

## Genetic variability, heritability and genetic advance studies in Vegetable Cowpea [*Vigna unguiculata* (L.) Walp.]

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### Abstract

Sixty diverse genotypes of vegetable cowpea were evaluated during summer 2013 for genetic parameters *viz.*, genetic variability, heritability and genetic advance. Analysis of variance revealed significant differences among the genotypes for all the 12 characters studied. The highest range of variation was observed for green pod yield per plant followed by ten pod weight, number of pods per plant and plant height. Higher values of PCV than GCV were observed for green pod yield per plant, number of pods per plant, pod length and number of seeds per pod which indicates partly interaction of the genotypes with the environment or other environmental factors influencing the expression of these characters. The value of PCV and GCV more or less equal were observed in the remaining characters which indicated that these characters were less influenced by the environment. High heritability along with high genetic advance was observed for green pod yield per plant, plant height, pod length, pod width, number of seeds per pod, number of pods per plant, ten pod weight, number of pods per cluster and hundred fresh seed weight indicating that these traits were mainly governed by additive gene action and responsive for further improvement of these traits.

**Key words:** Genetic variability, heritability, genetic advance, cowpea.

### Introduction

Vegetable cowpea [*Vigna unguiculata* (L.) Walp] is grown over a vast area in the country as well as world and a little increase in its yield potential would make a tremendous impact on the total production. The improvement of green pod yield largely depends on magnitude of genetic variability present and the extent to which green pod yield determining characters are heritable, as it provides wider scope for selection. Thus, effectiveness of selection is dependent upon the nature, extent and magnitude of genetic variability present in the material and the extent to which it is heritable. Hence, in present investigation an attempt was made to assess the variability of important green pod yield and yield contributing traits, along with the indices of variability *i. e.* genotypic coefficient of variation (GCV), phenotypic coefficient of variation (PCV), heritability in broad sense ( $h^2_{bs}$ ), genetic advance (GA) and genetic advance as percentage of mean (GA%). This study will facilitated an understanding behind expression of character and also role of environment therein.

### Materials and methods

Sixty genotypes of vegetable cowpea were sown in a Randomized Block Design (RBD) with three replications during summer 2013. Each genotype was accommodated in a single row of 3.0 m length with a spacing of 120 cm x 30 cm. The experiment

was surrounded by two guard rows to avoid damage and border effects. The recommended package of practices was followed for raising a healthy crop. The observations were recorded on five randomly selected plants in each genotype from each replication and their mean values were used for the statistical analysis for twelve characters *viz.*, days to 50% flowering, days to first green pod picking, number of primary branches per plant, plant height (cm), pod length (cm), pod width (cm), number of seeds per pod, number of pods per cluster, pod weight (g), hundred fresh seed weight (g), number of pods per plant and green pod yield per plant (g). The data were subjected to different statistical analysis *viz.*, analysis of variance, magnitude of genetic variability were performed following the standard procedures, phenotypic (PCV) and genotypic (GCV) coefficients of variation were estimated as suggested by Burton (1952), heritability (broad sense) and genetic advance as followed by Allard (1960).

### Results and discussion

The analysis of variance revealed highly significant differences among the genotypes for all the characters studied indicating sufficient genetic variability exist among the genotypes (Table 1). The present experimental material showed the maximum phenotypic range of variations (Table 2)

for green pod yield per plant ranged from 11.21 to 233.20 with a general mean of 105.87g. The next wide range was found for pod weight (19.54 - 97.42) with a mean of 43.15g followed by number of pods per plant (4.28 - 59.19, 31.41) and plant height (28.65 - 74.50, 44.21cm). Moderate range was registered by hundred fresh seed weight (13.30 - 39.12, 25.37g) and days to first green pod picking (57.00 - 79.00, 67.27days). Remaining characters viz., days to 50% flowering (45.33 - 59.67, 52.37 days), pod length (10.30 - 21.40, 14.99 cm), number of seeds per pod (9.00 - 14.40, 11.26), number of primary branches per plant (2.85 - 7.85, 4.70), number of pods per cluster (1.02 - 3.35, 2.36) and pod width (0.56 - 0.92, 0.69 cm) had exhibited narrow range of phenotypic variation.

Phenotypic coefficients of variation (PCV) for all the characters are given in Table 2. The highest phenotypic coefficient of variation was observed for green pod yield per plant (52.07%) followed by number of pods per plant (43.98%), ten pod weight (36.80%), hundred fresh seed weight (25.36%), plant height (23.15%), number of pods per cluster (22.10%) and number of primary branches per plant (21.49%). Pod length (15.26%), pod width (12.23%) and number of seeds per pod (11.51%) had moderate values, while days to first green pod picking (7.74%) and days to 50% flowering (5.31%) exhibited low phenotypic coefficients of variation.

The highest genotypic coefficient of variation (GCV) was observed for green pod yield per plant (48.83%) followed by number of pods per plant (41.96%), pod weight (35.97%), hundred fresh seed weight (25.25%), plant height (22.37%), number of pods per cluster (21.76%) and number of primary branches per plant (21.38%). Pod length (14.04%), pod width (11.51%) and number of seeds per pod (10.44%) had moderate value, while, days to first green pod picking (7.66%) and days to 50% flowering (4.97%) exhibited low genotypic coefficients of variation. High estimates of GCV in vegetable cowpea have been reported for green pod yield per plant (Vidhya *et al.*, 2002; Narayankutty *et al.*, 2003); number of pods per plant (Vidhya *et al.*, 2002; Narayankutty *et al.*, 2003; Pal *et al.*, 2003; Girish *et al.*, 2006); ten pod weight (Vidhya *et al.*, 2002; Narayankutty *et al.*, 2003; Vavilapalli *et al.*, 2013); hundred fresh seed weight (Pan *et al.*, 2004; Kumawat *et al.*, 2005; Manggoel *et al.*, 2012); plant height (Girish *et al.*, 2006; Singh *et al.*, 2010; Vavilapalli *et al.*, 2013); number of pods per cluster (Kumawat *et al.*, 2005; Nwosu *et al.*, 2013); number of primary branches per plant (Nehru and Manjunath, 2001). The moderate GCV has been reported in vegetable cowpea for pod length (Kalaiyarasi and Palanisamy, 2000).

The estimates of genotypic (GCV) and phenotypic (PCV) coefficients of variation indicated that the values of PCV were higher than GCV for green pod yield per plant, number of pods per plant, pod length and number of seeds per pod due to partly interaction of the genotypes with the environment or other environmental factors influencing the expression of these characters. Narrow differences between the PCV and GCV or the value of PCV and GCV more or less equal were observed in days to 50% flowering, days to first green pod picking, number of primary branches per plant, plant height, pod width, number of pods per cluster, pod weight and hundred fresh seed weight, which indicated that these characters were less influenced by the environment. Similar results were obtained by Vidya *et al.* (2002), Narayankutty *et al.* (2003), Pan *et al.* (2004), Girish *et al.* (2006), Tamgadge *et al.* (2008), Singh *et al.* (2010), Nwosu *et al.* (2013) and Vavilapalli *et al.* (2013) for green pod yield and its components in vegetable cowpea.

In the present investigation, high heritability (broad sense) estimate was observed for all the characters taken for the study. High heritability estimates indicated that the characters were least influenced by the environmental factors and high capacity of the characters for transmission to subsequent generation. This also suggested that the phenotypes were the true representative of their genotypes for these traits and selection based on phenotypic value could be reliable. The high magnitude of heritability in vegetable cowpea has also been reported by Suganthi and Murugan (2007) and Nwosu *et al.* (2013) for hundred fresh seed weight; Pal *et al.* (2003) for number of primary branches per plant; Vavilapalli *et al.* (2013) for days to first green pod picking; Suganthi and Murugan (2007) for number of pods per plant; Vidya *et al.* (2002) and Pan *et al.* (2004) for ten pod weight; Girish *et al.* (2006) for plant height; Pan *et al.* (2004), Girish *et al.* (2006), Suganthi and Murugan (2007) and Nwosu *et al.* (2013) for number of pods per plant. The heritability estimates were found to be moderate for pod width, green pod yield per plant, days to 50% flowering, pod length and number of seeds per pod. Similar results were reported in vegetable cowpea by Pan *et al.*, (2004) and Manggoel *et al.* (2012) for number of seeds per pod, pod length and days to 50% flowering.

The expected genetic advance was the highest for green pod yield per plant followed by pod weight and number of pods per plant. The characters like, plant height and hundred fresh seed weight had moderate values for genetic advance. High values of expected genetic advance in vegetable cowpea was also observed by Kumawat *et al.* (2005) and

Vivalapalli *et al.* (2013) for green pod yield per plant while Narayankutty *et al.* (2003) for ten pod weight. The moderate values of expected genetic advance in vegetable cowpea have been observed by Suganthi and Murugan (2007) for hundred fresh seed weight; Nehru and Manjunath (2001) and Pal *et al.* (2003) for plant height. In the present study, the low genetic advance was observed for days to 50% flowering, days to first green pod picking, pod length, number of seeds per pod, number of primary branches per plant, number of pods per cluster and pod width. Similar results were reported by Girish *et al.* (2006) and Vavilapalli *et al.* (2013) for days to 50% flowering and days to first picking; Tamgadge *et al.* (2008) for number of seeds per pod and pod width.

The estimates of genetic advance expressed as percentage of mean (Table 2) were found to be high for all characters studied except days to 50% flowering, days to first green pod picking and number of seeds per pod. Whereas, moderate genetic advance expressed as percentage of mean was observed for days to first green pod picking and number of seeds per pod and the character days to 50% flowering recorded low GA (%).

Johnson *et al.* (1955) suggested that the heritability and genetic advance when considered together would be more reliable and useful in predicting the resultant effects of selection. Rapid progress in selection can be achieved when high heritability is accompanied with high genetic advance, which forms the most reliable index of selection (Burton, 1952). In the present study, high estimates of heritability coupled with high genetic advance expressed as percentage of mean were observed for all characters except days to 50% flowering, days to first green pod picking and number of seeds per pod which may be attributed to the preponderance of additive gene action and possess high selective value and thus, selection pressure could profitably be applied on these characters for their rationale improvement (Panse, 1957). High estimates of heritability with moderate or low genetic advance were observed for days to 50% flowering, days to first green pod picking and number of seeds per pod which revealed the presence of non-additive gene action and influence of environment in the expression of these characters and thus, the selection would be less effective.

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**Table 1.** Analysis of variance for various characters in vegetable cowpea

Source	d. f.	Days to 50% flowering	Days to first green pod picking	Number of primary branches per plant	Plant height (cm)	Pod length (cm)	Pod width (cm)
		1	2	3	4	5	6
Replication	2	2.817	1.706	0.012	104.597	3.942	0.0002
Genotype	59	21.251**	80.220**	3.045**	300.562**	14.085**	0.020**
Error	118	0.969	0.536	0.011	6.939	0.807	0.001

  

Source	d. f.	Number of seeds per pod	Number of pods per cluster	Pod weight (g)	Hundred fresh seed weight (g)	Number of pods per plant	Green pod yield per plant (g)
		7	8	9	10	11	12
Replication	2	1.962	0.038	11.023	0.00055	125.800	1635.023
Genotype	59	4.445**	0.799**	734.164**	123.514**	538.045**	8384.044**
Error	118	0.299	0.008	11.175	0.343	17.192	366.343

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



**Table 2.** Range of variation, mean, phenotypic (PCV) and genotypic (GCV) coefficients of variation, heritability ( $h^2_{bs}$ ), genetic advance (GA) and genetic advance expressed as per cent of mean (GA%) for twelve characters in vegetable cowpea

Characters	Range of variation		Mean	Phenotypic coefficient of variation (PCV) (%)	Genotypic coefficient of variation (GCV) (%)	Heritability in broad sense ( $h^2_{bs}$ ) (%)	Genetic advance (GA)	Genetic advance expressed as percentage of mean (GA %)
	Minimum	Maximum						
Days to 50% flowering	45.33-	59.67	52.37	5.31	4.97	87.46	5.01	9.57
Days to first green pod picking	57.00 -	79.00	67.27	7.74	7.66	98.02	10.51	15.62
Number of primary branches per plant	2.85	7.85	4.70	21.49	21.38	98.95	2.06	43.80
Plant height (cm)	28.65	74.50	44.21	23.15	22.37	93.38	19.69	44.54
Pod length (cm)	10.30	21.40	14.99	15.26	14.04	84.58	3.98	26.59
Pod width (cm)	0.56-	0.92	0.69	12.23	11.51	88.60	0.15	22.32
Number of seeds per pod	9.00	14.40	11.26	11.51	10.44	82.23	2.19	19.50
Number of pods per cluster	1.02	3.35	2.36	22.10	21.76	96.88	1.04	44.11
Pod weight (g)	19.54	97.42	43.15	36.80	35.97	95.57	31.26	72.45
Hundred fresh seed weight (g)	13.30	39.12	25.37	25.36	25.25	99.17	13.14	51.80
Number of pods per plant	4.28	59.19	31.41	43.98	41.96	90.99	25.89	82.44
Green pod yield per plant (g)	11.21	233.20	105.87	52.07	48.83	87.94	99.87	94.33