



## Genetic divergence in chickpea

A.R. GAIKWAD\*, N.C.DESAI<sup>1</sup>, G.H. PAWAR AND A.M. LANGHI<sup>2</sup>

Sorghum Improvement Project, Mahatma Phule Krishi Vidyapeeth, Rahuri, AHMEDNAGAR (M.S.) INDIA

**Abstract :** The genetic diversity was assessed using Mahalanobis's  $D^2$  statistics wherein 40 genotypes were grouped in eight clusters. The clustering pattern of the genotypes was independent of their geographical distribution. Based on inter cluster distance, Cluster VII was the superior for the character seed yield per plant, protein content and number of pods per plant, cluster II for days to 50 per cent flowering and reaction to insect pest (heliathis), while cluster VIII for plant height and 100-seed weight and cluster VII for number of primary branches per plant and number of secondary branches per plant. Therefore, it may be concluded that the genotypes belonging to these groups can be utilized in developing diverse variability and improving seed yield in chickpea. The characters pods per plant, number of secondary branches per plant, 100-seed weight, days to 50 % flowering contributed maximum to the divergence.

**Key Words :** Chickpea, Genetic divergence

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### INTRODUCTION

The Mahalanobis (1936)  $D^2$  analysis is a powerful tool for quantifying the divergence between two populations. Many studies based on this technique also indicated that geographical isolation is not necessarily related to genetic diversity. It thus gives better idea about the magnitude of divergence and is independent of size of sample and provides the basis for selection of parental lines for further breeding programme. This experiment was carried out for grouping different genotypes on the basis of their divergences.

### MATERIAL AND METHODS

The experimental material consisted of 40 genotypes of chickpea [*Cicer arietinum* L.] obtained from the different locations. Experiment was conducted in Randomized Block Design having three replications. Each genotype was sown

in single row with spacing 10 cm within row and 30 cm between rows, two border lines of same genotypes were grown along the width of each plot. The experiment was planted during *Rabi* 2005-06 at Pulses Research Station, N.M. College of Agriculture, Navsari Agricultural University, Navsari.

In each replication and in each plot, five plants were randomly selected and tagged excluding border plants to minimize border effects. Observations were taken on the characters *viz.*, Days to 50 per cent flowering, Days to maturity, Plant height (cm), number of primary branches per plant, number of secondary branches per plant, number of pods per plant, number of seeds per pod, 100-seed weight (g), Protein content (%), Seed yield per plant (g), Reaction of insect pest (Heliathis %) damage. The analysis of genetic divergence using Mahalanobis ' $D^2$ ' statistic was carried out as described by Rao (1982). On the basis magnitude of  $D^2$  value the genotypes were grouped into number of clusters as suggested by Tocher (1952).

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**\* Author for correspondence**

<sup>1</sup>Department of Agricultural Botany, Pulse Research Station, N.M. College of Agriculture, Navsari Agricultural University, NAVSARI (GUJARAT) INDIA

<sup>2</sup>Agricultural Research Station, Mahatma Phule Krishi Vigyan Kendra, Rahuri, AHMEDNAGAR (M.S.) INDIA

## RESULTS AND DISCUSSION

Analysis of variance revealed highly significant differences among genotypes for most of the characters studied indicating existence of variability among the genotypes hence further analysis to estimate  $D^2$  values was done and on the basis of relative magnitude of  $D^2$  value all Forty genotypes were grouped into eight clusters. The cluster I had the highest number of genotypes (11) followed by cluster II (7 genotypes), V (7 genotypes), III (5 genotypes), IV (4 genotypes) and Cluster VI (4 genotypes) respectively followed by VII, VIII had 1 genotype each. Presence of variability in the genetic architecture of crop species is the basic for their systematic improvement. The plant breeders have always been

fascinated by diversity in crop plants. Mahalonobis (1928, 1936 and 1949) stated  $D^2$  statistics is useful tool and now well established and widely used in plant plant breeding for classifying genetic divergence between populations. Such high amount of diversity among chickpea were also reported by Tripathi (1997) and Prakash (2006).

Study of the data revealed that the inter cluster distance (D) ranged from 8.984 to 24.213. The maximum inter cluster distance (D = 24.213) was observed between cluster - II and cluster - VIII followed by those between cluster - IV and cluster - VIII (D = 21.953). The minimum inter cluster distance (D = 8.984) was observed between cluster I and cluster VI followed by cluster I and cluster V (D = 10.099).

With regards the cluster mean cluster VII had maximum

**Table 1 : Composition of chickpea genotypes into 8 different clusters by Mahalanobis  $D^2$  statistics**

Cluster No.	No of strains	Genotypes included	Number of genotypes
I	11	ICCV-10, GJG-0104, Vishal, PG-12, IC-327927, Vihar, IC-327725, IC-327928, IC-327218, IC-327099, KAK-2.	11
II	7	ICCV-4, Vaibhav, Gujarat Gram-1, Vijay, GJG-0205, ICCV-2, Dahod Yellow.	7
III	5	IC-327352, IC-327707, IC-327209, Virat, PG-9425-5.	5
IV	4	Gujarat Gram-4, Chaffa, Gujrat Gram-2, IC-327708.	4
V	7	IC-327046, IC-327921, IC-327725, IC-327967, PG-5, IC-327045, IC-327091.	7
VI	4	IC-327264, IC-327724, IC-327267, IC-327347.	4
VII	1	IC-327908	1
VIII	1	GJG-2018	1

**Table 2 : Character wise and cluster wise distribution of different genotypes**

Characters	Sources (Clusters)	No of genotypes	Name of genotypes
Seed yield per plant	VII	1	IC-3279908
Plant height	VIII	1	GJG-2018
Days to 50 per cent flowering	II	7	ICCV-4, Vaibhav, Gujarat Gram-1, Vijay, GJG-0205, ICCV-2, Dahod Yellow
Branches per plant	IV	4	Gujarat Gram-4, Chaffa, Gujrat Gram-2,
No. of pods per plant	III	5	IC-327708, IC-327352, IC-327707, IC-327209, Virat, PG-9425-5.
100 seed weight	VIII	1	GJG-2018.

**Table 3 : Per cent contribution of different characters to the genetic diversity**

Characters	Per cent contribution	No of times appearing 1 <sup>st</sup> in ranking
Days to 50 per cent flowering	16.54	129
Days to maturity	2.31	18
Plant height	4.23	33
Primary branches per plant	0.26	2
Secondary branches per plant	2.44	19
No. of pods per plant	24.44	168
No of seed per pod	0.00	0
100 seed weight (g)	42.31	330
Protein content	5.13	40
Reaction to insect pest (Heliothis)	1.41	11
Seed yield per plant	3.85	30
Total	100.02	663

mean value for seed yield per plant (33.003 g) which was followed by the cluster III (23.725 g) and cluster IV (19.405 g). Invitingly the main yield contributing character pod per plant had also depicted the similar trend with regards to cluster mean. The cluster VII also ranked first for the character number of seeds per pod. The least and desirable cluster mean was recorded by cluster II for days to 50 % flowering (44.230) and reaction to insect pest (heliiothis) (11.17). For plant height cluster VIII (23.66) and for protein content VII (21.22) was found to be superior. For days to maturity (94.66), cluster III had maximum mean value which was also the second best character for the traits plant height (43.40), number of secondary branches per plant (19.26), number of seeds per pod (1.21) and seed yield per plant (23.72). In case of 100 seed weight cluster VIII had the highest cluster mean (33.59). Regarding the contribution of different characters to diversity, the unity of D<sup>2</sup> analysis is enhanced by its estimate the relative contribution of various plant characters to genetic divergence.

The present study revealed that 100 seed weight (42.31 %) have contributed more to genetic diversity as reflected from table, which was followed by number of pods per plant (24.54 %) and days to 50 % flowering (16.54 %). The study also reflects that the number of pods has not contributed at all to the genetic diversity which was followed by the character number of primary branches per plant.

Intra cluster distance (D) ranged from 6.256 to 10.771. At intra cluster level, cluster - VI had the highest value (D = 10.771) which was followed by the cluster V (D = 7.984) and cluster III (7.127). The minimum intra cluster distance was observed in cluster I (6.256). The clustering pattern of the genotypes was independent of their geographical distribution. Based on inter cluster distance, Cluster VII was the superior for the character seed yield per plant, protein content and number of pods per plant, cluster II for days to 50 per cent flowering and reaction to insect pest (heliiothis), while cluster VIII for plant height and 100-seed weight and cluster VII for number of primary

**Table 4 : Cluster mean for eleven characters studied in chickpea**

Cluster No	Days to 50 % flow	Days to Matu	Plant Height	Primary branches per plant	Secondary branches per plant	No of pods per plant	No of seed per pod	100-Seed weight	Protein content	Reaction to insect pest Heliiothis	Seed YLD/plant
I	48.364	100.818	51.818	3.242	13.00	45.365	1.248	24.284	20.198	14.917	12.692
II	44.238	99.981	53.714	3.143	12.81	53.857	1.257	16.129	20.86	11.173	9.856
III	45.467	94.667	43.400	3.200	19.26	81.133	1.213	25.300	20.832	17.253	23.725
IV	49.083	100.917	51.667	3.083	19.50	83.583	1.275	19.193	20.663	15.267	19.405
V	61.952	104.714	54.286	3.143	13.76	52.762	1.229	23.292	20.440	17.871	14.074
VI	49.333	98.000	43.083	3.167	13.33	45.667	1.217	24.703	18.791	20.318	12.496
VII	61.000	102.333	53.667	3.667	17.66	86.333	1.200	32.827	21.227	18.567	33.003
VIII	45.333	98.333	56.667	3.333	16.66	38.333	1.267	33.590	19.733	23.770	15.437

**Table 5 : Inter and intra cluster D and D<sup>2</sup> values of chickpea**

Cluster No	I	II	III	IV	V	VI	VII	VIII
I	6.256 (39.13)	11.717 (137.28)	11.43 (130.64)	13.358 (178.43)	10.099 (101.98)	8.984 (80.712)	12.778 (163.27)	15.289 (233.75)
II		7.03 (49.42)	15.25 (232.56)	11.634 (135.34)	11.762 (138.34)	14.883 (251.50)	18.358 (337.01)	24.213 (586.26)
III			7.127 (50.794)	11.027 (121.05)	15.253 (232.65)	12.938 (167.39)	11.675 (136.30)	15.822 (250.33)
IV				7.015 (49.41)	13.382 (179.07)	15.746 (247.93)	15.225 (231.38)	21.953 (481.93)
V					7.984 (63.74)	13.093 (174.42)	13.437 (180.55)	21.076 (444.19)
VI						10.771 (116.04)	15.06 (226.80)	15.24 (232.25)
VII							0.00 (0.00)	17.119 (293.06)
VIII								0.00 (0.00)

Figures in parenthesis indicates D<sup>2</sup> values

branches per plant and number of secondary branches per plant. The characters pods per plant, number of secondary branches per plant, 100-seed weight, days to 50 % flowering contributed maximum to the divergence. Similar work on chickpea was done by Chand and Singh (1995); Murthy and Arunachalam (1996); Nimbalkar and Harer (2001); Samal and Jagdev (1996) and Sharma *et al.* (2004).

The cluster mean for different characters showed that the genotypes included in cluster III are very early flowering (44.23 days). The maximum mean value for plant height was observed in cluster VIII (GJG-2018, 56.66 cm). Cluster VII (IC-327908) showed highest mean values for primary branches per plant (3.66) and cluster IV showed highest secondary branches per plant (19.50). The varieties included in cluster VII exhibited highest no of pos per plant (86.333). Cluster I had showed resistance to insect pest heliothis (14.917). The genotype IC-327908 included in cluster VII give highest seed yield per plant. On the basis of results obtained in the present study, it is suggested that parents for hybridization programme may be selected from different clusters with maximum inter cluster distance.

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