

## Genetic Divergence Analysis for Seed Yield and its Components in Chickpea (*Cicer arietinum* L.)

Vinod Singh Sikarvar, RN Sharma and Devendra Payasi

Department of Plant Breeding and Genetics, Indira Gandhi Agricultural University, Raipur (Chhattisgarh)

Cluster analysis among 204 genotypes of chickpea excluding checks for nine quantitative traits revealed considerable genetic diversity in the material. Ten clusters for nine characters were obtained. Cluster III consisted of maximum 38 genotypes followed by cluster X which consisted of 35 genotypes whereas, cluster I consisted of two genotypes (as cluster I showed the maximum intra cluster distances with other clusters hence both genotypes) the maximum inter cluster distance was recorded between clusters I and IX followed by clusters I and V and I and VI, hence genotypes belonging to these clusters can be used as parents for hybridisation programme for the development of high yielding chickpea genotypes.

**Key words:** Chickpea, Cluster group, Cluster distance, Cluster means, Seed yield, Genetic divergence

Varieties from geographically diverse localities are generally included in hybridization programmes presuming genetic diversity and greater likelihood of recovering promising segregants. However, this being an inferential criterion, it can not be successfully utilized for discrimination between parents. The problem of selection may further be simplified if one could identify the characters responsible for discrimination between parents. The reports available on this aspect in chickpea are rather scanty. Therefore, the present investigation was aimed at ascertaining the nature and magnitude of genetic diversity among a set of chickpea genotypes. Genetic divergence analysis by using cluster statistics is a powerful tool in quantifying the degree of divergence between biological populations and to assess the relative contribution of different components to the total divergence.

### Materials and Methods

The experimental material comprised 220 accessions of chickpea including four checks, viz. 2001-02, JG-74, Vaibhav and RG938 repeated five times. These accessions were evaluated in augmented design. Each entry was sown in two rows of 4 m length placed at 30 cm apart.

Observations on metric traits were recorded on single plant basis from five randomly selected competitive plants in each genotype from each plot for the traits. Observations on first flowering, days to 50% flowering, days to maturity, plant height, primary branches/ plant, pods/ plant, seeds/ pod, 100 seed weight and seed yield/ plant were subjected to multivariate analysis using Mahalanobis  $D^2$  statistics suggested by Rao (1952).

### Results and Discussion

Analysis of variance revealed that significant differences among the strains for all the characters studied indicating

thereby the existence of genetic variability among the genotypes. Over all 204 accessions were grouped into ten clusters showing sufficient variability for selecting the genotypes for future breeding programmes. These cluster composition is presented in Table 1. The cluster III consisted of maximum 39 genotypes followed by cluster X consisted 35 genotypes. Whereas, cluster I consisted of minimum number of genotype i.e. two. Cluster IX consisted of 31 genotypes, cluster II consisted of 25 genotypes, cluster VII consisted of 23 genotypes, cluster VI consisted of 16 genotypes, cluster IV consisted of 13 genotypes, cluster VIII consisted of 10 genotypes and cluster V consisted of 10 genotypes. The different combination of different cluster distances are presented in Table 2.

Results of cluster analysis indicated that the highest intra-cluster distance was observed for cluster VI followed by cluster VII, cluster IX, cluster II and cluster V. Moreover, the highest inter-cluster distance was measured between cluster IX and I followed by V and I, VI and I and II and I. Whereas, the minimum distance was observed between X and IX followed by X and III, IV and II and VII and III.

Mean performance of individual cluster for different characters are presented in Table 3. For days to flower initiation cluster II possessed the highest mean value and lowest days to flower initiation was recorded for cluster IX. Days to 50% flowering exhibited the highest mean performance for the cluster number II, whereas, lowest days to 50 per cent flowering was observed for cluster IX. The cluster VI possessed the longest maturity and cluster I had the earliest maturity. Cluster VIII exhibited the highest plant height whereas, cluster IV possessed the lowest plant height, cluster VI had maximum number

**Table 1. Cluster composition in chickpea**

Clusters	Number of Accession	Accessions
I	2	ICC-11284, ICC-1923
II	25	ICC-6537, ICC-637, ICC-4872, ICC-9586, ICC-1356, ICC-1 437, ICC-7272, ICC-1 1198, ICC-8318, ICC-1398, ICC-9942, ICC-4841, ICC-13523, ICC-16524, ICC-12941, ICC8621, ICC-10885, ICC-13524, ICC-3512, ICC-3572, ICC-8350, ICC-5504, ICC-9137, ICC-3218, ICC-1 1627.
III	39	ICC-1397, RG-2001-02, Vaibhav, ICC-3776, ICC-14077, ICC-5639, ICC-15888, ICC-1098, ICC-8950, ICC-2507, ICC-16269, ICC-6816, ICC-16207, ICC-12824, ICC-1392, ICC-5383, ICC-16915, ICC-13124, ICC-1052, ICC-8058, ICC-10399, ICC-14098, ICC-14402, ICC-5613, ICC-12654, ICC-4918, ICC-3230, ICC-10341, ICC-10949, ICC-1083, ICC-13599, RG-2001-02, ICC-11584, ICC-7861, RG-2001-08, RG-2001-14, RG-9949, RG-9920.
IV	13	ICC-1161, ICC-14815, ICC-9755, ICC-15612, ICC-708, ICC-4567, ICC-2263, ICC-9420, ICC-14799, ICC-6874, ICC-1 2299, ICC-4657, ICC-5879
V	10	ICC-1180, ICC-2242, ICC-14669, ICC-2720, ICC-11098, ICC-762, ICC-1510, ICC-1230, ICC-456, ICC-95
VI	16	ICC-15518, ICC-8855, ICC-6579, ICC-3325, ICC-9002, ICC-6816, ICC-13628, ICC-124-92, ICC-440, ICC-1205, ICC-3946, RG-938, ICC-11498, ICC-11944, ICC-506, ICC-3761
VII	23	ICC-8195, ICC-12307, ICC-2277, ICC-9643, JG-74, ICC-13357, ICC-5337, ICC-7308, ICC-7554, ICC-13187, ICC-2919, ICC-10755, ICC-12037, ICC-8384, ICC-13461, KBL-12328, ICC-13764, ICC-2072, ICC-7571, ICC-12866, ICC-5845, ICC-8522, RG-2001-19
VIII	10	ICC-791, ICC-7184, ICC-15610, ICC-2629, ICC-6293, ICC-3421, ICC-2580, ICC-8740, ICC-15333, ICC-2990
IX	31	ICC-15510, ICC-1422, ICC-4463, ICC-12916, ICC-1715, ICC-13863, ICC-1194, ICC-11664, ICC-13219, ICC-15618, ICC-6571, ICC-6802, ICC-2210, ICC-13077, ICC-7668, ICC-11121, ICC-14595, ICC-13283, ICC-867, ICC-11764, ICC-8151, ICC-1 6374, ICC-2065, ICC-15567, ICC-4495, RG-9903, RG-2001-03, RG-2001-18, RG-2001-20, RG-9930, RG-2001-08
X	35	ICC-12851, ICC-9862, ICC-1882, ICC-283, ICC-67, ICC-2884, ICC-2979, ICC-16487, ICC-12155, ICC-14778, ICC-14051, ICC-12928, ICC-7255, ICC-9895, ICC-4814, ICC-4593, ICC-1392, ICC-15435, ICC-15697, ICC-11378, ICC-15606, ICC-13892, ICC-4639, ICC-1915, ICC-10393, ICC-12537, ICC-4533, ICC-12726, ICC-5135, ICC-16261, ICC-9848, ICC-8607, ICC-11879, ICC-3637, ICC-6279.

**Table 2. Inter- and intra-cluster distance of genotypes in chickpea gene pool**

Cluster	I	II	III	IV	V	VI	VII	VIII	IX	X
I	1.657	-	-	-	-	-	-	-	-	-
II	6.278	1.899	-	-	-	-	-	-	-	-
III	5.332	3.526	1.835	-	-	-	-	-	-	-
IV	5.212	2.095	2.999	1.597	-	-	-	-	-	-
V	6.571	4.500	3.934	4.600	1.886	-	-	-	-	-
VI	6.412	3.144	3.975	3.699	2.938	2.588	-	-	-	-
VII	6.084	3.639	2.103	3.193	3.882	3.847	2.095	-	-	-
VIII	6.291	3.918	3.496	3.360	0.5307	5.018	2.598	1.899	-	-
IX	6.649	3.915	2.237	3.946	3.956	3.725	2.499	4.851	2.036	-
X	5.723	2.175	2.087	2.419	3.836	2.912	2.814	4.303	2.047	1.855

**Table 3. Mean performance in individual cluster for different yield traits**

Cluster	Days to flower initiation	Days to 50% flowering	Days to maturity	Plant height (cm)	Branches/plant	Pods/plant	Seeds/pod	100 seed weight	Seed yield/plant
I	55.00	60.00	96.00	47.50	5.50	39.90	1.15	17.23	27.60
II	60.64	66.16	111.24	42.18	5.03	26.39	1.18	11.69	14.79
III	44.64	50.36	108.77	39.88	4.38	28.09	1.26	15.24	25.60
IV	58.69	65.62	108.38	36.79	4.07	30.80	1.20	19.42	21.65
V	47.00	52.00	110.20	44.42	6.38	84.12	1.28	16.25	11.13
VI	52.94	59.81	111.31	39.67	7.90	61.55	1.09	13.76	17.14
VII	46.13	52.70	110.96	48.59	4.79	30.00	1.21	23.36	25.07
VIII	55.40	62.10	111.10	50.34	4.26	27.78	1.32	22.91	40.38
IX	40.90	45.90	111.10	40.57	4.47	29.75	1.11	16.31	15.06
X	49.83	56.11	109.63	38.81	4.76	28.66	1.14	12.37	14.77

of branches per plant. The highest number of pods/ plant was observed for cluster V whereas, lowest number was observed for cluster II.

The maximum number of seeds/ pod was noted for cluster VIII, whereas lowest number of seeds/ pod was

noted for cluster VI. Cluster VII exhibited the highest 100 seed weight whereas, cluster II showed lowest 100 seed weight. The highest seed yield/ plant was noted for cluster number VII whereas, lowest seed/plant was noted for cluster number V. The pattern of distribution of 204

genotypes in various clusters revealed that there was considerable genetic diversity in the material. In the present investigation, 204 genotypes were grouped into ten clusters. The highest intra-cluster distance was observed for cluster VI, which consisted of 16 genotypes. The maximum inter-cluster distance was recorded between clusters I and IX followed by clusters I and V and I and VI. As cluster I showed maximum intra-cluster distances with other clusters hence, both the genotypes belonging to cluster-1. (ICC-11284 and ICC-1923) could be utilized as parents in future breeding programme with the desirable genotypes belonging to clusters IX, V and VI. These results are in general agreement with the findings of Lal *et al.* (2001), Harisatyanarayana and Reddy (2001), Nimbalkar and Harer (2001), Gupta *et al.* (2003), Rao *et al.* (2003), Nanda (2003), Singh (2003), Billore *et al.* (2003), Kashyap *et al.* (2003), Dasgupta *et al.* (2003), Katiyar and Singh (1979), Adhikari and Pandey (1983) and Jain *et al.* (1981).

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