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Research Article

Genetic diversity among the land races of sorghum collected in Tamil Nadu

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Abstract:
Sixty three local land races of sorghum (*Sorghum bicolor L.*) collected from different parts of Tamil Nadu were evaluated for their genetic diversity based on nine characters. The genotypes were grouped into 14 clusters indicating high genetic divergence among them. The study indicated no definite relationship between geographic and genetic diversity and geographic diversity cannot be used as an index of genetic diversity. Based on the inter cluster distance and cluster mean for various characters it could be seen that the clusters VI, X, XII were the most divergent from the other clusters. The genotypes from these parents possibly be utilized for hybridization programme. Days to flowering, plant height, ear head length and grain weight contributed highly towards the genetic divergence among the genotypes studied.

Keywords:
Sorghum, genetic divergence, inter cluster, cluster mean, contributed characters

Introduction

Sorghum is grown in Tamil Nadu predominantly as rainfed due to its inherent adaptation to moisture stress situation. Number of land races with different plant and grain characteristics are grown traditionally in different parts of the state. Sorghum is a fifth important cereal crop after rice, wheat, maize and barley in the world. The crop is drought tolerant and moderately salt tolerant and it is the crop par excellence in dry areas. Sorghum grain is mainly used for human food and feed for cattle. The crop has potentiality to grow under adverse condition and requires minimum input and care and its cultivation can be extended in dry and saline areas. Moreover, seeds are used as cattle and poultry feed, besides it is used in the preparation of alcohol, starch and sugar. Hybridization involving genetically diverse parents is known to provide an opportunity for bringing together gene constellations to yield in desirable segregants in advanced generation. Knowledge of genetic diversity among plant populations and its quantitative assessment usually helps a breeder in choosing desirable parents for breeding program as selection of parents on the basis of divergent analysis would be more effective. Genetic divergence as measured by Mahalanobis (1936) generalized distance (D^2) has been one of the important statistical tool to provide a rational basis for selection of parents in breeding programmes. The present study was therefore, undertaken to assess the extent of genetic diversity in 63 land races of sorghum genotypes collected from different districts of Tamil Nadu. It will be helpful in selecting suitable parents for future breeding programme.

Material and methods

A collaborative sorghum germplasm was undertaken in Tamil Nadu jointly by the Tamil Nadu Agricultural University, Coimbatore and National Research Centre, Hyderabad during 2006 and 2007. The exploration efforts resulted with a collection of 130 new sorghum genotypes. These genotypes were raised in a randomized block design with two replications in the Department of Millets, TNAU, Coimbatore during *kharif* 2008. Among them, 63 genotypes flowered during the season and the rest were photosensitive types. Data were recorded only for the sixty three genotypes and were subjected to statistical analysis. Each genotype was raised in two rows of 4m length spaced at 45 cm between rows and 20 cm between plants. Five randomly selected plants from each genotype in each replication were taken for recording observations on nine characters *viz.,* Days to 50% flowering, plant height (cm), ear head length (cm), ear head width (cm), stem girth (cm), brix (%), biomass weight (g/plant), grain weight (g/plant), 1000 grain weight. Analysis of variance for the individual character and analysis of co-variance for character pairs were carried out as described by Cochran and Cox (1957). Wilk criteria was used to test the significance of pooled differences (Singh and Chaudhari, 1977). Genetic divergence was estimated by multivariate analysis using Mahalanobiss D^2 statistics. The genotypes were grouped into different clusters by following Tocher's method (Rao, 1952) and principal component analysis was done according to Rao (1964).

Results and discussion

Genetic diversity plays an important role in sweet sorghum because hybrids between lines of diverse origin, generally display a greater heterosis and broad spectrum of segregations than those between closely related parents. The germplasm under study was therefore examined for the variability present in the accessions in respect of yield and yield components. The analysis of variance showed highly significant differences among the genotypes for all the characters studied. The inter cluster distances were higher than the average intra cluster distance which, indicated wide genetic diversity among the genotypes of different groups than those of same cluster. On the basis of D^2 values, 63 genotypes were grouped into fourteen clusters (Table 1). Cluster II was the largest having 23 genotypes followed by cluster I with 20, Cluster III with 8, cluster X with 2 and other clusters each having one genotype. The maximum inter cluster distance was observed between clusters VI and X (157.60) followed by clusters VI and XII (155.25) while the minimum inter cluster distance was found in cluster III with 33.67 (Table 2). The maximum inter cluster distance between clusters VI and X suggested that the genotypes from those clusters if chosen for hybridization program may give heterotic F_1s and broad spectrum of variability in segregating generations. This finding is in support with Singh and Ramanujam (1981) and Mian and Bhal (1989). The clusters contributing maximum to the divergence were given greater emphasis for deciding the type of cluster for the purpose of further selection and the choice of parents for hybridization. Genetic diversity is generally associated with geographical diversity but the former is not necessarily directly related with geographical distribution. The genotypes grouped in cluster I, II and III originated from all parts of Tamil Nadu. This indicated that the geographical and genetic distributions did not follow the same trend. This finding was also reported by Nadaf *et al.,* (1986) and Shanmugam and Rangasamy (1982).

Based on the cluster means of different characters, the genotypes that are involved in clusters XIV, VIII, X had the outstanding mean performance for yield and biomass yield characters. These genotypes which are useful for the development of intervarietal and interspecific crosses for creation of variability for yield and biomass production in their segregating progenies are also likely to yield good recombinants for economic traits. The cluster contributing maximum to the divergence were given greater emphasis for deciding the type of cluster for the purpose of further selection and the choice of parents for hybridization. Based on the cluster mean (Table 3) clusters II and XIV were identified for the earliness (days to 50% flowering), cluster XIV had the maximum values for biomass weight (g/plant), grain weight (g/plant), 1000 grain weight, brix, plant height (cm) and ear head width (cm).

The highest mean values for grain weight (g/plant) and ear head length (cm) were scored by cluster VIII but the highest mean values for biomass weight was obtained in cluster X. Endang *et al.,* (1971) stated that clustering pattern offered a better scope in choosing parents for hybridization to generate variability for effective selection of various economic traits in advanced generation. Therefore the results suggest that the grain yield (g/plant), 1000 grain weight, ear head length, ear head width, biomass weight g/plant, brix, plant height (cm) were the influential traits for improving yield potential and the genotypes in the clusters XIV, cluster VIII and cluster X were found economically worthful.

The contribution of characters towards genetic divergence was assumed by cluster means. As regards the inter and intra cluster distances and cluster means of the important yield and biomass contributing characters such as grain yield (g/plant), ear head length, 1000 grain weight, biomass (g/plant) and plant height (cm), the genotypes *viz.,* EG 103, EG 41, EG 42 and EG 52 were identified as prospective parents for increasing yield and fodder yield potential. Besides, the genotypes which belong to cluster I was suitable for improving special trait like biomass characters through hybridization programme. It can be concluded from the present analysis that the genotypes included in the diverse clusters namely IV and X hold good as parents for obtaining potential hybrids and also for generating greater genetic variability with a scope to improve the grain as well as fodder sorghum.

The contribution given by a particular character to the genetic divergence is presented in Table 4. The principal component analysis revealed positive high values for days to flowering, plant height, ear head length and grain weight for both vector I and II. Such results indicated that these four characters contributed maximum towards the divergence. The greater divergence in the present material due to these four characters will offer a good scope for improvement of yield through selection of parents for producing heterotic sorghum hybrids.

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Table 1 – Composition of clusters based on D^2 statistics in sorghum

Clusters	No. of genotypes	Included land races
I	20	EG 45 (I), EG 96, EG 57 (I), EG 25 (I), EG 76 (N), EG 38 (I), EG 33 (I), EG 32 (I), EG 93 (I), EG 37 (I), EG 100, EG 46 (NC), EG 95, EG 44 (S), EG 56 (I), EG 59 (I), EG 36 (SK), EG 58 (I), EG 92 (VSC), EG 28 (V)
II	23	EG 74 (S), EG 101, EG 66 (V), EG 17 (V), EG 18 (V), EG 19 (V), EG 68 (V), EG 97, EG 67 (V), EG 20 (V), EG 21 (V), EG 24 (KO), EG 23 (V), EG 22 (VC), EG 99, EG 102, EG 35 (SK), EG 15 (V), EG 98, EG 53 (VK), EG 54 (VK), EG 55 (N), EG 27 (V), EG 23 (V)
III	8	EG 11(KR), EG 12 (KR), EG 10 (KV), EG 8 (V), EG 16 (V), EG 6 (V), EG 5 (V), EG 29 (I)
IV	1	EG 34 (V)
V	1	EG 30 (I)
VI	1	EG 46 (N)
VII	1	EG 49 (S)
VIII	1	EG 103
IX	1	EG 31(V)
X	2	EG 41 (N), EG 42 (S)
XI	1	EG 43 (S)
XII	1	EG 48 (M)
XIII	1	EG 65 (PM)
XIV	1	EG 52 (M)

* Abbreviations of the local names in the brackets

V	-	Vellai cholam	N	-	Nattu cholam
K	-	Kari cholam	M	-	Makkattai cholam
KR	-	Karaireddu cholam	VK	-	Vailkattu cholam
KO	-	Kovilpatti cholam	PM	-	Periya Manjal cholam
I	-	Irungu cholam	VS	-	Valappu sigappu cholam
S	-	Sencholam	SK	-	Senkatan cholam

Table 2 – Average intra and inter cluster D^2 values for 14 clusters in sorghum

	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	XIII	XIV
I	31.9	116.1	73.1	91.0	81.5	48.8	102.7	106.6	79.8	118.9	74.0	115.4	57.2	65.6
II		32.9	65.7	47.6	52.6	148.3	60.0	44.2	94.7	67.7	65.3	95.7	123.2	76.3
III			33.7	63.9	48.1	95.6	82.4	55.3	67.0	93.8	58.5	112.9	97.5	61.7
IV				0.0	38.4	128.3	28.7	60.1	32.6	57.3	41.9	62.2	85.6	46.8
V					0.0	113.1	61.8	60.0	55.0	80.4	41.2	92.3	88.5	56.9
VI						0.0	142.2	136.2	118.7	157.6	109.1	155.3	83.2	100.5
VII							0.0	73.1	32.7	43.2	54.9	38.8	91.0	49.3
VIII								0.0	63.2	68.4	64.4	108.8	126.7	79.6
IX									0.0	45.7	34.6	55.9	79.2	43.8
X										32.7	62.7	62.0	118.0	77.5
XI											0.0	78.7	79.5	56.7
XII												0.0	88.6	65.9
XIII													0.0	60.2
XIV														0.0

Table 3 – Cluster mean for nine characters of 63 genotypes in sorghum

Clusters	Days to 50% flowering	Plant Height (cm)	Ear head length (cm)	Ear head width (cm)	Stem girth (cm)	Brix (%)	1000 grain weight (g)	Biomass weight (g/plant)	Grain weight (g/plant)
I	90	354	27.07	5.30	1.43	11.6	19.3	282.5	22.7
II	61	177	12.41	5.38	1.36	13.1	21.6	257.7	21.1
III	68	264	21.26	6.01	1.58	15.3	21.8	194.4	21.7
IV	74	218	10.50	5.00	2.25	6.0	20.8	340.5	22.0
V	91	234	9.55	4.15	1.45	13.0	16.7	262.5	23.1
VI	93	415	30.90	5.55	1.25	11.5	20.9	213.5	20.4
VII	64	216	12.25	5.40	1.60	12.0	19.5	411.0	21.4
VIII	64	180	28.65	5.55	1.15	11.5	21.5	196.0	27.8
IX	73	235	24.65	5.30	2.50	10.5	19.5	361.0	20.0
X	66	174	29.13	5.53	1.33	19.3	19.4	389.3	18.6
XI	94	236	24.95	6.15	1.30	14.5	21.4	312.5	12.3
XII	66	233	11.65	5.30	2.15	16.5	22.5	519.5	21.6
XIII	93	354	12.25	5.25	1.95	10.5	26.5	417.5	21.7
XIV	63	295	12.65	6.50	1.20	17.5	20.9	357.5	26.9

Table 4 – Relative contribution of nine characters to the total divergence in sorghum

	Vector 1	Vector 2
Days to 50% flowering	0.929	0.053
Plant height	0.892	0.207
Ear head length	0.779	0.277
Ear head width	-0.221	0.505
Stem girth	0.213	-0.687
Brix	-0.331	0.377
Biomass weight	0.174	-0.477
Grain weight	0.234	0.028
1000 grain weight	-0.454	-0.357