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GENETIC DIVERGENCE IN SORGHUM (SORGHUM BICOLOR) (L.) Moench)

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ABSTRACT

Forty diverse genotypes of sorghum (**Sorghum bicolor** (L.) Moench) evaluated for the genetic diversity were grouped into 15 clusters indicating the high genetic divergence among them. The pattern of D^2 clusters clearly demonstrated that the geographical distribution in sorghum were not fully related to genetic diversity. Based on the intercluster distance and cluster mean for various characters, potential parents were identified from different clusters for hybridisation programme. Grain yield, straw yield and grain number contributed maximum towards the genetic divergence among the types studied.

KEY WORDS : Sorghum, Genetic divergence.

Collection and evaluation of germplasm of the crop species is *sine qua non* for any crop improvement programme. The germplasm provides the best scope for building up a basic population of wide genetic diversity. Crosses involving parents which are genetically diverse will result in high heterosis and a wide range of recombinations.

MATERIALS AND METHODS

Forty sorghum (*Sorghum bicolor* (L.) Moench) types of diverse sources and habit chosen from the germplasm maintained at Millet Breeding Station, Tamil Nadu Agricultural University, Coimbatore were raised during Kharif, 1977. Observations on ten biometric character were recorded. Mahalanobis' D^2 analysis was used to estimate the genetic diversity. Clusters were formed as suggested by Tocher (Rao, 1952). Ranking of individual D^2 values contributed by individual character was done as the highest contributor taking rank 1 and the lowest rank 9.

RESULTS AND DISCUSSION

Analysis of variance showed significant differences among the types for all the characters studied. The generalised [illegible] values ranged from 0.6046 to 494.9025.

By the application of clusteri[ng] technique forty types were grouped i[n] fifteen different clusters indicating the hi[gh] degree of genetic divergence among th[e] (Table 1). Among the fifteen clusters, IV w[as] found to be the largest having six typ[es] followed by V and X each having 4 typ[es]. Of the remaining clusters, I, VI, VII and V[III] had three types each and other six cluste[rs] had two varities each. The clusters XIV a[nd] XV were having only one type each.

The clustering of types according t[o] geographic origin was observed only i[n] seven out of fifteen clusters. The clusters II, III, X, XIII, XIV and V contained types fro[m] single geographical source. There we[re] instances as in clusters IV, V, VI, VII, VIII, X[,] XI and XII where types from differe[nt] geographical origin were grouped togeth[er] in a single cluster. It was also observed th[at] types originating from the same place we[re] found scattered in different cluster[s]. Geographic diversity though importan[t] thus appears not the only factor i[n] determining the genetic divergence.

The intra and inter-cluster D^2 and [illegible] values among th fifteen clusters ar[e]

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presented in Table 2. The intra cluster distance (D) ranged from 1.237 (II) to 5.645 (XIII). The highest inter-cluster distance (D=20.099) was noted between XI and XII, while the clusters II and XV were closely related (D=3.209). There appeared a parallel and similar intra and inter-cluster divergence, although the clusters vary in their constituents. The cluster IV containing as many as six types within, recorded the intra-cluster distance which was parallel to the distances recorded by other clusters having lesser number of types. A similar trend was noted in the cluster distances also. such a parallelism and similar intra and inter cluster divergence was explained by Singh and Gupta (1968).

Based on the inter-cluster distance (D), the clusters XIII, XIV and XV were found to be highly divergent from all other clusters. Hence, the types from these clusters when crossed with the types from other clusters may result in high heterosis. Murthy and Anand (1966) claimed that there is a positive relationship between the specific combining ability and the degree of genetic diversity. The close relationship between the clusters III, IV, V and VII based on the inter cluster distance suggested homo geneity in ecotypic differentiation. It could also suggest similarities of natural and human selections operated during the development of these types.

The cluster means of the various characters are presented in Table 3. Clusters recording highest mean values were cluster IX for grain yield, grain number and peduncle thickness, cluster XIV for straw yield, grain weight and plant height, cluster VIII for panicle length and whorl number and cluster XV for leaf number and days to half bloom. Endang *et al.* (1971) have stated that the clustering pattern could be utilized in chosing parents for cross combinations likely to generate the highest possible variability for various economic characters. Based on the high mean values, the following types may be suggested as parents for hybridisation programmes based on their mean and genetic divergence.

Table 1. Composition of D^2 clusters

Cluster	No. of types	Crosses	Origin
I	3	SPV 59, CSV 3, CSV 2	Andhra Pradesh
II	2	296, CSV 5	Andhra Pradesh
III	2	CO 18, USV 4	Tamil Nadu
IV	6	1036-B	Maharashtra
		3660-B	Andhra Pradesh
		7505-B	USA
		SB 1066, SB 409	Karnataka
		534-B	Andhra Pradesh
V	4	K.4, CO 12, K2	Tamil Nadu
		AS 3889	USA
VI	3	USV.1	Tamil Nadu
		SPV 95, 78	Andhra Pradesh
VII	3	AS 3858	USA
		CSV 4	Andhra Pradesh
		AS 3863	USA
VIII	3	USV 2	Tamil Nadu
		2947-B	USA
		CSV 1	Andhra Pradesh
IX	2	USV 3, USV 5	Tamil Nadu
X	4	CO 4	Tamil Nadu
		AS 3880, IS 2586	USA
		AS 817	Tamil Nadu
XI	2	AS 3668	Tamil Nadu
		AS 5242	South Africa
XII	2	SPV 100	Andhra Pradesh
		AS 5057	Tamil Nadu
XIII	2	3677-B, IS 3691	USA
XIV	1	IS 11025	Ethiopia
XV	1	CS 3687	Andhra Pradesh

Under such conditions Chaudhary *et al.* (1975) suggested that selection of one type from each cluster and testing them by a

Cluster	Character	Types
XI	Grain number	USV 3, USV 5
XI	Earliness	AS 5242
XIV	Grain weight and straw yield	IS 11025

Table 2. Intra (Diagonal) and inter-cluster average of D^2 and D values (within parenthesis)

Cluster	I	II	III	IV	V	VI	VII	VIII	IX	V	XI	XII	XIII	XIV	XV
I	2.98 (1.72)	46.30 (6.80)	114.61 (10.70)	143.81 (11.99)	62.86 (7.92)	23.44 (4.84)	71.04 (8.42)	23.03 (4.84)	132.55 (11.51)	22.73 (4.76)	226.86 (15.06)	109.75 (10.47)	41.61 (6.45)	19.39 (4.40)	52.76 (7.26)
II		1.52 (1.23)	62.61 (7.91)	51.31 (7.16)	58.49 (7.64)	13.42 (3.66)	26.88 (5.18)	49.76 (7.05)	72.79 (8.53)	39.18 (6.25)	154.77 (12.44)	47.07 (6.86)	90.93 (9.53)	44.30 (6.65)	10.29 (3.20)
III			2.74 (1.65)	23.08 (4.80)	21.99 (4.68)	72.01 (8.48)	19.69 (4.43)	180.26 (13.42)	17.78 (4.21)	58.64 (7.65)	30.03 (5.48)	28.60 (5.34)	244.11 (15.62)	114.07 (10.68)	111.59 (10.56)
IV				10.33 (3.21)	57.17 (7.56)	79.81 (8.93)	22.83 (4.77)	185.49 (13.62)	26.94 (5.19)	92.08 (9.59)	50.57 (7.11)	27.00 (5.19)	252.94 (15.90)	147.45 (12.14)	93.55 (9.67)
V					9.44 (3.07)	45.39 (6.73)	22.64 (4.75)	129.16 (11.36)	32.31 (5.68)	29.85 (5.46)	66.00 (8.12)	43.65 (6.60)	175.44 (13.24)	78.77 (8.87)	95.95 (9.79)
VI						5.70 (2.39)	36.09 (6.00)	36.93 (6.07)	83.48 (9.13)	21.56 (4.64)	168.81 (12.99)	70.01 (8.36)	68.64 (8.28)	27.51 (5.24)	17.01 (4.12)
VII							6.54 (2.55)	113.87 (10.67)	22.02 (4.69)	41.98 (6.48)	65.12 (8.07)	29.08 (5.39)	165.30 (12.85)	86.05 (9.27)	61.17 (7.82)
VIII								4.74 (2.17)	200.20 (14.14)	59.46 (7.71)	326.32 (18.06)	157.38 (12.54)	27.83 (5.27)	28.91 (5.37)	34.81 (5.90)
XI									7.06 (2.65)	87.04 (9.33)	32.53 (5.70)	30.40 (5.51)	268.17 (16.37)	144.31 (12.01)	119.70 (10.94)
X										13.37 (3.65)	145.97 (12.08)	69.28 (8.32)	91.52 (9.56)	25.26 (5.02)	57.61 (7.59)
XII											11.28 (3.36)	57.73 (7.59)	403.96 (20.09)	244.44 (15.63)	227.46 (15.08)
XIII												26.07 (5.10)	217.83 (14.75)	111.42 (10.55)	94.34 (9.71)
XIV													31.86 (5.64)	55.93 (7.47)	70.17 (8.37)
XV															44.95 (6.70)

Table 3. Cluster mean for ten characters in sorghum

Cluster	Plant height (cm)	Days to half bloom	Leaf No.	Peduncle thickness (cm)	Panicle length (cm)	Whorl No.	Grain No.	Grain weight (g)	Straw yield (g)	Grain yield (g)
I	138.7	57.6	7.2	0.9	28.4	11.6	1533.7	2.4	49.8	37.6
II	108.6	66.2	10.2	0.8	20.9	12.3	1436.4	2.6	60.7	36.0
III	211.6	59.3	8.8	0.9	12.3	8.8	1989.2	2.9	116.0	59.0
V	125.2	60.8	9.0	0.8	23.1	9.6	1514.5	2.3	53.1	34.3
V	201.0	58.2	8.5	1.0	16.2	9.8	2278.2	2.3	99.7	52.4
VI	147.0	67.7	10.3	0.9	21.2	11.4	1219.7	2.6	106.9	31.1
VII	129.4	56.3	9.1	0.9	24.4	9.9	1752.3	2.2	60.0	38.7
/III	121.2	61.6	9.7	0.8	30.4	14.6	1467.4	2.4	43.2	34.5
IX	142.0	64.2	10.7	1.1	24.1	8.9	2679.7	2.7	119.9	73.0
X	215.7	57.6	8.0	0.8	19.0	11.0	1417.2	2.7	95.9	36.0
XI	191.1	53.8	7.3	0.9	19.6	5.7	1683.6	2.1	64.8	36.2
XII	131.6	54.5	8.1	0.9	18.2	7.9	1133.4	3.2	52.6	37.8
XIII	93.4	57.7	8.6	0.9	24.1	13.7	766.5	2.2	40.9	16.7
XIV	220.8	67.6	11.2	0.9	15.5	10.9	110.3	5.0	198.7	60.4
XV	128.2	73.6	12.9	0.8	25.0	14.4	1696.0	2.5	92.5	42.2

series of diallel analysis may prove to be highly fruitful.

The ranking technique was adopted to rank the characters in the order of contribution to genetic divergence (Murthy *et al.*, 1965). The rank totals for all the ten characters are presented in Table 4. The highest contributor was found to be the grain yield followed by straw yield, grain number, peduncle thinckness, grain weight, leaf number, panicle length, whorl number and days to half bloom. Murthy *et al.* (1967) found that the spikelet number, distance between whorls, panicle length and days to flower contributed maximum to the genetic divergence while Arunachalam and Jawahar Ram (1967) reported that flowering duration, number of leaves per plant, plant height, number of whorls in rachis and length of rachis were important for divergence.

Table 4. Rank totals for the ten characters in sorghum

S.No.	Character	Rank Total
1.	Plant height	5430
2.	Days to half bloom	5406
3.	Leaf number	4646
4.	Peduncle thickness	4354
5.	Panicle length	4748
6.	Whorl number	5137
7.	Grain number	3734
8.	Grain weight	4453
9.	Straw yield	2803
10.	Grain yield	2189

The major contribution of grain yield grain number and straw yield to genetic divergence was well confirmed by their cluster mean (Table 3), where the range for grain yield and grain number were very wide indicating the major role of these characters in differentiative at intercluster level. The cluster mean for grain yield was 16.79 g for the cluster XIII and 73.03 g for the cluster IX with a difference of almost five times. This was also confirmed by the largest intercluster distance between these two clusters.

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CORRELATION AND PATH COEFFICIENT ANALYSES IN PIGEONPEA

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ABSTRACT

Seed yield per plant in pigeonpea showed significant positive correlation with number of plant height, number of branches, number of clusters and number of seeds per pod. Similarly, path coefficient analysis indicated the importance of number of pods per plant, which had maximum direct effect on seed yield. However, characters like plant height, number of branches per plant, number of clusters per plant and number of seeds per pod affected seed yield **via** number of pods per plant. Therefore, selection based on early maturity, medium tall plant height, moderate number of branches per plant, number of clusters per plant, number of seeds per pod with more number of pods per plant and medium seed size is expected to improve the seed yield in pigeonpea.

KEY WORDS : Pigeonpea, Correlation, Path analysis.

The knowledge of interrelationship of plant characters with seed yield and among themselves is of paramount importance to the breeder for making improvement in a complex character like seed yield for which direct selection is not much effective. Path coefficient analysis provides an effective means of partitioning direct and indirect causes of association. It permits a critical look to recognize the specific forces acting to produce a given correlation and measures the relative importance of each causal factor. The present study was, therefore, undertaken to study the type of association and to judge the direct and indirect effect of various quantitative traits on seed yield.

MATERIALS AND METHODS

Under rainfed conditions, 42 strains of pigeonpea (*Cajanus cajan* (Linn.) Millsp) having diverse characteristics were grown during rainy season of 1980, in a randomized block design with three replications. The individual plot size was 3 rows of 4 m length with plant spaced 20 cm apart. The interrow distance was 60 cm. The crop received a basal dressing of 20 kg N/ha and 40 kg P/ha. The total rainfall received during the cropping season was 230 mm. Five plants were selected at random from middle row of each plot for recording observations. Phenotypic and genotypic correlation coefficients for all

1. S-2 (Plant Breeding) 2. S-2 (Statistics)