Journal of Pharmacognosy and Phytochemistry

Available online at www.phytojournal.com

E-ISSN: 2278-4136
P-ISSN: 2349-8234
JPP 2019; 8(6): 2510-2512
Received: 19-09-2019
Accepted: 21-10-2019

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Genetic variability, heritability and genetic advance in F_3 generation of chickpea (*Cicer arietinum* L.)

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Abstract
Nineteen F_3s + one check variety of chickpea were grown at the Pulses Research Station, Junagadh Agricultural University, Junagadh during *rabi* 2016-17 to estimate variability, heritability and genetic advance for 11 traits (days to 50% flowering, days to maturity, plant height (cm), number of branches per plant, number of pods per plant, first pod bearing node (cm), number of seeds per pod, 100-seed weight (g), seed yield per plant (g), biological yield per plant (g) and harvest index%). Significant variation among the F_3s was evident for genetic variability among the traits studied. A wide range of variation was observed for harvest index, number of pods per plant, plant height and days to maturity. The high genotypic coefficients of variation were observed for number of pods per plant, harvest index and biological yield per plant. High estimates of heritability were registered by most of the characters but number of pods per plant and number of branches per plant had moderate estimates. The high estimates of phenotypic and genotypic coefficient variation, heritability and genetic advance expressed as percentage of mean were observed for number of pods per plant, harvest index, biological yield per plant and 100-seed weight.

Keywords: Chickpea, GCV, genetic advance, heritability, PCV

Introduction
Chickpea is one of the most important grain legume crop that plays a significant role in the nutrition of rural and urban poor in the developing world, grown as rainfed in cool and dry climate in semi-arid regions. Two types of chickpea *i.e.*, Kabuli (grown in the temperate regions) Desi type (grown in the semi-arid tropics) (Muehlbauer and Singh, 1987) [2]. Variability parameters were studied by many workers using fix/stable genetic material. Very few reports are available which include segregating material. Therefore, the present investigation was planned to obtain information on genetic parameters using F_3 populations of chickpea. This will help breeder to finalize the appropriate selection criteria for the improvement of seed yield.

Material and Methods
Nineteen F_3 populations of chickpea were evaluated in randomized block design with three replications during *rabi* 2016-17 at Pulses Research Station, Junagadh Agricultural University, Junagadh under irrigated condition. Each F_3 population was accommodated in two rows of 4 m length with line-line and plant-plant spacing of 45 × 15 cm. Recommended practices were followed to raise a good crop. The data were collected on 20 randomly selected and tagged plants for plant height (cm), number of branches per plant, number of pods per plant, first pod bearing node (cm), number of seeds per pod, seed yield per plant (g), biological yield per plant (g) and harvest index (%). The observations for days to 50% flowering, days to maturity and 100-seed weight were recorded on plot basis. Average values were subjected to standard statistical producers to estimate GCV, PCV, heritability and genetic advance.

Results and Discussion
The analysis of variance (Table 1) revealed that significant differences among the F_3 generation was observed for all the characters. This indicated the presence of sufficient variability in the genetic material. A wide range of variation was observed for harvest index, number of pods per plant, plant height and days to maturity. The phenotypic range was found moderate for 100-seed weight, days to50% flowering and first pod bearing node. The relative amount of variation expressed by

Table 1: Analysis of variance for 11 characters in 19 F_3 generation + 1 check variety of chickpea

Characters	Replication (MSS)	MSS due to Genotypes (F_2s)	Error
Days to 50% flowering	9.216*	12.030**	2.514
Days to maturity	22.216*	18.908**	5.269
Plant height (cm)	20.167*	20.298**	5.558
Number of branches per plant	0.006*	0.004**	0.001
Number of pods per plant	37.967*	126.745**	9.258
First pod bearing node (cm)	15.268**	7.146**	1.424
Number of seeds per pod	0.006*	0.004*	0.002
100- seed weight (g)	21.554**	17.906**	4.035
Seed yield per plant (g)	0.518*	0.640**	0.148
Biological yield per plant (g)	1.352*	2.577**	0.395
Harvest index (%)	247.445*	270.320**	61.196

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

The relative amount of variation expressed by different traits was judged through estimate of phenotypic and genotypic coefficient of variation. Narrow differences between GCV and PCV for most of the characters indicated that they were comparatively stable to environmental variation. These results are in agreement with those of Singh (2004) [7], Jeena *et al*. (2005) [1], Vekariya *et al*. (2008) [10] and Shivkumar *et al*. (2013). These finding also suggested that genetic factors were predominantly responsible for the expression of these attributes. A high degree of GCV was noticed for number of pods per plant, harvest index and biological yield per plant. Similar finding were also reported by Salimath and Patil (1990) [4], Singh (2004) [7] and Vekariya *et al*. (2008) [10]. High estimate of GCV for above said characters indicated that sufficient genetic variability and selection based on phenotype would be effective. The variation due to phenotypic and genotypic presented in Table 2. Partitioning of total phenotypic variance into heritable and non-heritable components is very useful because only heritable portion of variation is exploitable through selection. It is a property not only of a character but also of the and of the environment to which individuals are subjected. In the present study, high heritability estimates were obtained for number of pods per plant (80.88%), biological yield per plant (64.78%), first pod bearing node (57.24%), days to 50% flowering (55.78%), 100-seed weight (53.39%), harvest index (53.25%) and seed yield per plant (52.41%), thereby suggesting the usefulness of making selection based on phenotypic observations. This high heritability may be due to additive gene effects, hence these traits are likely to respond to direct.

Table 2: Estimates of different genetic parameters for 11 characters in 19 F_3 generation + 1 check of chickpea

Characters	Phenotypic range of variation	Mean	PCV (%)	GCV (%)	Heritability (bs) (%)	Genetic advance	Genetic advance as per cent of mean
Days to 50% flowering	47.33-56.00	50.41	4.73	3.53	55.78	2.74	5.43
Days to maturity	88.33-98.00	92.96	3.37	2.29	46.32	2.98	3.21
Plant height (cm)	38.09-48.20	41.90	7.72	5.29	46.92	3.12	7.46
Number of branches/ plant	1.18-1.34	1.24	4.22	2.41	32.57	0.03	2.83
Number of pods/plant	28.70-54.53	41.32	16.83	15.14	80.88	11.59	28.05
First pod bearing node (cm)	16.05-21.45	18.83	9.68	7.33	57.24	2.15	11.42
Number of seeds/pod	1.00-1.12	1.05	4.93	2.53	26.31	0.02	2.67
100- seed weight (g)	17.13-26.33	22.01	13.36	9.76	53.39	3.23	14.70
Seed yield per plant (g)	5.31-7.23	6.52	8.56	6.20	52.41	0.60	9.24
Biological yield/plant (g)	6.85-10.47	8.29	12.77	10.28	64.78	1.41	17.05
Harvest index (%)	62.41-94.71	79.90	14.31	10.44	53.25	12.55	15.70

Selection. Since broad sense heritability represents the upper limit that can be achieved through selection, such estimates should be used judiciously for evaluation studies. Such types of results were also reported by Saki *et al*. (2009) [5] and Parhe *et al.* (2014) [3]. The character, harvest index (12.55) and number of pods per plant (11.59) expressed high genetic advance. High value of heritability coupled with high to moderate genetic advance as per cent of mean was observed for number of pods per plant, biological yield per plant, harvest index, first pod bearing node and 100-seed weight. Similar results were observed by Sowjanya *et al*. (2017) [8] and Thakur *et al*. (2018) [9]. Number of seeds per pod, number of branches per plant, days to maturity, days to 50% flowering and plant height showed low heritability coupled with low genetic advance as per cent of mean indicating that variation for these characters was environmental.

Therefore, the present study reiterated and corroborated the finding of earlier workers that characters such as number of pods per plant, biological yield per plant, first pod bearing node, harvest index and 100-seed weight exhibiting high heritability coupled with high genetic advance, could be profitably used to improve the yield of chickpea through an effective selection programme.

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