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Genetic diversity analysis in chickpea (*Cicer arietinum* L.)

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Abstract

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 I was with the highest number of genotypes (14) followed by cluster II (10), clusters III & V (06), cluster VI (05) and IV and VII had one genotype. The maximum inter cluster distance ($D = 557.89$) was observed between cluster VII and cluster VI, while the minimum inter cluster distance ($D = 78.36$) was observed between clusters VI & IV. Considering all the characters, it was suggested that the genotypes in clusters VII and cluster VI are suitable for further breeding programme.

Keywords: Chickpea, genetic diversity, germplasm, variability, clusters

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 (1006 kg/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)]^[8].

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)^[7]. If the parents selected for hybridization have diverse background the more are the chances of improving the characters under consideration (Chowdhury *et al.* 2002)^[1].

Mahalanobis's (1936)^[5] 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.

Material and Methods

The experimental materials used for study consisted of Forty three genotypes of chickpea, out of which 25 genotypes were obtained from International Crop Research Institute for Semi Arid Tropics, Hyderabad, 15 genotypes from the A.R.S. Badnapur and three standard checks. Forty 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)^[5] as described by Rao (1952)^[6].

Result 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 2. It was observed that, 100 seed weight (39.42%) contributed highest for divergence. It was followed by harvest index (22.26%), days to 50% flowering (19.16%), number of pods per plant (8.31%), number of primary branches per plant (3.77%), days to maturity and number of secondary branches per plant (3.21%), plant height (0.55%) and seed yield per plant (0.11%).

The maximum contribution towards divergence was observed by Devendrappa *et al.* (2011)^[2] in days to maturity. Dwevedi and Lal (2009)^[3] 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 inter cluster distance ($D = 557.89$) was observed between cluster VII and cluster VI. The characters secondary branches per plant, 50% flowering and 100 seed weight showed considerable amount of variability. Similar results were obtained by Jeena *et al.* (2005)^[4] and Dwevedi and Gaibriyal

(2009)^[3]. 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. 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. In the present investigation, the cluster means for the ten characters studied are presented in Table 4. The cluster mean for days to 50 per cent flowering varied from 43.00 (VII) to 57.10 (VI). The cluster means for days to maturity ranged between 85.50 (VII) to 111.00 days (VI). The highest cluster mean for plant height was 54.65 cm, which was observed in cluster (III) and lowest for (cluster IV) 42.90. The cluster mean for the number of primary branches per plant ranged from 3.04 (cluster I) to 4.19 (cluster II). The cluster mean for secondary branches per plant ranged between 15.49 (cluster I) and 25.00 (cluster VII). The cluster mean for number of pods per plant was maximum in (cluster III) 81.30 and it was minimum in (cluster I) 51.72. The cluster mean for number of seeds per pod was maximum in (cluster III) 1.37 and it was minimum in (cluster VII) 1.10. The cluster mean for 100 seed weight was minimum in (cluster II) 19.80 and it was maximum in (cluster VII) 26.12 g. The cluster mean for seed yield per plant ranged between 12.45 (cluster II) and 27.70 (cluster III). The cluster mean for harvest index was maximum in (cluster IV) 34.73% and minimum in case of (cluster II) 17.81%.

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.

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	0.18	56.07**	0.63
2.	Days to maturity	6.69	131.50**	2.12
3.	Plant height	61.96	73.27**	16.21
4.	Number of primary branches per plant	0.50	1.48	0.14
5.	Number of secondary branches per plant	3.60	30.75**	2.79
6.	Number of pods per plant	35.94	414.20**	23.77
7.	Number of seeds per pod	0.03	0.04	0.02
8.	100 seed weight	0.77	32.46**	3.71
9.	Harvest index	2.12	122.62**	3.40
10.	Seed yield per plant	12.10	77.80**	8.83

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

Table 2: Per cent contribution of different characters to genetic diversity in chickpea

Sr. No.	Characters	No. of times appearing I in ranking	% contribution
1.	Days to 50% flowering	173	19.16%
2.	Days to maturity	29	3.21%
3.	Plant height	5	0.55%
4.	Number of primary branches per plant	34	3.77%
5.	Number of secondary branches per plant	29	3.21%
6.	Number of pods per plant	75	8.31%
7.	Number of seeds per pod	0	0.00%
8.	100 seed weight	356	39.42%
9.	Harvest Index	201	22.26%
10.	Seed yield per plant	1	0.11%
	Total	903	100

Table 3: Composition of Forty three chickpea genotypes into different clusters by Tocher’s method.

Cluster No.	No. of strains	Genotypes included in the cluster
I	14	BICS 15, BICS 35, BICS 8, BICS 31, BICS 13, BICS 4, BICS 23, BICS 6, BICS 12, BICS 19, BICS 43, BICS 34, BICS 29, BICS 26
II	10	BCG 37-12, BCG 25-1, BCG 19-1, BCG 25-12, BCG 54, BCG 20-2, BCG 25-8, BCG 36, BCG 34-1, BDNG 2016-6.
III	06	BICS 36, BICS 44, BICS 10, BICS 21, BICS 28, BICS 46.
IV	01	Akash (BDNG-797).
V	06	BICS 17, BICS 47, BICS 64, BICS 48, BCG 25-1, BICS 50.
VI	05	BCG 37, BDNG 2017-1, JAKI 9218, Digvijay, BCG 54-2.
VII	01	BICS 42.

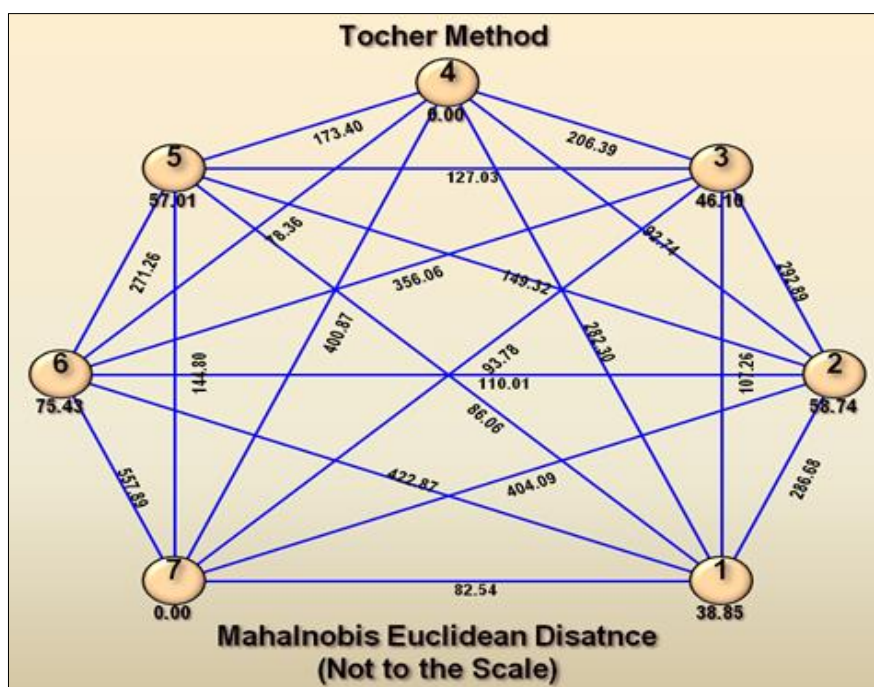


Fig 1: Diagram showing the cluster distance

Table 4: 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	45.00	54.70	44.83	52.50	46.67	57.10	43.00
2.	Days to maturity	90.64	103.00	91.58	106.00	94.33	111.00	85.50
3.	Plant height	51.88	44.01	54.65	42.90	50.37	45.12	44.50
4.	Number of primary branches per plant	3.04	4.19	3.63	3.70	3.85	3.82	3.50
5.	Number of secondary branches per plant	15.49	20.01	18.87	19.80	18.45	21.24	25.00
6.	Number of pods per plant	51.72	54.50	81.30	55.40	56.35	68.46	72.85
7.	Number of seeds per pod	1.32	1.18	1.37	1.30	1.30	1.24	1.10
8.	100 seed weight	26.08	19.80	23.50	20.60	20.41	22.34	26.12
9.	Harvest index	21.96	17.81	34.01	34.73	18.03	24.46	24.79
10.	Seed yield per plant	18.47	12.45	27.70	17.88	14.80	23.10	20.81

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