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Assessment of genetic variability and heritability in chickpea (*Cicer arietinum* L.)

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Abstract
The present experiment was laid out with 25 cultivars of Chickpea (*Cicer arietinum* L.) in a Randomized block design in AKS University, Satna, during *Rabi* season 2021-22. Data were collected on twelve characters *viz.*, Days to 50% flowering, Number of primary branches per plant, Number of pods per plant, Number of seeds per pod, Pod length (cm.), Plant height (cm.), Pod diameter (cm.), Days to maturity, 100 Seed Weight, Biological Yield per plant (gm.), Harvest index (%), Seed Yield per plant (gm.). The maximum genotypic coefficient variation was observed in hundred seed weight, followed by pod length, harvest index, seed yield/plant and number of seeds/pod. High heritability coupled with high genetic advance observed for hundred seed weight, pod length and number of seeds/pod 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. The analysis of variance indicated the existence of sufficient amount of variability among genotypes for all the characters and can be improved through individual plant selection.

Keywords: Chickpea, variability, heritability and genetic advance

Introduction
Pulse crops occupy premier position in agriculture economy of India. Pulses provide dietary protein for vegetarian population, green nutritious fodder and feed for livestock and helps in atmospheric nitrogen fixation in soil (Ali, 2007) [1]. Chickpea (*Cicer arietinum* L.) belongs to Cicer genus 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 a highly self-pollinated and annual grain legume crops, diploid species contains with 2n = 2x = 16 chromosomes. Chickpea is eaten fresh as a green vegetable or parched, fried, or boiled seed. Split chickpea without seed coat locally known as 'Dal' and flour are used extensively in India as a thick soup for making breads. Chickpea (*Cicer arietinum* L.) is cultivated in almost all part of world covering more than 50 countries spread over Asia, Europe, Australia N. America and S. America.

In India, chickpea was cultivated on 10.76 million hectares area and production contributed 11.16 million tones with the productivity of 1037 kilogram per hectare in 2017-18. (Anonymous, 2018) [2] In Madhya. Pradesh chickpea area was 2620.57 thousand hectares with 2297.02 thousand tones production (2015-16).

The success of any crop breeding programme depends on the nature and amount of variability existing with germplasm collections. The variability for the characters of economic importance is the basic perquisite for improvement. The genetic reconstruction of plant is required for developing high yielding varieties by incorporating and improving the characters. Germplasm serves as the most valuable natural reservoir in providing needed attributes for superior varieties (Hawkes, 1981) [3]. Lack of adequate variability has been implicated as one of the major limitation in improving the productivity of chickpea. There have been reports on genetic variability in chickpea but mostly based on limited number of germplasm lines (Sivakumar 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 differences 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.

Knowledge of genetic variability, heritability and genetic association of different characters provides a basis for plant breeders to breed high yielding or high quality genotypes in chickpea. Crop breeders continue to be involved in improving the genetic potential of this crop meet the needs of continuously increasing population. Knowledge of the nature and magnitude of genetic variation in the qualitative and quantitative characters and their relationships between individuals comprising different genotype species is an essential requirement for a systematic breeding program.

Materials and Methods

The field experiment under present investigation was conducted during *Rabi*, 2021-22 at Research farm Genetics and Plant Breeding AKS University Sherganj, Satna, Madhya Pradesh. Geographically, Sherganj situated between at $24^{0}58'$ N latitude, $80^{0}83'$ E longitude and at about 2 km away from district head quarter of Satna and on 322 meters above the mean sea level.

The climate of district Satna is semi-arid and sub tropical type with hot dry summer and cold dry winter. Nearly 80 percent of total rain fall is received during the monsoon (only up to September) with a few showers in the winter. The annual rainfall is around 950 mm. May and June are the hottest month where maximum temperature reaches 45 ºC. January is the coldest month of year when average minimum falls to 6 ºC.

The metrological data during the period of experiment pertaining to annual rain fall Temperature (minimum and maximum) and relative humidity during the crop season has been given in the Table 3.1. The lowest rainfall recorded in the month of December, 2021 (0.33). It was maximum (2.47) rainfall in the month of January, 2022. The mean lowest temperature (10.73) was recorded in January, 2022 whereas the maximum temperature (39.91) was observed in the month of April, 2022. The minimum relative humidity (2.53) was observed in the month of April, 2022 whereas the maximum relative humidity (82.04) was recorded in the month of January, 2022. Month wise weather parameters have been given below. The soil type of experimental site was sandy loam in nature having neutral pH as 6.5-7.0.

The collections of 25 varieties/strains of chickpea (*Cicer arietinum* L.) germplasm comprising indigenous genotypes, constituted the experimental materials for this study. These genotypes exhibiting wide spectrum of variability for various agronomic and morphological characters were obtained from the, JNKV Jabalpur, KVK Majhgawan, Farmers field and Department of Genetics and Plant Breeding, AKS University Sherganj, Satna M.P.

The experiment was conducted to evaluate 25 chickpea germplasm under irrigated condition, following Randomized Block Design. The entire experimental field divided in 3 blocks of equal size and each block had 25 plots. Each plot was consisted of four rows 1.5 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.

Observations on yield and yield contributing characters were recorded. In each plot, five competitive plants were randomly selected for recording observations for all the qualitative and quantitative characters, which were recorded on the plot basis. The data were recorded for the following characters: Days to 50% flowering, Number of primary branches per plant, Number of pods per plant, Number of seeds per pod, Pod length (cm.), Plant height (cm.), Pod diameter (cm.), Days to maturity, 100 Seed Weight, Biological Yield per plant (gm.), Harvest index (%), Seed Yield per plant (gm.)

Results and Discussion

The present investigation was carried out with 25 diverse strain/varieties of chickpea (*Cicer arietinum* L.). These lines were grown during *rabi* season 2021-22. The data recorded on yield and their components for twelve characters were subjected to various statistical analysis. The analysis of variance for the design of the experiment involving 25 chickpea strains/varieties were evaluated in Randomized Block Design with three replications for the twelve quantitative characters. The design of the experiment indicated highly significant differences for all the characters. Non-significant differences due to replications were observed for all the characters. Table 1 Similar results were reported by Mushtaq *et al.* (2013) [5], Dumbre *et al.* (1884) [6]. Akhtar *et al.* (2011) [7] reported a considerable range of variability for days to first flowering, secondary branches, plant height, dry matter and grain yield. Mohamed *et al.* (2015) [8] also reported genetic variability for seed yield, flowering date, days to maturity and number of seed per plant.

The grand means of 25 genotypes and range for 12 characters are presented in Table 2. The days to 50% percent flowering ranged from JK 5 (67.67 days) to JG 16 (74.33 days). The genotype JK 5 (67.67 days) have taken minimum days to 50% flowering followed by JG 218 (68.00 days), JG 14 (68.00 days), JG 63 (68.67 days), Vijay (68.67 days), JG 226 (69.00 days), and Narendra 2 (69.00 days). The genotypes JG 16 (74.33 days) have taken maximum days to 50% flowering followed by Safed chana (74.00 days), Hara chana (74.00 days), Jaki 9218 (74.00 days), JG 322 (73.67 days), JG 24 (73.67 days). The days to 1st flowering exhibited low value GCV and PCV were (2.987 and 3.097) respectively for this character.

The number of primary branches/plant ranged from JK 5 (4.00) to JG 315, JG 36, JG 14, JG 16, and JAKI 9218 (3.00). The highest number of primary branches/plant have observed in JK 5 (4.00) followed by Kala chana (3.60), Hara chana (3.60), JG 226 (3.47), JG 11(3.47), RVG 202 (3.47), and Vijay (3.40). The GCV and PCV exhibited by this character are (7.06 and 7.398) respectively.

The highest number of pods per plant was observed in genotype JG 24 (28.93) while the lowest number of pods per plant was observed in JK 5 (20.00). The top best lines for number of pods per plant are *viz*., JG 24 (28.93) followed by JG 12 (28.67), Safed chana (27.87), JG 315 (27.87) and JG 14 (27.53). The GCV and PCV exhibited by this character are (4.207 and 8.178) respectively.

The highest numbers of seeds per were observed in case of JG 24 (1.73) and lowest number of seeds per pod were recorded in four cultivars *viz*., JG 322, Vijay, Narendra 2, and RAJ 128 (1.00). In the top cultivars for higher number of seeds per pod recorded in JG 24 (1.73) followed by JG 11 (1.53), JG 6 (1.47), JG 218 (1.47), Safed chana (1.47) and Annagiri (1.40). The GCV and PCV exhibited by this character are (13.738 and 15.122) respectively. The higher value of genotypic coefficient variance and phenotypic coefficient variance indicating that environment has played significant role in the expression of this character.

The longest and shortest pod length observed in JK 5 and RVG 202 (2.64 cm. and 1.26 cm.) respectively. The highest pod length was recorded in JK 5 (2.64 cm.) followed by JG 6 (2.21 cm.), JG 24 (2.01 cm.), JG 412 (1.97 cm.), and JG 11

(1.95 cm.). The higher value of genotypic coefficient variance and phenotypic coefficient variance obtained for this character indicating that, the environment has played significant role in the expression of this character. The GCV and PCV exhibited by this character are (15.923 and 16.35) respectively.

The highest and lowest mean performance for plant height was shown by JG 24 and Safed chana (67.80 cm. and 44.40 cm.) respectively. The maximum plant height were recorded in JG 24 (67.80 cm.) followed by JK 5 (66.60 cm.), JG 6 (61.53 cm.), JG 315 (60.20 cm.) and RVG 202 (59.73 cm.) The GCV and PCV exhibited by this character are (10.558 and 11.052) respectively.

The highest and lowest mean performance for Pod diameter was observed in JK 5 and Safed chana (3.29 cm. and 1.50 cm.) respectively. The maximum pod diameter were recorded in JK 5 (3.29 cm.) followed by JG 6 (2.65 cm.), JG 24 (2.61 cm.), JG 16 (2.59 cm.), JG 218 (2.51 cm.), and Narendra 2 (2.50 cm.). The GCV and PCV exhibited by this character are (11.97 and 12.028) respectively.

The lowest and highest days to maturity ranged from 95.67 days to 125.33 days (JK 5 and Safed chana) respectively. Minimum days to maturity were observed in JK 5 (95.67 days), followed by JG 14 (103.00 days), JG 11 (108.33 days), RAJ 128 (109.33 days) and VIJAY (109.67 days). The varieties Safed chana (125.33 days), Kala chana (122.33 days), JG 315 (120.33 days), Harra chana (120.33 days), Annagiri (118.67 days), JG 12 (118.33 days) an JG 322 (118.00 days) have taken maximum days to maturity. The genotypic coefficient variation (GCV) and phenotypic coefficient variation (PCV) exhibited by this character are (5.303 and 5.364) respectively.

The 100 seed weight varied from JK 5 (44.67 gm.) to JG 24 (19.33 gm.) The most promising varieties observed for this trait in order to high 100 seed weight are JK 5 (44.67 gm.) followed by Safed chana (32.80 gm.), Kala chana (27.67 gm.), JG 322 (27.33 gm.), and JG 36 (26.00 gm.). The highest value of genotypic coefficient variance (GCV) and phenotypic coefficient variance (PCV) obtained for this character indicating that, the environment has played significant role in the expression of this character. The GCV and PCV exhibited by this character are (17.809 and 17.93) respectively.

The highest and lowest mean performance for biological yield per plant was observed in JG 24 (25.71 gm.) and JG 16 (13.68 gm.) respectively. Out of 25 varieties/genotypes best five lines for higher biological yield *viz*., JG 24 (25.71 gm.), JG 218 (22.18 gm.), JK 5 (21.30 gm.), RAJ 128 (21.29 gm.) and JG 315 (21.24 gm.). The low value of genotypic coefficient variance (GCV) and higher value of phenotypic coefficient variance (PCV) obtained for this character indicating that, the highest influence of environment in the expression of this character. The GCV and PCV exhibited by this character are (7.458 and 17.032) respectively.

The highest harvest index was exhibited by Jaki 9218 (84.91%) while JK 5 (20.65%) showed lowest harvest index. The best six varieties/ genotypes for this trait was JK 5 (20.65%), JG 14 (37.03%), KALA CHANA (43.03%), JG 63 (45.11%), JG 24 (46.07%) and JG 11 (47.77%). The GCV and PCV exhibited by this character are (15.515 and 21.68) respectively also indicating the high environmental role in the expression of this character. The highest seed yield per plant (14.06 gm.) was produced by JG 315 while, the lowest seed yield per plant (4.40 gm.) was recorded in JK 5. The most promising lines/varieties for this trait in order to merit were JG 315 (14.06 gm.) followed by RVG 202 (12.44 gm.), JG 6 (12.29 gm.), JG 412 (12.05 gm.), RAJ 128 (12.01 gm.), JG 24 (11.83 gm.) and JG 218 (11.19 gm.). The genotypes with lowest mean performance for seed yield per plant were recorded in JK 5 (4.40 gm.), Kala chana (7.53 gm.), JG 14 (7.59 gm.), JG 12 (8.26 gm.), JG 36 (8.31 gm.) and Harra chana (8.39 gm.). The higher value of genotypic coefficient variance (GCV) and phenotypic coefficient variance (PCV) obtained for this character indicating that, the environment has played significant role in the expression of this character also. The GCV and PCV exhibited by this character are (14.934 and 21.239) respectively.

A wide range of variation in mean performance of genotypes was observed for all the characters under study. The comparison of mean performance of 25 varieties/genotypes for 12 characters revealed existence of very high level variability in the evaluated genotypes collections as given in Table 2. The genotypes showing very high performance in desirable direction for various characters listed in Table 3 can serve as suitable donors for improving the traits for which they had high mean performance.

The maximum genotypic coefficient variation was observed in hundred seed weight, followed by pod length, harvest index, seed yield/plant and number of seeds/pod. This is an indicative of less amenability of these characters to environmental fluctuations and hence, greater emphasis should be given to these traits. The high PCV were recorded for harvest index, followed by seed yield/plant, hundred seed weight, biological yield/plant and pod length. The magnitude of PCV ranged from days of 50% flowering (3.097) to harvest index (21.68). 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 Mathur and Mathur (1996) [9] reported high GCV and PCV in case of 1000 grain weight. Sable *et al.* (2000) [10] observed high estimates of GCV for seed yield per plant, 100 seed weight and biological yield per plant. Jeena *et al.* (2005), Younis *et al.* (2008) [12], Alwani *et al.* (2010) [13] and Babbar *et al.* (2012) [14] also reported high GCV for number of pods/plant and 100 seed weight. Kumar *et al.* (2012) reported high value of GCV and PCV for 100 seed weight, seed yield per plant and plant height. In present investigation GCV and PCV estimates found lowest for days to 50% flowering.

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. Heritability estimates are used to predict expected advance under selection so that breeders are able to anticipate improvement from different of selection intensity. Johnson *et al.* (1955) [16] have suggested heritability estimates in association with genetic advance are much useful for selection than heritability alone. Burton (1952) [17] suggested that the GCV along with heritability estimate could provide better picture of the genetic advance to be expected by phenotypic selection. Heritability in broad sense includes both additive and non-additive gene effects (Hanson *et al.* 1956) [18]. Heritability in broad sense 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 biological yield per plant (19.2) and number of pods per plant (26.5). The heritability value ranged from 19.2 percent for biological yield per plant to 99.00 for pod diameter. High heritability estimates were found for pod diameter (99.0), hundred seed weight (98.7), days to maturity (97.8), pod length (94.8), days of 50% flowering (93.1), plant height (91.3), no. of primary branches/plant (91.1) and Number of seeds/Pod (82.5) 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. However, moderate heritability (>40% to <80%) observed for harvest index (51.2) and seed yield/plant (49.4) and low Heritability (<40%) was estimated for biological yield per plant (19.2) and number of pods per plant (26.5). Bicer and Sarkar (2008) [19] and Younis (2008) [12] also reported the similar results. Saleem *et al.* (2002a) [20] assessed high heritability estimates for hundred seed weight, days to 50% flowering. Farshadfar *et al.* (2013) [21] reported high heritability estimates for 100 seed weight and seed yield per plant.

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 in percent of mean ranged from 4.459% for number of pods/plant to 36.439% for hundred seed weight. High estimate of expected genetic advance were found for Hundred Seed Weight (36.439%), Pod Length (31.944%) and Number of seeds/Pod (25.711%). While moderate genetic advance as percent of mean (5%) was observed for pod diameter (24.541%) harvest index (22.872%) seed yield/plant (21.631%) and plant height (20.779%). Low estimates of expected genetic advance were found for number of pods/plant (4.459%), days of 50% flowering (5.936%), biological yield/plant (6.727%) days to maturity (10.802%) and number of primary branches/plant (13.878%). High heritability coupled with high genetic advance observed for hundred seed weight, pod length and number of seeds/pod 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 Yadav *et al.* (2003) [24] and Kumari *et al.* (2013) [23]. Low heritability coupled with low genetic advance estimated for number of pods/plant, and biological yield/plant. These findings are in agreement with Arshad *et al.* (2003) [26], Akanksha *et al.* (2016) [25]. Low heritability coupled with low genetic advance indicates that the trait is highly influenced by environmental effect and selection would be not effective.

Table 1: Analysis of variance for 12 quantitative characters in Chickpea

Source of Variation	Degree of Freedom	Mean sum of squares											
		Days to 50% flowering	Number of Primary Branches/plant	Number of Pods/Plant	Number of seeds/Pod	Pod Length	Plant height	Pod diameter	Date to maturity	100 Seed Weight	Biological yield/plant	Harvest index	Seed yield/plant
Replication	2	1.493	0.021	13.111	0.026	0.015	3.099	0.001	4.493	2.023	11.0121	263.729	2.999
Treatments	24	14.694**	0.177**	13.112**	0.111**	0.245**	108.68**	0.252**	112.208**	63.036**	28.886**	430.923**	12.789**
Error	48	1.021	0.015	9.642	0.019	0.013	9.494	0.002	2.521	0.848	23.348	210.235	6.466

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

Table 2: Mean performance of 12 characters of chickpea genotypes.

S.N.	Genotypes	Ch 1	Ch 2	Ch 3	Ch 4	Ch 5	Ch 6	Ch 7	Ch 8	Ch 9	Ch 10	Ch 11	Ch 12
1	JG 315	72.33	3.00	27.87	1.13	1.59	60.20	2.47	120.33	25.67	21.24	66.27	14.06
2	JG 412	70.67	3.33	25.40	1.33	1.97	55.40	2.31	113.33	24.67	20.39	61.06	12.05
3	JG 130	72.67	3.20	25.73	1.33	1.79	54.07	2.47	116.67	24.33	18.93	51.45	9.51
4	JG 36	72.33	3.00	25.00	1.40	1.86	55.60	2.23	113.67	26.00	14.92	55.52	8.31
5	JG 14	68.00	3.00	27.53	1.13	1.82	58.47	2.48	103.00	24.00	20.46	37.03	7.59
6	JG 6	73.00	3.27	27.40	1.47	2.21	61.53	2.65	113.00	24.33	19.81	61.33	12.29
7	JG 12	70.33	3.00	28.67	1.20	1.70	54.93	2.21	118.33	24.33	17.20	52.82	8.26
8	JG 218	68.00	3.20	26.33	1.47	1.45	51.27	2.51	114.67	24.33	22.18	49.39	11.19
9	JG 226	69.00	3.47	25.67	1.33	1.57	50.33	2.49	114.00	23.00	15.09	60.81	9.20
10	JG 63	68.67	3.33	25.20	1.13	1.75	56.73	2.11	114.33	23.67	20.04	45.11	8.64
11	JG 322	73.67	3.00	25.07	1.00	1.73	54.40	2.47	118.00	27.33	16.15	61.11	9.89
12	JG 11	71.00	3.47	25.33	1.53	1.95	57.93	2.40	108.33	23.67	19.41	47.77	9.10
13	JG 16	74.33	3.00	25.13	1.20	1.81	49.67	2.59	114.33	24.00	13.68	62.41	8.52
14	KALA CHANA	73.00	3.60	24.67	1.13	1.52	49.20	2.25	122.33	27.67	17.55	43.03	7.53
15	SAFED CHANA	74.00	3.60	27.87	1.47	1.38	44.40	1.50	125.33	32.80	17.80	53.57	9.53
16	HARRA CHANA	74.00	3.27	21.33	1.33	1.59	46.93	2.32	120.33	25.67	13.92	59.86	8.39
17	RVG 202	73.00	3.47	22.47	1.40	1.26	59.73	2.49	112.33	23.33	19.64	66.93	12.44
18	JG 24	73.67	3.33	28.93	1.73	2.01	67.80	2.61	110.67	19.33	25.71	46.07	11.83
19	JK 5	67.67	4.00	20.00	1.33	2.64	66.60	3.29	95.67	44.67	21.30	20.65	4.40
20	JYOTI 5	72.00	3.27	26.07	1.07	1.60	48.73	2.45	116.33	24.67	13.83	65.10	8.97
21	ANNAGIRI	72.67	3.27	26.87	1.40	1.83	49.67	2.45	118.67	24.67	19.05	58.93	10.99
22	VIJAY	68.67	3.40	26.47	1.00	1.77	57.00	2.25	109.67	24.67	15.33	58.22	8.69
23	JAKI 9218	74.00	3.00	24.60	1.33	1.47	44.80	2.37	112.33	23.67	14.87	84.91	10.83
24	NARENDRA 2	69.00	3.27	24.47	1.00	1.89	54.07	2.50	115.33	23.67	15.66	56.49	8.81
25	RAJ 128	71.00	3.27	25.00	1.00	1.56	52.00	2.35	109.33	25.00	21.29	56.21	12.01

Ch-1= Days of 50% flowering, Ch-2= Number of Primary Branches/plant, Ch-3= Number of Pods/Plant, Ch-4= Number of seeds/Pod, Ch-5= Pod Length, Ch-6= Plant height, Ch-7= Pod diameter, Ch-8= Days to maturity, Ch-9= 100 Seed Weight, Ch-10= Biological yield/plant, Ch-11= Harvest index, Ch-12= Seed yield/plant.

Table 3: Most desirable chickpea genotypes identified for different traits.

S. No.	Traits	Genotypes
1	Days of 50% flowering	JK 5, JG 218, JG 14, JG 63, Vijay, JG 226, and Narendra 2.
2	No. of Primary Branches/plant	JK 5, Kala chana, Hara chana, JG 226, JG 11, RVG 202, and Vijay.
3	Number of Pods/Plant	JG 24, JG 12, Safed chana, JG 315 and JG 14.
4	Number of seeds/Pod	JG 24, JG 11, JG 6, JG 218, Safed chana and Annagiri.
5	Pod Length	JK 5, JG 6, JG 24, JG 412, and JG 11.
6	Plant height	JG 24, JK 5, JG 6, JG 315 and RVG 202.
7	Pod diameter	JK 5, JG 6, JG 24, JG 16 JG 218 and Narendra 2.
8	Days to maturity	JK 5, JG 14, JG 11, RAJ 128 and VIJAY
9	Hundred Seed Weight	JK 5, Safed chana, Kala chana JG 322 and JG 36.
10	Biological yield/plant	JG 24, JG 218, JK 5, RAJ 128 and JG 315.
11	Harvest index	JK 5, JG 14, KALA CHANA, JG 63, JG 24 and JG 11.
12	Seed yield/plant	JG 315, RVG 202, JG 6, JG 412, RAJ 128, JG 24 and JG 218.

Table 4: Mean, Range, Genotypic, Phenotypic and environmental variances, and coefficient of variation for 12 quantitative characters in chickpea

S.N.	Characters	Grand mean	Range		GCV	PCV	ECV	C.V. @ 5%
			Min.	Max.				
1	Days of 50% flowering	71.47	67.67	74.33	2.987	3.097	1.414	1.41
2	No. of Pri. Branches/plant	3.28	3.00	4.00	7.06	7.398	3.832	3.83
3	Number of Pods/Plant	25.56	20.00	28.93	4.207	8.178	12.147	12.15
4	Number of seeds/Pod	1.27	1.00	1.73	13.738	15.122	10.946	10.95
5	Pod Length	1.75	1.26	2.64	15.923	16.35	6.432	6.43
6	Plant height	54.46	44.40	67.80	10.558	11.052	5.658	5.66
7	Pod diameter	2.41	1.50	3.29	11.97	12.028	2.033	2.03
8	Days to maturity	114.01	95.67	125.33	5.303	5.364	1.393	1.39
9	Hundred Seed Weight	25.57	19.33	44.67	17.809	17.93	3.602	3.60
10	Biological yield/plant	18.22	13.68	25.71	7.458	17.032	26.522	26.52
11	Harvest index	55.28	20.65	84.91	15.515	21.68	26.229	26.23
12	Seed yield/plant	9.72	4.40	14.06	14.934	21.239	26.157	26.16

Table 5: Heritability (%) in broad sense, Genetic advance and genetic advance as percent of mean (5%) for 12 quantitative characters in chickpea

S.N.	Characters	Heritability (h^2b)	Heritability (h^2b %)	Genetic Advance 5%	Gen. Adv. as % of Mean 5%
1	Days of 50% flowering	0.931	93.1	4.242	5.936
2	No. of Pri. Branches/plant	0.911	91.1	0.455	13.878
3	Number of Pods/Plant	0.265	26.5	1.14	4.459
4	Number of seeds/Pod	0.825	82.5	0.328	25.711
5	Pod Length	0.948	94.8	0.558	31.944
6	Plant height	0.913	91.3	11.316	20.779
7	Pod diameter	0.99	99.0	0.591	24.541
8	Days to maturity	0.978	97.8	12.315	10.802
9	Hundred Seed Weight	0.987	98.7	9.316	36.439
10	Biological yield/plant	0.192	19.2	1.226	6.727
11	Harvest index	0.512	51.2	12.644	22.872
12	Seed yield/plant	0.494	49.4	2.103	21.631

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