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Pasala Bala Swetha
Department of Genetics and Plant Breeding, Naini Agricultural Institute, Faculty of Agriculture, Faculty of Health Sciences, Sam Higginbottom University of Agriculture, Technology and Sciences, Allahabad, Uttar Pradesh, India

G Roopa Lavanya
Department of Genetics and Plant Breeding, Naini Agricultural Institute, Faculty of Agriculture, Faculty of Health Sciences, Sam Higginbottom University of Agriculture, Technology and Sciences, Allahabad, Uttar Pradesh, India

Correspondence
Pasala Bala Swetha
Department of Genetics and Plant Breeding, Naini Agricultural Institute, Faculty of Agriculture, Faculty of Health Sciences, Sam Higginbottom University of Agriculture, Technology and Sciences, Allahabad, Uttar Pradesh, India

Genetic variability, heritability and character association for yield and component characters in chickpea (*Cicer arietinum* L.)

Pasala Bala Swetha and G Roopa Lavanya

Abstract
The experiment was conducted to estimate variability, heritability and genetic advance, correlation among yield and its component traits. Maximum GCV and PCV were recorded for seed yield/plant, biological yield and pods/plant. High heritability coupled with high genetic advance was registered for pods/plant and biological yield. High genetic advance as percent of mean recorded for pods/plant and biological yield. Seed yield/plant exhibited significant and positive correlation both at genotypic and phenotypic levels with biological yield, pods/plant and harvest index. Heritability, genetic advance and correlation coefficient analysis indicated that these traits may be used for the selection of high grain yielding chickpea genotypes to improve yield of chickpea.

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

Introduction
Pulses are the important food crop of the world because it provides a good source of vegetable dietary protein. Pulses provide a source of rich protein for those people who prefer vegetable to animal proteins in their diet for cultural or religious reasons (Singh, 1985) [17]. Chickpea (*Cicer arietinum* L.) is the third most important pulse crop in the world and ranks first in the Indian subcontinent and Mediterranean basin (Jain *et al.* 2013) [8]. The major chickpea growing states of our country are Madhya Pradesh, Uttar Pradesh, Rajasthan, Maharashtra, Andhra Pradesh and Karnataka and are mainly grown under rainfed situations (Anonymous, 2009) [5]. The success in any breeding programme depends upon the nature and magnitude of genetic variability and heritability, which provides better chances of selecting desired types (Kumar *et al.*, 2016). For an efficient breeding program, a survey of genetic variability with the help of suitable parameters like genetic coefficient of variability, phenotypic coefficient of variability, heritability and genetic advance are absolute necessary (Gul *et al*., 2013) [7]. Breeding chickpea for various desirable traits is limited by the lack of adequate selection criteria (Meena *et al.,* 2014) [12]. Determination of correlation between yield and its components and to estimate genetic parameters of variability are important for selection of favourable gene and genotypes while breeding (Meena *et al.*, 2014) [12]. The present study was aimed to assess variability, heritability, genetic advance and correlation coefficients for finding the optimal selection criteria to improve the seed yield of the Chickpea.

Materials and Methods
The present investigation was carried out at the Field Experimentation Centre, Department of Genetics and Plant Breeding, Naini Agricultural Institute, Sam Higginbottom University of Agriculture, Technology & Sciences, Allahabad, U.P. (India) during *Rabi*, 2016. The experimental materials consist of 31 genotypes obtained from AICRIP and Dept. of GPB. The experiment was laid out in Randomized Complete Block Design with three replications. The genotypes were sown by hand dibbling in each plot by imposing randomization in each replication along with check Uday. The spacing of 30cm between rows and 10cm between plants. Fertilizer dose of 20:40:40 kg of NPK/ha is applied as Nitrogen as two splits, phosphorus and potassium as basal dose. All recommended package of practices were followed during the cropping period to raise good crop. Observations were recorded in each plot and replication by taking five plants randomly for 10 quantitative characters *viz*, days to 50% flowering, plant height, number of primary branches per plant, pods per plant, days to maturity, seed index, biological yield, harvest index, protein content and seed yield per plant. The statistical analysis was carried out for different experiment separately per standard statistical procedures. Heritability and genetic advance was done as per method described by

Lush (1949) [11], Johnson *et al.* (1955) [9] and Allard, 1960 [2]. Analysis of variance was carried out as per statistical methods proposed by Panse and Sukhatme (1967) [14]. Correlation coefficients analysis was carried out in accordance with Johnson *et al.* (1955) [9] and Fisher and Yates (1963) [6].

Results and Discussion

The analysis of variance for different characters was presented in table 4.1 The treatment i.e. mean sum of squares due to genotypes showed highly significant differences for all ten characters except of primary branches per plant. In the present study, variation among the characters are estimated by Genotypic Coefficient of Variation (GCV) and Phenotypic Coefficient of Variation (PCV). High GCV and PCV were recorded for seed yield per plant (34.08 and 37.91) followed by biological yield (33.07 and 36.99) and number of pods/plant.

The estimates of variation revealed that GCV was smaller than PCV indicating that the apparent variation was not only due to genetic changes but also due to the favorable influence of environment.

Heritability provides the assessment of amount of transmissible genetic variability from parent to offspring, happens to be the most important basic component that determines the genetic response to selection (Kumar G *et al*., 2015). High heritability (broad sense) was recorded for characters *i.e.*, Protein Content (93%), days to 50% flowering (87%), Seed Yield/ Plant (81%), Pods/ Plant (80%), biological yield (80%), Plant Height (78%), Seed Index (77%). The present study indicated that protein content had high heritability Muhammad *et al.* (2002) [13] also obtained similar results for protein content in chickpea. High genetic advance as percent mean was recorded for seed yield per plant (63.11), biological yield (60.93) and number of pods per plant (45.02). High heritability coupled with high genetic advance was recorded for pods per plant and biological yield per plant. Similar results were also reported by Thakur and Sirohi, (2008) [19].

The genotypic and phenotypic correlation coefficients were computed among 10 characters (table 3). Biological yield, pods per plant and harvest index showed highly significant positive association with seed yield at both genotypic and phenotypic levels. Therefore, these characters appeared as greatest important associates of seed yield per plant and have also been observed by preceding workers Renukadevi and Subbalakshmi, (2006) [16]; Singh, (2007) [18]; Ali Q *et al.* (2012) [3]; Kumar *et al*. (2016). The presence of positive and significant association between seed yield per plant and yield related traits suggests that seed yield can be improved through simultaneous selection of these traits (Ramanappa *et al*., 2013) [15]. The correlation coefficient analysis is an important tool which provides symmetrical measurement of nature of interaction between various quantitative traits to determinate the component characters on which selection can be based for the genetic improvement in yield.

Conclusion

The results from present study, High GCV and PCV observed for seed yield per plant. High heritability was coupled with high genetic advance observed for the characters, number of pods per plant and biological yield hence these parameters could be used for selection. biological yield, number of pods per plant seed index and harvest index had shown positive significant correlation with the seed yield per plant. Thus, priority should be given to these characters during selection for yield improvement in chickpea.

Table 1: Analysis of variance for different characters of chickpea

Source of variation	d.f.	Days to 50% Flowering	Plant Height	Primary Branches/ Plant	Pods/ Plant	Days to Maturity	Biological Yield	Harvest Index	Seed Index	Protein Content	Seed Yield/ Plant
Replications	2	0.61	23.37	0.093	38.37	2.29	35.51	16.50	2.93	0.14	8.91
Treatments	30	30.05**	100.23**	0.086	707.40**	4.17*	117.11**	204.19**	21.08*	3.21*	41.25**
Error	60	1.42	8.57	0.029	53.90	1.45	13.64	39.35	1.94	0.076	3.02

*, ** Significant at 5%, 1% level of significance respectively

Table 2: Estimates of variability, heritability and genetic advance as per cent of mean for seed yield and yield component characters of chikpea

S. No.	Characters	Range		Grand Mean	Genotypic coefficient of variation (GCV)	Phenotypic coefficient of variation (PCV)	Heritability (broad sense) (%)	Genetic advance as percent mean
		Minimum	Maximum					
1	Days to 50% Flowering	81.00	91.67	86.10	3.59	3.85	87	6.89
2	Plant Height	46.80	68.13	57.13	9.68	10.95	78	17.61
3	Primary Branches/ Plant	2.07	2.80	2.36	5.80	9.32	39	7.42
4	Pods/ Plant	29.13	96.2	60.46	24.41	27.26	80	45.02
5	Days To Maturity	124.33	130.00	126.52	0.75	1.21	38	0.96
6	Biological Yield	11.14	48.25	22. 32	33.07	36.99	80	60.93
7	Harvest Index	33.03	69.87	46.74	15.86	20.78	58	24.94
8	Seed Index	11.53	21.78	16.25	15.54	17.76	77	28.02
9	Protein Content	20.12	24.40	22.73	4.50	4.66	93	8.94
10	Seed Yield/ Plant	5.22	18.74	10.47	34.08	37.91	81	63.11

Table 3: Genotypic and Phenotypic correlation coefficients between yield component character and seed yield of Chickpea

Characters		Plant Height	Primary Branches/ Plant	Pods/ Plant	Days to Maturity	Biological Yield	Harvest Index	Seed Index	Protein Content	Seed Yield/ Plant
Days to 50% Flowering	G	0.243*	-0.358*	0.0725	0.540**	0.417**	-0.098*	0.364**	-0.017	0.329**
	P	0.181	-0.224*	0.023	0.255*	0.319**	-0.076	0.314**	0.002	0.257*
Plant Height	G	1.00	0.0008	0.343**	0.384**	0.291**	-0.475**	0.259*	-0.184	0.117
	P	1.00	0.012	0.326**	0.301**	0.280**	-0.405**	0.135	-0.157	0.127
Primary Branches/ Plant	G		1.00	0.584**	-0.093	0.120	0.453**	-0.096	0.027	0.300**
	P		1.00	0.333**	0.047	0.157	0.211*	-0.052	0.009	0.269*
Pods/ Plant	G			1.00	0.041	0.645**	0.146	0.079	-0.138	0.714**
	P			1.00	0.045	0.528**	0.075	0.002	-0.136	0.593**
Days to Maturity	G				1.00	0.027	-0.110	0.552**	-0.128	0.029
	P				1.00	0.053	-0.110	0.296**	-0.119	0.027
Biological Yield	G					1.00	-0.073	0.375**	-0.058	-0.058
	P					1.00	-0.149	0.283**	-0.03	0.812**
Harvest Index	G						1.00	-0.159	-0.055	0.346**
	P						1.00	-0.092	-0.086	0.310**
Seed Index	G							1.00	0.873**	0.302**
	P							1.00	-0.154	0.227*
Protein Content (%)	G								1.00	-0.172
	P								1.00	-0.148

G = Genotypic correlation coefficient, P = Phenotypic correlation coefficient. *Significant at 5% level, **Significant at 1% level.

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