Indian J. Genet., 57 (1): 43–47 (1997)

GENETIC DIVERGENCE OF SUGAR YIELD CONTRIBUTING CHARACTERS IN *SACCHARUM ROBUSTUM* BRANDES ET JESWIET EX GRASSL.

G. HEMAPRABHA AND BAKSHI RAM*

Breeding Discipline, Sugarcane Breeding Institute, Coimbatore 641007

(Received: November 20, 1992; accepted: June 27, 1994)

ABSTRACT

Fifty one flowering clones of *Saccharum robustum* were evaluated for yield and quality parameters to study the pattern of genetic divergence using Mahalanobis' D^2 statistics. The clones were grouped into eleven clusters. Cluster IV was the most divergent. Cluster IX was the most distant from the other clusters. Cluster means indicated that cluster VI was the best for cane yield, but was poor for quality, while cluster IX was the best for quality and was poor for cane yield. Crossing *S. robustum* clones from divergent clusters for intra-population improvement or hybridization of F_1s evolved by crossing commercial hybrids or *S. officinarum* clones with *S. robustum* clones from divergent clusters to derive double cross hybrids may pave way for enhancing variability so as to select progenies with high stalk yield and improved juice quality.

Key words: Genetic divergence, Mahalanobis' D^2 statistic, *S. robustum*, stalk yield, juice quality.

In the present day commercial cultivars of sugarcane, the genome of *Saccharum robustum*, a wild species of *Saccharum* is poorly represented, mainly due to the slowness in getting desired results in nobilization programmes because of n+n chromosome transmission unlike with the other wild species *S. spontaneum*. However, the species possesses an enormous wealth of variability and great potential for cane yield which attract the breeders in utilizing the species in hybridization. A clear understanding of the degree of divergence for economic characters in the species will be an added advantage in this regard, as intermating of divergent groups would increase variability and range of frequency distribution [1]. But no published information exist on genetic divergence in *S. robustum*. This study is aimed at estimating the degree of genetic divergence in some of the flowering types of *S. robustum* and identifying diverse clones to be used in future nobilization programmes.

*Address for correspondence: Sugarcane Breeding Institute, Regional Centre, Post Box No. 52, Karnal 132001.

MATERIALS AND METHODS

The experimental material comprised 51 *S. robustum* clones which flower at Coimbatore and/or Cannanore. These clones include 37 collections from New Guinea (NG), 10 from Irian Java (IJ) and 4 collections from Indonesia-Maluka (IM). The clones were evaluated in a randomized block design with two replications at Sugarcane Breeding Institute, Coimbatore during 1989-90. Each clone was planted in a single row of 6 m length spaced 90 cm apart. Twenty three-budded sets were planted in each row. Germination per cent was estimated at 30 days and sample juice analysis was done at 300 days. The trial was harvested at 360 days of crop age during which eleven characters of cane yield and quality were estimated. The data were subjected to Mahalanobis D^2 analysis. The clones were grouped into various clusters by Tocher's method as explained by Rao [2].

RESULTS AND DISCUSSION

The analysis of variance showed significant differences among the clones for all characters. Fifty one clones were grouped under eleven clusters on the basis of thirteen characters (Table 1). Cluster I had the maximum number of 23 clones followed by cluster II with 13 clones. There were five clones in cluster III and three in cluster IV. Clusters V to XI

Table 1. Classification of *S. robustum* clones into different clusters on the basis of yield and quality characters

Cluster	No. of clones	Clones
I	23	28 NG 289, 57 NG 45, 57 NG 80, 57 NG 238, NG 77-2, NG 77-23, NG 77-32, NG 77-35, NG 77-53, NG 77-55, NG 77-58, NG 77-94, NG 77-122, NG 77-186, NG 77-219, NG 77-221, IJ 76-337, IJ 76-360, IJ 76-414, IJ 76-445, IJ 76-495, IJ 76-559, IM 76-258
II	13	28 NG 251, 57 NG 19, 57 NG 83, NG 77-1, NG 77-21, NG,77-24, NG 77-34, NG 77-136, NG 77-145, NG 77-147, NG 77-160, IJ 76-435, IJ 76-536
III	5	51 NG 91A, 57 NG 134, IJ 76-436, IM 76-255, IM 76-256
IV	3	51 NG 63, 57 NG 11, 57 NG 56
V	1	IM 76-232
VI	1	IJ 76-293
VII	1	NG 77-39
VIII	1	NG 77-38
IX	1	NG 77-57
X	1	NG 77-73
XI	1	NG 77-59

had single clone in each and they were IM 76-232, IJ 76-293, NG 77-39, NG 77-38, NG 77-57, NG 77-73 and NG 77-59, respectively. The clustering pattern of different clones did not follow their geographical distribution suggesting that factors other than geographical separation are also responsible for divergence. Cluster means indicated that the best clusters for cane diameter of 2.00 cm were IV, X and XI. Cane length varied from 243 cm in cluster VI and 240 cm in cluster V to 148 cm in cluster VIII. Single cane weight was the maximum in cluster VI. Number of millable canes (NMC) was high in cluster VIII, VII and V. The best clusters for cane yield and its components were VI and V. For juice quality characters cluster IX was the best. Clusters IV, I, VII and II were also better for quality, whereas clusters V, VI and III were poor for quality traits. It was seen that high quality clusters, viz., IX was the poorest in yield while high yield in clusters VI and V fell into the class showing poor juice quality. Cluster means for cane yield and juice quality characters of clusters I and IV comprising more number of clones (23 and 3, respectively) was above the general mean for the characters.

Table 2. Cluster means for thirteen yield and quality characters of *S. robustum*

Character	Cluster means										
	I	II	III	IV	V	VI	VII	VIII	IX	X	XI
CCS/plot (kg)	1.3	1.1	0.4	1.6	0.5	1.9	1.1	1.2	1.8	0.4	1.9
Cane yield per plot (kg)	27.9	23.8	14.0	29.9	36.6	60.9	25.3	35.3	22.3	28.0	8.6
CCS %	4.7	4.5	3.0	5.4	1.4	3.3	4.3	3.4	7.7	4.4	4.2
Brix %	13.5	13.2	11.9	14.7	10.0	12.2	13.1	14.8	15.4	11.0	12.1
Sucrose % (300 days)	6.0	9.8	6.0	8.3	5.8	3.8	7.1	10.1	10.8	5.0	4.6
Sucrose % (360 days)	8.4	8.2	6.3	9.4	4.2	6.7	8.7	7.6	12.0	7.6	7.8
Purity %	62.2	61.6	54.8	64.8	42.5	55.1	66.0	59.0	77.3	62.6	69.2
NMC/plot	84.0	63.2	38.6	69.3	98.5	89.0	109.5	141.0	64.0	20.5	54.5
Single cane weight (g)	33.0	38.0	30.0	38.0	37.0	67.0	35.0	35.0	35.0	32.0	50.0
Cane diameter (cm)	1.6	1.7	1.6	2.0	1.9	1.6	1.7	1.7	1.5	2.0	2.0
Cane length (cm)	212	203	175	157	240	243	192	148	188	212	222
Extraction %	29.7	28.7	23.6	35.2	31.9	37.3	26.7	25.4	37.8	33.1	29.6
Germination %	62.3	63.5	52.9	44.0	70.0	56.7	69.4	72.0	86.7	52.0	82.7

Intracluster distances ranged from 0.00 to 6.53 (Table 2) in cluster IV which was the most diversed. Intercluster distance ranged from 6.60 between clusters III and X to 14.84 between clusters VIII and IX. Least divergence was observed for cluster I, whereas cluster IX showed maximum divergence with all clusters except cluster II. The divergence of cluster IX from other clusters might be due to its best juice quality traits especially the sucrose per cent at 360 days followed by lower mean values for NMC and cane yield. Cluster IX, i.e., NG77-57 thus showed great potentiality as a breeding stock by virtue of its better juice quality characters as well as maximum genetic diversity. The high yielding clones IM 76-232 and IJ 76-293 (clusters VI and V, respectively) had higher intercluster distance from NG 77-57. The specific cross combination of NG 77-57 with IM 76-232 or IJ 76-293 and also with clones from clusters I and IV may prove beneficial for effective selection of recombinants combining cane yield and quality for intraspecific improvement. Earlier studies had indicated that intermating of divergent groups would lead to greater opportunity for crossing over which would release latent variation by breaking up predominantly repulsion linkages [3], and utilization of diverse parents in breeding was also stressed by many workers [4–7].

S. robustum being a wild species cannot be utilised directly in commercial breeding programmes. But double cross hybrids obtained by crossing F_1 of commercial hybrid or *S. officinarum* with the *S. robustum* clone NG 77-57 or with similar F_1s involving *S. robustum* clones as IJ 76-293 or IM 76-232, or with the clones from clusters I and IV may prove beneficial in isolating nobilized hybrid clones of different genetic base not represented in

Table 3. Average intracluster (in bold) and intercluster distances (D) on the basis of thirteen characters in *S. robustum*

Clusters	I	II	III	IV	V	VI	VII	VIII	IX	X	XI
I	**5.2**	7.3	7.4	7.2	6.9	8.0	7.2	10.4	10.9	7.3	7.3
II		**5.4**	8.8	7.4	7.6	11.2	10.1	8.9	9.2	10.0	10.7
III			**5.5**	7.6	8.6	10.5	7.4	11.7	13.8	6.6	10.4
IV				**6.5**	9.0	10.0	8.8	10.6	11.5	8.3	9.6
V					**0.0**	8.5	9.0	10.6	11.6	9.9	10.7
VI						**0.0**	9.1	13.5	14.2	8.6	8.4
VII							**0.0**	11.9	13.8	7.8	9.4
VIII								**0.0**	14.8	14.3	14.5
IX									**0.0**	13.2	11.5
X										**0.0**	6.7
XI											**0.0**

the present day cultivars. In one of our study, we [8] observed improvement in cane yield in double cross ($F_1 \times F_1$) progenies.

REFERENCES

1. R. Alicchio and L. D. Palenzona. 1974. Phenotypic variability and divergence in disruptive selection. Theor. Appl. Genet., **45**: 122–125.

2. C. R. Rao. 1952. Advanced Statistical Methods in Biometrical Research. John Wiley and Sons Inc., New York: 357–363.

3. J. M. Thoday. 1960. Effects of disruptive selection. III. Coupling and repulsion. Heredity, **14**: 35–49.

4. Y. P. Singh, Awadesh Kumar and B. P. S. Chauhan. 1981. Genetic divergence in pearl millet. Indian J. Genet., **41**: 186–190.

5. A. V. Rao, A. S. R. Prasad, T. Sai Krishna, D. V. Seshu and T. E. Sreenivasan. 1981. Genetic divergence among some brown plant hopper resistant rice varieties. Indian J. Genet., **41**: 179–185.

6. H. N. Singh and S. B. Singh. 1981. Genetic divergence in sugarcane. Proc. Intern. Soc. Sug. Technol., **17**: 1198–1203.

7. Bakshi Ram and G. Hemaprabha. 1991. Genetic divergence in some flowering clones of *S. barberi* and *S. sinense*. Indian J. Pl. Genet. Resources, **4**: 40–44.

8. G. Hemaprabha and Bakshi Ram. 1993. Genetic variability in nobilization stages of *Saccharum robustum* Brandes et Jeswiet ex Grassl. Sugar Cane, **6**: 6–9.