

Genetic Variability and Correlation Studies in Chickpea (*Cicer arietinum* L.)

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Abstract The present investigation was conducted to examine the genetic variability and correlation existing among 16 genotypes of chickpea, during *rabi* (2015-16) under randomized block design with three replications. The data were recorded for nine quantitative characters to obtain estimates of variability, heritability, and genetic advance. Significant differences were observed among the genotypes for all the characters studied. High estimates of genetic coefficient of variation and phenotypic coefficient of variation were observed for seed yield followed by pods per plant, primary branches. High heritability coupled with moderate genetic advance was recorded for pods per plant, suggesting greater role of non-additive gene action in their inheritance. The genotype C-1023 was recorded as the maximum number of pods per plant (66.33) and genotype C-210 recorded as maximum biological yield per plant and

C-210 for maximum seed yield and C-205 recorded as maximum number of primary branches per plant. Genotype C-1026 has maximum harvest index. Harvest mean performance was estimated for days to maturity and days to 50% flowering. The high value of GCV and PCV was recorded for number of pods per plant and number of primary branches per plant. High genetic advance as a percent of mean recorded in number of pods per plant. Hence, these characters may serve as effective selection parameter during breeding program for crop improvement.

Keywords Chickpea, Variability, GCV, PCV, Heritability.

Introduction

Chickpea (*Cicer arietinum* L.), also known as bengal gram, kadale, channa, garbanzo is an edible legume (pulse). It is the only widely cultivated species of the genus *Cicer* and belongs to the subfamily Faboideae of the Fabaceae family. The crop is a self-pollinated diploid ($2n = 2x = 16$). Chickpea is the principal *rabi* pulse crop and important source of

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calories and protein in India which is predominantly grown in the vast rainfed areas of the country [1].

Pulse grain protein nutritionally complements the protein in cereals grain. Pulses contain 20-25% protein on dry seed basis, which is almost 2.5-3.0 times of the value normally found in cereals. These crops have additional advantage for sustainable agriculture, because of their soil enriching capabilities and varied use as feed and fodder. Chickpea (*Cicer arietinum* L.) is the second most important pulse crop in the world, after dry beans and field peas [2].

Pulses maintain the soil fertility by fixing atmospheric nitrogen and improved soil structure. Pulses also play an important role in rainfed agriculture by improving physical, chemical and biological properties of soils and so considered excellent crop for natural resources management environmental crop diversification and consequently for viable agriculture. A healthy crop of chickpea can fix up to 141 kg nitrogen per hectare. Presently India produces around 8567.8 thousand tonnes of total pulse from an area of nearly 23 million hectare of land [3].

Chickpea reached a record high global area of 13.3 million ha and production of 11.75 million tons during 2011. In 2013 the area of chickpea cultivation increased to 13.05 m ha but production remained at 13.1 MT. *Desi* chickpea has a very low glycemic index making them a healthy food source for people with diabetes. Chickpea plays an important role to improve soil fertility by fixing up atmospheric nitrogen with the help of root nodules [4].

The low yields have been attributed to several factors among which include low genetic diversity of cultivated chickpea and several biotic and abiotic stresses [5]. During the year 2009-10, the country produced 14.66 million tons of pulses from 23 million ha area, with an average yield of 637 kg/ha [6]. The value of germplasm relies not only on the number of accessions it possesses, but also upon the genetic variability present in those accessions for agronomic and yield components. In addition to genetic variation, heritability of economically important characters is essential for effective breeding program and selection of specific traits. High broad sense heritability has been reported in chickpea for

100 seed weight and seed yield per plant and days to flowering and plant height [7].

Materials and Methods

The present investigation was conducted during *rabi*, 2015-16 at the Field Experimentation Center of Department of Genetics and Plant Breeding, Sam Higginbottom Institute of Agricultural, Technology and Sciences, Allahabad. Genotypes are : 1. C-205, 2. C-206, 3. C-207, 4. C-210, 5. C-213, 6. C-223, 7. C-224, 8. C-226, 9. C-1021, 10. C-1022, 11. C-1023, 12. C-1025, 13. C-1026, 14. C-1027, 15. C-1028, 16. C-222.

The experiment was conducted in randomized block design with 16 genotypes which obtain from Department of Genetics and Plant Breeding, Sam Higginbottom Institute of Agricultural, Technology and Sciences, Allahabad. The genotypes were replicated three times. Treatments were randomly arranged in each replication divided into 48 plots. The recommended dose of fertilizer @ 20 : 40 : 40 (N : P : K kg/ha) was applied in the form of urea, single super phosphate and muriate of potash, respectively as basal dose at the time of sowing. The field was irrigated as and when required up to physiological maturity. Intercultural operations like weeding were done manually at different intervals of crop growth as and when required up to maturity stage. The data were recorded on five randomly selected plants of each genotype. Parameters are Days to 50% flowering, Plant height (cm), Number of primary branches per plant, Number of pods per plant, Day to maturity, Biological yield, Harvest index, Test weight, Seed yield per plant (g).

Statistical / Biometrical analysis

The mean values of data obtained from the field were subjected to following statistical analysis : Analysis of variance, Genetic parameters, Correlation.

Results and Discussion

Plant height (cm)

Mean performance of plant height ranged from 51.76

Table 1. Estimates the genetic parameters for nine quantitative characters in chickpea genotype.

Sl. No.	Characters	VG	VP	GCV	PCV	h^2 (%)	GA	GA as% of mean
1	Days to 50% flowering	4.60	15.36	3.01	5.51	30.00	2.42	3.40
2	Plant height	5.79	13.03	4.16	6.24	44.40	3.30	5.72
3	No. of primary branches/plant	0.60	1.33	14.14	20.91	45.7	1.08	19.69
4	No. of pods per plant	100.63	128.29	25.46	28.76	78.4	18.2	46.45
5	Days to maturity	3.17	10.49	1.54	2.80	30.2	14.06	1.74
6	Biological yield	25.16	42.32	20.19	26.18	59.5	2.01	32.07
7	Harvest index	70.08	105.38	19.42	23.82	66.5	7.96	32.63
8	Test weight	10.86	14.46	14.46	17.2	75.2	5.88	26.71
9	Seed yield per plant	8.08	11.25	28.23	33.30	71.9	4.96	49.32

to 63.00 with grand mean value of 57.78 cm (Table 1). The genotypes C-1028 exhibited (51.76 cm) minimum plant height value followed by C-54.04 (1022) and C-1025 (55.62), while the genotype C-210 exhibited highest (63.00 cm) plant height followed by C-1023 (61.70) and C-223 (60.68).

Number of primary branches per plant

Mean performance of number of primary branches ranged from 3.83 to 7.10 with grand mean value of 5.52. Maximum (7.10) number of primary branches was recorded in the genotype C-205 followed by C-1028 (7.00) and C-223 (6.73). While the genotype C-1027 exhibited minimum (3.833) number of primary branches per plant followed by C-1026 (4.06) and C-210 (4.93).

Days to 50% flowering

Mean performance of days to 50% flowering ranged from 65.66 to 76.00 with grand mean value of 71.14. The genotype C-1027 exhibited (65.66) late days to 50% flowering followed by C-206 (67.66) and C-1025 (67.66) whereas genotype C-207 exhibited (76.00) early days to 50% flowering followed by C-210 (74.33) and C-1025 (67.66) (Table 2).

Days to maturity

Mean performance of days to maturity ranged from 111.33 to 120.00 with grand mean value of 115.62. The genotypes C-1022 exhibited (120.00) late ma-

turity followed by C-1-26 (1103.00) and C-207 (112.66) where as genotypes C-1025 exhibited (111.33) early maturity followed by C-1021 (119) and C-210 (118.33).

Number of pods per plant

Mean performance of number of pods per plant ranged from 27.10 to 66.33 with mean value of 39.38. the genotype C-1023 exhibited (66.33) maximum number of pods per plant followed by C-210 (53.16) and C-207 (49.96) where as genotype C-1028 exhibited (27.10) minimum number of pods per plant followed by C-206 (28.10) and C-222 (29.36).

Test weight

Mean performance of test weight ranged from 16.67 to 27.42% with grand mean value of 22.03%. The genotype C-222 exhibited (27.42) maximum test weight percent followed by C-213 (27.25) and C-226 (26.60) whereas genotype C-1026 exhibited (16.67) minimum test weight percent followed by C-223 (16.99) and C-206 (18.34).

Harvest index

Mean performance of harvest index ranged from 22.86 to 55.69% with grand mean value of 43.09%. The genotype C-1026 exhibited (55.69) maximum harvest index percent C-226 (55.48) and C-224 (53.29) where as genotype C-222 exhibited (22.86) minimum harvest index percent followed by C-1022 (30.38) and C-205 (33.67).

Table 2. Mean performance of 16 genotypes of chickpea for 9 Characters during *rabi* 2015-16. GCV = Genotypic coefficient of variation, PCV = Phenotypic coefficient of variation, h^2 = heritability, GA = Genetic advance.

Genotypes name		Days to 50% flowering	Plant height (cm)	Primary branches/plant	Pods/plant	Days to maturity	Biological	Test weight (g)	Harvest index (%)	Seed yield/plant
							yield/plant (g)			
1.	C-205	72.33	59.89	7.10	34.13	114.33	27.83	20.36	33.67	8.25
2.	C-206	67.66	56.76	5.66	28.10	117.66	21.89	18.34	39.39	7.25
3.	C-207	76.00	56.94	5.96	49.96	112.66	34.41	20.77	42.64	12.88
4.	C-210	74.33	63.00	4.93	53.16	118.33	36.13	24.87	48.39	17.66
5.	C-213	71.00	57.62	6.00	43.36	114.33	30.20	27.25	39.86	12.14
6.	C-223	71.00	60.68	6.73	38.96	117.33	19.48	16.99	48.61	8.83
7.	C-224	73.33	58.97	5.33	42.76	115.66	19.57	25.40	53.29	10.71
8.	C-226	73.00	58.29	5.46	37.36	114.66	23.65	26.60	55.48	10.80
9.	C-1021	71.66	57.28	5.10	30.53	119.00	22.40	20.45	46.08	8.91
10.	C-1022	71.33	54.04	5.13	31.73	111.33	18.18	21.34	30.38	4.62
11.	C-1023	71.00	61.70	5.26	66.33	115.66	24.67	20.25	49.50	10.49
12.	C-1025	67.66	56.60	5.80	37.80	120.00	23.24	23.24	39.14	9.26
13.	C-1026	70.66	59.67	4.06	44.30	113.00	22.69	16.67	55.69	12.22
14.	C-1027	65.66	55.62	3.83	35.13	115.00	24.40	22.64	41.23	12.01
15.	C-1028	74.33	51.76	7.00	27.10	115.00	17.95	19.97	43.23	7.95
16.	C-222	67.33	55.77	4.93	29.36	116.00	30.73	27.42	22.86	7.09
	Mean	71.14	57.78	5.52	39.38	115.62	24.84	22.03	43.09	10.07
	Range lowest	65.66	51.76	3.83	27.10	111.33	17.95	16.67	22.86	4.62
	Range highest	76.00	63.00	7.10	66.33	120.00	36.13	27.42	55.69	17.66
	CV	4.61	4.65	15.41	13.36	2.33	16.67	8.60	13.78	17.65
	CD 5%	5.46	4.48	1.41	8.77	4.51	6.90	3.16	9.90	2.96

Biological yield

Mean performance of biological yield ranged from 17.95 to 36.13 with grand mean value of 24.84 g. The genotype C-210 exhibited (36.16 g) maximum biological yield followed by C-207 (34.41) and C-222 (30.73) whereas the genotype C-1028 exhibited (17.95) minimum biological yield followed by C-1022 (18.18) and C-223 (19.48).

Seed yield per plant (g)

Mean performance of seed yield per plant ranged from 4.62 to 17.66 with grand mean value of 10.07 g. The genotype C-210 exhibited (17.66 g) maximum seed yield per plant followed by C-207 (12.88) and C-1026 (12.22) where as the genotype C-1022 exhibited (4.62 g) minimum seed yield per plant (g) followed by C-222 (7.09) and C-206 (7.25).

Genetic variability and parameters

Genetic variance and phenotypic variance of days to

50% flowering is (4.60 and 15.36), plant height (5.79 and 13.03), number of primary branches per plant (0.60 and 1.33), number of pods per plant (100.63 and 128.29), biological yield (25.16 and 42.32), harvest index (70.08 and 105.38), days to maturity (3.17 and 10.49), seed yield (8.08 and 11.25) and test weight (10.86 and 14.46).

Heritability

The estimates ranged from (30) days to 50% flowering to (78.4) pods per plant. High heritability was observed for characters like harvest index (66.5%), biological yield (59.7%), test weight (75.2%) corresponding to these moderate heritability characters having plant height (44.40%), number of primary branches (45.7%) and days to maturity (30.2%) and low for days to 50% flowering (30.00%).

Conclusion

The highest variability's V_p and V_g was recorded for the number of pods per plant (128.30 and 100.63)

and harvest index (105.29 and 0.08). Both PCV and GCV estimates were highest for seed yield per plant (33.30/28.24) followed by pods per plant (28.76/25.46). High estimates of heritability was for pods per plant (78.4%) and lowest for days to maturity and flowering (30.2% and 30%). Genetic advance recorded maximum for the pods per plant (18.3) and lowest for days to maturity (2.01). Genetic advance as percent of mean was highest for seed yield/plant (49.32%) followed by pods per plant (46.45%), harvest index (32.63%), biological yield (32.07%) and lowest for days to maturity (1.74%). High heritability along with high genetic advance as percent of mean was registered for pods/plant, seed index, and seed yield/plant. High heritability coupled with high genetic advance was registered for pods/plant (78.4/18.2), suggesting predominance of additive gene action in the expression of these traits. Path analysis at phenotypic level indicated that harvest index (0.5429) had positive direct effect on seed yield per plant followed by biological yield (0.4982) and pods per plant (0.1516). Seed yield per plant showed the positive significant correlation association with plant

height (0.7925**), followed by biological yield per plant (0.7565), pods per plant (0.7088**)

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