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GENETIC DIVERGENCE OF STALK YIELD AND JUICE QUALITY AND THEIR COMPONENTS IN FLOWERING CLONES OF *SACCHARUM OFFICINARUM*

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ABSTRACT

Fifty three clones of *Saccharum officinarum* which flower at Coimbatore and/or Cannanore were evaluated to study the pattern of genetic divergence. Data on six characters each of stalk yield and juice quality were recorded and subjected to multivariate D^2 analysis separately. The clones were grouped in eleven clusters on the basis of stalk yield and its traits, and in seven clusters on the basis of juice quality traits. Hybridisation among the clones from diverse clusters may help in isolating progenies with higher stalk yield and improved juice quality.

Key words: Genetic divergence, multivariate analysis, stalk yield, juice quality and *Saccharum officinarum*.

Saccharum officinarum being the source of genes for sucrose accumulation and low fibre content is the most important cultivated species as a large proportion of the genome of commercial hybrids is derived from this species. Since there are a large number of clones (752 of which about 60 are flowering type) of *S. officinarum* available in the germplasm and each and every one cannot be utilized, it is necessary to group the clones based on quality and select the elite among them for utilization in breeding [1]. The intermating of unlikes leads to greater opportunity for crossing over which releases latent variation by breaking up the predominantly repulsion phase linkages. The present study aims at understanding the pattern of genetic divergence among flowering type *S. officinarum* clones for further improvement in the species clones.

MATERIALS AND METHODS

The experimental material comprised 53 *S. officinarum* clones which flower at Coimbatore and/or Cannanore were evaluated in a randomised block design with two

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replications at Sugarcane Breeding Institute, Coimbatore. The clones were planted in a row plot of 6 m length spaced 90 cm apart. Twenty three-budded setts were planted in each row at equal distance. Sample juice analysis was done at 10 month crop age and the trial was harvested at 12 month crop age. Data on six quantitative characters each of stalk yield and juice quality were recorded and subjected to Mahalanobis' D^2 analysis. The clones were grouped in various clusters by Tocher method as explained by Rao [2].

RESULTS AND DISCUSSION

The analysis of variance showed significant differences among clones for all stalk yield and juice quality characters indicating the potentiality of population to isolate parents which may produce better progenies.

STALK YIELD

On the basis of stalk yield and its five components 53 clones were classified into eleven clusters (Table 1). The maximum number of clones (21) were included in cluster I, followed by cluster II (13). Four clones, viz., Rayada, Sarawak unknown, 28 NG 208, NG 77-62 formed individual clusters. Cluster means indicated that cluster VII was the best for stalk yield mainly due to the highest number of millable stalks (Table 2). The stalk yields of clusters I,

Table 1. Distribution of *S. officinarum* clones on the basis of stalk yield characters

Clusters	No. of clones	Clones
I	21	Cebu Lt. purple, Koelz 11132, Mant. 1585, M. Red, Oramboo, 28 NG 210, 28 NG 224, 57 NG 57, 57 NG 57, 57 NG 110, 57 NG 161, 57 NG 177, 57 NG 222, NG 77-26, NG 77-43, NG 77-60, NG 77-63 str, NG 77-65, NG 77-66, NG 77-99, NG 77-137
II	13	Bt. Str. Aubin, Fiji 40, NC-116, Red Cane, 28 NG 215, 28 NG 221, 51 NG 53, 57 NG 45, NG 77-14, NG 77-15, NG 77-31, NG 77-63, Nstr., NG 77-117
III	4	Baragua, Gungera, 57 NG 126, NG 77-81
IV	4	Fiji 15, Sinense, 51 NG 77, 57 NG 203
V	3	Green German, Saipan G, 57 NG 168
VI	2	Str. mauritius, NG 77-92
VII	2	M. Gayam, Naz
VIII	1	Rayada
IX	1	Sarawak unknown
X	1	28 NG 208
XI	1	NG 77-62

Table 2. Cluster means for stalk yield characters in *S. officinarum*

Cluster	Stalk yield per plot (kg)	NMS	Stalk diameter (cm)	Stalk length (m)	Single stalk weight (g)	Germination %
I	29.4	41	2.32	1.81	0.71	68.0
II	15.8	24	2.58	1.27	0.65	60.3
III	69.6	76	2.72	1.80	0.94	70.9
IV	37.4	74	1.93	1.95	0.52	65.4
V	44.5	45	2.93	1.62	1.02	64.0
VI	22.8	22	2.59	2.13	1.03	56.7
VII	89.0	138	2.23	1.85	0.64	61.3
VIII	26.5	23	3.45	1.35	1.14	42.4
IX	79.0	56	3.15	2.18	1.43	61.4
X	18.8	24	3.25	1.85	0.78	72.0
XI	78.1	73	2.25	2.48	1.07	74.7

VI and VIII were more or less similar. Clusters VIII, IX and XI were the best for stalk diameter, stalk length, single stalk weight and germination per cent respectively.

Intracluster distance varied from 0.00 to 4.24, cluster VI being the most diverse. Clusters I, II, IV and V were quite close to each other (Table 3). Clusters VI and VIII, VIII and XI, VI

Table 3. Average intra- (in bold) and intercluster distance (D) values on the basis of stalk yield and its components in *S. officinarum*

Cluster	I	II	III	IV	V	VI	VII	VIII	IX	X	XI
I	**3.71**	5.46	6.91	5.29	4.99	10.88	5.08	8.44	8.67	6.45	9.14
II		**3.57**	9.21	7.96	5.33	13.36	5.77	5.74	10.60	6.05	12.57
III			**3.22**	7.42	5.82	7.44	9.24	11.08	5.04	10.16	5.49
IV				**3.81**	7.52	8.51	7.59	11.29	10.32	9.02	8.91
V					**3.17**	11.06	5.68	6.22	6.45	6.41	9.29
VI						**4.24**	13.64	15.66	10.67	14.65	8.44
VII							**3.85**	6.79	9.33	5.45	11.06
VIII								**0.00**	10.90	6.43	14.81
IX									**0.00**	10.93	5.86
X										**0.00**	13.04
XI											**0.00**

and X, VI and VII, II and VI, X and XI were widely placed and hybridization among clones from these cluster combinations will yield the maximum variability for stalk yield and its components. Utilization of clones in breeding from different clusters with the maximum diversity among themselves had been suggested by many workers in sugarcane [3–5].

JUICE QUALITY

Fifty three clones were grouped into seven clusters on the basis of juice quality characters (Table 4). Cluster I accommodated most of the clones. Four clones, viz. Gungera, 28 NG 221, NG 77- 63 Nstr, and NG 77-63 Str formed individual clusters (IV to VII). The cluster means showed cluster IV as the best and cluster III as the poorest for juice quality (Table 5). These two clusters were complementary to each other for all the characters except juice extraction per cent.

Table 4. Distribution of *S. officinarum* clones in different cluster on the basis of juice quality characters

Cluster	No. of clones	Clones
I	42	Baragua, Bt. Str. Aubin, Cebu Lt. purple, Fiji-40, Green german, Koelz 11132, Mant. 1585, M. Red, NC-116, Oramboo, Red cane, Saipan G, Sarawak unknown, Str. Mauritius, Sinense, 28 NG 208, 28 NG 210, 28 NG 215, 28 NG 224, 51 NG 53, 51 NG 77, 57 NG 45, 57 NG 57, 57 NG 77, 57 NG 110, 57 NG 126, 57 NG 161, 57 NG 168, 57 NG 177, 57 NG 203, 57 NG 222, NG 77-14, NG 77-26, NG 77-43, NG 77-60, NG 77-62, NG 77-65, NG 77-66, NG 77-81, NG 77-92, NG 77-99, NG 77-137
II	5	Fiji-15, Rayada, NG 77-15, NG 77-31, NG 77-117
III	2	M. Gayam, Naz
IV	1	Gungera
V	1	28 NG 221
VI	1	NG 77-63 NStr.
VII	1	NG 77-63 Str.

Intracluster distance varied from 0.00 to 4.91 (Table 6), cluster I being the most diverse. Intercluster distances ranged from 6.84 between clusters I and V to 16.44 between clusters III and IV. The maximum divergence was observed between cluster III and all other clusters, except cluster VI.

Forty two clones out of 53 were grouped in a single cluster, indicating clustering of most of the clones around the general mean (10.4%) for commercial cane sugar per cent (CCS %)

Table 5. Cluster means for six juice quality traits in *S. officinarum*

Cluster	CCS %	Purity	Sucrose %		Brix %	Juice extaction %
			10 months	12 months		
I	10.8	85.2	13.1	15.9	18.7	52.9
II	8.1	75.2	8.0	12.7	16.9	54.4
III	4.4	63.1	7.6	7.9	12.5	50.2
IV	14.1	92.1	17.7	20.0	21.7	53.8
V	12.3	90.6	13.2	17.6	19.5	25.6
VI	5.8	66.5	10.5	10.0	14.9	48.4
VII	12.5	91.0	11.3	17.8	19.6	57.1

Table 6. Average intra- (in bold) and inter-cluster distance (D) values on the basis of six juice quality traits in *S. officinarum*

Cluster	I	II	III	IV	V	VI	VII
I	**4.91**	7.11	15.40	7.83	6.84	8.81	7.62
II		**4.78**	13.86	12.24	9.72	7.37	9.46
III			**3.00**	16.44	15.64	9.01	16.20
IV				**0.00**	7.87	11.80	9.07
V					**0.00**	9.95	9.01
VI						**0.00**	11.61
VII							**0.00**

of the population. Clusters III and IV are at the two extremes and, the hybridization between the clones frnm these two clusters may not change the population mean but the variance and the range of the frequency distribution are expected to increase [6] due to crossing over which releases latent variation by breaking up the predominantly repulsion phase linkages [7]. This will provide the opportunity to select better recombinants for various characters and utilisation of such improved clones of the species in breeding would seem appropriate in achieving better and quicker gains.

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