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Assessment of Genetic Variability Parameters for Yield and Yield Components in Chickpea (*Cicer arietinum* L.)

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ABSTRACT: An investigation consisted of eight chickpea genotypes *viz.*, RSG-888, CSJD-884, RSG-963, RSG-973, RSG-974, CSJ-515, Avrodhi and HC-5 and crossed in all possible combinations under two environments *i.e.* timely (E_1) and late sown (E_2) conditions at Rajasthan Agricultural Research Institute (RARI), SKNAU, Durgapura (Jaipur) Rajasthan during *Rabi* 2021-22. The objective of present study was to estimate magnitude of different parameters of genetic variability for yield and its components. The observations were recorded for fifteen different yield and its contributing characters and the obtained results indicated that in general the phenotypic coefficient of variance was found to be higher as compared to genotypic coefficient of variance for all studied traits. High heritability with high genetic advance (% mean) was reported for biological yield per plant and seed yield per plant in both the environments while for pods per plant in E_1 condition. Thus, the high heritability with high genetic advance confirmed the presence of additive gene effect for all the studied characters and hence can be enhanced through selection.

Key words: Chickpea, genotypes, diallel, heritability, genetic advance.

INTRODUCTION

Chickpea (*Cicer arietinum* L.) is a self-pollinated crop of family *Leguminaceae.* Chickpea (*Cicer arietinum* L.) commonly known as Gram, Chana and Bengal gram is the most important pulse crop of arid and semiarid regions. The somatic chromosome number in chickpea is 2n = 16. Domestication leads the formation of two major cultivar types designated as 'desi' (=microsperma) and 'kabuli'(=macrosperma).

Chickpea is classified as one of the world's oldest and most commonly cultivated legumes in the Fabaceae (Leguminosae) family (Ullah *et al*., 2020). It is a good source of protein (24.6%), vitamins, and carbohydrates (64.6%). (Abu-Salem and Abou 2011). Chickpea protein is rich in lysine and arginine but most deficient in sulphur containing amino acids methionine and cystine. In general, *Kabuli* types are richer in protein content than *desi* types (Singh *et al*., 2009). This food legume has diversified uses, and presently as many as 140 countries are importing chickpea (Gaur *et al.*, 2012). Being a legume crop, it maintains soil fertility by utilizing *Rhizobium* spp. to fix atmospheric nitrogen. The global chickpea area is about 14.84 million hectares with a production of 15.08 million tonnes with an average yield of 1,016 kg/ha (FAOSTAT, 2020). In India, chickpea is cultivated on an area of 9.85 million hectares with production of 11.99 million tonnes and productivity of 1217 kg/ha (Anonymous, 2021). In Rajasthan, chickpea occupies about 2.26 million hectares area with production of 2.66 million tonnes with a productivity of 1177 kg/ha (Anonymous, 2022).

Improvement of yield and quality of crop is the primary objective of plant breeder. For crop improvement selection of superior plants plays a vital role. The efficiency of selection depends on the identification of genetic variability from the phenotypic expression of the character. Variability means differences among the individuals of a single species or different species. The variability may be due to environment or genotypes or interaction of both. Assessment of genetic variability in the original population is the first step in any breeding

programme. Genetic variability is most important indices for plant breeders because it provides a source of variation and raw material for yield improvement (Gaur *et al.,* 2020).

MATERIALS AND METHODS

The 8 parents mentioned above were grown at Research Farm, Rajasthan Agricultural Research Institute (Sri Karan Narendra Agriculture University, Jobner), Durgapura, Jaipur during *Rabi* 2019-20 & 2020-21 were crossed in diallel fashion (excluding reciprocals) in all possible combinations. In *Rabi* 2021-22 eight varieties were evaluated in two environments *viz*., (Environments were created by one is timely sowing conditions and another is the late sowing condition respectively with three replications in randomized block design at Agricultural Research Farm, RARI, Durgapura (Jaipur). The rows with 3 m length, row to row and plant to plant distance was kept 30 cm and 10 cm, respectively. Non-experimental rows were planted all around the experiment to eliminate the border effects, if any. All recommended agronomical package of practices were adopted to raise good crop in both the conditions.

Table 1: Observations recorded for yield and yield contributing traits.

Sr. No.	Characters
1.	Days to first flowering
2.	Days to 50% flowering
3.	Days to first pod formation
4.	Days to last pod development
5.	Days to maturity
6.	First pod height
7.	Plant height
8.	No. of primary branches/plant
9.	No. of secondary branches/plant
10.	Pods per plant
11.	Seeds per pod
12.	Biological yield per plant
13.	Seed yield per plant
14.	Harvest index
15.	100-seed weight

Statistical analysis: The genotypic coefficient of variation (GCV) and phenotypic coefficient of variation (PCV) computed by the formula suggested by Burton (1952). The PCV and GCV values were ranked as low (0-10%), medium (10-20%) and high (>20%). The heritability in per cent in broad sense was calculated by the procedure suggested by Singh and Choudhary (1985). Heritability values are categorized on the basis of range of percentage as low (<50%), moderate (50-70%) and high (≥70%). Genetic advance was expressed as percentage of mean by using the formula suggested by Johnson *et al*., (1955). Genetic advance as per cent of mean was classified as low (0-10%), moderate (10-20%) and high (≥20%).

RESULTS AND DISCUSSION

Estimation of Genetic variability. The estimates of various parameters *viz.,* genotypic coefficient of variance (GCV), phenotypic coefficient of variance (PCV), heritability (h^2) and genetic advance revealed that sufficient variability was present for all the traits (Table 2).

The phenotypic coefficient of variation was higher than the corresponding genotypic coefficient of variation for all the characters. The genotypic coefficient of variation and phenotypic coefficient of variation were categorized as low (<10%), moderate (10-20%) and high (>20%). The phenotypic coefficient of variation (PCV) was recorded high for biological yield per plant (29.67%) and seed yield per plant (23.39%) in E_2 environment. The moderate PCV was recorded for harvest index (17.49%, 15.21%) in both the environments while for pods per plant (15.32%), biological yield per plant (18.22%) and seed yield per plant (17.51%) under E_1. The genotypic coefficient of variation (GCV) was recorded the highest for biological yield per plant (28.34%) and seed yield per plant (31.41%) in E_2 environment. While, the moderate GCV was recorded for harvest index (14.62%, 11.84%) in both E_1 and E_2 and for pods per plant (13.60%), biological yield per plant (17.16%), seed yield per plant (15.53%) in E_1. The estimated GCV and PCV helped in getting a clear understanding of the variability present among various genotypes. The earlier findings of Jeena *et al*. (2005); Dubey and Srivastava (2007); Kumar *et al*. (2012); Banik *et al.* (2018).

The classification for estimate of h^2 (BS) was made as low (<50%), moderate (50-70%) and high (>70%). The high heritability was recorded by biological yield per plant (88.63, 91.29%), days to first flowering (85.33, 77.09), days to 50% flowering (82.22, 74.47), seed yield per plant (78.67, 83.84%), days to last pod development (75.68, 74.48) and seeds per pod (70.0, 72.73%) in both the environments while for pods per plant (78.78%), plant height (76.37), days to first pod formation (74.35%) and days to maturity (73.84%) in E_1 condition. The moderate heritability recorded by harvest index (69.86, 60.61%), number of secondary

branches/plant (60.84, 58.68%) and first pod height (67.06, 64.17%) in both the environments while for days to first pod formation (67.58%), days to maturity (66.53%), plant height (66.94%), number of primary branches/plant (60.29%) and 100-seed weight (60.55%) it was observed in E_2 condition. The low heritability was observed by number of primary branches/plant (46.15%), pods per plant (45.36%) in E_2, 100-seed weight (47.67%) in E_1 condition. Similar results were noted by, Dubey and Srivastava (2007); Monpara and Gaikwad (2014); Banik *et al.,* (2018); Gautam *et al.,* (2021).

Genetic advance as *per cent* of mean was recorded for yield and other characters (Table 2). It was also categorized as High (>20%), Medium (10-20%), Low (<10%). Genetic advance as *percent* of mean was high for biological yield per plant (33.27 & 55.79%) and seed yield per plant (28.37 & 40.39%) in both the conditions, while for pods per plant (24.86%) and harvest index (27.17%) in E_1 conditions. The medium genetic gain was observed by plant height (16.8 & 12.82%), number of primary branches/plant (10.46 & 13.65%), number of secondary branches/plant (15.41 & 14.65%) and seeds per pod (12.98 & 15.58%) in both the environment while for harvest index (18.99%), first pod height (12.91%) and 100-seed weight (10.37%) in E_2 condition. The low heritability was recorded by days to first flowering (8.58 & 6.63%), days to 50% flowering (5.55 & 5.91%), days to first pod formation (4.10 & 4.81%), days to last pod development (3.65 & 3.68%) and days to maturity (3.62 & 2.54%) in both the environments. The study done by Arshad *et al.* (2004); Gautam *et al.,* (2021) showed the similar results.

High heritability with high genetic advance was reported for biological yield per plant and seed yield per plant in both the environments while for pods per plant in E_1 condition. These results were also reported earlier by Gautam *et al.,* (2021).

Table 2: Estimates of Genetic parameters of variation under timely (E_1) and late sown (E_2) conditions for yield & yield components in chickpea.

Characters	Env.	GCV	PCV	h2	GA	GA as % of mean
1	2	3	4	5	6	7
Days to first flowering	E_1	4.51	4.88	85.33	5.03	8.58
	E_2	3.66	4.17	77.09	3.22	6.63
Days to 50% flowering	E_1	2.97	3.28	82.22	3.50	5.55
	E_2	3.32	3.85	74.47	3.16	5.91
Days to first pod formation	E_1	2.31	2.68	74.35	2.69	4.10
	E_2	2.84	3.46	67.58	2.56	4.81
Days to last pod development	E_1	2.04	2.34	75.68	3.05	3.65
	E_2	2.07	2.40	74.48	2.66	3.68
Days to maturity	E_1	2.04	2.38	73.84	4.71	3.62
	E_2	1.51	1.86	66.53	2.77	2.54
First pod height	E_1	5.89	7.19	67.06	2.73	9.94
	E_2	7.82	9.77	64.17	3.13	12.91
Plant height	E_1	9.34	10.69	76.37	9.27	16.81
	E_2	7.60	9.29	66.94	6.47	12.82
1	2	3	4	5	6	7
No. of primary branches/plant	E_1	7.47	11.00	46.15	0.48	10.46
	E_2	8.53	10.99	60.29	0.59	13.65
No. of secondary branches/plant	E_1	9.59	12.29	60.84	1.61	15.41
	E_2	9.28	12.12	58.68	1.33	14.65
Pods per plant	E_1	13.60	15.32	78.78	17.42	24.86
	E_2	6.18	9.18	45.36	4.47	8.58
Seeds per pod	E_1	7.53	9.00	70.00	0.26	12.98
	E_2	8.87	10.40	72.73	0.29	15.58
Biological yield per plant	E_1	17.16	18.22	88.63	8.39	33.27
	E_2	28.34	29.67	91.29	10.03	55.79
Seed yield per plant	E_1	15.53	17.51	78.67	2.74	28.37
	E_2	21.41	23.39	83.84	2.50	40.39
Harvest index	E_1	14.62	17.49	69.86	9.89	25.17
	E_2	11.84	15.21	60.61	6.92	18.99
100-seed weight	E_1	5.20	7.53	47.67	1.39	7.39
	E_2	6.47	8.32	60.55	1.79	10.37

CONCLUSION

In order to increase chickpea output, selection must be made in the characteristics, according to analyses of genetic parameters including genotypic coefficient of variation, phenotypic coefficient of variation, heritability, and genetic advance as a *per cent* of mean. High heritability with high genetic advance was reported for biological yield per plant and seed yield per plant in both the environments while for pods per plant in E_1 condition indicating that these characters governed by additive gene action. Hence, selection for genetic improvement in these traits would be effective for increasing seed yield in chickpea crop.

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Conflicts of Interest. None.

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