

**RESEARCH PAPER****Genetic diversity studies for yield attributing characters in chickpea (*Cicer arietinum* L.) germplasm and their clusters**

B. G. Kamble, S. B. Sarode, M. D. Patil, M. B. Akhare and U. G. Gadkar\*

Department of Botany, College of Agriculture (VasantNaik Agricultural University), Badnapur (M.S.) India  
(Email : maheshdp182000@gmail.com)

**Abstract :** Genetic diversity is a prerequisite for undertaking any crop breeding programme for the development of high yielding crop varieties to enhance the national food production for the food security. Protein is an important component in the human diet, which is obtained for the vegetarian people from the pulses. Chickpea is an important source of protein for the Indian and African population. Therefore, breeding for high yielding chickpea varieties is a continuous process whose success is dependent on the availability of genetic diversity in the chickpea germplasm. In the present studies forty one genotypes of chickpeas were grouped into twelve clusters. The cluster I was with the highest number of genotypes (23) followed by cluster IV (09), II, III, V, VI, VII, VIII, IX, X, XI and XII which had only 1 genotype in each cluster, respectively. The intra cluster distance (D<sub>2</sub>) ranges from 68.72 to 90.06 while the inter cluster distance (D<sub>2</sub>) ranges from 49.00 to 1217.31. The maximum inter-cluster distance (D<sub>2</sub> = 1217.31) was observed between cluster VI and cluster XII followed by cluster XII and VIII (D<sub>2</sub> = 1069.94), cluster VI and cluster X (D<sub>2</sub> = 962.24) and cluster V and cluster VI (D<sub>2</sub> = 919.90). It was observed that, seed yield per plant (42.20%) contributed highest for divergence followed by plant height (16.83%), 100 seed weight (16.34%), days to maturity (6.83%), number of pods per plant (5.37%), number of primary branches (4.51%), number of secondary branches per plant (3.05%), harvest index (2.20%), number of seeds per pod (2.07%) and days to 50% flowering (0.61%).

**Key Words :** Chickpea, Genetic-diversity, Yield attributing characters, Clusters

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**INTRODUCTION**

Chickpea (*Cicer arietinum* L.) is divided into two types *i.e.* *Kabuli* and *Desi* chickpea. *Desi* type is distinguished by small, coloured, angular shaped seeds with high content of fibre while *Kabuli* is characterized by large, coloured, ram-head-shaped seeds with low fibre content. It is a nutrient-rich food, providing around 20% or higher of the Daily Value (DV) of protein, foliate

dietary fibre and minerals like iron and phosphorus, Vitamins like B<sub>6</sub>, thiamine. The magnesium and zinc contents are moderate providing 10–16% of DV. Compared to reference levels established by the UN Food and Agriculture Organization and World Health Organization, the proteins in cooked and germinated chickpeas are rich in essential amino acids such as lysine, isoleucine, tryptophan and total aromatic amino acids.

\*Author for correspondence:

Genetic diversity is a prerequisite for undertaking any crop breeding programme for the development of high yielding crop varieties to enhance the national food production for the food security. Protein is an important component in the human diet, which is obtained for the vegetarian people from the pulses.

Chickpea is an important source of protein for the Indian and African population. Therefore, breeding for high yielding chickpea varieties is a continuous process whose success is dependent on the availability of genetic diversity in the chickpea germplasm. Genetic diversity knowledge helps in the recognition of gene stock, the tagging of germplasm and the initiation of core collections (Upadhyaya *et al.*, 2007). The more genetically diverse parents have chosen for hybridization, the greater chances of enhancing the traits under consideration (Chowdhury *et al.*, 2002).

## MATERIAL AND METHODS

The present investigation was conducted during *Rabi* season of 2021-2022 at the College of Agriculture, BadnapurVNMKV, Parbhani Maharashtra to estimate the genetic diversity. The experimental material consisted of 41 diverse genotypes of chickpea including the five standard checks *viz.*, Akash (BDNG-797), Digvijay,

Vijay, PhuleVikram and JAKI 9218. These chickpea germplasms/genotypes were evaluated in Randomized Block Design (RBD) with two replications. These genotypes were sown in one row of 4 m length with a spacing of 45 cm for row to row, and 10 cm for plant to plant. Observations were recorded for ten traits *viz.*, days to 50% flowering, days to maturity, plant height, 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, seed yield per plant and harvest index. The analysis of divergence was carried out by D2 statistics proposed by Mahalanobis (1928, 1936) and described by Rao (1952).

## RESULTS AND DISCUSSION

The experimental findings obtained from the present study have been discussed in following heads :

### Clustering pattern of the genotypes :

The forty one chickpea genotypes were grouped into twelve clusters based on the magnitude of D2 values investigated (Table 1, Fig. 1). The cluster I was with the highest number of genotypes (23) followed by cluster IV (09), II, III, V, VI, VII, VIII, IX, X, XI and XII which had only 1 genotype in each cluster, respectively.

**Table 1: Composition of forty one chickpea genotypes into different clusters Tocher's method**

Cluster No.	No. of genotypes	Genotypes in the cluster
I	23	BDNG2018-8, PhuleVikram, PHULE G2012 10-17, PHULE G1221-2-6, AKG1808, AKG 1506, PHULEG181609, ICC16348-2, Digvijay, BDNG2017-23, ICC85, BDNG2017-1, BDNG 2018-13, BDNG2018-15, AKG1709, JAKI 9218, AKG1402, AKG1809, ICCG-26, Vijay, ICCB-88, ICC06718, BDNG 797.
II	01	ICCB-26
III	01	ICCN0114
IV	08	ICC NO 112, ICC 0117676, ICC G-27, ICC 261, ICC NG 113-1, ICC 12735-1, ICC 8111-2, ICC BG 73-1.
V	01	BDNG2018-16.
VI	01	ICC16348.
VII	01	ICCB-50
VIII	01	ICC1127
IX	01	ICC14872
X	01	AKG 1702
XI	01	ICC 813
XII	01	ICC8111-1

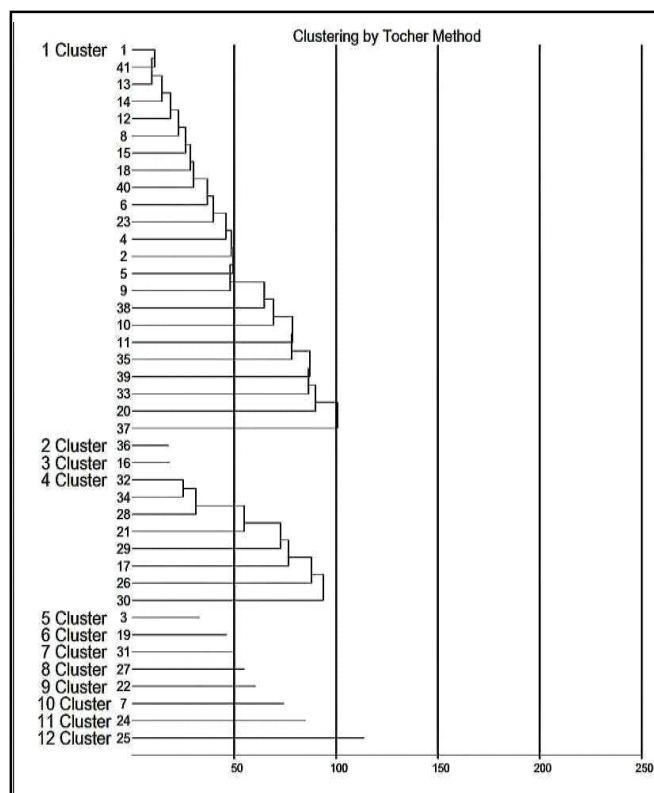


Fig. 1: Diagram showing formation of clusters by Tocher method

### Intra and inter cluster divergence :

The intra cluster distance ( $D_2$ ) ranges from 68.72 to 90.06 while the inter cluster distance ( $D_2$ ) ranges from 49.00 to 1217.31. The maximum inter cluster distance ( $D_2 = 1217.31$ ) was observed between cluster VI and cluster XII followed by cluster XII and VIII ( $D_2 =$

1069.94), cluster VI and cluster X ( $D_2 = 962.24$ ), cluster V and cluster VI ( $D_2 = 919.90$ ) and cluster V and VIII ( $D_2 = 860.24$ ). The minimum inter cluster distance ( $D_2 = 49.00$ ) was observed between clusters III and VII .

### Cluster means for different characters :

The cluster means for the ten characteristic in chickpea genotypes is depicted in Table 2. The cluster mean for days to 50 per cent flowering varied from (41.00) cluster VI to (54.00 days) cluster V. The cluster mean for days to maturity ranged from (94.00) cluster IX to (113.50 days) cluster V. The cluster mean for plant height ranged between (35.16) cluster IV to (73.55 cm) cluster X. The cluster mean for the number of primary branches per plant ranged between (2.00) cluster III to (3.10) cluster VII and cluster XII. The cluster mean for secondary branches per plant ranged between (7.00) cluster VI to (14.30) cluster XII.

The cluster mean for number of pods per plant was minimum in cluster VII (45.50) and it was maximum in cluster II (120.30). The cluster mean for number of seeds per pod was minimum in cluster VI and cluster VIII (1.00) and it was maximum in cluster IX and X (1.30). The cluster mean for 100 seed weight was minimum in cluster VI (13.20 g) and it was the maximum in cluster XII (36.00 g). The cluster mean for harvest index was maximum in cluster III (44.91%) and minimum in case of cluster VI (32.61%). The cluster mean for seed yield per plant was minimum in cluster VI (13.40 g) and it was maximum in cluster XI (41.52 g).

The application of  $D_2$  analysis to determine the relative contribution of various plant characters to genetic

Table 2 : Cluster means of different characters to genetic diversity in chickpea

Clusters	Days to 50 % flowering	Days to maturity	Plant height (cm)	No. of pri. branches /plant	No. of sec. branches /plant	Number of pods / plant	Number of seeds/ pod	100 seed weight(g)	Harvest index (%)	Seed yield /plant (g)
I	52.83	110.17	51.17	2.38	10.61	79.83	1.26	24.01	39.25	21.16
II	53.50	109.00	44.00	2.30	10.70	120.30	1.20	19.05	41.97	26.99
III	48.00	106.00	48.87	2.00	10.10	92.10	1.10	32.40	44.91	34.34
IV	48.88	103.94	35.16	2.80	10.15	74.83	1.23	18.33	36.34	15.16
V	54.00	113.50	60.37	2.10	9.20	58.30	1.30	32.16	41.00	19.37
VI	41.00	97.00	37.54	2.20	7.00	87.60	1.00	13.20	32.61	13.40
VII	47.50	104.00	46.85	3.10	9.50	45.50	1.20	28.75	42.03	20.50
VIII	44.00	95.00	39.67	2.50	13.90	105.90	1.00	15.95	33.48	16.93
IX	45.50	94.00	46.56	2.20	11.10	66.00	1.30	24.40	36.02	17.22
X	44.50	110.50	73.55	3.00	12.60	94.70	1.30	33.00	43.23	29.50
XI	43.00	95.00	40.40	2.30	12.40	109.05	1.20	32.20	42.43	41.52
XII	45.50	106.50	45.62	3.10	14.30	67.60	1.10	36.00	40.23	35.50

**Table 3 : Average intra and inter cluster (D<sup>2</sup>) values in chickpea**

Clusters	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XIII
I	68.72	129.27	124.76	212.86	142.56	446.47	119.68	418.20	131.79	220.52	228.31	367.11
II		0.00	305.20	86.86	396.40	164.09	305.55	179.83	151.78	484.88	346.70	701.72
III			0.00	404.40	71.23	733.86	49.00	668.22	182.79	117.72	84.64	117.94
IV				90.06	523.49	142.08	326.89	151.78	145.93	595.36	362.90	730.08
V					0.00	919.90	104.24	858.49	296.18	85.38	278.56	201.92
VI						0.00	665.64	54.91	280.56	962.24	628.00	1217.31
VII							0.00	603.68	141.85	132.48	100.20	113.64
VIII								0.00	200.51	825.99	516.20	1069.94
IX									0.00	290.02	125.44	397.60
X										0.00	242.42	180.10
XI											0.00	153.51
XII												0.00

divergence improved its utility. Table 3 shows the percentage contribution of the ten parameters studied to overall divergence. It was observed that, seed yield per plant (42.20%) contributed highest for divergence. It was followed by plant height (16.83%), 100 seed weight (16.34%), days to maturity (6.83%), number of pods per plant (5.37%), number of primary branches (4.51%), number of secondary branches per plant (3.05%), harvest index (2.20%), number of seeds per pod (2.07%) and days to 50% flowering (0.61%).

The maximum contribution towards divergence was reported by Renuka *et al.* (2018) in pods per plant, harvest index and 100 seed weight. Dwevedi and Gaibriyal (2009) reported the highest contribution exhibited by harvest index, 100 seed weight and number of pods per plant. Singh *et al.* (2012) reported maximum contribution by days to 50% flowering. Devendrappa *et al.* (2011) reported it for days to maturity. Reddy *et al.* (2021) found that maximum contribution towards the total divergence was of the number of secondary branches per plant (35%), number of pods per plant (14.5%), seed yield per plant (10%), harvest index (9%), plant height (6.53%) which contributed to 75% of the total divergence followed by number of seeds per plant (6%), days to maturity (5%), seed index (3.2%), days to 50% pod setting (3%) and biological yield per plant. Soumyashree *et al.* (2021) reported the highest contribution for the genetic divergence due to number of pods per plant and seed yield per plant.

### Conclusion :

The chickpea germplasm characters *viz.*, seed yield per plant, plant height and 100 seed weight were the

major contributors towards divergence which should be considered for the development of high yielding chickpea variety and in the chickpea improvement research programme.

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### Conflict of interest:

There is no conflict of Interest.

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