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Study on Genetic Divergence in Desi Chickpea (*Cicer arietinum* L.)

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A B S T R A C T

Generally plant breeders select the parents on the basis of phenotypic divergence, but for effective breeding, the knowledge of genetic diversity among the parents with respect to the characters which are to be improved is essential. The present investigation entitled, "Genetic Divergence Studies in Chickpea (*Cicer arietinum* L.)" has been carried out. The genotypes under study fall into seven clusters. The cluster III was with the highest number of genotypes (11) followed by cluster II (10), clusters V (09), cluster VI (06) and IV and VII had one genotype. The maximum inter cluster distance (D =309.50) was observed between cluster VII and cluster V, while the minimum inter cluster distance (D = 41.46) was observed between clusters IV and II. Considering all the characters, it was suggested that the genotypes in clusters VII and cluster V are suitable for further breeding programme.

Introduction

Among the pulse, the chickpea is a first important *Rabi* pulse crop of the region. Among all pulses chickpea contributes 36% area and 46% production in year 2017-18. During 2017-18 estimated area and production of chickpea in Maharashtra is 18.92 lakh ha and 17.61 lakh ton respectively. The productivity is also highest during 2016-17 (1006kg/ha). In India percentage of area is increased upto 10.81% during year 2017-18 as compared to previous year while percentage of area decreased by 4.38% in Maharashtra. Maharashtra is having 14.69% contribution in the area with 13.74% production share in the nation (average of last ten years). Madhya Pradesh is having highest area of 35.90 lakh ha, production 45.95 lakh tons and productivity 1280 kg/ha during the year 2017-18. During 2017-18, the area in Maharashtra was 20 lakh ha with production of 17.61 lakh tons and productivity is 881 kg/ha. (Anonymous, 2017). In plants, genetic diversity determines the potential for improved efficiency and hence their use for breeding, which eventually may result in enhanced food production. The knowledge of

genetic diversity helps in tagging of germplasm, identification of gene stock and establishment of core collections (Upadhyaya *et al.,* 2007). If the parents selected for hybridization have diverse background the more are the chances of improving the characters under consideration (Chowdhury *et al.,* 2002).

Mahalanobis's (1936) reported that D^2 statistics is a powerful tool for estimating 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.

Materials and Methods

The experimental materials used for study consisted of fourty three genotypes of chickpea, out of which 25 genotypes were obtained from International Crop Research Institute for Semiarid Tropics, Hyderabad, 15 genotypes from the A.R.S. Badnapur and three standard checks. Fourty genotypes of chickpea along with three standard checks *viz.* Akash (BDNG-797), Digvijay, JAKI 9218 were evaluated in a randomized block design with two replications during *Rabi* season of 2017-18. Each genotype was sown in two rows of 4 m length with spacing of 45 cm between rows and 10 cm within rows. The data were recorded on five randomly selected plants of each replication for all characters such as days to 50% 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, Harvest index and seed yield. The analysis of divergence was carried out by D^2 statistics proposed by Mahalanobis (1928, 1936) as described by Rao (1952).

Results and Discussion

The utility of D^2 analysis was enhanced by its application to estimate the relative contribution of the various plant characters to genetic divergence. The per cent contribution of ten characters studied, towards total divergence is presented in Table 1. It was observed that, 100 seed weight (30.90 %) contributed highest for divergence. It was followed by days to maturity (19.38 %). The maximum contribution towards divergence was observed by Devendrappa *et al.,* (2011) in days to maturity. Followed by harvest index (17.83 %), seed yield per plant (11.85 %), days to 50% flowering (7.64 %), number of pod per plant (5.20 %), number of seeds per pod (2.66), number of secondary branches per plant (2.44 %), plant height (1.11 %) and number of primary branches per plant (1.00 %). Dwevedi and Lal (2009) observed highest contribution was exhibited by harvest index, 100 seed weight and number of pods per plant.

On the basis of D^2 values all the genotypes were grouped into the seven clusters with varying number of genotypes in the clusters.

The clustering pattern of these genotypes does not follow the geographical distribution. The maximum genetic distance (D) of 309.50 was found between the clusters VII and V. The characters seed yield per plant and secondary branches per plant showed considerable amount of variability. Similar results were obtained by Jeena *et al.,* (2005) and Dwevedi and Gaibriyal (2009). Greater the divergence between the two clusters, wider is the genetic diversity in the genotypes. The crosses involving the parents with extreme divergence have also been reported to exhibit decrease in heterosis (Table 2). Therefore, while selecting the parents by considering the diversity, their performance and cluster mean for the characters also need due to consideration in the crop improvement programme (Fig. 1).

Fig.1 Diagram showing the cluster distance

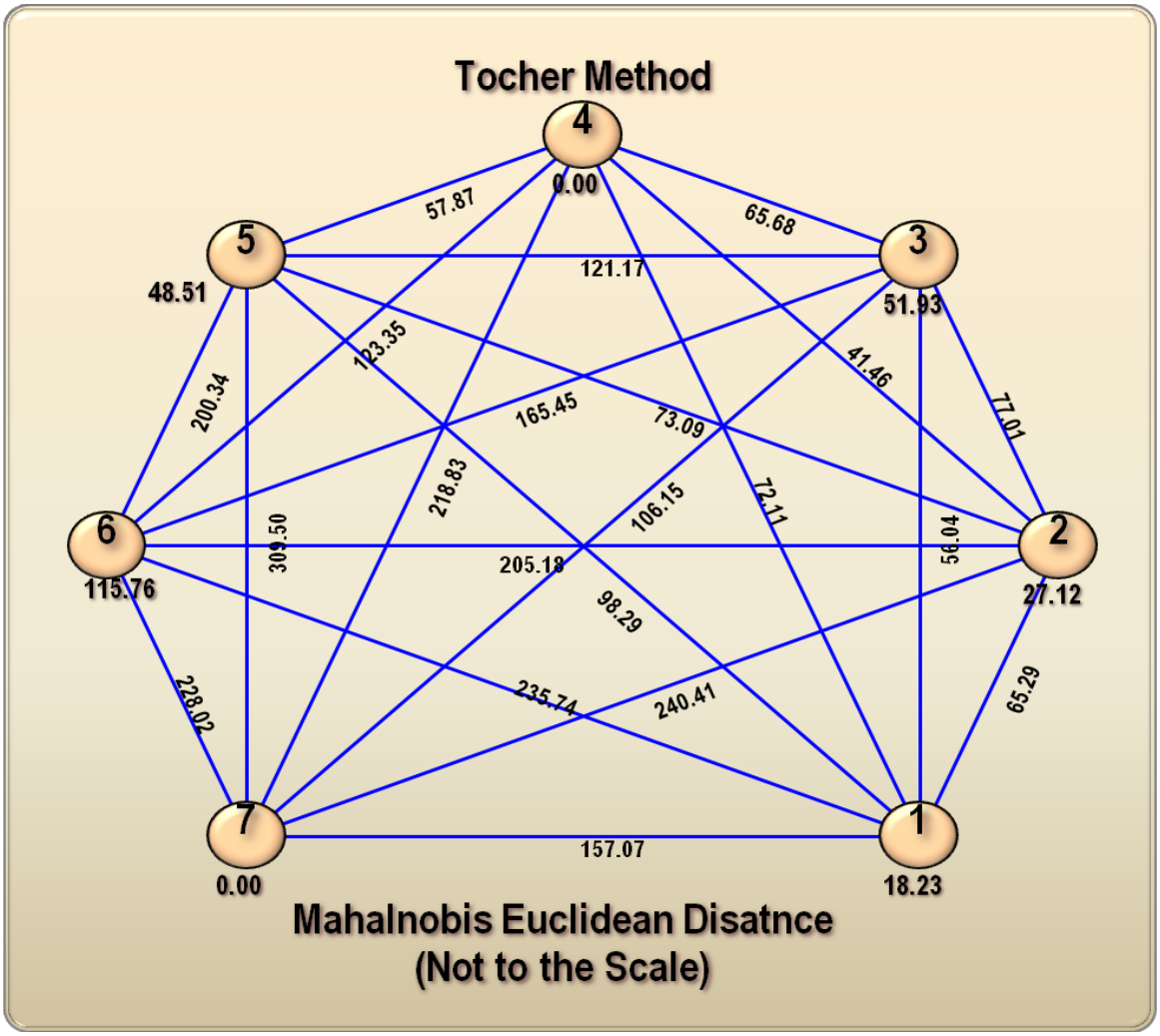

Table.1 Analysis of variance for ten quantitative characters in chickpea

Sr. No.	Name of the characters	Mean sum of square		
		Replications (df=1)	Genotypes (df=42)	Error (df=42)
1.	Days to 50 % flowering	6.69	93.02**	4.12
2.	Days to maturity	3.36	107.19**	3.31
3.	Plant height	0.32	26.57**	5.59
4.	Number of primary branches per plant	0.00	26.57**	0.10
5.	Number of secondary branches per plant	0.31	11.94**	1.30
6.	Number of pods per plant	66.80	318.13**	29.65
7.	Number of seeds per pod	0.02	0.09	0.01
8.	100 seed weight	0.32	25.55**	0.65
9.	Harvest index	4.74	25.55**	3.40
10	Seed yield per plant	5.64	17.19**	4.32

* -Significant at 5 % level of significance
**- Significant at 1 % level of significance

Table.2 Composition of fourty three chickpea genotypes into different clusters by Tocher's method

Cluster No.	No. of strains	Genotypes included in the cluster
I	5	BICS 1, BICS 16, BICS 41, BICS 30, BICS 37.
II	10	BCG 10-1, BCG 14-9, BICS 22, BICS 14, BICS 2, BICS 20, BICS 18, BICS 33, BICS 38, BCG 10-14.
III	11	BICS 7, BICS 24, BICS 3, BICS 5, BCG 10-7, BICS 39, BICS 11, BICS 32, BCG 10.28, BCG 10.10, BICS 27.
IV	1	BCG 15-44
V	9	BICS 45, BICS 49, BCG 12-2, BICS 25, BICS 40, BCG 10-11, BCG 2-24, BCG 10-11, BDNG 2017-1.
VI	6	Digvijay, Akash, JAKI 9218, BCG 13-16, BDNG 2016-6, BCG 10-4.
VII	1	BICS 9

Table.3 Cluster means of different characters to genetic diversity in chickpea

Sr. No.	Characters / Clusters	I	II	III	IV	V	VI	VII
1.	Days to 50 % flowering	43.30	41.00	41.95	45.50	49.67	55.50	40.00
2.	Days to maturity	89.30	90.10	91.32	101.00	96.39	103.25	80.50
3.	Plant height	41.40	41.57	44.60	43.80	45.51	47.09	46.60
4.	Number of primary branches per plant	3.20	3.34	3.29	2.80	2.62	3.17	3.90
5.	Number of secondary branches per plant	9.63	10.93	12.00	11.80	11.05	14.13	12.60
6.	Number of pods per plant	37.86	50.02	51.60	58.00	37.91	56.77	53.10
7.	Number of seeds per pod	1.10	1.08	1.06	1.00	1.28	1.30	1.20
8.	100 seed weight	25.96	19.44	24.87	21.15	21.03	22.43	29.70
9.	Harvest index	15.77	17.57	23.65	19.60	15.16	31.02	37.70
10	Seed yield per plant	9.09	10.38	13.51	10.85	9.81	16.94	16.10

In the present investigation, the cluster means for the ten characters studied are presented in Table 3. The cluster mean for days to 50 % flowering varied from 40.00 (VII) to 55.50 (VI). The cluster mean for days to maturity ranged between 88.50 (VII) to 103.25 days (VI). The highest cluster mean for plant height was 47.09 cm, which was observed in cluster (VI) and lowest for (cluster I) 41.40. The cluster mean for the number of primary branches per plant ranged from 2.62 (cluster V) to 3.90 (cluster VII). The cluster mean for secondary branches per plant ranged between 9.63 (cluster I) and 14.13 (cluster VI). The cluster mean for number of pods per plant was maximum in cluster IV (58.00) and it was minimum in cluster I (37.86). The cluster mean for number of seeds per pod was maximum in cluster VI (1.30) and it was minimum in cluster IV (1.00). The cluster

mean for 100 seed weight was minimum in cluster II (19.44) and it was maximum in cluster VII (29.70). The cluster mean for seed yield per plant ranged between (9.09) cluster I and (16.94) cluster VI. The cluster mean for harvest index was maximum in cluster VII (37.70) % and minimum in case of cluster V (15.16 %). Crossing between the genotypes belonging to the same clusters will not give desired improvement hence; the parents selected for crossing should be from different clusters.

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