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Research Article

Genetic variability, heritability, genetic advance studies in cowpea germplasm [*Vigna unguiculata* (L.) Walp.]

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Abstract
One hundred and eighty genotypes of cowpea (*Vigna unguiculata* (L.) Walp) were evaluated during *kharif* 2017 and thirteen biometrical traits were recorded. Analysis of variance revealed that significant difference existed among the genotypes for all the traits studied. The phenotypic coefficient of variation was higher than genotypic coefficient of variation for all the traits studied. The high estimates of GCV was found in traits *viz*., number of pods per plant, number of clusters per plant, hundred seed weight and single plant yield. High heritability was observed for plant height, days to 50 per cent of flowering, number of racemes per plant, peduncle length, number of pods per plant, number of clusters per plant, days to maturity, pod length, hundred seed weight and single plant yield. High heritability coupled with high genetic advance as per cent of mean was observed for plant height, number of racemes per plant, peduncle length, number of pods per plant, number of clusters per plant, pod length, hundred seed weight and single plant yield. The high degree of variability was observed among the genotypes for different yield contributing traits. This could be utilised in the breeding programme for the improvement of cowpea.

Keywords
Cowpea, *Vigna unguiculata*, genetic variability, heritability, genetic advance.

Introduction

Cowpea (*Vigna unguiculata*, 2n=2x=22) also called as southern pea and black eyed pea, is well adapted to the tropics. Genome size of cowpea is 620 Mbp. Vavilov (1951) recognised India and Africa as the centres of origin, while China is considered as secondary centre of origin of cowpea. Cowpea is primarily used in the form of dry seeds, fodder, green pod, green manure and cover crops. The cowpea primary gene pool comprises of *Vigna unguiculata* section *catiang*. The seeds contain high protein content (23-29%). It is a fast growing, drought resistant crop, which improves soil fertility by fixing atmospheric nitrogen (Ortiz, 1998). The success of breeding programme relies on the variability present in the breeding material. Selection is also effective when there is significant amount of genetic variability among the individuals in a population. Genotypic and phenotypic coefficients of variation and heritability accompanied with genetic advance are very important parameters in improving traits before introduced to a local environment.

Materials and Methods

The present study was undertaken with one hundred and eighty germplasm of cowpea. These germplasm were grown in randomised block design with two replications at Department of Pulses, CPBG, Tamil Nadu Agricultural University, Coimbatore during *kharif* 2017. Each genotype was sown in one row of four meter length with a spacing of 4 X 10 cm. The observations on three randomly selected plants in different genotypes in each replication recorded for thirteen quantitative traits such as plant height (cm), number of primary branches per plant, days to 50 per cent flowering, number of racemes per plant, peduncle length (cm), number of pods per plant, number of clusters per plant, number of pods per cluster, days to maturity, pod length (cm), number of seeds per pod, hundred seed weight (g) and single plant yield (g).

Genetic variability parameters viz., phenotypic coefficient of variation (PCV), genotypic coefficient of variation (GCV), and genetic advance in percentage of mean were estimated according to Johnson *et al*. (1955). Heritability in broad sense was estimated according to the method proposed by Lush (1940).

Results and Discussion

The analysis of variance revealed significant difference among the genotypes for all the characters studied (Table 1). It indicates the presence of sufficient variability among the genotypes. The values of GCV, PCV, Genetic

advance, Heritability and Genetic advance as per cent of mean of the present experimental material are presented in Table 2.

Wide range of variation was observed for plant height (30.8-76.7cm), days to 50 per cent flowering (35.5-56.5), number of racemes per plant (8.5-36.2),days to maturity (63.5-92.0), pod length (9.9-23.9cm), hundred seed weight (5.7-20.4g) and single plant yield (3.0-24.2g) depicting the existence of maximum variability among the genotypes for these traits. The number of primary branches per plant varied from 2.8-6.8, peduncle length from 13.8-29.9cm, number of pods per plant from 3.8-18.5, number of clusters per plant from 2.7-18.7 and number of seeds per pod varied from 8.4-16.5 indicating the presence of considerable variation. The number of pods per cluster varied from 1.2-2.9 indicating narrow variation.

Genotype exhibiting maximum mean value was RC-305 for plant height, VCP-9-001 for number of primary branches per plant, CP-182 for number of racemes per plant, CP-23 for peduncle length, K-13-CP-35 for number of pods per plant, number of clusters per plant and single plant yield, K-13-CP-41 for number of pods per cluster, VCP-12-008-1 for pod length, VCP-11-001 for number of seeds per pod and K-13-CP-40 for hundred seed weight.VCP-08-04 was early maturing genotype as they recorded minimum days to 50 per cent flowering.

The phenotypic coefficient of variation (PCV) in general was higher than genotypic coefficient of variation (GCV) for all the traits studied indicating the influence of the environment on manifestation of these characters. The genotypic coefficient of variation for various characters varied from 5.33 to 42.15 per cent. High genotypic coefficient of variation was observed for number of pods per plant, number of clusters per plant, hundred seed weight and single plant yield. While, moderate GCV was observed for plant height, number of primary branches per plant, number of racemes per plant, peduncle length and pod length. Low GCV values are observed for days to 50 per cent flowering, number of pods per cluster, days to maturity and number of seeds per pod. Similar magnitude of these parameters for high GCV were found by Nwosu *et al*. (2013), Hasan khan *et al*. (2015) in cowpea for single plant yield, Nwosu *et al*. (2013) in cowpea for number of clusters per plant, Sapara *et al*. (2014) and Khanpara *et al*. (2015) in cowpea for number of pods per plant, Nwosu *et al*. (2013) and Sapara *et al*. (2014) in cowpea for hundred seed weight. Similarly moderate GCV were found by Nwosu *et al*. (2013) in cowpea for plant height, Sapara *et al*. (2014) in cowpea for number of primary branches per plant, Khanpara *et al*. (2015) in cowpea for pod length.

The phenotypic coefficient of variation for various characters varied from 6.53 to 51.20 per cent. High phenotypic coefficient of variation was observed for plant height, number of primary branches per plant, number of racemes per plant, number of pods per plant, number of clusters per plant, hundred seed weight and single plant yield. While, moderate PCV was observed for peduncle length, number of pods per cluster, pod length and number of seeds per pod. Low PCV values are observed for days to 50 per cent flowering and days to maturity. Similar magnitude of these parameters for high PCV were found by Sapara *et al*. (2014) and Mahesh Sharma *et al*. (2017) in cowpea for plant height, Mahesh Sharma *et al*. (2017) in cowpea for number of primary branches per plant, Sapara *et al*. (2014) and Khanpara *et al*. (2015) in cowpea for number of pods per plant and hundred seed weight, Mahesh Sharma *et al*. (2017) and Khanpara *et al*. (2015) in cowpea for single plant yield. Similarly moderate PCV were found by Sapara *et al*. (2014) and Khanpara *et al*. (2015) in cowpea for pod length, Khanpara *et al*. (2015) in cowpea for number of seeds per pod whereas low PCV by Khanpara *et al*. (2015) in cowpea for days to 50 per cent flowering and Mahesh Sharma *et al*. (2017) in cowpea for days to maturity.

The amount of heritable portion due to high degree of genetic variation can only be determined with the help of heritability estimates and genetic gain. High heritability estimates indicated that the characters are least influenced by the environmental factors and have capacity of the characters for transmission to subsequent generation. High heritability estimates were observed for plant height, days to 50 per cent of flowering, number of racemes per plant, peduncle length, number of pods per plant, number of clusters per plant, days to maturity, pod length, hundred seed weight and single plant yield. While, moderate heritability estimates were observed for number of seeds per pod. Low estimates of heritability were found in number of primary branches per plant and number of pods per cluster. Similar magnitude of these parameters for high heritability were reported by Suganthi and murugan (2007), Nwosu *et al*. (2013) in cowpea for hundred seed weight, Suganthi and murugan (2007) , Ramnarayan khandait *et al*. (2016) in cowpea for number of pods per plant and Nwosu *et al*. (2013) in cowpea for single plant yield. Similarly, moderate heritability was reported by Pan *et al*. (2004) and Manggoel *et al*. (2012) in cowpea for number of seeds per pod. Low heritability was

reported by Ramnarayan khandait *et al*. (2016) in cowpea for number of primary branches per plant.

The success of genetic advance under selection depends on the magnitude of genetic variability present in base population and heritability of the character under consideration. The genetic advance is usually expressed as percentage of mean. High genetic advance as per cent of mean were observed for plant height, number of racemes per plant, peduncle length, number of pods per plant, number of clusters per plant, pod length, hundred seed weight and single plant yield. While, moderate genetic advance as percent of mean was observed for number of primary branches per plant and number of seeds per pod. Low genetic advance as per cent of mean was observed for days to 50 per cent flowering, number of pods per cluster and days to maturity. Similar, magnitude of these parameters for high genetic advance as per cent of mean were reported by Ramnarayan khandait *et al*. (2016) and Khanpara *et al*. (2015) in cowpea for number of pods per plant and single plant yield.

According to Johnson *et al*. (1955), heritability along with genetic advance is mostly useful and more reliable in predicting the resultant effects of selection. Selection can only be achieved when high heritability is accompanied with high genetic advance (Burton, 1952). In the present study, high estimates of heritability coupled with high genetic advance as per cent of mean were observed for the characters plant height, number of racemes per plant, peduncle length, number of pods per plant, number of clusters per plant, pod length, hundred seed weight and single plant yield. While, high heritability along with low genetic advance as per cent of mean was observed for days to 50 per cent flowering and days to maturity. Similar magnitude of these parameters for high heritability coupled with high genetic advance as per cent of mean were reported by Mahesh Sharma *et al*. (2017), Sapara *et al*. (2014) in cowpea for plant height, number of pods per plant and hundred seed weight. Mahesh Sharma *et al*. (2017) in cowpea for single plant yield.

Based on the present study, it can be concluded that high degree of variability was observed for all the characters studied since variation is the basic step in crop improvement. The values of phenotypic coefficient of variation were higher than genotypic coefficient of variation for all the characters indicating the influence of environment. High heritability accompanied with high genetic advance as per cent of mean was observed in plant height, number of racemes per plant, peduncle length, number of pods per plant, number of clusters per plant, pod length, hundred seed weight and single plant yield indicates that most likely heritable and will be helpful to develop high yielding varieties and also to use as parents in the crossing programme for further improvement of cowpea.

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Table 1.Analysis of variance for different characters in cowpea

Source	d.f	Plant height	Number of primary branches per plant	Days to 50 per cent flowering	Number of racemes per plant	Peduncle length	Number of pods per plant	Number of clusters per plant	Number of pods per cluster	Days to maturity	Pod length	Number of seeds per pod	Hundred seed weight	Single plant yield
Treatment	178	181.50**	1.11**	14.90**	30.43**	28.90**	19.09**	10.94**	0.16**	42.97**	8.16**	4.01**	10.25**	18.03**
Error	178	44.60	0.67	3.57	5.07	4.29	2.08	1.17	0.08	6.54	1.12	1.38	0.30	3.45

** Significant at 1% level.

Table 2. Estimation of genetic parameters for different characters in cowpea germplasm.

Character	Mean	Range	GCV%	PCV%	Heritability (h^2) %	Genetic advance	GA as percent of mean
Plant height (cm)	51.7	30.8-76.7	16.00	20.56	60.54	13.19	25.51
Number of primary branches per plant	4.0	2.8-6.8	11.45	23.58	23.59	0.45	11.25
Days to flowering	44.6	35.5-56.5	5.33	6.81	61.32	3.81	8.54
Number of racemes per plant	18.9	8.5-36.2	18.83	22.29	71.38	6.16	32.59
Peduncle length(cm)	22.4	13.8-29.9	15.65	18.18	74.09	6.18	27.58
Number of pods per plant	9.4	3.8-18.5	31.01	34.60	80.34	5.35	56.91
Number of clusters per plant	6.4	2.7-18.7	34.51	38.46	80.52	4.06	63.43
Number of pods per cluster	2.0	1.2-2.9	8.66	17.32	25	0.17	8.5
Days to maturity	76.1	63.5-92.0	5.60	6.53	73.54	7.50	9.85
Pod length (cm)	14.4	9.9-23.9	13.02	14.95	75.86	3.34	23.19
Number of seeds per pod	12.0	8.4-16.5	9.53	13.69	48.51	1.63	13.58
Hundred seed weight (g)	10.0	5.7-20.4	22.29	22.95	94.30	4.43	44.3
Single plant yield (g)	6.4	3.0-24.2	42.15	51.20	67.78	4.55	71.09