Estimation of genetic variability for yield and its component traits in Chickpea (*Cicer arietinum* L.)

ABSTRACT

The present investigation was conducted with 12chickpea genotypes, raised in randomized block design with three replications during the *Rabi* season 2023-2024 at at Organic Research Farm, Karguanji, Institute of Agricultural Sciences, Bundelkhand University, Jhansi (U.P.).The experiment was laid-out in randomized block design with three replications of the plant geometry was maintained at 30 cm x 10 cm.The present experimental material showed a wide range of phenotypic variation for number of seed per pod, number of primary branches per plant, biological yield per plant and seed yield per plant, number of secondary branches per plant, number of pods per plant and harvest index whereas, low phenotypic coefficient of variation was observed for plant height, 100-seed weight, days to 50 per cent flowering and days to maturity as revealed by high values of Coefficient of Range.The estimates of high heritability coupled with high genetic advance expressed as a per cent of mean were observed for biological yield per plant, seed yield per plant and number of pods per plant manifesting the preponderance of additive gene action on the expression of these traits. In the investigation,genotypes viz., RSG-44 and Aruna were superior not only for seed yield per plant but also related traits like 100-seed weight, biological yield per plant, number of pods per plant and number of primary branches per plant.

Key words: chickpea, genotypes, genetic variability, heritability, genetic advance, seed yield

INTRODUCTION

Chickpea (C. arietinum L.) belongs to the family Fabaceae, within the tribe Cicerae. It is a self-pollinated, diploid, annual grain legume crop. The global production of chickpea is nearly 11million tonnes and India is the major producer accounting for 64% of the total chickpea production. It is a major source of high quality protein in human diet and also provides high quality crop residues for animal feed.Chickpea is eaten fresh as a green vegetable or parched, fried, roasted, or boiled seeds. Dal (split chickpea without seed coat) and flour are used extensively in India as a thick soup for making breads. Sprouted seeds are eaten as a vegetable or added to salads. Young seedlings and green pods are also eaten. Chickpea seeds may be milled or directly used for animal feed. Leaves yield an indigo like dye. Acid exudates from the leaves can be used as a medicine or used as vinegar. Chickpea seeds contain 21% starch, which is suitable for textile sizing, giving light finish to silk, wool and cotton cloth.

Among the temperate pulses, chickpea is the most tolerant crop to heat and drought stress and is suitable for cultivation in low fertility soils. Chickpea also helps to maintain soil fertility through biological nitrogen fixation and contributes to the sustainability of cropping systems in the cereal-legume crop rotations. Chickpea crop meets 80% of its nitrogen (N) requirement from symbiotic nitrogen fixation and can fix up to 140 kg N ha-1 from air. It leaves a substantial amount of residual nitrogen for subsequent crops and adds plenty of organic matter to maintain and improve soil health. Because of its deep tap root system, chickpea can withstand extended periods of drought by extracting water from deeper layers of the soil.The limiting amino acid concentrations are 0.52 for methionine, 1.45 for lysine and cystine, 0.71 for threonine and 0.16 for tryptophan. The amino acid composition of seeds with 19.5% protein, 5.5% oil is (per 16 g N): 7.2 g lysine, 1.4 g methionine, 8.8 g arginine, 4.0 g glycine, 2.3 g histidine, 4.4 g isoleucine, 7.6 g leucine, 6.6 g phenylalanine, 3.3 g tyrosine, 3.5 g threonine, 4.6 g valine, 4.1 g alanine, 11.7 g aspartic acid, 16.0 g glutamic acid, 0.0 g hydroxyproline, 4.3 g proline, and 5.2 g serine. Percent fatty acid compositions are: 'Desi': oleic 52.1, linoleic 38.0, myristic 2.74, pactic 5.11 and steatic 2.05; 'Kabuli': oleic 50.3, linoleic 40.0, myristic 2.28, palmitic 5.74, stearic 1.61, and arachidic 0.07%. The leaves contain 4-8% protein.

The success of any crop breeding programme depends on the nature and amount of variability existing with variety collections. The genetic reconstruction of plant is required for developing high

yielding varieties by incorporating and improving the characters. Yield improvement through genetic means usually comes from exploitation of new variety or traits. Variety serves as the most valuable natural reservoir in providing needed attributes for engineering successful varieties. Therefore, collection, evaluation and conservation of variety and their use in hybridization programme are essential for present as well as future crop improvement programmes.

MATERIALS AND METHODS

The experimental material used in the present study comprised of the 12 genotypes. The experiment was laid-out in randomized block design with three replicationsduring the Rabi season 2023-2024 at at Organic Research Farm, Karguanji, Institute of Agricultural Sciences, Bundelkhand University, Jhansi (U.P.).Observations on plot basis were recorded for days to 50 per cent flowering, days to maturity, which observations based on single plant were recorded for plant height (cm), number of primary branches per plant, number of secondary branches per plant, number of pods per plant, number of seed per pod, 100-seed weight (g), biological yield per plant (g), harvest index and seed yield per plant. The data collected for eleven characters on individual plant basis (except days to 50 per cent flowering and days to maturity) for five randomly selected plants were analyzed first by randomized block design (Panse and Sukhatme, 1985) to test the significance of differences among the genotypes and the variability parameters were measured by the formula suggested by Johnson et al. (1955).

RESULTS AND DISCUSSION

Analysis of variance revealed that the mean square for genotypes was highly significant for all the traits, indicating the presence of a sufficient amount of genetic variability among the variety for all the 11 characters studied.Hence, it provides ample scope for the selection of different quantitative and qualitative characters for yield improvement in chickpea. A similar result has been reported by Arora and Jeena (2001), Yadav et al. (2003), Eswari and Rao (2006), Khan et al. (2006), Yucel et al. (2006), Chaurasia et al. (2009), Vaghela et al. (2009), Ojha et al. (2010), Yadav et al. (2010), Zali et al. (2011), Kumar et al. (2012), Kumar et al. (2013),Bhanu et al. (2017), Barad et al. (2018), Johnson et al. (2018) and Bhoite et al. (2020).

The magnitude of PCV was slightly greater than GCV manifesting little influence of environment on the expression of these characters. The high genotypic coefficient of variation and phenotypic coefficient of variation was observed for seed yield per plant, number of primary branches per plant, number of seed per pod, number of secondary branches per plant, number of pods per plant and harvest index whereas, low GCV recorded in plant height, 100-seed weight, days to 50 per cent flowering and days to maturity.Analogous results were reported by Arora and Jeena (2001),Eswari and Rao (2006), Khan et al. (2006), Yucel et al. (2006), Chaurasia et al. (2009), Vaghela et al. (2009), Yadav et al. (2010), Zali et al. (2011), Bhanu et al. (2017), Bhoite et al. (2020) and Tsehaye et al. (2020).

The estimates of high heritability coupled with high genetic advance expressed as a per cent of mean were observed for biological yield per plant, seed yield per plant and number of pods per plant manifesting the preponderance of additive gene action on the expression of these traits.Similar findings were also reported by Thakur and Sirohi (2008), Saki et al. (2009), Borate et al. (2010), Sharma and Saini (2010).

Table 1 Analysis of variance (ANOVA) for yield and its component traits in chickpea genotypes

Source of variation	Degree of freedom (df)	Mean sum of squares										
		Days to 50% flowering	Days to maturity	Plant height (cm)	No. of primary branches/ plant	No. of secondary branches/ plant	Number of pod per plant	Number of seeds per pod	100 – seed weight	Harvest index	Seed yield per plant	Biological yield
Replications	2	2.52	9.69	18.38	0.69	6.77	0.02	0.10	8.54	3.28	6.98	42.76
Genotypes	11	20.86**	53.78**	62.05**	1.32*	11.36**	210.08**	0.32*	13.27**	105.66**	63.51**	346.73**
Error	22	3.376	13.11	5.90	0.51	3.08	28.72	0.13	2.89	16.28	4.80	18.63

*, ** Significant at 5% and 1% levels, respectively

Table 2: Mean values of 12 genotypes for 11 characters in chickpea genotypes

Genotypes	DF 50	DM	PH	NPB	NSB	NPP	NSP	100-SW	HI	SYP	BY
CSG-515	52.66	107.66	54.80	3.00	10.67	63.00	1.33	22.21	48.71	21.66	44.34
RSG-44	49.33	104.66	50.33	3.33	16.00	70.00	2.00	29.37	48.71	30.81	63.34
RSG-931	47	105.33	45.00	4.33	12.00	48.00	1.20	25.40	68.79	25.61	37.47
RSG-963	46.66	105.33	58.33	2.67	14.33	57.33	1.67	24.93	49.21	19	38.87
RSG-888	45	111.33	45.00	2.33	12.33	69.00	1.47	25.88	49.43	19.92	40.20
CSJK-6	52.33	100.66	50.67	3.33	14.33	58.00	1.67	22.69	48.33	25.75	53.33
ARUNA	47.33	107.00	55.00	4.67	15.00	71.00	2.07	27.15	47.09	29.48	62.63
GNG-2144	53	113.00	52.33	3.00	14.00	50.00	1.53	23.90	47.12	23.65	50.10
GNG-1969	48.33	108.33	45.33	3.33	9.67	64.00	1.27	26.42	52.98	16.50	31.27
GNG-1958	49.33	115.00	55.00	3.33	15.67	72.00	1.93	27.70	48.19	28.00	58.37
SAMRAT	51	103.66	51.33	2.67	12.67	70.67	1.20	24.77	48.58	25.61	52.87
VARDAN	51.33	111.66	56.00	3.33	13.67	68.67	2.00	23.67	49.54	18.55	37.42
GM	**49.44**	**107.80**	**51.59**	**3.27**	**13.36**	**63.47**	**1.61**	**25.34**	**50.55**	**23.71**	**47.51**
SE	**1.06**	**2.09**	**1.40**	**0.41**	**1.01**	**3.09**	**0.21**	**0.98**	**2.36**	**1.26**	**2.49**
CD 5%	**3.11**	**6.13**	**4.11**	**1.21**	**2.97**	**9.07**	**0.62**	**2.88**	**6.94**	**3.71**	**7.30**
CV	**3.72**	**3.36**	**4.71**	**21.84**	**13.14**	**8.44**	**23.06**	**6.71**	**8.11**	**9.24**	**9.08**

Table 3: Genetic variability parameters for yield and its attributing traits in chickpea genotypes

Characters	DF 50	DM	PH	NPB	NSB	NPP	NSP	100-SW	HI	SYP	BY
Maximum	54.0000	118.0000	60.0000	5	18.0000	75.0000	2.4	31.5000	79.2464	33.4000	66.7000
Minimum	44.0000	98.0000	42.0000	2	8.0000	40.0000	1	20.2300	44.5148	15.3200	30.2000
Grand Mean	49.4444	107.8056	51.5944	3.2778	13.3611	63.4722	1.61	25.3414	50.5551	23.7147	47.5169
SEm	1.0609	2.0911	1.4027	0.4134	1.0134	3.0943	0.214	0.9820	2.3666	1.2652	2.4921
CD 5%	3.1114	6.1331	4.1141	1.2124	2.9721	9.0754	0.629	2.8801	6.9409	3.7106	7.3091
CD 1%	4.2289	8.3360	5.5917	1.6478	4.0397	12.3350	0.855	3.9145	9.4339	5.0434	9.9344
ECV	3.7162	3.3597	4.7090	21.8434	13.1368	8.4439	23.06	6.7118	8.1080	9.2404	9.0841
GCV	4.8837	3.4152	8.3853	15.8585	12.4343	12.2498	15.36	7.3420	10.7657	18.6552	22.0087
PCV	6.1368	4.7908	9.6171	26.9927	18.0883	14.8781	27.71	9.9475	13.4774	20.8183	23.8097
Heritability (Bs)	63.33	50.82	76.02	34.52	47.25	67.79	30.74	54.48	63.81	80.30	85.44
GA	3.9585	5.4068	7.7708	0.6291	2.3526	13.1875	0.2828	2.8289	8.9560	8.1666	19.9136
GA % mean	8.0060	5.0153	15.0613	19.1929	17.6078	20.7768	17.55	11.1632	17.7153	34.4368	41.9084

CONCLUSION

In the present investigation, genotypes viz., RSG-44 and Aruna were superior not only for seed yield per plant but also related traits like 100-seed weight, biological yield per plant, number of pods per plant and number of primary branches per plant. These diverse genotypes can be used in future breeding programme of chickpea.

DISCLAIMER (ARTIFICIAL INTELLIGENCE)

Author(s) hereby declare that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc) and text-to-image generators have been used during writing or editing of this manuscript.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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