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Estimation of genetic variability parameters in chickpea (C*icer arietinum* L.) germplasm

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Abstract
Under experiment 105 genotypes of chickpea were evaluated for 11 quantitative characters, during Rabi season of 2013-14. The genotypic coefficient of variation was highest for seed yield per plant followed by harvest index, number of pods per plant, 100 seed weight and plant height. High heritability estimates were observed for 100 seed weight, plant height, days to maturity, number of pods per plant, biological yield per plant, harvest index, seed yield per plant and days to 50 per cent flowering. The expected genetic advance as percent of mean was high for seed yield per plant, harvest index, 100 seed weight, number of pods per plant and biological yield per plant. The high heritability coupled with high genetic advance for 100 seed weight, number of pods per plant, harvest index, seed yield per plant and plant height would be helpful for indirect selection in improvement of seed yield.

Keywords: chickpea, germplasm, coefficient of variation, genetic advance and heritability

Introduction
Chickpea (*Cicer arietinum* L.) is an important grain legume crop in India and plays a crucial role in the agriculture of rainfed areas of our country. It is the world's third most important pulse crop as a source of dietary protein after soybean and pea. It is considered to be less labor-intensive crop; its production requires less external inputs as compared to cereals and serves as a multi-use crop. It also plays a significant role in improving soil fertility by fixing the atmospheric nitrogen. It can fix up to 140 kg N ha-1 from air and meet most of its nitrogen requirement. After harvest, the leaves provide substantial amount of residual nitrogen for subsequent crops and adds some amount of organic matter to maintain and improve soil health and fertility. It is called as poor man meat (reported by Huisman and Vander Poel, 1994) [2]. Chickpea is rich and readily available source of protein both for human and animals. It makes up the deficiency of cereal diets. It is the cheapest and most readily available source of protein (19.5%), fat (1.4%), carbohydrates (57-60%), ash (4.8%) and moisture (4.9-15.59%). Chickpea is also known as 'King of pulses'. In India, total pulses were grown on an area of 25.26 m ha with production of 19.25 million tones and productivity 764 kg/ha in year 2013-14 (Anonymous, 2015a). Chickpea (*Cicer arietinum* L.) is the premier pulse crop of India covering 9.93 million hectares area and production contributing 9.53 million tones with the productivity of 960 kg/ha in 2013-14 (Anonymous, 2015b). The area, production and productivity of Utter Pradesh has been possessed 577.00 thousand ha, 475.40 thousand tones, 824 kg/ha respectively in year 2013-14 (Anonymous, 2015c). The average production of chickpea is low in the country; this may be attributed to the lack of high yielding varieties, resistant to diseases and pests, high response to high inputs and other management practices. Keeping in view these problems, it is of prime importance to evaluate the limiting factors contributing to growth and yield of chickpea. Creation of genetic variability and selection for important traits is a crucial activity that any plant breeder should apply to achieve better yield and other desirable agronomic traits. However, to carry out effective selection, the information on available genetic variation among chickpea genotypes, the nature of component traits on which selection would be effective and the influence of environmental factors on each trait need to be known. Information on the nature and magnitude of variability and heritability in a population is one of the prerequisite for successful breeding programme in selecting genotypes with desirable characters. It is therefore, of great importance for breeder to know the heritability of the agronomical characters to improve the yield of the crop effectively

Materials and Methods
A field experiment was conducted in Augmented Block Design at Student's Instructional Farm of Narendra Deva University of Agriculture and Technology, Narendra Nagar, Kumarganj, Faizabad (U.P.) during *Rabi* 2013-2014.The experimental material comprised of 105 varieties

/strains of chickpea including elite lines and land races with five popular check varieties *viz.,* HK 94-134, KWR 108, GCP-105, Udai and Pant G- 186. These genotypes were obtained from the germplasm maintained at Pulse Section of the University. Each line was grown in single row of 4m length representing a plot in non-replicated way, while checks were replicated ten times. Row to row and plant to plant spacing was kept 30cm and 10cm, respectively. On the basis of five randomly selected plants, data were recorded on number of primary branches plant^{-1} , number of secondary branches plant^{-1}, plant height (cm), pods plant^{-1}, seeds pod^{-1}, biological yield plant^{-1} (g), seed yield plant^{-1} (g), harvest index (%) and 100-seed weight (g) except days to 50% flowering and days to maturity which were recorded on plot basis.

Analysis of variance (ANOVA) for augmented block design for all attributes (major and minor) was done using statistical software, Windostat ver.80 (Khetan, 2012). Analysis of variance and the genetic parameters were computed by following standard statistical procedure. The phenotypic and genotypic coefficients of variation (PCV, GCV) were computed according to the method suggested by (Burton 1954), heritability (h^2) and genetic advance as per (Allard 1960).

Results and Discussion

The analysis of variance exhibited highly significant difference among genotypes for all the characters indicating the presence of adequate amount of genetic variability among the genotypes. The mean squares due to blocks, checks and error for all the characters are presented in Table-1. The variation due to blocks were significant for plant height, biological yield per plant, number of pods per plant, harvest index, seed yield per plant, days to 50% flowering, days to maturity and 100 seed weight at 1% probability level and secondary branches per plant at 5% probability level. The variation due to checks were significant for harvest index, biological yield per plant, plant height, number of pods per plant, seed yield per plant, days to maturity and 100 seed weight at 1% probability level. For the remaining traits variations due to block and checks were found non-significant.

The phenotypic coefficients of variation (PCV) were invariably slightly higher than their corresponding genotypic coefficients of variation (GCV) due to environmental influence (Table 2). The high PCV and GCV were observed for seed yield per plant (35.136% and 28.525%), harvest index (27.696% and 22.926), number of pods per plant (26.226 and 21.875%), 100 seed weight (19.118 and 18.896%), plant height (17.495 and 16.546%) and biological yield per plant (17.806 and 14.746%), respectively. These findings indicate that these traits were main yield contributing characters. Further the estimates of PCV were higher than GCV for all the characters under study indicating the extent of environmental influences on these traits. High values of PCV and GCV for above traits have also been reported by (Qurban *et al*., 2011). The presence of high amount of genetic variability in the evaluated germplasm for the major yield contributing characters along with seed yield indicating that further improvement of these traits is possible.

An estimate of heritable fraction of variability is of paramount importance in any crop improvement programme. The present study revealed that estimates of broad sense heritability (Table 2) were high (>50%) for all the traits studied except number of primary branches per plant, number of secondary branches per plant and number of seeds per pod. High heritability for different traits under study *viz.,* 100 seed weight, days to 50% flowering, plant height and seed yield per plant has been earlier reported by (Khan *et al*., 2006 and Dwevedi and Lal 2009) [7]. High genetic advance in per cent of mean (>20%) was recorded for seed yield per plant (47.706), harvest index (39.092), 100 seed weight (38.475), number of pods per plant (37.588), plant height (32.237) and biological yield per plant (25.156) indicating that direct selection for these traits would be effective for the improvement. Moderate estimates of genetic advance in per cent of mean (10-20%) were recorded for days to 50 per cent flowering (10.752) and its low estimate (<10%) was recorded for days to maturity (7.163) and number of secondary branches per plant. Similar findings related to high genetic advance as per cent of mean for various traits have been reported by (Vaghela *et al*., 2009) [8]. The character having high heritability with high genetic advance generally indicates that heritability is more due to the additive gene effect and advocated the use of high estimates of heritability along with high magnitude of genetic advance for genetic improvement in any trait through selection. In present investigation, high heritability with high genetic advance was observed for traits 100 seed weight (97.70, 38.475), number of pods per plant (69.60, 37.588), harvest index (68.50, 39.092), seed yield per plant (65.90, 47.706), plant height (89.40, 32.237) and biological yield per plant (68.60, 25.156). High heritability with high genetic advance for seed yield per plant has also been reported by (Khan *et al*., 2006) [7] which supports the result of present investigation.

Thus it may be concluded that there is sufficient genetic variability for most of the economic traits studied in the above genetic material and a combination of various traits contributes to seed yield. This would help us in designing the selection methodology which can further be utilized in the breeding programme for improvement of seed yield.

Table 1: Analysis of variance for 11 quantitative characters in chickpea

Characters	Source of variation		
	Blocks (d. f. =4)	Checks (d. f. =4)	Error (d. f. =16)
DF	167.42**	14.10	12.17
DM	157.63**	126.26**	8.89
PH	895.24**	310.24**	7.83
PB	0.07	0.68	0.16
SB	3.37*	2.26	0.63
PP	471.00**	261.72**	29.23
SPP	0.09	0.03	0.09
100 SW	126.53**	112.86**	0.54
BYP	749.92**	432.91**	37.44

HI	399.54**	468.47**	16.63
SYP	285.93**	159.23**	11.00

Traits: DF=Days to 50% flowering, DM=Days to maturity, PH=Plant height (cm), PB=Primary branches plant^{-1}, SB=Secondary branches plant^{-1}, PP=Number of pods plant^{-}1, SPP=Number of seeds pod^{-1}, 100 SW= 100 seed weight (g), BYP=Biological Yield plant^{-1} (g), HI=Harvest index (%) and SYP=Seed yield plant^{-1} (g)
*, ** Significant at 5 and 1 per cent probability level, respectively

Table 2: Estimate of coefficient of variation (PCV and GCV), heritability and genetic advance for 11 quantitative characters in chickpea

Parameter	Range	Mean	GCV (%)	PCV (%)	Heritability (h^2b) (%)	GA	GA (% of mean)
DF	60.00-90.20	74.38	6.458	7.990	65.30	7.973	10.752
DM	117.48-150.28	133.56	3.985	4.568	76.10	9.566	7.163
PH	33.05-72.13	49.23	16.546	17.495	89.40	15.874	32.237
PB	1.74-3.61	2.55	-8.926	12.982	-47.30	-0.323	-12.644
SB	3.41-7.43	4.90	4.676	16.833	7.70	0.131	2.676
PP	20.55-70.55	37.24	21.875	26.226	69.60	14.048	37.588
SPP	1.05-2.89	1.84	-8.054	13.931	-33.40	-0.176	-9.593
100 SW	15.56-43.10	25.03	18.896	19.118	97.70	9.733	38.475
BYP	39.82-91.10	61.39	14.746	17.806	68.60	15.423	25.156
HI	12.93-46.71	25.99	22.926	27.696	68.50	10.257	39.092
SYP	8.03-31.03	16.01	28.525	35.136	65.90	7.713	47.706

Traits: DF=Days to 50% flowering, DM=Days to maturity, PH=Plant height (cm), PB=Primary branches plant^{-1}, SB=Secondary branches plant^{-1}, PP=Number of pods plant^{-}1, SPP=Number of seeds pod^{-1}, 100 SW= 100 seed weight (g), BYP=Biological Yield plant^{-1} (g), HI=Harvest index (%) and SYP=Seed yield plant^{-1} (g)
Parameters: GCV=Genotypic coefficient of variation, PCV=Phenotypic coefficient of variation, GA=Genetic Advance

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