Website : www.asthafoundation.in
Frontiers in Crop Improvement
Vol 10 (1) : 50-53 (January-2022) Print ISSN : 2393-8234 Online ISSN : 2454-6011
Astha Foundation, Meerut (U.P.) India

Studies on Variability, Heritability and Genetic Advance for Grain Yield and its Attributes in Chickpea (*Cicer arietinum* L.)

Raghubeer Singh[1], S.C. Gaur[1]*, P.N. Singh[1], Hariom Prasad[1], Tarkeshwar[2], Abhishek Kumar[1], Ankur Kumar Rai[3] and S.P. Singh[4]

[1]*Department of Genetics and Plant Breeding, BRD (PG) College Deoria-274001 U.P.*
[2]*Department of Genetics and Plant Breeding, ANDUAT, Kumarganj, Ayodhya-224229 U.P.*
[3]*Dept. of Horticulture Fruit and Fruit Technology, BAU, Sabour Bhagalpur-813210, Bihar*
[4]*CSAUAT-Agriculture Research Station, Kalai, Aligarh, U.P.*
**Corresponding Author Email : scgaur101@gmail.com*

Abstract

The field experiment under present investigation was conducted during *Rabi* 2019-2020at Agriculture research farm of B.R.D.P.G. College (Campus), Deoria UP. The experiment was conducted to evaluate 21 Chickpea germplasm line in normal soil under timely sown with Randomized block design. The observation was recorded on Initial flowering days, days to 50 percent flowering, initial podding days, days to 50 percent podding, maturity days, plant height (cm), primary branch per plant, secondary branch per plant, pod bearing length(cm), number of pods per plant, number of seeds per pod, biological yield per plant (g), seed yield per plant (g), harvest index (%), seed index (g). The mean squares due to genotype (treatments) were highly significant for all the fifteen characters under study. The magnitude of phenotypic coefficient of variation (PCV) higher than the genotypic coefficient of variation (GCV) for all the character. The high magnitude (>20 %) of PCV along with high GCV was observed for pod bearing length, secondary branch per plant, primary branch per plant and number of pods per plant and, harvest index. Seed yield per plant had high PCV in combination with moderate GCV. While moderate estimates of both parameters were recorded for seed yield per plant and harvest index. Initial flowering, days to 50% flowering, initial podding days, days to 50 percent podding, maturity days and biological yield sowed low values for GCV as well as PCV. The high magnitude of heritability couple with high genetic advance in per cent over mean was observed for seed index, pod bearing length, primary branch per plant, secondary branch per plant, and number of pods per plant which indicates that good response to selection is likely to observed for these characters. The existence of high character heritability with moderate genetic advance for harvest index, seed yield per plant, number of seed per pod indicate that these characters may also provide good response to selection owing to their moderate transmissibility and variability. However, occurrence of moderate heritability values along with low genetic advance for plant height and biological yield per plant suggest that these characters are indices for selection. Therefore, the above promising accessions have greater genetic variability and sufficient information in further breeding programs to introduce ideotype Chickpea genotypes.

Key words : *Cicer arietinum, heritability, GCV, PCV, variability and genetic advance.*

Introduction

Bengal gram or chickpea is annual herbaceous legume belonging to the family Leguminosae sub family papilionaceae. Chickpea (*Cicer arietinum* L.) 2n=2x=16 is considered as 'King of pulses', and know by different name *viz.,* channa in UP, Bihar, Rajasthan, MP, Gujarat and Haryana; Chhola in West Bengal; boot in Orissa.Chickpea is known to have originated in western Asia and domesticated in the middle east. It is wildly cultivated in India after origination. Chickpea dispersed in two direction, large seeded and small seeded. Large seeded (Kabuli) type is well adopted to spring sowing from in Afghanistan, westwards to middle east, South Europe and North Africa. Small seeded cultivars of different colors are known as desi type; and it is mostly cultivated in Pakistan, Ethiopia, Sudan Chile, etc. in winter season. Chickpea is grown in more than 50 countries (89.7% area in Asia, 4.3% in Africa, 2.6 in Oceania, 2.9 in the USA and 0.4 % in Europe.) India is the largest producers accounting for 64% of the total chickpea production. The other major chickpea producing country are Pakistan, turkey, Iran, Myanmar, Australia, Ethiopia, Canada, Mexico and Iraq. Among the temperature chickpea is the most tolerant crop to heat and drought stress and is suitable for cultivation in low fertility soil, chickpea also helps to maintain soil fertility through biological nitrogen fixation and contributes to the sustainability of crop in system in then cereal-legume crop rotation (1). Chickpea crop meets 80% its nitrogen requirement from symbiotic nitrogen fixitation and can fix up to 140 kg N per hectare from air.

The basic rational in any crop improvement programs is the increase in the yield potential of the crop.

Received : November-2021; Revised : December-2021; Accepted : December-2021

Table-1 : Analysis of variance of randomized block design for 15 character of chickpea germplasm.

Source of variation	DF	Initial flowering	days of 50% flowering	Initial podding days	Days to 50% podding	Maturity days	Plant height (cm)	Primary branchper plant	Secondary branch per plant
Replication	2	8.87	7.42	10.34	13.92	60.11	134.35	0.08	0.23
Treatment	20	175.92**	176.47**	168.09**	158.97**	90.91**	116.96**	5.56**	20.15**
Error	40	10.92	11.82	11.36	11.57	11.19	28.56	0.72	1.50

Table-1 : Contd...

Source of variation	DF	Pod bearing length (cm)	Number of pods per plant	Number of seed per pod	Biological yield per plant	Harvest index (%)	Seed index	Yield per plant
Replication	2	4.98	27.50	0.06	0.68	1.64	0.03	0.42
Treatment	20	244.13**	705.37**	0.41**	45.54**	111.71**	68.45**	9.95**
Error	40	21.13	52.19	0.10	12.85	10.85	0.48	0.82

*,** significant at 5% and 1% level, respectively.

Table-2 : Range, mean, genotypic and phenotypic coefficient variation, heritability and genetic advance in percent over mean for 15 characters of chickpea germplasm.

Characters	Parameters								
	Range		Mean	Coefficient of Variation (%)			Heritability in broad sense	Genetic advance	Genetic advance in % of mean
	Min.	Max.		GCV	PVC	ECV	5%	5%	5%
Initial flowering days	60.67	86	72.60	10.21	10.54	4.55	0.93	14.79	20.38
Days of 50% flowerig	68.67	93.33	80.23	9.23	9.56	4.29	0.93	14.74	18.37
Initial podding days	73.33	98.33	85.82	8.42	8.72	3.92	0.93	14.38	16.75
Days to 50% podding	78.67	104.33	90.89	7.71	8	3.74	0.92	13.90	15.29
Maturity days	122	141.33	130.89	3.93	4.20	2.56	0.88	9.94	7.59
Plant height (cm)	52.93	73.03	61.67	8.80	10.12	8.67	0.76	9.72	15.76
Primary branch/plant	2.78	7.33	4.58	27.72	29.73	18.61	0.87	2.43	53.26
Secondary branch/plant	4.50	13.50	8.43	29.54	30.71	14.53	0.92	4.94	58.55
Pod bearing length (cm)	16.13	44.57	28.10	30.67	32.09	16.35	0.91	16.97	60.39
No. of pod plant	19.97	83.17	52.66	28.01	29.11	13.71	0.92	29.25	55.54
No. of seed/pod	1	2.17	1.61	19.89	22.96	19.83	0.75	0.57	35.52
Biological yield/plant (gm)	21.83	36.23	30.64	10.77	12.71	11.69	0.71	5.76	18.89
Seed yield/plant (gm)	7.07	12.77	9.86	17.69	18.47	9.21	0.91	3.44	34.89
Harvest index %	20.73	41.14	32.69	17.73	18.66	10.07	0.90	11.34	34.71
Seed index	12.90	29.50	18.05	26.36	26.45	3.87	0.99	9.78	54.11

The character like yield has got a complex gene action and is as a result of many factors. In order to study it properly, different factors influencing the yield must be considered and evaluated with regard to their contribution towards the yield for a particular crop. The knowledge of variability available in the breeding material due to genetic and non-genetic causes is a pre-requisite in the selection of superior plant type. The information on association of attributes with seed yield and among themselves is of considerable importance in exercising selection programs (2). Selection of superior plants is done on the basis of crop improvement. The efficiency depends on the identification of genetic variability for the characters. Assessment of genetic variability in the base population is the first step in any breeding program. It should be determined with the help of certain parameters, such as genotypic and phenotypic coefficient of variation, Heritability is the proportion of phenotypic variance among individuals in a population that is due to heritable genetics effects, also known as heritability in the narrow sense. Similarly, heritability in broad sense is defined as the proportion variance that is attributable to an effect for the whole genotype, comprising the sum of additive, dominance, and epistatic effects of phenotypic. “High heritability coupled with high genetic advance indicates that the character is under the control of the additive gene action. High heritability and low genetic advance indicate that the character is govern by the non-additive genes. Low heritability and low genetic advance indicate that the trait is greatly influenced by environment (3)”.

Materials and Methods

A germ plasm collection of 21varieties of chickpea (*Cicer arietinum* L.) comprising indigenous as well as exotic genotypes, constituted the experimental materials for this study. These genotypes exhibiting wide spectrum of variability for various agronomic and morphological characters are obtained from the Indian Institute of Pulse Research, Kanpur.

Experimental Details : The Experimental Research Farm is geographically located in the east part of U.P. India. The site of experiment is located at 26.5^0N latitude, 83.79^0E longitudes and 68 meter (223 feet) above the sea level. The climate of district Deoria is semi-arid with hot summer and cold winter. Nearly 80% of total rain fall is received during the monsoon (only up to September) with a few showers in the winter The experimental material was evaluate at B.R.D. P.G. College, research farm Deoria U.P., in Randomized Block Design with three replications during *Rabi* 2019-2020.Each treatment was planted in Double row of 3m length, the inter and intra row spacing were 45 cm and 10 cm, respectively. To avoid the border effects the experimental plot was surrounded from all sides by non-experimental rows. Recommended cultural practices were followed to raise a good crop.

Observations : Five competitive plants from each plot were randomly selected for recording of observations on fifteen characters. Averages of the data from selected plants of each plot in respect of different characters were used for various statistical analyses. The data were recorded for the following characters on Initial flowering days, days to 50 percent flowering, initial podding days, days to 50 percent podding, maturity days, plant height (cm), primary branch per plant, secondary branch per plant, pod bearing length (cm), number of pods per plant, number of seeds per pod, biological yield per plant (g), seed yield per plant(g), harvest index (%), seed index(g). This data was undertaken to assess genetic variability, heritability and genetic advance as suggested by (3,4,5).

Results and Discussion

The mean squares due to genotype (treatments) were highly significant for all the fifteen characters under study Initial flowering days, days to 50 per cent flowering, initial podding days, days to 50 percent podding, maturity days, plant height(cm), primary branch per plant, secondary branch per plant, pod bearing length(cm), number of pods per plant, number of seeds per pod, biological yield per plant (g), seed yield per plant(g), harvest index (%), seed index(g). Replications, treatments and error for all the characters are presented in Table-1.

Coefficient of variation : The genetic variability is the raw material of plant breeding industry on which selection acts to evolve superior genotypes. Thus, higher the amount of variation present for character in the breeding materials, greater is the scope its improvement through selection. The estimated of genotype and phenotypic coefficient of variation for 15 character of Chickpea germplasm collection are present in Table-2. The high magnitude of coefficient of variation at genotypic as well as phenotypic level was observed for pod bearing length, primary branch per plant, secondary branch per plant, number of pods per plant and harvest index. Thus, indicates possibility of obtaining higher selection response in respect of these traits. Seed yield per plant had high PCV in combination with moderate GCV,this parameter may also provide considerable scope for improvement through selection. However, occurrence of moderate PCV and GCV values for seed yield and harvest index indicated that exiting variation in these traits may limit scope of improvement by selection. Low estimates of both parameters were recorded for initial flowering, days to 50% flowering, initial podding days, days to 50% podding, maturity days and biological yield. The occurrence of low estimates of genotypic and phenotypic coefficient of variation for the above characters indicated that selection directly based on these traits could not be of much use. The magnitude of phenotypic coefficient of variation (PCV) higher than the genotypic coefficient of variation (GCV) for all the character. The high magnitude (>20%) of PCV along with high GCV was observed for pod bearing length, secondary branch per plant, primary branch per plant and number of pods per plant and, harvest index. Seed yield per plant had high PCV in combination with moderate GCV. While moderate estimates of both parameters were recorded for seed yield per plant and harvest index. Initial flowering, days to50%flowering, initial podding days, days to 50 percent podding, maturity days and biological yield sowed low values for GCV as well as PCV.

Heritability and Genetic Advance : Heritability and genetic advance are important selection parameters. Heritability estimate along with genetic advance are normally more helpful in predicting the gain under selection than heritability estimates alone. The estimate of heritability can be utilized for the prediction of genetic gain, which indicates the genetic improvement that would result from the selection n of best individual. Hence, estimate of heritability is an essential pre-requisite for formation of an effective selection method for genetic improvement Heritability in broad sense (h^2b), genetic advance (Ga) and genetic advance as percent of mean (Ga%) were estimated for all the characters and are presented in Table-2. Highest estimate of broad sense heritability (h^2b) was recorded for seed index (0.99), followed by initial flowering days, days to 50% flowering initial podding days

(0.93 each), days to 50% podding, secondary branch per plant, number of pod per plant (0.92 each), pod bearing length(cm), seed yield per plant (0.91 each), harvest index (0.90), maturity days (0.88), primary branch per plant (0.87), plant height (0.76), and moderate broad sense heritability recorded for number of seed per pod (0.75), biological yield per plant (0.71) in broad sense, respectively.

The genetic advance in percent of mean varied from 7.59 to 60.39 for number of primary branch and pod bearing length per plant, respectively. Highest genetic advance (Ga) in percent of mean was found in pod bearing length (60.39), secondary branch per plant (58.55), number of pods per plant (55.54), seed index (54.11), primary branch per plant (53.26). as means respectively moderate genetic advance was observed for number of seed per pod (35.52), seed yield per plant (34.89), harvest index (34.71) and lowest genetic advance mean at 5% matrix recorded for initial flowering days (20.38), days to 50% flowering (18.37), initial podding days (16.75), plant height (15.76), days to 50% podding (15.29), maturity days (7.59).

The high magnitude of heritability couple with high genetic advance in percent of mean was observed for seed index, pod bearing length, primary branch per plant, secondary branch per plant, and number of pods per plant (Table-2); which indicates that good response to selection is likely to observed for these characters. The existence of high character heritability with moderate genetic advance for harvest index, seed yield per plant, number of seed per pod indicate that these characters may also provide good response to selection owing to their moderate transmissibility and variability. However, occurrence of moderate heritability values along with low genetic advance for plant height and biological yield per plant suggest that these characters are indices for selection. The use of simple selection method will be suitable for improving these characters. The estimates of heritability and genetic advance for most of the characters under study were in accordance with earlier reports (6,7,8,9).

Conclusions

The maximum variability was found for pod bearing length, primary branch per plant, secondary branch per plant, number of pods per plant and harvest index. Highest h^2bs and genetic advance at 5% mean found for seed index, pod bearing length, primary branch per plant, secondary branch per plant and pod per plant. These traits to exploit effective selection for genetic improvement in future breeding programs.

References

1. Saini M.S., Tiwana U.S. and Jagandeep Singh (2021). Effect of nitrogen and phosphorus on the growth, yield attributes and seed yield of late sown toria (*Brassica rapa* L.) under Punjab conditions. *Progressive Research : An International Journal*, 16(1): 5-7.
2. Parmar J.G., Javia R.M., Sharma L.K., Vala J.P., Nayee S.J. and Singh S.P. (2021). Character association and path coefficient analysis in blackgram [*Vigna mungo* (L.) hepper] during summer season. *Progressive Research : An International Journal*, 16 (2): 115-119.
3. Panse V.G. and Sukhatme P.V. (1988). Statistical methods for agricultural worker. ICAR Publ., (II ed.), New Delhi
4. Lush J.L. (1949). Intra-sire correlation or regression offspring on dam as a method of estimating heritability of characteristics. *Ann. Prod. Am. Animal Prod.*, 33: 293-301.
5. Johnson H.W., Robinson H.F. and Comstock R.E. (1955a): Estimates of genetic and environmental variability in soybean. *Agron. J.*, 47: 314-318.
6. Setty N.A., Patil, M.S. and Hiremath, K.G. (1977). Genetic variability and correlation studies in *Cicer arietinum* L. *Mysore J. Agric. Sci*, 11: 131-134.
7. Saki A.L., Zaman M.A., Khatun M.T., Kamal M.M. and Begum H. (2009). Genetic variability, correlation and path coefficient analysis for agronomic traits in chickpea. *The Agriculterist,* 17(1/2): 12-21.
8. Alemu B., Tesfaye K., Haileselassie and Lue D. (2017). Broad sense heritability and genetic advance for grain yield and its components of chickpea (*Cicer arietinum* L.) genotypes in western Ethiopia. *Int. J. Genet. Mol. Biol,* 9(4): 21-25.
9. Sing V., Vimal S.C., Shrivastav S.P., Maurya V. and Singh N. (2020). Genetic variability, heritability and genetic advance for yield and contributing traits in Chickpea. *Int. J. Curr. Microbiol. App. Sci.,* 9(9): 445-45.