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D^2 Analysis in sesame (*Sesamum indicum* L.)

PRITI RODGE, S.B. SAKHARE AND P. SANJANA REDDY
Dept. of Agricultural Botany, Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Akola

Abstract: Mahalanobis D^2 statistics was used to study the genetic diversity among 36 genotypes of sesame grown in the Kharif season of 2001. Observations recorded on ten characters revealed the wide genetic diversity of 36 genotypes. By applying Tocher's method, 36 genotypes were grouped into 7 clusters. The clustering pattern indicated that there was no relationship between genetic diversity and geographic diversity. Maximum intercluster distance was observed between clusters VI and VII (D=84.48). Genotypes having their divergence in between m+s and m-s were selected as parent which are supposed to give rise to higher frequency of heterotic crosses.

Key words : Genetic divergence, Sesame, D^2, Cluster, Heterosis.

Introduction

Information about the nature and magnitude of genetic divergence in a population is essential for selection of diverse parents in hybridization programme. Assessment of genetic divergence by the use of Mahalanobis D^2 statistics is useful in choosing parents for any breeding objectives (Murty, 1965). Sesame is one of the nine major oilseed crops produced in India. Due to its use for variety of purposes, it is referred to as queen of oilseed crops. According to Van Oheenen (1981), India is rich in different forms of cultivated *Sesamum indicum*. However, a very little work has been done in sesame and hence an attempt was made to study genetic divergence quantitatively.

Materials and Methods

Thirty-six genotypes of sesame produced from Regional Station, National Bureau of Plant Genetic Resources, Akola, Maharashtra were raised in randomised block design replicated thrice during Kharif season, 2000. Each plot consisted of each genotype with a plant to plant distance of 15 cm and row to row distance of 20 cm. Recommended cultural practices were followed to raise a healthy crop. Observations on days to 50 per cent flowering, days to maturity, plant height (cm), number of branches per plant, number of capsules per plant, number of seeds per capsule, test weight (g), seed yield per plant (g), harvest index and oil content percentage were recorded on five randomly selected plants of each genotype in each replication. The mean values were analysed statistically. Differences among varieties were tested by mean of analysis of variance separately for all the characters. Pooled effects of the ten characters were tested by using Wilk's criterion. The ten characters were transformed into uncorrelated variables by applying pivotal condensation method to the dispersion matrix and 630 D^2 values were calculated and tested for statistical significance by X^2 test. To determine group constellations, the method suggested by Tocher (Rao, 1952) was adopted. The contribution of each character appeared in the first rank. The intracluster distance was calculated by taking the average of the component genotypes in that cluster and the average inter cluster divergence was arrived at by taking into consideration all the component D^2 values possible among the members of the two clusters considered. The values of 'D' and the genetic distance between the clusters were arrived by taking the square root of the average D^2 values.

Results and Discussion

Analysis of variance (Table 1) showed highly significant differences among the genotypes for all the traits indicating substantial genetic variability. Wilk's criteria also showed highly significant differences amongst genotypes. The D^2 valus ranged from 47.37 to 7487.66. Based on these values, 36 genotypes were grouped into 7 clusters (Table 2). The genotypes included in a cluster were from diverse geographical origin indicating that the geographic diversity need not be necessarily related to genetic diversity. These results are in conformity to those reported by Dhamu *et al.* (1983) and Dikshit and Swain

Table 1. Analysis of variance for ten characters in 36 genotypes of sesame (Mean sum of squares)

Sl. No.	Source of variation	D.F.	Days to 50% flowering	Days to maturity	Plant height (cm)	No. of branches per plant	No. of capsules per plant	No. of seeds per capsule	Test weight (g)	Seed yield per plant (g)	Harvest index (%)	Oil content (%)
1.	Replications	2	1.23	0.25	38.65**	0.05	6.17	0.14	0.0089	0.061	0.42	0.0078
2.	Genotypes	35	65.8**	142.26**	673.91**	2.33**	181.86**	315.80**	0.51**	1.68**	141.70**	129.65**
3.	Error	70	1.65	2.11	8.20	0.10	3.23	0.94	0.0041	0.019	0.178	0.22

P ≤ 0.01

(2000). Contribution towards genetic divergence is represented in Table 3. It was observed that among all the characters, the contribution of harvest index was maximum (49.52%) followed by oil content (24.60%) and number of seeds per capsule (14.92%). Thangavelu and Rajasekaran (1983), Patil and Sheriff (1994) also showed the importance of some of the above characters in their study in sesame. The average intra and inter cluster distance presented in Table 4 showed maximum intercluster distance between cluster VI and VII (D=74.53) which suggested that the hybridisation programme involving parents from these clusters is expected to give higher frequency of better segregates or desirable combinations for development of useful genetic stocks or varieties. The maximum intra cluster distance was reported in cluster II (D=32.87) followed by cluster IV (D=27.93).

The data on the character means for 7 clusters indicated cluster VII showed the highest cluster mean for five characters viz. plant height, number of capsules per plant, test weight, seed yield per plant and harvest index. Cluster VI recorded higher mean value for two characters *viz.* days to 50 per cent flowering and days to maturity while harvest cluster mean for number of branches per plant, oil content and number of seeds per capsule were exhibited by clusters II, III and V respectively (Table 5).

It is well known that crosses between divergent parents usually produced greater heterotic effect than between closely related ones. Therefore for selection of suitable parents, Arunachalam and Bandyopadhyay (1984) stated that if 'm' is the mean of the genetic divergence among parents and 'S' is the standard deviation of their genetic divergence, the crosses would have higher chance of producing higher frequency and magnitude of heterosis if genetic divergence between their parents is not greater than (m+s) and less than (m-s). Lalitha Reddy *et al.* (2000) also supported the above consideration of choosing parents in sesame. In the present study, considering mean statistical distance as a guideline to select parents, 15 cluster combinations have been identified. On the basis of mean and standard deviation of parental divergence, 165 cross combinations have been finally suggested from 15 cluster combinations which are expected to yield desirable genetic gain in breeding programmes.

From the present investigation, the cross combination IC 043231-A (from India) and EC-133844 (from Nigeria) is recommended to give relatively good amount of heterosis in F_1 among all the possible cross combinations.

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Table 2. Grouping of 36 genotypes of sesame into different clusters

luster	No. of Genotypes	Genotypes and their origin	
		Genotypes	Origin
	23	EC-118571-1	Nigeria
		IC-006168	India
		IC-096074	India
		IC-131689	India
		IC-131914	India
		IC-043231	India
		EC-346394	U.S.A.
		EC-370455	Turkey
		EC-347084	Pakistan
		IC-041931	India
		IC-132413	India
		IC-131696	India
		EC-037771	Ethiopia
		IC-132383	India
		EC-346952	India (Introduced)
		EC-346294	Korea
		IC-043202-1	India
		IC-131496	India
		EC-351887	China
		IC-132247	India
		EC-357017	Korea (South)
		EC-346396	FAO (Donor Insti.)
I	6	EC-178377	Egypt
		IC-59273	India
		IC-110245	India
		IC-131902	India
		EC-308593	South Africa
		EC-244615	Canada
III	2	IC-132384	India
		EC-351884	China
IV	2	EC-132828	U.S.A.
		IC-131692	India
V	1	EC-370817	U.S.S.R.
VI	1	EC-133844	Nigeria
VII	1	IC-043036-A	India

Table 3. Contribution of different quantitative characters towards genetic divergence (D) in sesame

Sl. No.	Source	Times ranked 1st	Contribution (%)
1.	Days to 50% flowering	1	0.15
2.	Days to maturity	3	0.47
3.	Plant height (cm)	14	2.22
4.	Number of branches per plant	0	0.00
5.	Number of capsules per plant	0	0.00
6.	Number of seeds per capsule	94	14.92
7.	Test weight (g)	51	8.09
8.	Seed yield per plant (g)	0	0.00
9.	Harvest index (%)	312	49.52
10.	Oil content (%)	155	24.60

Table 4. Average intra and intercluster distance, D Ö = D²

Cluster	I	II	III	IV	V	VI	VII
I	27.51	53.26	35.90	38.65	42.97	53.48	46.94
II		32.87	74.00	45.45	63.34	74.53	40.28
III			23.79	46.10	46.36	40.56	70.69
IV				27.93	52.66	40.53	54.21
V					0	58.19	68.69
VI						0	84.48
VII							0

D = 44.41

Table 5. Cluster means for ten characters

Cluster	Days to 50% flowering	Days to maturity	Plant height (cm)	No. of branches per plant	No. of capsules per plant	No. of seeds per capsule	Test weight (g)	Seed yield per plant (g)	Harvest index (%)	Oil content (%)
I	38.65	84.17	72.34	2.86	16.08	53.74	1.83	1.53	20.59	43.53
II	43.60	95.00	87.24	4.35	26.91	65.71	1.73	2.72	30.59	31.86
II	37.66	83.50	62.56	2.40	12.54	46.03	1.67	0.88	11.75	44.70
IV	45.00	98.33	84.13	3.20	24.60	49.87	1.14	1.70	21.46	31.14
V	36.33	91.33	59.00	3.13	7.73	87.00	1.42	0.95	12.31	43.26
VI	56.33	104.00	87.53	3.33	9.13	45.27	1.46	0.59	8.50	32.43
VII	42.67	81.33	96.47	4.13	33.67	51.40	1.84	3.16	34.95	43.21
S.D.	6.75	8.51	14.05	0.68	9.85	14.86	0.25	0.95	9.97	6.37
Variance	45.66	72.53	197.47	0.47	97.17	221.10	0.06	0.91	99.59	40.60

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