Indian J. Genet., 68(1): 90-92 (2008)

Short Communication

Performance of elite cultivars of sugarcane (*Saccharum* spp.) under water deficit conditions

G. Hemaprabha[1], R. Nagarajan and S. Alarmelu

Division of Crop Improvement, Sugarcane Breeding Institute, Coimbatore 641 007

(Received: June 2007; Revised: January 2008; Accepted: February 2008)

www.IndianJournals.com
Members Copy, Not for Commercial Sale
Downloaded From IP - 61.247.228.217 on dated 27-Jun-2017

The frequency of occurrence of drought stress in tropical world is highly unpredictable and its severity leads to moderate to heavy yield losses including crop failure. The most effective and economical way of drought management strategies is the development and utilization of drought resistant varieties. The present study was conducted to evaluate the response of 1210 elite sugarcane clones (1068 Co canes bred at Coimbatore, 20 Co allied varieties, 32 foreign commercial hybrids and 90 interspecific hybrids of commercial value) to water deficit stress in order to identify potential drought resistant clones and the traits that are more reliable for screening for drought resistance. These clones were planted in December 2003 in single rows of 3 metre length spaced 90 cm apart with normal seed rate. Recommended package of practices except irrigation was followed during the period under evaluation. A total rainfall of 623 mm was received and eleven irrigations, instead of 35 under normal conditions, were provided to the crop. The crop received 50 mm rainfall and a single irrigation during formative growth phase (90-150 days), resulting in severe drought in the experimental field. Early vigour in these clones was quantified in terms of number of tillers, number of cane formed tillers, tiller height and single tiller weight at 150 days of crop age. At 360 days, those clones with ten or more canes per plot were taken for assessing yield and quality traits. Mean, range and standard deviation (SD) for the individual traits were calculated using standard statistical procedures [1]. From this experiment, 115 genotypes were re-evaluated during 2004-05 season. These genotypes were planted in 3.0 metre rows with 90cm spacing and the crop was raised under restricted irrigation conditions beyond 90 days of crop growth. Data on early vigour and juice quality and cane yield parameters were recorded and statistically analyzed as in 2003-04 season.

Evaluation at 150 days to assess the early vigour of 1210 sugarcane clones (Table 1) revealed significantly higher number of tillers in 123 clones. Number of superior clones for tiller height and percentage of cane formed tillers over total tillers was 90 and 125 respectively. More number of inferior clones were observed for tiller height and number of tillers. Therefore, drastic reduction in early growth was mainly due to reduction in these two traits. Mean single tiller weight was 0.19 kg and 13 genotypes recorded above 0.40 kg. There were 120 clones that were less adversely affected by water deficit conditions at 150 days of crop age. On the basis of cane population and early vigour, 915 clones were selected for quality analysis at 360 days (Table 1) as the rest, numbering 295 (24.38%) either had very few cane formed tillers or remained as shoots, showing their susceptibility to drought conditions. Adverse effects of water deficit stress were revealed from the fact that a large number of clones showed drastic reduction in cane height, number of internodes, sucrose % and purity %. Stress at formative phase has been found to have a direct influence on growth, photosynthesis, dry mass accumulation, sucrose synthesis and yield [2, 3] and magnitude of effect differed with varieties [4]. Superior 115 clones were selected on the basis of combined performance for cane yield and its components and sucrose % in juice for further evaluation under water deficit stress during 2004-05 season.

[1]Corresponding author, e-mail: hemaprabha@sify.com

Table 1. Mean and standard deviation among 915 genotypes analysed for juice quality and among 115 selections and the number of superior and inferior genotypes for fourteen traits during 2003-04

Sl. No.	Character	Values based on 915 clones taken for juice quality analysis				Values of 1 1 5 selected clones		
		Mean	SD	No. of superior genotypes	No. of inferior genotypes	Mean	SD	% improvement
1.	Number of tillers	28.94	10.24	123	199	32.4	10.47	13.82
2.	Tiller height	68.79	15.39	90	287	77.77	15.99	13.37
3.	No. of cane formed tillers	7.50	5.83	91	18	11.24	5.61	50.46
4.	Single tiller weight	0.19	19.46	0	0	0.21	0.09	7.12
5.	Percentage of cane formed tillers	26.4	0.53	125	39	35.9	17.73	36.41
6.	NMC	15.92	5.72	142	225	19.14	5.61	20.23
7.	Cane diameter	2.28	1.13	1	0	2.36	0.34	3.71
8.	Cane height	115.1	28.95	129	112	133.2	26.54	13.38
9.	Number of internodes/cane	22.82	4.49	107	121	24.12	4.69	5.38
10.	Single cane weight	0.47	1.80	0	0	0.49	0.21	1.84
11.	Brix%	17.43	1.53	126	89	17.42	1.35	-0.37
12.	Sucrose%	13.26	1.96	102	127	13.29	1.81	-0.93
13.	Purity%	75.71	6.33	98	115	76.00	5.39	-0.26
14.	CCS%	8.54	2.89	60	115	8.46	1.50	-0.92

www.IndianJournals.com
Members Copy, Not for Commercial Sale
Downloaded From IP - 61.247.228.217 on dated 27-Jun-2017

Percent improvement of selections over the unselected ones (915 clones) provided important information on the traits that are more reliable for selection under water deficit conditions (Table 1). Mean tiller number and tiller height of the selections showed an increase of 13.82 % and 13.37 %, respectively. Maximum improvement of 50.46% was observed for the number of cane formed tillers, followed by the percentage of cane formed tillers over total number of tillers, while tiller weight and height showed a marginal increase in the selections. Among the four cane yield parameters (NMC, single cane weight, cane diameter and cane length), NMC and cane length showed an improvement of 20.23% and 13.38%, respectively, and could be more useful in selection. Juice quality traits showed a decline, though the differences were not significant. These findings gave valid reasons to believe that better performance of a genotype under drought depended mainly on improvement in cane yield, and more specifically on rapid early growth with cane formation in the initial months of crop leading to increased NMC and cane length and not on improvement in juice quality. Improvement in sucrose could be difficult to achieve in light of earlier studies that showed significant reduction of sucrose in the canes of water stressed crops at maturity as compared to the normal cane [4, 5]. Identification of genotypes with rapid early growth would thus be the first stage of selection for drought resistance.

Cane yield showed nonsignificant positive correlation with tiller weight, tiller number and percentage of cane formed tillers (Table 2) indicating that early vigour alone cannot be taken as an index of high yield at crop maturity under drought conditions. Cane yield showed significant correlation with NMC (0.420), single cane weight (0.498), cane height (0.323) and CCS (0.944). NMC showed negative correlation with single cane weight, cane diameter and juice quality parameters (Brix %, sucrose % and CCS %), whereas, single cane weight showed significant positive correlation with both cane height and cane diameter. Thus correlation studies gave clear indication of the importance of cane yield through increase in cane height and NMC and moderate/ high sucrose% for a better CCS yield under water deficit conditions. Earlier studies gave indications that cane elongation was positively correlated with water availability during grand growth period and large reduction in stalk number; cane yield and sucrose were noticed due to drought [3]. SD values for cane diameter and single cane weight were less (0.34 and 0.21, respectively) in the selections in comparison with other traits, indicating that selection of types with better cane yield has resulted in indirect selection for cane diameter and single cane weight (Table 1). Two clones (Co 200010 and Co 8372) combined good yield and juice quality and the remaining selections possessed high yield but with moderate/low juice quality. The clones with better juice quality were poor in cane yield. It could also be observed that clones with better juice quality were poor in cane yield. Hence, identification of beneficial types under drought situation would largely depend on identifying the genotypes with better juice

Table 2. Correlation between cane yield, NMC and single cane weight with other yield and juice quality traits based on evaluation of 915 clones under water deficit conditions

Cane yield	CCS	0.944 **	NMC	CCS%	-0.031
	NMC	0.420 **		Brix %	-0.039
	CCS%	0.014		Sucrose %	-0.020
	Brix %	0.011		Single cane weight	-0.019
	Sucrose %	0.014		Cane height	0.064
	Single cane weight	0.498**		Cane diameter	-0.063
	Cane height	0.323**	Single cane weight	CCS%	-0.004
	Cane diameter	0.033		Brix %	0.029
				Sucrose %	0.010
				Cane height	0.348 **
				Cane diameter	0.249 **

**Significant at 1% level of significance.

Table 3. Mean, Standard deviation and number of superior and inferior genotypes for eleven traits of 115 genotypes during 2004-05 season

	Germination %	No. of tillers	NMC	Tiller height (cm)	Single cane wt.(kg)	Cane diameter (cm)	Cane height (cm)	Brix %	Sucrose %	Purity %	Cane yield (kg/plot)
Mean	20.6	23	16.8	90.74	0.58	2.37	151.1	19.4	16.33	83.24	13.6
SD	4.96	5.52 7	7.98	20.08	0.23	0.37	30.67	1.748	1 .908	7.52	4.13
Range	16.7	7	10	47	0-14	1.8	85	14.39	9.85	66.36	3.50
	(Co 8372)	(Co 99015, Co 978, Co 97009)	(Co 99015, Co 978, Co 87013)	(Co 1223, Co 97009)	(ISH 176)	(Co 62251)	(Co 8315)	(ISH 176)	(ISH 282)	(Co 88013)	(Co 8216)
	-	-	-	-	-	-	-	-	-	-	-
	78.7	27	43	123	1.33	3.5	200	20.39	18.03	88.42	22.80
	(Co62251, Co 62300)	(Co 87026)	(ISH 147)	(ISH 147)	(Co 8372)	(Co 8372)	(ISH 147)	(Co 200010)	(Co 200010)	(Co 200010)	(Co 86002)
No. superior clones	10	14	5	15	13	7	17		11		16
No. of inferior clones	9	9	1	8	7	11	11		8	2	8

www.IndianJournals.com
Members Copy, Not for Commercial Sale
Downloaded From IP - 61.247.228.217 on dated 27-Jun-2017

quality among the high yielding clones. The selected 115 clones could serve as parents in breeding aimed at developing commercial clones suitable for drought situations.

Evaluation of 115 elite clones along with two drought tolerant standards *viz*., CoC 671 and Co 7219 during 2004-05 (Table 3) revealed that 16 genotypes were superior for mean cane yield (13.6 Kg/plot), while for sucrose eleven genotypes were superior over the mean (16.33). Based on the mean performance of these clones in two seasons, twelve elite genotypes (Co 200002, Co 200010, Co 7636, Co 8368, Co 8372, Co 87016, Co 87023, Co 87026, Co 955, Co 98017, Co 99004 and ISH 100) were identified with potential drought resistance. Large scale testing of these clones in drought prone areas would lead to the identification of promising varieties which is expected to sustain sugarcane productivity in drought areas and to improve sugar productivity in general.

References

1. **Singh R. K. and Chaudhary B. D.** 1985. Biometrical methods in quantitative genetic analysis. Kalyani Publishers, New Delhi.
2. **Venkataramana S.** 1986. The effects of water stress during the formative phase on stomatal resistance and leaf water potential and its relationship with yield in ten sugarcane varieties. Field Crop Res., **13**: 345-353.
3. **Singh S. and Reddy M. S.** 1980. Growth, yield and juice quality performance of sugarcane varieties under different soil moisture regimes in relation to drought resistance. Proc. Intern. Soc. Sugar Cane Technol., **XVII**: 541-555.
4. **Srivatsava R. P., Johari D. and Singh G. P.** 1997. Varietal performance under soil moisture stress in sugarcane (*Saccharum officinarum*). Indian J. Agric. Sci., **67**: 597-598.
5. **Hemaprabha G., Nagarajan R. and Alarmelu S.** 2004. Response of sugarcane genotypes to water deficit stress. Sugar Tech., **6**: 165-168.