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Genetic Diversity Studies in Chickpea (*Cicer arietinum* L.) Germplasm

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A B S T R A C T

The present investigation was undertaken with thirty five genotypes of chickpea, (including one check) during *Rabi* 2017-18 in a randomized block design with three replications at Field Experimentation Center of Department of Genetics and Plant Breeding, Sam Higginbottom University of Agriculture, Technology & Sciences Allahabad. The data was recorded for ten characters to study genetic variability, heritability and genetic diversity. Analysis of variance among 35 genotypes showed highly significant difference. High estimates of genotypic coefficient of variation and phenotypic coefficient of variation were observed for economical yield followed by biological yield and number of pods per plant. High heritability coupled with high genetic advance was recorded for economical yield suggesting greater role of non-additive gene action in their heritance. Mahalnobis's D^2 analysis revealed considerable amount of diversity in the material. Thirty five genotypes were grouped into six heterogeneous clusters. Among these clusters Cluster VI has maximum number of genotypes. On the basis of mean performance of the genotypes, IC-275323 was recorded high yield among 35 genotypes under study. Characters such as economical yield, biological yield should be given top priority for effective selection. The present investigation revealed that the cluster II and cluster V are most diverse to each other, and the genotypes constituted in these clusters may be used as a parent for further hybridization programme.

Introduction

The word Cicer is a derivative from the Greek word kiros referring to a well-known roman family Cicero. Arietinum is derived from the Latin word arise meaning ram which refers to the ram's head shape of the chickpea (Singh, 1985). Chickpea (*Cicer arietinum* L.) is known by different names in various countries such as gram, Chana, Bengal gram, Kadleetc. Chickpea isan important Rabi season legume having extensive geographical distribution. Chickpea is a diploid species with a chromosome number 2n= = 14. It is a self-pollinated crop and it belongs to sub family *Papilionoideae* and tribe, *Cicereae* of the family leguminaceae. Later on, *Cicer* was considered to belong to tribe, Viceae Alef. Chickpea is the third most important pulse crop in the world after beans and peas. It is cultivated on an area of 12 million hectares with 8.9 million tons of annual production. Chickpea plays an important role to improve soil fertility by fixing atmospheric nitrogen

with the help of root nodules (Anabessa *et al.*, 2006). Chickpea is native of south-eastern Turkey and Syria (Saxena and Singh, 1987).

Pulses are the important food crop of the world because it provides a good source of vegetable dietary protein. Pulses provide a source of rich protein for those people who prefer vegetable to animal proteins in their diet for cultural or religious reasons. Pulse grain protein nutritionally complements the protein in cereal grains. Pulses contain 20-25 percent on dry seed basis, which is almost 2.5-3.0 times of the value normally found in cereals (Singh, 1985).

Materials and Methods

The experiment was carried out at Field Experimentation Centre of the Department of Genetics and Plant Breeding, Naini Agricultural Institute (NAI), Sam Higginbottom University of Agriculture, Technology & Sciences, Allahabad (UP), during *Rabi*, 2017-18. The experimental material for the present study was obtained from Vasasntrao Naik Marathwada Krishi Vidyapeeth, Parbhani (Maharashtra). Thirty four genotypes of chickpea and one check viz. Uday was grown in a randomized block design with three replications during *Rabi* 2017-18. Each genotype was sown in a single row of 4 m length with spacing of 30 cm between rows and 10 cm between plants. The data were recorded on five randomly selected plants of each replication for all characters such as days to 50% of flowering, Plant height (cm), Number of primary branches per plant, Number of secondary branches per plant, Number of pods per plant, Days to maturity, Seed index, Biological yield per plant, Harvest index, economical yield and biological yield. The statistical analysis was carried out as per the equation suggested by Fisher (1936) and coefficient of variation by Burton (1952) and D^2 analysis by Mahalnobis (1936).

Results and Discussion

The variation among genotypes were highly significant for day to 50 % flowering, day to maturity, plant height, number of primary branches per plant, number of secondary branches per plants, pod per plant, number of seed per pod, seed index, biological yield, economical yield and harvest index (Table 1).

The highest broad sense heritability recorded highest for economic yield (82%) followed by number of pods per plant (76%) and Harvest index (75%). High heritability (> 70 %) was observed in most of the characters, other characters had moderate to low heritability percentage. The estimates of Genetic Advance ranged from 0.62 to 51.07 with the highest estimate in case of biological yield (51.07 %), number of pods per plant (18.41 %), plant height (9.94 %), days to maturity (2.61 %) (Table 3). The remaining characters recorded low genetic advance. The D^2 values showed adequate genetic diversity among the genotypes studied. On the basis of D^2 values all the genotypes were grouped into the six 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 152.13 was found between the clusters II and V (Table 1–4).

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 genetic diversity, their performance and cluster mean for the characters also need due consideration in the crop improvement programme. In the present investigation, the cluster means for the ten characters studied are presented in Table 5.

Table.2 Mean performance of ten quantitative characters in thirty five genotypes of chickpea

No	Character	Days to 50 % Flowering	Plant height (cm)	No. of Primary Branches Plant^{-1}	No. of Secondary Branches Plant^{-1}	No. of Pod Plant^{-1}	Biological Yield (gm)	Days to Maturity	Harvest Index (%)	Seed Index (gm)	Economical Yield (gm)
1	ICC-807	71.00	60.50	2.40	13.26	66.66	204.66	124.00	50.16	27.66	102.66
2	ICC-303	71.66	54.26	2.60	9.73	64.40	118.66	123.66	65.17	21.33	77.33
3	ICC-3812	73.33	47.86	1.26	5.00	60.80	128.33	119.66	44.16	18.00	56.66
4	ICC-144	73.00	54.13	2.33	9.40	59.80	148.33	125.33	52.81	17.66	78.33
5	BCG-902	72.66	58.66	2.06	7.13	57.60	107.6	124.66	56.35	20.00	60.66
6	BCG-944	67.66	54.40	2.86	5.86	46.73	114.66	123.66	45.35	25.00	52.00
7	BCG-101	69.00	55.80	2.60	9.60	43.40	127.00	122.00	50.39	21.33	64.00
8	PG-12310	69.33	62.80	1.83	5.60	43.00	96.66	120.66	55.52	19.00	53.66
9	PG-739	69.00	59.20	2.26	6.33	51.90	129.00	121.00	52.45	19.66	67.66
10	BCG-708	67.33	57.80	1.26	7.33	57.13	101.66	120.00	60.33	22.00	61.33
11	PBC-1103	71.33	58.26	1.53	5.93	40.80	107.33	123.00	44.10	20.00	47.33
12	PBC-37	69.00	51.46	2.26	7.93	43.06	113.66	120.66	45.75	20.00	52.00
13	IC-275313	69.00	63.23	2.00	8.00	49.73	108.66	122.00	46.63	18.00	50.66
14	IC-275321	70.00	68.46	1.76	5.00	40.13	95.66	117.00	47.39	20.66	45.33
15	IC-275323	71.33	58.26	2.40	9.20	68.13	184.33	119.66	67.99	25.00	125.33
16	IC-275326	67.66	48.80	2.40	10.06	34.400	111.66	121.66	53.73	22.33	60.00
17	IC-275329	72.66	49.76	2.06	7.80	50.86	109.00	122.00	56.88	20.00	62.00
18	IC-275338	69.33	53.46	2.66	8.86	46.40	127.66	118.66	60.84	17.33	77.66
19	IC-275339	68.33	51.33	2.53	12.00	44.60	131.33	119.33	59.14	18.33	77.66
20	IC-275340	71.66	49.63	2.86	10.86	31.60	115.333	120.00	58.96	20.00	68.00
21	IC-275341	71.33	47.63	2.46	11.53	28.73	106.00	122.00	58.81	21.33	62.33
22	IC-275347	69.66	40.60	2.53	7.60	25.93	76.00	116.00	47.81	18.66	36.33
23	JAKI-9218	71.33	34.46	2.46	10.40	30.13	100.00	117.00	40.67	20.33	40.66
24	SAKI-9516	74.66	43.60	2.73	12.20	31.13	98.66	118.00	41.55	18.66	41.00
25	BDNGK-798	72.00	41.93	3.00	11.73	38.66	136.00	119.66	28.68	17.33	39.00
26	PKV-2	71.00	39.66	2.53	7.13	38.06	130.33	121.00	39.13	18.66	51.00
27	PKV-4	75.00	43.80	2.86	7.60	26.33	90.33	115.33	59.41	21.33	53.66
28	Kripa	75.33	48.00	2.80	10.46	50.13	183.33	116.00	38.18	17.66	70.00
29	Vijay	73.33	50.44	2.66	8.06	59.53	212.33	117.666	41.44	18.66	88.00
30	Virat	75.67	43.93	2.26	9.13	42.00	168.66	118.333	45.85	20.66	77.3
31	BDNG-797	74.33	44.20	2.86	8.66	42.80	120.00	121.00	48.61	22.00	58.33
32	Digvijay	69.00	52.13	3.26	8.26	41.53	99.33	122.33	66.78	25.66	66.33
33	Vishal	72.33	58.26	3.60	6.80	36.80	102.33	123.33	57.98	23.33	59.33
34	Phule G Vikram	75.00	61.40	3.40	7.06	37.33	116.66	121.33	54.00	19.33	63.00
35	Uday (check)	66.00	63.90	2.80	6.86	38.26	107.66	119.33	53.25	18.00	57.33
	Mean	71.15	52.34	2.46	8.56	44.18	123.38	120.48	53.99	20.42	62.97
	Range Lowest	66.00	34.46	1.26	5.00	25.93	76.00	115.33	32.81	17.33	36.33
	Range Highest	75.66	68.46	3.60	13.26	66.66	212.33	125.33	76.47	27.66	125.33
	C.D. 5%	4.66	11.18	0.78	2.83	9.46	31.80	4.27	9.73	4.97	13.16

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

Sr. No.	Characters	Mean sum of square		
		Replications (df=2)	Treatments (df=34)	Error (df=68)
1	Days to 50% flowering	1.038	19.14**	8.18
2	Plant height	1.18	187.27**	47.09
3	Number of Primary Branches/ Plant	0.016	0.83**	0.23
4	Number of Secondary Branches/ Plant	1.39	13.69**	3.02
5	Number of Pods per Plant	103.50	350.00**	33.72
6	Days to Maturity	0.88	19.57**	6.89
7	Seed Index	7.65	19.03**	9.31
8	Biological Yield	713.71	3022.48**	381.08
9	Harvest Index	97.64	358.35**	35.71
10	Economical Yield	148.30	964.75**	65.251

* -Significant at 5 % level of significance

Table.3 Estimates of variability parameters for ten quantitative characters in chickpea

Sr. No.	Characters			Coefficient of variation		h^2 (%) (b.s.)	Genetic Advance 5%	Gene. Adv. as % of mean
		Vg	Vp	GCV	PCV			
1	Days to 50% flowering	3.65	11.84	2.69	4.84	31	2.19	3.07
2	Plant height	46.73	93.82	13.06	18.50	50	9.94	18.99
3	Primary Branches/ Plant	0.20	0.43	18.07	26.75	46	0.62	25.42
4	Secondary Branches/ Plant	3.56	6.58	22.2	30.08	54	2.86	33.50
5	Number of pods/plant	105.43	139.15	23.24	26.69	76	18.41	41.66
6	Days to maturity	4.23	11.12	1.71	2.77	38	2.61	2.17
7	Seed index	3.24	12.55	8.81	17.34	26	1.88	9.22
8	Biological yield/plant	880.47	1261.55	23.99	28.72	70	51.07	41.29
9	Economical yield	299.83	365.09	27.50	30.34	82	32.33	51.33
10	Harvest Index	107.54	143.26	19.21	22.17	75	18.51	34.28

Table.4 Composition of Thirty five chickpea genotypes into different clusters

Cluster No.	No. of genotypes	Genotypes included
I	08	ICC 807, PG 739, BCG 944, PG 12310, BCH 902, BDNGK 798, VIRAT, PKV 2
II	05	BCG 101, BCG 708, PBC 37, IC 275313, PHULE G VIKRAM
III	03	IC 275347, JAKI 9218, SAKI 9516
IV	04	KRIPA, VIJAY, IC 275321, IC 275322
V	05	ICC 144, IC 275326, ICC 3812, ICC 303, PKV 4
VI	10	PBC 1103, IC 275341, DIGVIJAY, VISHAL, IC 275323, IC 275340, IC 275339, BDNG 797, IC 275329, IC 275338

Table.5 Cluster means of different characters to genetic diversity in chickpea

Sr. No.	Character / Cluster	I	II	III	IV	V	VI
1	**Days to 50% flowering**	70.625	69.13	72.66	72.83	**73.40**	70.33
2	**Plant height**	51.142	**63.33**	40.00	53.28	51.68	51.47
3	**No. of primary Branches/Plant**	2.48	1.98	2.73	2.43	2.10	**2.80**
4	**No. of secondary Branches/Plant**	7.78	6.28	**11.44**	9.91	7.96	9.11
5	**No. of pods/plant**	46.34	42.38	33.31	53.58	**53.85**	37.04
6	**Days to maturity**	120.95	120.40	118.22	119.91	**121.53**	120.53
7	**Seed Index**	21.41	19.33	18.77	**23.00**	18.66	20.63
8	**Biological yield/plant**	116.45	103.20	111.55	**192.50**	135.33	110.0
9	**Harvest Index**	54.13	49.95	39.89	54.06	52.18	**61.02**
10	**Economical yield**	60.66	50.86	40.22	**98.33**	65.53	62.26

The cluster mean for days to 50 per cent flowering varied from 73.40 (V) to 70.33 (VI). The cluster means for days to maturity ranged between 121.53 (V) to 118.22 days (III). The highest cluster mean for plant height was 53.28 cm, which was observed in cluster (IV) and lowest for cluster III (40.00). The cluster mean for the number of primary branches per plant ranged from 2.80 (cluster VI) to 1.98 (cluster II). The cluster mean for secondary branches per plant ranged between 7.20 (cluster VII) and 12.33 (cluster VI).

The cluster mean for number of pods per plant was maximum in cluster (V) 53.85 and it was minimum in cluster VI (37.04). The cluster mean for seed index was minimum in cluster V (18.66 g) and it was maximum in cluster IV (23.00). The cluster mean for biological yield was maximum in cluster IV (192.50) and minimum in case of cluster II (103.20). The cluster mean for economical yield was maximum in cluster IV (98.33) and minimum in case of cluster III (40.22). The cluster mean for harvest index was maximum in cluster VI (61.02) and minimum in case of cluster III (39.89).

From the fore going results, it can be concluded that the IC-275323 recorded high

seed yield among 35 chickpea genotypes. High heritability coupled with high genetic advance as percent of mean is observed in economic yield, pods per plant, harvest index; hence the parameters can be used for selection. The investigation further revealed that cluster II and cluster V are most diverse followed by cluster IV and cluster VI. Therefore, genotypes included in these clusters are suggested to provide broad spectrum of variability in segregating generations and can be used as parent for further hybridization programme to develop desirable plant types.

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