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EVALUATION OF *SACCHARUM SPONTANEUM* CLONES UNDER RAINFED CONDITIONS OF NORTH-WESTERN ZONE

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Fifteen clones of *S. spontaneum* were evaluated under normal and rainfed conditions to identify suitable genetic stocks. The clones exhibited no clone-environment interactions for stalk diameter, stalk length, juice extraction per cent and juice quality traits. Highest heritability values coupled with higher genetic correlation between two environments and near unity correlated response of stalk diameter and single stalk weight indicated their importance in selection. Three clones, viz., SES-222, SES- 275 and SES-352 showed similar performance in two environments in respect to stalk yield, single stalk weight, stalk diameter and juice extraction percentage and hence identified as the best parents for future utilization in breeding.

Key words : Genetic stocks, polymorphism, heritability, variance, correlation studies

Saccharum spontaneum, a wild form, is a highly polymorphic species growing in tropics and subtropics, 8°S to 40°N (Brandes *et al.* 1939). Plants vary in appearance from short bushy types with no stalk, to large stemmed clones over 5m in height. It survives under a range of temperatures from tropic heat to winter snow and is found from sea level upto 2700 m in the Himalayas (Mukherjee, 1950). In India, sugarcane is grown predominantly under deficient irrigation conditions or under rainfed situations. Hence, crop suffers from moisture stress at one or the other stages of its growth. The resistance to various stresses had been imparted to the present day commercial varieties from *S.spontaneum* clones but its sampling is just limited to a few clones in relation to great diversity available. The present study was undertaken to identify *S.spontaneum* clones suitable for rainfed conditions of north-western zone.

MATERIALS AND METHODS

The experimental material comprised 15 clones of *S.spontaneum* brought from the world germplasm collection maintained at Sugarcane Breeding Institute, Coimbatore. These clones were evaluated during autumn season 1991-92 in

Randomised block design with three replications in two experiments representing normal irrigated (N) and rainfed (RF) conditions. The rainfed experiment was irrigated only once after planting to ensure the germination. Two meter space was left around the rainfed experiment and was protected by bunds to avoid seepage of water. Data on nine characters were recorded at harvest. Standard statistical procedures were adopted to analyse the data. The correlated response (CR) of an attribute was computed as follows:

$$CR = \frac{r_A h^2_y}{h^2_x}$$

where

r_A : genotype correlation between two environments

h^2_y : heritability in normal environment

h^2_x : heritability in rainfed environment

RESULTS AND DISCUSSION

The analysis of variance indicated significant differences among clones for nine characters studied (Table 1). The differences were also significant between two environments, i.e. normal (N) and rainfed (RF), for all the traits excepting juice extraction percentage. The clones exhibited no clone-environment interactions for stalk diameter, stalk length, juice extraction percentage, sucrose percentage, brix percentage and purity percentage. Thus the reaction of individual clones to the environmental variation did not differ significantly from that of an average of all clones in the experiment. The clone - environment interactions were singnificant for stalk yield, number of millable stalks (NMS) and single stalk weight indicating differential response of clones in two environments for these three attributes.

Table 1 : Analysis of variance for nine characters in *Saccharum spontaneum*

Source of variance	D.F.	Mean square								
		Stalk yield	NMS	SSW	Stalk dia-meter	Stalk length	Juice extr-acti-on(%)	Sucr-ose (%)	Brix (%)	Purity (%)
Clones (C)	14	1191.2**	3645.0**	0.046**	0.432**	4778.9**	141.6**	4.77**	12.66**	257.9**
Environ-ments (E)	1	11289.6**	14187.8**	0.119**	0.077**	113422.5**	34.5	8.14**	39.22**	1771.5**
C × E	14	407.2**	5100.4**	0.004**	0.011	402.3	22.6	1.17	1.67	60.9
Error	56	30.3	365.2	0.001	0.009	728.4	12.9	0.84	1.46	59.9

**Significant at P = 0.01

Single stalk weight (SSW) followed by stalk yield were the most variable characters (Table 2). The differences in genotypic coefficients of variation were not conspicuous in two environments for most of the charatcers. This indicated that *S.spontaneum* clones were able to express its genetic differences under both normal and rainfed environments. According to Mukherjee (1950) *S.spontaneum* is highly adaptable, as its clones are found under drought stress in deserts, water-logged conditions in marshes, and saline conditions near the sea.

The heritability values were the maximum for stalk diameter followed by SSW in both environments (Table 2). Heritability values were more under rainfed conditions for stalk yield, NMS, stalk length, sucrose percentage and purity percentage indicating the necessity for evaluating clones under rainfed conditions to select tolerant clones. Further, the efficient environment within which to select can also be judged by correlated response (CR) of various traits in rainfed environment. CR values of stalk yield, NMS, stalk length, sucrose percentage and purity percentage were less than unity, indicating that selection for these traits would be more effective in rainfed environment. Blum (1983) also emphasized the selection for yield and its components under stress environment whereas selection for stalk diamater, SSW, juice extratcion percentage and brix percentage, where CR values were near unity, would be equally effective in both environments. Of these, stalk dieameter and SSW were least influenced by the environment as indicated by their highest heritability values and hence should be useful as selection criteria.

Table 2 : Genotypic coefficients of variation (GCV), heritability in broadsense (h^2), genotypic correlation coefficients (rA) and correlated response (CR) of nine characters

Character	GCV		h^2			
	N	RF	N(h^2Y)	RF (h^2x)	rA	CR
Stalk yield	42.99	31.28	0.74	0.79	0.7976	0.7471
NMS	14.53	18.41	0.68	0.76	0.4815	0.4308
SSW	44.63	44.19	0.82	0.71	0.9574	1.1057
Stalk diameter	26.19	25.09	0.89	0.87	0.9707	0.9930
Stalk length	9.01	15.57	0.57	0.68	0.4998	0.6752
Juice extraction(%)	19.52	23.63	0.66	0.68	0.9378	0.9102
Sucrose(%)	24.88	26.61	0.65	0.69	0.5789	0.5453
Brix(%)	14.37	11.40	0.68	0.66	0.9818	1.0116
Purity (%)	20.57	24.83	0.54	0.60	0.6200	0.5580

N: Normal, RF : Rainfed

Table 3 : Performance of *Saccharum spontaneum* clones for various quantitative traits under normal (N) and rainfed (RF) conditions

Clones	Stalk yield (t/ha)		NMS (000′ /ha)		Single Stalk weight (kg)		Stalk diameter (cm)		Stalk length (cm)		Juice extraction (%)		Sucrose (%)		Brix (%)		Purity (%)	
	N	RF	N	RF	N	RF	N	RF	N	RF	N	RF	N	RF	N	RF	N	RF
SES-222	19.1	12.5 (65)	189	181 (96)	0.10	0.08 (80)	0.69	0.65 (94)	303*	233 (77)	19.8	19.6 (99)	3.48	2.97 (85)	10.27*	11.80 (115)	33.89*	25.07 (74)
SES-275	30.9	27.2 (88)	291*	247 (85)	0.11	0.09 (82)	0.62	0.63 (102)	308*	252 (82)	15.2	17.7 (116)	5.57*	4.16 (75)	13.97	15.25 (109)	40.30*	27.28 (68)
SES-352	29.4	21.3 (72)	247*	192 (78)	0.06	0.06 (100)	0.58	0.59 (102)	257*	220 (86)	19.3	16.7 (87)	2.40	1.90 (79)	11.50*	13.12 (114)	20.87	14.83 (71)
IND84-412	97.0*	65.1 (67)	284	270 (95)	0.35*	0.26 (74)	1.25	1.30 (104)	287*	228 (79)	26.4	27.7 (105)	4.16*	3.12 (75)	9.64	10.42 (108)	42.54*	29.86 (70)
IND84-409	101.4*	51.2 (50)	267	248 (93)	0.38*	0.25 (66)	1.33*	1.19 (89)	283*	200 (71)	29.9	26.6 (89)	5.89*	4.71 (80)	10.91	12.04 (110)	53.98*	38.80 (72)
SES-235	75.5*	46.0 (61)	342*	265 (77)	0.22*	0.17 (77)	1.11	1.13 (102)	262*	195 (74)	23.8	23.3 (98)	4.79	5.06 (106)	11.51*	12.96 (113)	41.45	42.64 (100)
SES-246	43.6*	32.8 (75)	342*	304 (89)	0.13*	0.08 (62)	0.93*	0.80 (86)	280*	215 (77)	15.8	17.0 (108)	5.45*	2.81 (52)	13.17	12.49 (95)	39.88*	22.28 (56)
SES-286	38.2*	22.3 (58)	328*	265 (81)	0.12	0.09 (75)	0.76	0.74 (97)	263*	187 (71)	22.8	16.7 (73)	3.43	3.20 (93)	12.27	12.23 (99)	27.90	32.96 (118)
IND84-404	87.2*	36.5 (42)	343*	238 (69)	0.26*	0.15 (58)	1.32*	1.19 (90)	220*	152 (69)	25.7	29.0 (113)	3.62	4.62 (128)	11.11	12.46 (112)	32.58	36.89 (113)

(*Table 3. continues*)

IND84-405	78.4*	38.2 (49)	328*	208 (63)	0.25*	0.19 (76)	1.25	1.21 (97)	240*	180 (75)	32.0	34.6 (108)	4.99*	3.90 (78)	10.04	10.91 (109)	49.70*	35.89 (72)
IND84-462	89.2*	40.9 (46)	243*	181 (74)	0.37*	0.25 (68)	1.29	1.30 (101)	270*	197 (73)	28.1*	22.5 (80)	3.59	2.81 (78)	9.58	10.87 (113)	37.47*	26.03 (69)
IND84-468	101.9*	44.5 (44)	325*	166 (51)	0.31*	0.27 (87)	1.27	1.23 (97)	295*	230 (78)	24.2	27.7 (114)	3.01	2.55 (85)	9.21	9.21 (100)	32.74	27.97 (85)
IND84-479	81.3*	24.7 (30)	331*	175 (53)	0.25*	0.14 (56)	1.18*	1.07 (91)	237*	148 (62)	26.4*	21.2 (80)	4.39	3.72 (85)	10.78*	12.36 (115)	40.78*	30.61 (75)
IND85-503	81.8*	32.6 (40)	277*	248 (89)	0.30*	0.14 (47)	1.19	1.20 (101)	250*	152 (61)	23.5	19.7 (83)	2.86	3.11 (109)	8.94	10.22 (114)	31.57	29.92 (95)
IND85-503	107.8*	43.4 (40)	341*	293 (86)	0.32*	0.16 (50)	1.37	1.29 (94)	262*	162 (62)	23.3	19.8 (85)	3.20	2.78 (87)	9.98*	11.14 (112)	32.06	24.72 (77)
Mean	69.9*	36.9 (53)	298*	262 (88)	0.23*	0.16 (70)	1.08*	1.03 (95)	268*	197 (74)	23.9	22.7 (95)	4.06*	3.43 (85)	10.86*	11.83 (109)	37.18*	29.21 (79)
LSD (5%)																		
Clones	9.16		21.62		0.36		0.107		30.54		4.08		1.037		1.367		8.75	
Environment	3.35		7.90		0.013		0.039		11.15		NS		0.379		0.499		3.20	

NMS = Number of milleable stalks

*Significant differences under normal and rainfed environments at P = 0.05

Figures in parenthesis indicates the percentage of corresponding values under normal environment

The mean performance of clones differed significantly in two environments for all the traits excepting juice extraction percentage (Table 3). Comparing the performances under normal and rainfed conditions for various characters, the maximum reduction (47%) was observed in stalk yield followed by 30 per cent reduction in SSW. The reduction in stalk yield under rainfed was due to decrease in both of its main components, i.e. NMS and SSW. The decrease in SSW was mainly due to reduced stalk length under rainfed conditions. Stalk diameter and juice extraction percentage were varied least in two environments.

Among the quality traits, there was reduction in sucrose percentage and purity percentage in rainfed experiment whereas about 9 per cent improvement was observed in brix percentage. Higher brix at harvest (November) in the rainfed canes of *S.spontaneum* clones as compared with the irrigated ones appeared to result mainly from the delay in maturity of canes under rainfed conditions. Another factor which might have contributed towards higher brix percentage under rainfed conditions is the contribution of immature portion of the cane which had got high concentration of reducing sugars. As length of cane was reduced by 26 per cent, the contribution of immature portion of cane is expected to be relatively increased. However, other factors like changes in anatomy of canes at tissue and cellular level cannot be ruled out.

The clone IND84-412 was the best for stalk yield (65.1 t/ha) followed by IND84-409 (51.2 t/ha) and SES-235 (46 t/ha) under rainfed conditions (Table 3). But performance of all these clones differed significantly in two environments. Reduction in yield in rainfed environment in comparison to normal environment was the maximum in IND84-409 (49%) followed by SES-235 (39%) and IND 84-412 (33%).

Three clones, viz., SES-222, SES-275 and SES-352 showed statistically similar performances under two environments for stalk yield. Among these three clones, SES-275 and SES-352 were superior to SES-222. The performances of SES-275 and SES-352 were similar in both environments in respect to SSW, stalk diameter, juice extraction percentage and brix percentage and showed least reduction in stalk length in rainfed environment. The clone SES- 275 was significantly superior to SES-252 and SES-222 for juice quality attributes. Therefore, considering the synchronisation in flowering with proven parents, these clones may be utilized in future breeding programmes for developing clones suitable for rainfed or restricted irrigated conditions of north-western zone.

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