.92 13.92 13.92 13.92 13.47	Root s area/ area/(CCm ²) DA 943 744 9436 805 985 110 1494 1466 1001 1083 154 2155 1522 1044 1043 556	CD CD at 120 AP .33 .00 5.67 .83 .33 .00 .33 .03 5.67 .67 1.67 1.33 1.33 .00 .0.67 .067 1.33 .00 CD (0.05	Total b stool (g D2 73 88 88 58 58 58 58 58 58 58 58 58 58 58	iomass /) (at 120 AP) i2.8 7.30 4.50 9.90 i4.50 2.40 8.50 i6.70 3.10 8.50 i1.50 8.10 9.20 5.20 CD (0.05)
Sugarcane variety 2011A 175 2011A 250 2011A 260 2011A 262 2006A 102 2006A 223 2009A 107 2010A 229 87A298(C) 2001A 212 2011A 319 2011A 313 2011A 294 83V 15 (C) Mean I	Numbe at h 59.83 54.45 50.79 46.63 52.53 54.62 51.84 51.67 51.14 54.79 43.85 54.62 47.85 44.37 54.79 51.58 SEm± 1.42	r of milla arvest (0 1 53.92 57.74 55.14 55.14 55.56 62.43 55.56 62.43 55.60 65.89 63.82 52.88 60.52 53.40 58.78 63.82 58.62 CD (0.05) 2.13	Mean 61.04 54.26 54.26 54.26 54.26 54.26 54.26 54.26 54.26 54.26 54.26 54.26 54.26 54.26 54.27 54.26 54.21 58.51 59.31 59.31	C <u>I</u> ₀ <u>59.85</u> <u>50.34</u> <u>56.25</u> <u>50.34</u> <u>56.40</u> <u>56.44</u> <u>56.44</u> <u>42.05</u> <u>52.16</u> <u>49.28</u> <u>51.846</u> <u>53.846</u> <u>53.846</u> <u>56.37</u> <u>SEm±</u> <u>0.79</u>	I1 78.41 77.30 75.20 75.20 78.10 58.90 93.0 82.12 66.60 66.60 58.00 90.00 58.00 96.00 63.40 63.40 63.40 75.21 CD (0.05) 2.28	Mean 69.13 71.48 62.77 67.15 52.71 79.50 80.22 61.50 61.22 76.42 50.02 71.08 72.64 57.62 58.13	Drought tolerance efficiency (% 76.32 84.92 66.94 71.95 78.98 70.96 95.37 84.68 85.38 85.38 85.38 72.50 57.96 51.33 81.76 84.53 74.95	I0 I0 16.48 16.61 16.67 14.84 12.86 19.74 16.79 12.59 17.73 16.79 18.51 18.50 17.60 17.91 17.51 16.73 SEm± 0.01	I1 19.71 16.55 18.66 13.52 15.50 17.68 17.78 19.31 15.50 11.94 18.55 19.45 19.45 19.45 19.45 19.45 19.45 10.04 CD (0.05) 0.03	Mean 18.09 16.58 17.66 14.18 14.18 14.18 14.18 17.06 13.37 17.75 18.07 18.68 18.70	I0 13.24 15.76 14.88 16.70 14.69 15.95 15.95 18.04 16.43 17.31 14.55 18.13 16.52 13.55 SEm± 0.18	I1 10.76 9.07 13.36 11.64 14.78 12.75 14.20 13.21 10.14 13.74 13.28 15.46 15.27 13.291 12.91 CD (0.05)	Mean 12.00 12.42 14.12 14.17 14.73 14.48 12.67 15.08 15.63 13.29 15.53 13.92 16.80 15.99 13.47	Root s area/ area/ (Cm ³) DA D43 9433 744 1466 8055 9855 110 1492 1700 1088 154 154 2155 1522 1044 1430 SEm± 58.6 58.6	CDB gread stool at 120 AP .33 .00 5.67 .83 .33 4.00 3.33 9.33 5.67 1.67 1.33 2.33 1.33 5.00 CD (0.05 179.0.2	Total b stool (g 02 73 88 102 73 88 103 70 72 73 78 102 122 152 152 753 766 73' 80: SEm± 126.0	iomass /) (at 120 AP) i2.8 7.30 4.50 9.90 i4.50 2.40 8.50 i6.70 3.10 8.50 i1.50 8.50 i1.50 8.10 9.20 (0.05) 378.0
Sugarcane variety 2011A 175 2011A 252 2011A 260 2011A 260 2006A 102 2006A 102 2006A 223 2009A 107 2010A 229 2011A 252 2011A 252 2011A 252 2011A 219 2011A 313 2011A 294 83V 15 (C) Mean I V	Numbe at h 59.83 54.45 50.79 46.63 52.53 54.62 51.84 51.67 51.14 54.79 43.85 54.62 47.85 44.37 54.62 47.85 54.63 54.63 54.63 54.63 54.63 54.63 54.63 54.63 54.63 54.63 54.63 51.84 51.67 51.54 54.63 54.63 51.84 51.67 51.58 54.63 54.63 54.63 51.84 51.67 51.84 51.67 51.58 54.63 54.63 51.84 51.67 51.58 54.63 54.63 51.84 51.67 51.58 54.63 51.67 51.58 54.63 51.67 51.58 54.63 51.67 51.58 54.63 51.67 51.58 54.63 51.67 51.68 51.67 51.68 51.67 51.68 51.67 51.68 51.67 51.68 5	r of milla arvest (0 <u>I</u> <u>62.25</u> <u>53.92</u> <u>57.74</u> <u>55.14</u> <u>56.35</u> <u>62.43</u> <u>55.56</u> <u>56.06</u> <u>65.89</u> <u>63.82</u> <u>52.88</u> <u>60.52</u> <u>53.40</u> <u>58.78</u> <u>63.82</u> <u>53.40</u> <u>58.78</u> <u>63.82</u> <u>53.40</u> <u>58.78</u> <u>60.52</u> <u>53.40</u> <u>58.78</u> <u>63.82</u> <u>53.40</u> <u>58.78</u> <u>63.82</u> <u>53.40</u> <u>58.78</u> <u>58.62</u> <u>CD</u> (0.05) <u>2.13</u> <u>5.48</u>	Mean 61.04 54.26 50.89 54.24 58.53 53.70 54.25 59.31 48.36 57.57 55.63 51.58	C 59.85 65.65 50.34 56.20 46.52 66.00 78.32 56.44 70.84 42.05 52.16 49.28 51.84 53.26 56.37 SEm± 0.79 2.16	Ii 78.41 77.30 75.20 78.10 58.90 93.0 82.12 66.60 66.10 82.00 58.00 90.00 96.00 63.40 63.40 75.21 CD (0.05) 2.28 6.26 6.26	Mean 69.13 71.48 62.77 67.15 52.71 79.50 80.22 61.50 61.22 76.42 50.02 71.08 72.64 57.62 58.13	Drought tolerance efficiency (% 76.32 84.92 66.94 71.95 78.98 70.96 95.37 84.68 85.38 86.39 72.50 57.96 51.33 81.76 84.53 74.95 -	Io Io 16.48 16.61 16.67 14.84 12.86 19.74 16.79 12.59 17.73 16.67 18.50 17.60 17.91 17.73 16.73 SEm± 0.01 0.03	I1 19.71 16.55 18.66 13.52 15.50 17.68 17.34 14.15 17.78 19.33 15.50 11.94 18.85 19.45 19.45 19.45 19.45 19.45 0.03	Mean 18.09 16.58 17.66 14.18 14.18 18.71 17.06 13.37 17.75 18.00 17.00 15.22 18.07 18.68 18.70	Io Io 13.24 15.76 14.88 16.70 14.69 16.27 15.95 15.95 18.04 16.43 17.31 14.55 14.55 13.55 15.65 SEm± 0.18 0.49	I1 10.76 9.07 13.36 11.64 14.78 12.68 12.75 14.20 13.21 10.14 13.74 13.25 15.46 15.27 13.39 12.91 CD (0.05) 0.52 1.44	Mean 12.00 12.42 14.12 14.17 14.73 14.48 12.67 15.08 15.53 13.29 15.53 13.92 16.80 15.99 13.47	Root s area/ (Cm ²) DA 943 744 943 744 946 805 985 9104 1466 805 985 1100 1084 1052 1522 104 1430 SEm± 58.6	CD CD at 120 AP	Total b stool (g D/ 73 88 577 58 103 120 74 75 76 120 75 76 75 75 76 75 76 76 76 76 76 76 76 76 76 76 76 76 76 773 80 SEm± 126.0	iomass /) (at 120 AP) 12.8 4.50 9.90 14.50 2.40 18.50 14.50 2.40 2.40



Fig. 1. Graphical representation of rainfall pattern during 2018-19 at RARS, Anakapalle.

Per cent (×) Soil Moisture per cent

Month	March	April	May	November	December	January
I ₀	10.11	10.51	11.91	13.15	12.54	11.71
I ₁	10.77	12.09	13.79	13.20	14.14	13.26





Fig. 2. Graphical representation of rainfall pattern during 2019-20 at RARS, Anakapalle.

Per cent (×) Soil Moisture percent (2019-20).

Month	April	May	June	July	August	December	January
IO	10.09	11.54	7.05	9.90	9.30	6.02	5.20
I1	10.49	12.20	11.02	11.90	9.90	11.50	9.90

The weather parameters during 2018-19 crop season of sugarcane revealed that a total of 899.44 mm rainfall received against normal rainfall of 1225 mm which accounts to -26.58% rainfall. The average monthly maximum °C accounts to 33.91 and minimum °C

30.0

20.0

10.0 0.0

> 0 1 2 3 5 6

4

Weeks

7 8 9 101112131

4151617

accounts to 21.08. The average monthly wind velocity is at 3.62 kmph with monthly average evaporation of 4.59 mm. The monthly average bright sun shine hours are at 5.49 hours.

12.5

0.2

1819202122232425262728293031323334353637383940414243444546474849505152535455

10.5

The weather parameters during 2019-20 crop season of sugarcane revealed that a total of 1047.2 mm rainfall received against normal rainfall of 1126.7 mm which accounts to -7.1 % rainfall. The average monthly maximum °C accounts to 33.1 and minimum °C accounts to 27.79. The average monthly wind velocity is at 3.2 kmph with monthly average evaporation of 4.3 mm. The monthly average bright sun shine hours are at 4.8 hours.

Tiller population: The data on tiller production at formative stage under stress varied from 67.54 000/ha (2011A 252) to 118.31 000/ha (2006A 102). Among 15 sugarcane clones tested 2006A 102 (118.31 000 ha) recorded significantly higher tiller production over standard 87A 298 (82.99 000/ha). Tiller production at formative stage was significantly high in normally irrigated I_1 condition (81.68 000 ha) over stress condition I_0 (77.14 000ha).

Number of Millable canes: Number of millable canes were high in I₁ treatment (58.62 000ha) over stress I₀ treatment (51.58 000 ha). Among the clones tested 2009A 252 recorded a higher millable canes of 59.31 000 ha followed by 2006A 223 (58.53 000ha), 2011A 319 (57.57 000 ha) and 2011A 313 (55.67 000 ha) over other clones tested. The standards 87A 298 recorded a millable cane of 58.52 000 ha which is on par with the said superior clones.

Percent juice sucrose: The cane quality in terms of percent juice sucrose was ranged from 13.27% (2010A 229) to 18.71% (2006A 223). Sugarcane clone 2006A 223(18.71%) recorded higher per cent juice sucrose over other clones tested and on par with the check 87A 298 (17.73 %).

Specific leaf area (cm²/g): The parameter indicating assimilation of photosynthates in leaf is SLA (cm²/g). It is ranged from 117.08 cm²/g (2011A 294) to 166.41 cm²g (2006A 223). The SLA of sugarcane clones 2011A 294 (117.08 cm²/g), 2006A 102 (117.40 cm²/g), 2011A 262 (117.46 cm²/g), 2009A 107 (123.12 cm²/g) recorded low SLA over other clones tested and standard 87A 298 (128.11 cm²/g) which indicated more photosynthetic assimilates per unit area under stress conditions. More over the SLA was compared to low in stress condition I₀ (118.3 cm²/g) over normal condition I₁ (153.48 cm²/g).

Root spread area: Among 15 sugarcane clones tested the root spread area at 120 DAP (stress conditions) ranged from 805.83cm² (2011A 262) to 2151.33 cm² (2011A 319). Sugarcane clones 2011A 319 (2151.33 cm²), 2011A 313 (1522.33 cm²) and 2010A 229 (1709.33 cm²) recorded higher root spread area over other clones tested. The standard 87A 298 recorded a root spread area of 1085.67 cm².

Total bio mass production per stool (g/stool): The dry matter production at 120 DAP (under stress) in sugarcane clones tested is ranged from 574.50 g/stool (2011A 260) to 1536.70 g/stool (2010 A 229). The dry matter production at 120 DAP at formative stage (under stress) was high in 2010A 229 (1536.7 g/stool) followed by 2009A 107 (1208.50 g/stool), 2011A 319 (1131.50 g/stool). The standard 87A 298 recorded a biomass production of 943.10 g/stool.

Sheath moisture per cent: Percent moisture in sheath which is an important trait for moisture stress studies was ranged from 68.56 per cent (87A 298) to 74.94 per cent (2011A 319). The percent leaf sheath moisture percent under stress was 69.22 percent which is lower over I₁ treatment (72.69%). Higher leaf sheath moisture under stress conditions during formative phase (Summer) was recorded in 2011A 319 (74.94%).

Leaf proline (μ moles/g fresh weight): Leaf proline content which is an important physiological drought tolerance denoting trait ranged from 55.58 μ moles/g fresh weight (2011A 222) to 128.87 μ moles/g fresh weight (2011 A 252). High leaf proline content recorded in 2011A 252 (121.87 μ moles/g fresh weight) followed by 2010A 229 (105.15 moles/g fresh weight), 2011A 3 175 (103.97 μ moles/g fresh weight). The standard 87A 298 recorded a leaf proline content of 118.55 μ moles/g fresh weight.

SPAD/SCMR values: The values of SPAD/SCMR of sugarcane clones tested at formative stage are ranged from 28.65 (87A 298) to 43.70 (2009 252). The SPAD/SCMR values of sugarcane clones under stress was low (39.23) than normally irrigated (40.79). Higher SPAD/SCMR values were recorded in sugarcane clones 83V 15 (44.59), 2009A 252 (43.70), 2011A 175 (41.65) and 2006A 102 (41.80) which are superior over 87A 298 (28.65).

Fibre per cent: The fibre percent of sugarcane clones ranged from 12.00% (2011A 175) to 16.80 (2011A 313). Highest fibre percent was recorded in 2011A 313 (16.80%) followed by 2011A 294 (15.99%) and 2011A 222 (15.53 %). The fibre percent of standard 87A 298 is at 15.63%.

Cane yield: Among 15 sugarcane clones tested cane yield was high in 2009A 107 (80.22 t/ha) and 2006A 223 (79.50 t/ha) which are significantly superior with check 87A 298 (61.22 t/ha) followed by sugarcane clones 2011A 313 (72.64 t/ha), 2011A 252 (71.48 t/ha) and 2011A 319 (781.08 t/ha). Cane yield was high in normal irrigated (I_1) clones (75.21 t/ha) over stress induced clones (56.37 t/ha).

Drought tolerance efficiency percentage: A physiological trait which significantly denotes drought tolerance efficiency based on cane yield under stress and normal conditions is high in 2009A 107 (95.37%) followed by 2009A 252 (86.39%) and 2011 252 (84.92%) over other clones tested. The standard check 87A 298 recorded a drought tolerance percentage of 85.38.

Many sugarcane researchers identified similar traits of sugarcane with higher cane yield and quality under soil moisture stress conditions. Sugarcane physiological parameters like sheath moisture per cent, leaf proline content, chlorophyll in terms of SPAD/SCMR values, specific leaf area (SLA cm²/g) under stress conditions registered significant and positive correlation with cane yield. 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); Sujatha and Jhansi, 2016; Mukunda Rao *et al.*, (2017 and 2021). Similar type of screening of sugarcane clones study

Rao et al.,

under moisture stress with similar performance of physiological traits under moisture stress and normal condition was also reported (Anonymous 2021).

CONCLUSION

Among 15 sugarcane clones studied in comparison with 87A 298 under early planted stress conditions, sugarcane clones 2009A 107, 2006A 223, 2009A 252, 2011A 313 and 2011A 252 are found suitable for cane cultivation under stress situations of limited irrigated conditions based on cane yield and quality parameters in relation to ancillary yield parameters and physiological stress tolerance traits.

Acknowledgement. The authors are sincerely thankful to the Acharya N.G. Ranga Agricultural University, Guntur for extending facilities, support and encouragement in the execution of the project and according permission for publication and presentation of the research paper.

REFERENCES

- Anonymous (2021). Annual Report of Crop physiology, RARS, Anakapalle, Published in Annual report of RARS, Anakapalle 2021.
- Anonymous (2021a) Cooperative sugar journal, National Federation of Cooperative sugar factories Ltd. Monthly Publication, No. 1, September, 2021 pp:42-44.
- Bhakshiram (2021). Global status of sugarcane agriculture and sugar industry, proceeding of CaneCon 2021 of SBI, Coimbatore. Pp:1-6
- Dhopte A.M., and M. Manuel Livera (1989). *Laboratory techniques for plant scientists*. Publications from Physiologists forum, Akola, India.
- FAOSTAT (2018). Sugarcane area harvested, yield and production for the year 2018. //http:// www.FAO.org/FAOSTAT/ end/11 date QC.
- Manimekalai, R.M., Hema Prabha, G. Mohan Raj, K. Selvi,
 A., Vasantha, S., Viswanathan R., Bakshi Ram,
 Jini Narayana, Mary, A. J. Ramvanniss & Saranya,
 J. (2021). Assessment of genetic variability and
 interrelationship among the quantitative traits of
 sugarcane under drought stress. *Proceedings of CaneCon* 2021 held on June, 19-22 at SBI,
 Coimbatore, pp 112-115.

- Meade, G. P., & Chen, J. C. P. (1977). *Cane Sugar Book*. 10th Edition. John Wiley Inter Science, John and Sons, New York.
- Mukunda Rao Ch., Appala Swamy, A. Veerabhadra Rao, K., & Venugopala Rao N. (2017). Identification of sugarcane clones suitable for rainfed cane cultivation. 47th proceedings of SISSTA Annual Convention held at Chennai at 30th June and 1st July, 2017, pp: 59-62.
- Mukunda Rao Ch., Sambasiva Rao P., Charumathi M., Bharathalakshmi M., & Jamuna P. (2021). Execution of pre release sugarcane clones under late planted rainfed conditions. *Proceedings of CaneCon 2021* held on June, 19-22 at SBI, Coimbatore, pp: 358-359.
- Mukunda Rao Ch., Rao P. S., Charumathi, M., Bharathalakshmi, M., & Jamuna, P. (2021a). Evaluation of pre released sugarcane clones under late planted rainfed condition for higher cane yield and quality. *Biological Forum – An International Journal*, 13(3): 277-281.
- Mukunda Rao Ch., Rao P. S., Vijaykumar N., & Bharathalakshmi, M. (2021b). Drought management in sugarcane at formative stage during pre monsoon period. *Biological Forum – An International Journal*, 13(3): 241-244.
- Panse, V. G., and Sukhatme, P. V. (1978). Statistical methods in Agricultural workers. ICAR publication. New Delhi pp. 347.
- Raja Rajeswari, V. K., Subash Chandra Bose and Naidu, N. V. (2003). Screening of sugarcane clones and their suitability to late planted rainfed conditions, presented in the National Seminar on "Physiological Interventions for improved crop productivity and quality opportunities and Constraints" held at Tirupathi from December, 2003. pp: 241-244.
- Raja Rajewari V., Mukunda Rao Ch & Naidu, N. V. (2009). Identification of sugarcane clones suitable for rainfed conditions. 40th Annual convention of SISSTA, pp.49-51.
- Rayes Ferrer Maira. M. R. Regal, J. D., & Padron (2021). Physiological studies of drought tolerance in sugarcane in Cuba. *Proceedings of CaneCon 2021* held on June 19-22, 2021 at SBI, Coimbatore, pp 85-88.
- Sujatha, T., & Jhansi, K. (2016). Effect of moisture stress on quality and yield in pre release sugarcane clones.46th Annual convention of SISSA, pp.1-3.

How to cite this article: Mukunda Rao Ch; Rao, P.S.; Charumathi, M.; Bharathalakshmi, M. and Jamuna, P. (2021). Sugarcane Clones Suitable for Moisture stress/Drought Conditions under Early Planting (December/January). *Biological Forum* – *An International Journal*, *13*(4): 292-296.