International Journal of Pharmaceutical Research and Applications
Volume 8, Issue 6 Nov-Dec 2023, pp: 2062-2067 www.ijprajournal.com ISSN: 2249-7781

Variability, Heritability and Genetic advance Studies of Chickpea (Cicer arietinum L.) Genotypes at Satna District of M.P.

Lukesh Kumar Janghel, Rajbeer Singh Gaur and Ayodhya Prasad Pandey
Department of Genetics and Plant Breeding
Faculty of Agriculture Science and Technology
AKS University, Satna- 485001 (M.P.)

Submitted: 10-15-2023 Accepted: 20-12-2023

ABSTRACT:
Twenty diverse cultivars of chickpea (Cicer arietinum L.) grown in a Completely Randomized block design (CRBD) at AKS University, Satna, during Rabi season on November 2022. The nine quantitative characters studied for the estimation of variance, genetic variability, heritability and genetic advance. The design of the experiment indicated highly significant differences for all the characters due to treatments. The analysis of variance indicated the existence of sufficient amount of variability among genotypes for all the studied characters. The maximum GCV and PCV was observed for seed yield per plant, number of seeds per pod, plant height (cm), number of pods per plant and days to maturity. High heritability coupled with high genetic advance observed for seed yield per plant, number of seeds per pod, days to maturity and plant height (cm) indicating that these characters could be prominently governed by additive gene action. So the selection of these traits could be more effective for desired genetic improvement.

Keywords: Chickpea, Variance, variability, heritability and genetic advance

I. INTRODUCTION:

Pulses are the very important source of dietary proteins in the diets of vegetarian who belongs to developing or developed countries. The legume crops helps in atmospheric nitrogen fixation in soil and increase the soil fertility **(Ali, 2007).** The legume crops ensure nutritional security to the poor masses of the country **(Chaturvedi and Ali, 2002).**

Chickpea belongs to Cicer genus, species arietinum of Papilionaseae subfamily of Leguminosae, also known as Fabaceae family. It originated in southeast turkey. The name Cicer is of Latin word, derived from the Greek word 'kikus' meaning of force or strength. It is more drought tolerant than cereals. Therefore, they have rightly described as "unique jewels of Indian crop husbandry" **(Swaminathan, 1981)** and livelihood of sustainable agriculture. During 2018- 19, globally it was grown on 150.61 lakh ha area, with the total production of 162.25 lakh tones **(FAOSTAT, 2020)** and in India it was grown on 9.70-million-hectare area, with the total production of 11.08 million tonnes during **(Anonymous 2019-20)**.

Germplasm serves as the most valuable natural reservoir in providing needed attributes for the development of superior varieties **(Hawkes, 1981).** There have been many reports on genetic variability in chickpea but mostly based on limited number of germplasm lines **(Shivkumar and Muthaiah, 2000)**. Therefore, evaluation of germplasm is essential for present as well as future crop improvement programme. The concept of heritability explains whether differences observed between individuals due to the differences in genetic constitution or because of environmental forces. Genetic advance gives the impression or idea of possible improvement of new individuals through selection as compared to the original populations. The genetic gain depends upon the quantity of genetic variability and magnitude of masking effect of the environment.

II. MATERIAL AND METHODS:

The present investigation was conducted during Rabi, 2022-23 at Research farm, Genetics and Plant Breeding, AKS University, Sherganj, Satna, Madhya Pradesh. The material consists 20 varieties/strains of chickpea (Cicer arietinum L.) germplasm comprising indigenous genotypes, evaluated in Completely Randomized Block Design. The entire experimental field divided in 3 blocks of

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Volume 8, Issue 6 Nov-Dec 2023, pp: 2062-2067 www.ijprajournal.com ISSN: 2249-7781

equal size and each block had 20 plots. Each plot was consisted of four rows 1.2 meters length, following row to row spacing of 30 cm. and plant to plant spacing of 10 cm. Recommended cultural practices were applied to raise a good crop.

Nine observations on yield and yield contributing characters were recorded. In each plot, five competitive plants were randomly selected for recording observations for all the twelve quantitative characters, which were recorded on the plot basis.

The analysis of variance for the design of the experiment was carried out according to the procedure outlined by Panse and Sukhatme, (1967). The genotypic coefficient of variation (GCV), phenotypic coefficient of variation (PCV) and environmental coefficient of variation (ECV) was estimated by the formula suggested by Burton and de Vane, (1953). Heritability in broad sense (h^2b) was estimated using the formula suggested by Burton and de Vane, (1953). Genetic advance was calculated by the method suggested by Johnson et al., (1955).

III. RESULT AND DISCUSSION

The analysis of variance for the design of the experiment involving 20 chickpea strains/varieties were evaluated in Randomized Block Design with three replications for the twelve quantitative characters expressed in **Table 1.** The design of the experiment indicated highly significant differences for all the evaluated characters. The maximum variances due to replication were found for Number of pods per plant (398.38) and highest variances due to treatment for Plant height (cm) (832.88**). Non-significant differences due to replications were observed for all the characters. Similar results were reported by **Balpande et al. (2022); Dhopre et al. (2022); Gulwane et al. (2022); Kandwal et al. (2022); Mushtaq et al. (2013), and Dumbre et al. (1884)** in their respective studies.

The comparison of mean performance of 20 varieties/genotypes for 9 characters revealed existence of very high level variability in the evaluated genotypes collections as given in **Table 2**. The grand means of 20 genotypes, range, GCV, PCV, and ECV for 9 characters are presented in **Table 3.** The maximum GCV and PCV was observed in seed yield per plant, number of seeds per pod, plant height (cm), number of pods per plant and days to maturity. This is an indicative of less amenability of these characters to environmental fluctuations and hence, greater emphasis should be given to these traits. The magnitude of PCV ranged from days of 50% flowering (8.561) to harvest index (22.912). The traits with high phenotypic coefficient of variation indicated more influence of environmental factors. Therefore, caution has to be exercised during the selection programme because the environmental variations are unpredictable in nature and may mislead the results. Similarly the results were observed by **Bukke et al. (2022)** reported high GCV and PCV in case of Total yield per plot, Grain yield per plant, and No of secondary branches. **Sriraj and Gurjar (2022)** were recorded Low value of PCV and GCV in No. of seeds per pod, Days to maturity and Days to 50% flowering, **Meena et al. (2021)** observed maximum (GCV) and (PCV) for seed yield per plant, number of pods per plant and number of branches per plant. **Kumar et al. (2012)** reported high value of GCV and PCV for 100 seed weight, seed yield per plant and plant height. **Babbar et al. (2012), Alwani et al. (2010), Younis et al. (2008),** and **Jeena et al. (2005),** also reported high GCV for number of pods/plant and 100 seed weight. **Sable et al. (2000)** observed high estimates of GCV for seed yield per plant, 100 seed weight and biological yield per plant. **Mathur and Mathur (1996)** reported high GCV and PCV in case of 100 grain weight. In present investigation GCV and PCV estimates found lowest for days to 50% flowering.

Heritability estimates are used to predict expected advance under selection so that breeders are able to anticipate improvement from different of selection intensity. The major function of heritability estimates is to provide information on transmission of characters from parents to the progeny. Such estimates facilitate evaluation of hereditary and environmental effect in phenotypic variation and thus aid in selection. **Burton and De Vane (1953)** suggested that the GCV along with heritability estimate could provide better picture of the genetic advance to be expected by phenotypic selection. Heritability h^2 (Broad Sense), h^2 (Broad Sense)%, Genetic Advancement @ 5%, and Genetic Advance as % of Mean 5% was estimated for all the characters and has been presented in **Table: 4.**

In general, higher estimates (h^2b) >80% were observed for all the characters except number of secondary branches per plant (36.00) and number of pods per plant (74.00). The heritability value ranged

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from 36.00 percent for number of secondary branches per plant to 99.7 for days to maturity. High heritability estimates were found for days to maturity (99.7) followed by seed yield per plant (99.6) days to 50 percent flowring (99.00) number of primary branches per plant (98.8) number of seeds pe (97.9) plant height (cm) (92.1) 100-seed weight (g) (82.8) suggested that the characters are least influenced by the environmental factors and also indicates the dependency of phenotypic expression which reflect the genotypic ability of strains to transmit the gene to their progenies. Similar results were obtained by **Balpande et al. (2022); Gulwane et al. (2022); Kandwal et al. (2022); Farshadfar et al. (2013); Saleem et al. (2002a) Bicer and Sarkar (2008),** and **Younis (2008)** in their respective studies.

Genetic advance is a measure of genetic gain under selection which depends upon main factors viz., genetic variability, heritability, and selection index **Allard RW, (1960).** The expected genetic advance as percent of mean at 5% ranged from days to maturity (8.63%) to secondary branches per plant (69.788%). High estimate of expected genetic advance were found for seed yield per plant (47.002%) followed by number of seeds per pod (44.404%), plant height (cm) (39.556%), number of pods per plant (34.797%) and days to maturity (31.411%). While moderate genetic advance as percent of mean (5%) was observed for number of primary branches per plant (28.184%) followed by 100-seed weight (gm.) (27.866%) and days to 50 percent (26.445%). Low estimates of expected genetic advance were found for number of secondary branches per plant (6.355%).

High heritability coupled with high genetic advance observed for seed yield per plant, number of seeds per pod, days to maturity and plant height (cm) indicating that these characters could be prominently governed by additive gene action. So the selection of these traits could be more effective for desired genetic improvement. It is supported by similar findings of **Balpande et al. (2022); Gulwane et al. (2022); Kandwal et al. (2022); Akanksha et al. (2016); Kumari et al. (2013),** and **Yadav et al. (2003)** in their respective studies.

IV. CONCLUSION

In the light of above findings it may be concluded that wide spectrum of exploitable variability in the material studied with respect to seed yield per plant and its component characters. As per mean performance the maximum yield was recorded by varieties/genotypes viz., JG 315, Kabuli bold, Kabuli medium, JG 11. The maximum GCV and PCV was observed for in seed yield per plant, number of seeds per pod, plant height (cm), number of pods per plant and days to maturity. Higher estimates (h^2b) >80% were observed for all the characters except number of secondary branches per plant (36.00) and number of pods per plant (74.00). High heritability coupled with high genetic advance observed for seed yield per plant, number of seeds per pod, days to maturity and plant height (cm) indicating that these characters could be prominently governed by additive gene action. So the selection of these traits could be more effective for desired genetic improvement in chickpea.

V. ACKNOWLEDGEMENT:

This paper and the research behind it would not have been possible without the exceptional support of my supervisor, Mr. Rajbeer Singh Gaur. I acknowledge to all the faculty of Department of Genetics and plant breeding and AKS University, Satna (M.P.) for providing the essential facilities during the research.

International Journal of Pharmaceutical Research and Applications
Volume 8, Issue 6 Nov-Dec 2023, pp: 2062-2067 www.ijprajournal.com ISSN: 2249-7781

Table 1 Analysis of variance for nine quantitative characters in Chickpea.

Source of Variation	Degree of Freedom	Mean sum of squares								
		Days to 50 percent flowering	Number of primary branches per plant	Number of secondary branches per plant	Number of pods per plant	Number of seeds per pod	Days to maturity	Plant height (cm)	100 Seed Weight	Seed yield/plant
Replication	2	28.01	1.54	3.58	398.38	0.05	30.29	6.47	0.53	103.76
Treatments	19	646.12**	3.42**	5.59**	676.25**	0.23**	182.31**	832.88**	45.03**	56.53**
Error	38	21.39	0.30	0.87	40.03	0.05	17.36	8.85	4.43	20.34

***Significant at 5% probability level, **Significant at 1% probability level.**

Table 2 Mean performance of 9 characters of chickpea genotypes.

S.N.	Genotypes	Days to 50 percent flowering	Number of primary branches per plant	Number of secondary branches per	Number of pods per plant	Number of seeds per pod	Days to maturity	Plant height (cm)	100-seed weight (g)	Seed yield per plant (g)
1	Mausmi bold	73.33	1.54	5.28	67.97	1.00	126.86	50.45	22.15	15.77
2	Mausmi medium	97.98	4.20	7.75	50.37	1.50	143.45	60.18	15.42	10.79
3	Gulabi	70.33	1.60	5.08	47.84	1.16	130.13	57.92	20.49	13.55
4	Desi	67.33	1.60	5.48	58.44	1.79	126.90	55.45	18.32	17.05
5	Kabuli bold	98.05	3.33	7.88	19.44	1.04	146.51	83.33	29.12	22.80
6	Kabuli medium	83.16	2.54	3.40	22.18	1.13	146.34	76.93	25.30	20.63
7	Kabuli small	98.25	4.27	6.67	35.78	1.21	141.85	68.73	22.46	9.72
8	Chanauli kabuli	58.00	1.54	3.40	63.59	1.69	121.74	33.43	19.20	15.81
9	JG 11	58.33	2.02	3.77	46.66	1.58	133.91	46.60	14.43	20.19
10	Vishal	68.00	2.13	3.20	37.36	1.66	132.67	44.67	15.86	15.31
11	Jockey	71.00	2.42	5.31	24.67	1.46	130.03	33.60	18.56	14.90
12	Radhe	97.71	4.00	7.38	25.11	1.15	144.61	42.60	24.18	13.16
13	JG 1	57.00	2.19	4.57	23.67	1.23	126.08	44.54	17.65	13.64
14	JG 218	98.33	3.67	6.50	25.55	1.12	145.00	56.47	18.87	12.54
15	JG 16	58.00	2.07	4.73	29.67	1.16	134.20	42.67	15.02	18.12
16	JYOTI 5	69.67	1.16	5.04	28.22	1.14	134.40	24.59	18.14	11.64
17	RVG 202	73.00	1.13	5.33	26.78	1.66	134.20	30.29	22.00	17.86
18	JG 315	71.33	1.09	5.22	30.69	1.36	138.37	35.29	16.48	27.85
19	JG 412	72.67	1.13	5.02	42.32	1.66	127.46	25.76	16.84	13.92
20	JG 24	75.33	1.55	5.03	55.89	1.93	126.38	28.62	15.62	16.43

Table 3 Mean, Range, Genotypic, Phenotypic and environmental variances, and coefficient of variation for 9 quantitative characters in chickpea.

S.N.	Characters	Grand mean	Range		GCV	PCV	ECV	C.V. @ 5%
			Min.	Max.				
1	Days to 50 percent flowring	75.84	57.00	98.33	12.902	12.967	2.241	7.64
2	Number of primary branches per plant	2.26	1.09	4.27	13.762	13.842	2.584	0.91
3	Number of secondary branches per plant	5.30	3.20	7.88	5.139	8.561	11.859	1.55
4	Number of pods per plant	38.11	19.44	67.97	19.643	22.842	20.193	10.46
5	Number of seeds per pod	1.38	1.00	1.93	21.785	22.018	5.526	0.38
6	Days to maturity	134.56	121.74	146.51	15.269	15.289	1.376	6.89
7	Plant height (cm)	47.11	24.59	83.33	20.007	20.846	10.141	4.92
8	100-seed weight (gm.)	19.30	14.43	29.12	14.862	16.328	11.712	3.48
9	Seed yield per plant (gm.)	16.08	9.72	27.85	22.864	22.912	2.561	7.45

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Volume 8, Issue 6 Nov-Dec 2023, pp: 2062-2067 www.ijprajournal.com ISSN: 2249-7781

Table 4 Heritability (%) in broad sense, Genetic advance and genetic advance as percent of mean (5%) in chickpea.

S.N.	Characters	Heritability (h^2b)	Heritability (h^2b %)	Genetic Advance	Gen. Adv. as % of Mean 5%
1	Days to 50 percent flowring	0.99	99	12.112	26.445
2	Number of primary branches per plant	0.988	98.8	43.383	28.184
3	Number of secondary branches per plant	0.36	36	0.307	6.355
4	Number of pods per plant	0.74	74	2.971	34.797
5	Number of seeds per pod	0.979	97.9	1.949	44.404
6	Days to maturity	0.997	99.7	39.054	31.411
7	Plant height (cm)	0.921	92.1	35.706	39.556
8	100-seed weight (gm.)	0.828	82.8	5.815	27.866
9	Seed yield per plant (gm.)	0.996	99.6	8.731	47.002

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