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Genetic Variability, Heritability and Genetic Advance Analysis in Chickpea (*Cicer arietinum* L.)

Lalit Kishor*, Indu Swarup, Anju Nehra, Girraj Kirar and Rajesh C. Jeeterwal[1]

Department of Plant Breeding and Genetics, College of Agriculture

(RajmataVijayaraje Scindia Krishi VishwaVidyalaya), Indore

[1]Division of plant Breeding and genetics, Rajasthan agricultural research institute

(SKN Agiriculture University), Durgapura, Jaipur

*Corresponding Author E-mail: lalitkishor091@gmail.com

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ABSTRACT

The present field experiment was conducted with forty chickpea genotypes, raised in randomized block design with three replications during rabi season of 2015-16 at field of regional research centre on pulses, College of Agriculture, Indore (M.P.). The observations were recorded on days to 50% flowering, days to maturity, plant height, lower branch height, number of primary branches per plant, number of pods per plant, number of seeds per pod, number of seeds per plant, biological yield per plant, 100-seed weight, harvest index and seed yield per plant from five competitive plants selected randomly from in each replication for collecting the information on existing genetic variability, heritability, expected genetic advance. The analysis of variance revealed highly significant differences among genotypes for all the characters study. Number of pods per plant followed by biological yield per plant, number of seeds per plant, seed yield per plant, number of primary branches par plant, 100-seed weight had high phenotypic and genotypic coefficient of variation. The characters viz., days to 50% flowering, days to maturity, 100 seed weight, plant height, number of seeds per plant, lower branch height, number of pod per plant, biological yield per plant, seed yield per plant, number of primary branches per plant and harvest index showed least differences among GCV and PCV estimates. The estimates of heritability in broad sense for most of the traits were low to high. High estimates were observed for number of seeds per plant (96.90%) followed by number of pods per plant, 100 seed weight, biological yield per plant, days to 50% flowering, plant height, lower branch height, days to maturity, seed yield per plant, number of primary branches per plant, while harvest index, number of seeds per pod registered the low heritability. Number of pods per plant, biological yield per plant, number of seeds per plant, seed yield per plant and number of primary branches per plant have high values of heritability coupled with high genetic advance as per cent of mean.

Key words: *Chickpea, Cicer arietinum, Genetic Variability, Heritability, Genetic advance.*

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INTRODUCTION

Gram or Chickpea (*Cicer arietinum* Linnaeus), also called garbanzo bean or Bengal gram, a member of family Fabaceae, is a self pollinated leguminous crop, diploid (2n=16) annual grown in different area of the world but its cultivation is mainly concentrated in semi-arid environments. It is the third most important food legume in the world after dry beans and peas. There are two distinct types of cultivated chickpea, Desi and Kabuli. Desi (microsperma) types have pink flowers, anthocyanin pigmentation on stems, and brown coloured and thick seed coat. The kabuli (macrosperma) types have white flowers, lack anthocyanin pigmentation on stem, white or cream colored seeds thin seed coat and smooth seed surface.

Chickpea is a good source of carbohydrates and proteins, which together constitute about 80% of the total dry seed mass. The starch content of chickpea cultivars have been reported to vary from 41% to 50%. The crude protein content of chickpea varies from 12.4 to 31.5%. Chickpea contains about 6% fat which is important in the vegetarian diets of resource-poor consumers. Chickpea contains nutritionally important minerals, notably calcium and iron, and the availability of iron is reported to be good. The protein quality is considered to be better than other pulses[2].

Crop improvement depends on the magnitude of genetic variability present in the base population. The expected improvement in yield components primarily depends on the nature and magnitude of heritable portion of total variation. Selection based on a single character may not always be effective. On the other hand, it is very cumbersome process for a breeder to consider a large number of component characters simultaneously in selection procedure. The presence of genetic variability is of utmost importance for any breeding programme and due to this reason the plant breeders have emphasized the evaluation of germplasm for the improvement of crop yield as well as for utilization in further breeding programmes. Evaluation of plant genetic resources is a pre-requisite for which the future breeding work is based[6]. In addition to genetic variation, heritability of economically important characters is essential for effective breeding programme and selection of specific traits. Heritability estimates and genetic advance in a population provides information about the expected gain in the following generations.

MATERIAL AND METHODS

The experimental material used in the present study comprised of forty genotypes including standard checks. The experiment was laid down in a randomized block design with three replications during *rabi* season of 2015-16 at field of regional research centre on pulses, College of Agriculture, Indore (M.P.). Each entry was sown in four rows of 4 m length with a row spacing of 30 cm and plant to plant distances were maintained as 5 cm. The material was sown on November 9, 2015. All recommended package of practices were followed during the conduction of experiment to raise a good crop. The observations were recorded on days to 50% flowering, days to maturity, plant height, lower branch height, number of primary branches per plant, number of pods per plant, number of seeds per pod, number of seeds per plant, biological yield per plant, 100-seed weight, harvest index and seed yield per plant.

The data on various characters were subjected to statistical analysis by using appropriate method of analysis of variance and covariance as described by Panse and Sukhatme[4]. Genotypic and phenotypic coefficients of variance were estimated according to Burton and Devane[1]. The broad sense heritability (h^2bs) was estimated by following the procedure suggested by Weber and Moorthy. Genetic advance for each character was predicted by the formula given by Johnson *et al*.[3].

RESULT AND DISCUSSION

Analysis of variance showed highly significant differences among all twelve traits for days to 50% flowering, days to maturity, plant height, lower branch height, number of primary branches per plant, number of pods per plant, number of seeds per pod, number of seeds per plant, biological yield per plant, harvest index,

100 seed weight and seed yield per plant indicating the presence of considerable variability among the all traits (Table 1).

The GCV values were lower than PCV values for all the characters under study. The highest GCV of 30.82% was recorded for number of pod per plant, followed by biological yield per plant (30.00%), number of seeds per plant (29.00%), seed yield per plant (24.49%), number of primary branches per plant (21.74%),100 seed weight (17.56%), lower branch height (10.22%), plant height (9.46%), number of seeds per pod (5.61%), harvest index (5.44%) and days to 50% flowering (5.26%) while the least GCV was recorded for days to maturity (3.74%). The highest PCV value was observed for number of pods per plant (31.43%), followed by biological yield per plant (31.14%), number of seeds per plant (29.46%), seed yield per plant (26.36%), number of primary branches per plant (23.87%),100 seed weight (17.98%), number of seeds per pod (17.00), lower branch height (10.77%), plant height (9.89%), harvest index (9.45%) and days to 50% flowering (5.48%) while the least GCV was recorded for days to maturity (3.96%). The difference between PCV and GCV was very meager for all the traits except number of seeds per pod under study. Maximum difference between PCV and GCV values was recorded for number of seeds per pod (11.39%) followed by harvest index (4.01%), number of primary branches par plant (2.13%), seed yield per plant (1.87%), biological yield per plant (1.14%). The lowest difference between PCV and GCV was recorded for days to 50% flowering and days to maturity (0.22%).

The estimates of heritability ranged between 10.9 per cent (number of seeds per pod) to 96.9 per cent (number of seeds per plant).High heritability was recorded for number of seeds per plant (96.90%) followed by number of pods per plant (96.20%), 100 seed weight (95.40%), biological yield per plant (92.80%), days to 50% flowering (92.10%), plant height (91.30%), lower branch height (89.90%), days to maturity (89.00%), seed yield per plant (86.30%), number of primary branches per plant (82.90%) while it was low for harvest index (33.10%) and number of seeds per pod 10.9 percent.

Genetic advance as per cent of mean was found highest for number of pods per plant (62.29%) followed by biological yield per plant (59.56%), number of seeds per plant (58.81%),seed yield per plant (46.88%), number of primary branches per plant (40.76%), 100 seed weight (35.32%); moderate for lower branch height (20.31%), plant height (18.62%), days to 50% flowering (10.39%) while low for day to maturity (7.26%), harvest index (6.44), number of seeds per pod (3.53%). (Table2).

Based upon the present investigation, it is suggested that the genetic variability reported for different characters in relation to yield should be exploited for future genetic improvement of chickpea. Characters showing high heritability with high genetic advance should be utilized in direct selection.

Table 4.1: ANOVA showing mean sum of squares for different traits in chickpea

Source of variation	Replication	Genotypes	Error
d. f.	2	39	78
Days to 50% flowering	0.68	39.38**	1.09
Days to maturity	4.68	45.96**	1.82
Plant height	4.79	55.89**	1.71
Lower branch height	4.39	48.66**	1.75
Number of primary branches /plant	0.29	2.06**	0.13
Number of pods/plant	11.44	313.97**	4.07
Number of seeds/plant	11.38	366.93**	3.87
Number of seeds/pod	0.01	0.04**	0.02
100-seed weight	0.73	83.42**	1.32
Biological yield per plant	5.04	66.87**	1.68
Harvest index	58.09	50.54**	20.34
Seed yield/plant	2.20	15.89**	0.79

* *Significant at 0.01 level of significance

Table 2: Genetic parameters of variability for various traits in chickpea

S.No.	Characters	Mean	Range		PCV (%)	GCV (%)	Heritability (Broad Sense) (%)	Genetic advance	Genetic advance as % of mean
			Min	Max					
1	**Days to 50% flowering**	67.91	62.03	74.77	5.48	5.26	92.1	7.06	10.39
2	**Days to maturity**	102.59	96.40	110.87	3.96	3.74	89	7.45	7.26
3	**Plant height (cm)**	44.94	35.43	55.97	9.89	9.46	91.3	8.37	18.62
4	**Lower branch height (cm)**	38.70	30.07	49.40	10.77	10.22	89.9	7.72	20.31
5	**Number of primary branches per plant**	3.68	2.40	6.53	23.87	21.74	82.9	1.50	40.76
6	**Number of pods per plant**	32.97	13.97	52.03	31.43	30.82	96.2	20.54	62.29
7	**Number of seeds per pod**	1.13	1.00	1.40	17.00	5.61	10.9	0.04	3.53
8	**Number of seeds per plant**	37.93	22.03	61.90	29.46	29.00	96.9	22.31	58.81
9	**Biological yield per plant (g)**	15.53	6.33	24.83	31.14	30.00	92.8	9.25	59.56
10	**Harvest index**	58.32	47.47	64.87	9.45	5.44	33.1	3.76	6.44
11	**100 seed weight (g)**	29.78	15.67	38.13	17.98	17.56	95.4	10.52	35.32
12	**Seed yield per plant (g)**	9.15	4.33	13.00	26.36	24.49	86.3	4.29	46.88

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