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GENETIC DIVERGENCE AMONG SELECTED SUGARCANE (*SACCHARUM* SPP.) CLONES FOR CANE YIELD AND QUALITY ATTRIBUTES

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Abstract

The investigation was carried out at the Zonal Agricultural Research Station V.C. Farm, Mandya- 571405, Karnataka during season 2008-09. Thirty selected sugarcane clones developed through fluff supply programme under All India Coordinated Research Project on sugarcane were tested in a randomized complete block design with two replications. The objective was to quantify the genetic diversity among these clones based on cane yield and quality traits. The results indicated that the genotypes were grouped into eight clusters based on the genetic distance using Mahalanobis statistics. Cluster III was the largest comprising of ten genotypes while cluster VIII comprising solitary genotype. Cane yield and sugar yield were major contributor towards the total divergence. Higher inter cluster distance was recorded between cluster I and VII (23.79) indicating high genetic diversity among these two clusters. Thus exploitation of genotypes within these two clusters as parents for crossing could produce good sugarcane segregants. The lowest intra cluster distance was reported in the cluster VII revealed that clones are identical and can not to be used as parents in crossing that results hybrid not desirable for the character studied.

A critical analysis of cluster means for different traits indicated that cluster VIII was high yielding cluster with maximum average mean values for most of the character studied. On the bases of high diversity, the divergent clone VCF 0517 need to be exploited for further improvement for cane and sugar yield in future breeding programme and production of desired recombinants.

Key words: Mahalanobis D^2 statistic, genetic divergence, cluster distance.

Introduction

Sugarcane is an important cash crop in India and plays a crucial role in the economy by contributing 21.4 per cent area and 22.1 per cent production ranks second (next to brazil). Sugarcane is a multipurpose crop plant that provides food, fodder, feed, fibre and fuel. In Karnataka, Sugarcane being cultivated in an area of 4.2 lakh hectares producing 359.10 lakh tons of cane with productivity of 85.5 t ha^{-1} (Anon., 2014). The main objectives of sugarcane breeding is to develop varieties capable of producing high sugar yields per unit land area. To achieve this goal we need special varieties, selection of genetically diverse genotypes is important for exploitation of heterosis and development of desirable recombinants. Multivariate analysis is the best suitable approach for generating the information on biometrical genetics of any corp. Mahalanobis D^2 statistic is a very sensitive tool for measuring genetic divergence based on quantitative traits and is widely used by plant breeders for indentifying the genetically diverse genotypes for their use in crop improvement programme. The present investigation was undertakes to study genetic divergence with respect to cane yield, quality and its components in sugarcane clones to select better genotypes for use in future breeding programme.

Materials and Methods

The experimental material was developed from fluff supply programme generated at Zonal Agricultural Research Station (UAS Bengaluru) V.C. Farm, Mandya, Karnataka under All India Coordinated Research Project on sugarcane. The experimental material for the present study consisted of 30 clones of sugarcane including two

standards *viz.,* Co 62175 and Co 86032 and the experiment was laid out during August season of 2008-2009 in randomized complete block design with two replications, each genotype planted in six rows and each row having of six meter length with a plot size of 32.4m^2. The setts having three eye buds each were planted with three setts per meter. The crop received 250 kg N, 100kg P_2O_5 and 125 kg K_2O ha^{-1}. All the recommended package of practices were adopted during the entire crop season. The crop was harvested at 12 month of age. The observations were recorded on five randomly tagged canes at 12th month stage. The following field and laboratory observations were recorded *viz.,* Germination per cent, number of tillers (000' ha^{-1}), number of millable canes (000' ha^{-1}), stalk length (m) stalk diameter (cm), single stalk weight (kg), stalk internode length (cm), number of stalk internodes, juice brix per cent, juice pol per cent, juice purity per cent, CCS per cent, sugar yield (ha^{-1}) and cane yield (ha^{-1}).

Analysis of variance for different characters was done based on standard procedure Mahalanobis D^2 statistic was used to asses genetic divergence. Genotype were grouped on the basis of minimum generalized distance using Tochers method as described By Rao (1952).

Results and Discussion

The analysis of variance revealed highly significant differences among genotypes for all the character studied, indicating adequate genetic variability among the genotypes.

Thirty clones were grouped into eight clusters (table 1). Cluster III was the largest comprising of ten genotypes followed by cluster V and II with five genotypes each.

Table 1: Distribution of 30 sugarcane genotypes to different clusters.

Clusters	No. of genotypes	Cluster composition
I	2	VCF 0557, VCF 0514
II	5	VCF 0486, VCF 03118, VCF 0353, VCF 051112, VCF 05141
III	10	VCF 03165, VCF 0427, VCF 0476, VCF 05510, VCF 0597, VCF 0564, VCF 0567, VCF 051115, VCF 0479, VCF 0494
IV	2	VCF 0592, VCF 05314
V	5	VCF 05121, VCF 0452, VCF 0488, VCF 0490, VCF 05132
VI	2	CO62175, CO 86032
VII	3	VCF 0482, VCF 05376, CO 94008
VIII	1	VCF 0517

Table 2: Contribution of each character towards to the divergence in sugarcane genotypes.

Sl. No.		No. of first rank	% Contri-bution
1.	Cane yield (t ha^{-1})	161	37.01
2.	Sugar yield (t ha^{-1})	86	19.77
3.	Number of tillers (000' ha^{-1})	63	14.48
4.	Single stalk weight (kg)	50	11.49
5.	Number of millable cane (000' ha^{-1})	29	6.67
6.	Juice brix per cent	11	2.53
7.	Number of internodes	9	2.07
8.	CCS per cent	9	2.07
9.	Juice purity per cent	6	1.38
10.	Juice pol per cent	4	0.92
11.	Stalk diameter (cm)	3	0.69
12.	Stalk length (mt)	2	0.46
13.	Germination per cent	1	0.23
14.	Stalk Internode length (cm)	1	0.23
	Total	**435**	**100.00**

Table 3: Intra and inter cluster D^2 values for 8 clusters formed by 30 genotypes.

	I	II	III	IV	V	VI	VII	VIII
I	**3.77**	20.09	15.54	18.12	10.41	12.94	23.79	14.26
II		**13.01**	14.46	10.17	17.10	12.25	15.39	18.41
III			**13.93**	11.62	13.38	11.47	16.53	15.75
IV				**4.82**	14.57	9.39	11.20	13.91
V					**10.77**	11.76	19.31	15.43
VI						**9.58**	16.24	12.46
VII							**15.02**	19.71
VIII								**0.00**

Cluster VII with three genotypes, cluster I, IV and VI comprised two genotype each while cluster VIII had single genotype (VCF 0517) this could not be grouped with any other genotype.

Out of the 14 character studied, all the characters showed the contribution towards divergence (table 2) and in these traits cane yield (t ha^{-1}) contributed to the highest to the diversity (37.0 %) followed by sugar yield (19.79 %), number of tillers per hectare (14.48 %), single stalk weight (11.49 %) and number of millable cane ha^{-1} (6.67 %). Other character showed low per cent contribution.

Inter cluster distance varies from 9.39 between cluster IV and VI to 23.79 between cluster I and VII (table 3). Higher inter cluster distance were observed

Table 4: Cluster means of different quantitative & qualitative traits.

Characters	Clusters							
	I	II	III	IV	V	VI	VII	VIII
Germination per cent	64.1	48.45	51.08	48.55	60.48	50.9	50.38	51.6
Number of tillers (000' ha^{-1})	208.85	135.28	161.94	137.08	183.4	160.5	118.48	162.35
Number of millable cane (000' ha^{-1})	112.55	110.36	104.74	101.53	103.25	113.2	82.37	110.75
Stalk length (m)	2.46	2.44	2.38	2.37	2.49	2.72	2.56	2.75
Stalk diameter (cm)	3.04	3.15	3.22	3.11	3.17	2.97	3.4	3.43
Stalk internode length (cm)	14.8	13.94	12.98	14.15	13.46	13.9	13.53	16.5
Number of stalk internodes	22.0	23.6	23.4	23.0	22.7	24.0	24.0	24.5
Single stalk weight (kg)	1.8	1.67	1.86	1.98	1.89	1.68	2.02	2.45
Juice brix per cent	19.0	18.58	17.97	18.75	16.66	19.6	16.85	20.2
Juice pol per cent	17.69	17.5	16.7	17.53	15.58	18.55	15.72	19.18
Juice purity per cent	93.27	94.48	93.22	93.68	93.73	94.79	93.57	95.58
CCS per cent	12.53	12.56	11.82	12.44	11.05	13.23	11.16	14.21
Sugar yield (t ha^{-1})	23.1	16.82	18.56	19.26	19.0	22.33	16.08	32.15
Cane yield (t ha^{-1})	184.0	136.8	157.61	155.0	174.2	168.75	144.67	234.0

between cluster VII and all other clusters. Intra cluster distance ranged from 0.00 to 15.02. The highest value was observed for cluster VII followed by cluster III and II while cluster I, IV and VI were quite close to each other.

Cluster means indicated that cluster VIII has the highest sugar yield where as cluster VII was the lowest (table 4). The cluster VIII was the best for cane yield but moderate for germination per cent. Cluster VIII was the best for sugar yield which combined both cane yield and juice quality traits. While cluster VIII can be categorized as a cluster with high values on stalk length, stalk diameter, stalk internode length, number of stalk internodes, single stalk weight, sugar and cane yield. Similarly cluster VIII can be considered as high quality characters such as juice brix per cent, juice pol per cent, juice purity per cent and CCS per cent.

The use of clones from various clusters with maximum diversity has been emphasized by many workers in sugarcane (Punia *et al.,* 1983, Gill *et al.,* 1983, Arunachalam *et al.,* 1989, Hooda *et al.,* 1990, Bakshiram and Hemaprabha 1991 and 1993, Srivastava *et al.,* 1999, Ravishankar *et al.,* 2003 and Ahmed *et al.,* 2010)

The most significant point emerged from the divergence studies is that cluster VIII registered higher inter cluster distance between them but also had highest cluster mean values for almost all the characters. The cluster VIII with solitary genotype indicates that the clone VCF 0517 could be beneficially employed in future breeding programme to improve both cane and sugar yield.

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