

Original Research Paper

Variability and Genetic Divergence in Vegetable Cowpea Germplasm of Goa

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ABSTRACT

Vegetable cowpea or Yard long bean [*Vigna unguiculata* var. *sesquipedalis* L. (Walp)] is a warm season leguminous crops grown especially for vegetable purpose along the west coast of India. In Goa, pole type varieties are preferred over bushy types as they offer multiple harvests with comparatively longer pods. There is wide variability found for different morphological and other traits in the local types cultivated in the state of Goa. Exploration of genetic variability in the available germplasm is a prerequisite for initiation of any successful breeding programme. Twenty nine genotypes of vegetable cowpea including three improved varieties collected from different parts of Goa state were evaluated for twelve quantitative characters including yield. High variability was observed for pod yield/plant, number of pods/plant and pod length. The high variability for pod yield per plant is apparent as the pod yield ranged from 315.25 to 2070.45 g/plant with an average of 827.48 g per plant. Pod yield depends on number of pods per plant, pod length and pod weight. Number of pods per plant ranged from 36.65 to 147.80. Pod weight depends on pod length, number of seeds per pod and hundred seeds weight. Wide variation was observed for all these characters in the present study. The GCV value was maximum for pod yield per plant (g) followed by pod weight (g) and number of pods per plant. Low values of GCV were observed for days to first flowering, days to first harvest and number of seeds per pod. In the present study, the twenty nine genotypes could be grouped into fourteen clusters based on genetic distance. High coefficient of variation was observed for pod yield per plant, pod weight, number of pods per plant and pod length indicating their significant contribution in determining the inter cluster distances.

Key words: Correlation coefficient, Genetic divergence, Quantitative character, Vegetable cowpea

INTRODUCTION

Vegetable cowpea popularly known as Yard long bean (*Vigna unguiculata* var. *sesquipedalis*) is an important leguminous vegetable crop of South India. Vegetable cowpea is an important vegetable grown as intercrop in different cropping systems. (Khanpara *et al.*, 2016). In Vegetable cowpea, among the different parts analyzed shells were rich in dietary fiber. Seeds were nutrient dense as compared to pods and shells, but more in anti-nutrients (Tiwari *et al.*, 2019). In Goa, pole type cowpea with indeterminate growth habit producing long green fleshy pods are preferred and fetch premium price in the market

through out the year. There are many varieties released in case of bush type of cowpea but the availability of improved varieties in pole type vegetable cowpea is rather scanty. Not much work has been carried out on the genetic improvement of pole type vegetable cowpea. There is wide variability found for different morphological and other traits in the local types cultivated in the state of Goa. Exploration of genetic variability in the available germplasm is a prerequisite for initiation of any successful breeding programme. In spite of its popularity and importance very little effort has been



made to upgrade the genetic makeup of this crop. Hence, the present investigation was carried out systematically to evaluate the local accessions to estimate the extent of genetic variability, heritability, genetic advance and genetic divergence in the locally collected germplasm of vegetable cowpea.

MATERIALS AND METHODS

Twenty nine genotypes of vegetable cowpea collected from different parts of Goa including three released varieties were evaluated in a randomized block design with two replications during *rabi* seasons starting from 2012-2016 in paddy fallow land. The soil is sandy loam with a pH of 5.1 with medium phosphorous and potassium availability. Recommended package of practices were followed to raise a good crop (Anon. 2004). Observations were recorded on twelve important quantitative characters, *viz.*, plant height (cm), number of primary branches, leaf length (cm), leaf width (cm), days to first flowering, days to first harvest, pod length (cm), pod weight (g), pods per plant, number of seeds per pod, 100 seeds weight (g) and pod yield per plant on five randomly selected plants/genotype/replication. The analysis of variance was carried out as suggested by Panse and Sukhatme (1985). The genotypic and phenotypic coefficient of variation was calculated as per the formula suggested by Comstock and Robinson (1952). Heritability (broad sense) and genetic advance were worked out as per the procedure given by Burton and De Vane (1953) and Allard (1960).

RESULTS AND DISCUSSION

Among the twelve quantitative characters studied, the twenty nine vegetable cowpea genotypes exhibited highly significant differences for all the characters indicating high variability in the cowpea accessions (Table 1). Wide range of variation was observed for all the characters studied. Highest variation was observed for pod yield/plant, number of pods/plant and pod length (Table 2). Such a high variability for the above characters was also reported earlier by De Mooy (1985), Resmi (1998) and Narayanankutty *et al.* (2003).

In the present study, all the characters exhibited narrow differences between the value of PCV and GCV. This indicated low impact of environment on the expression of all the quantitative characters. The

same was reported earlier by Narayanankutty *et al.* (2005).

The GCV value was maximum for pod yield per plant (g) followed by pod weight (g) and number of pods per plant. Low values of GCV were observed for days to first flowering, days to first harvest and number of seeds per pod (Table 2). Shobha and Vahab (1998) and Narayanankutty *et al.*, (2003) reported high GCV for yield per plant and pod weight in vegetable cowpea. Low GCV values for days to first flowering and number of seeds per pod has been reported by Sreekumar *et al.*, (1996). The results of analysis of variance for different traits are given in Table 3.

The high variability for pod yield per plant is apparent as the pod yield ranged from 315.25 to 2070.45 g / plant with an average of 827.48 g per plant. Pod yield depends on number of pods per plant, pod length and pod weight. Number of pods per plant ranged from 36.65 to 147.80. Pod weight depends on pod length, number of seeds per pod and hundred seeds weight. Wide variation was observed for all these characters in the present study. Similar findings have been reported by other workers (De Mooy(1985), Resmi (1998), Shobha and Vahab(1998) and Narayanankutty *et al.*,(2005)

With the help of variability and subsequent GCV alone, it is not possible to determine the amount of genetic variation that is heritable to the further generations. Burton and De Vane (1953) suggested that GCV combined with estimates of heritability would give the best results of genetic advance to be expected from selection. In the present study, heritability values were high (>90%) for all the characters studied except number of seeds per pod. High values of heritability for quantitative characters have also been reported by earlier workers, Sobha and Vahab (1998) and Narayanankutty *et al.* (2003). The accurate value for heritable variation can be estimated when heritability is combined with genetic advance. In the present study, high heritability coupled with high genetic advance was observed for pod yield per plant (g) and pod weight (g). This may be due to the preponderance of additive gene action for these characters there by indicating the advantages of selection for their



Table 1. Mean performance of vegetable cowpea germplasm of Goa

S.No.	Accession number	Plant height	No of 1 ^o branches	Leaf length	Leaf width	Days to 1 st flowering	Days to 1 st harvest	Pod length	Pod weight	Pods per plant	No of seeds per pod	100 seeds weight	Pod yield per plant
1	VCG1	4.49	6.60	13.48	9.68	43.00	57.60	35.17	10.58	77.00	14.61	17.32	820.50
2	VCG2	5.29	8.25	11.39	8.25	50.40	71.15	40.77	12.36	77.65	14.70	27.23	950.50
3	VCG3	4.85	5.25	10.63	7.77	51.30	71.00	47.35	13.90	74.40	13.76	25.65	1030.45
4	VCG4	6.29	4.10	12.54	9.56	46.40	60.00	64.70	35.52	58.35	13.19	19.22	2070.45
5	VCG5	3.46	5.60	9.98	6.47	52.20	69.70	40.85	9.26	54.50	17.34	25.25	505.50
6	VCG6	4.37	5.85	11.29	8.67	56.15	69.90	39.42	9.00	50.45	16.97	19.82	455.40
7	VCG7	3.90	5.25	11.13	9.33	48.50	62.90	37.53	8.47	67.15	15.15	14.90	565.65
8	VCG8	4.26	4.60	12.21	9.14	43.50	60.00	37.90	11.58	147.80	15.63	18.47	1710.65
9	VCG9	4.35	4.85	11.94	9.34	45.20	60.90	36.69	9.80	92.45	14.52	22.50	910.40
10	VCG10	4.41	6.65	10.84	7.97	50.60	66.90	40.32	11.13	72.50	14.77	13.45	810.00
11	VCG11	4.99	4.40	11.88	7.40	46.40	64.20	41.24	10.89	78.50	15.88	20.11	850.45
12	VCG12	4.64	4.80	11.08	7.27	51.90	77.10	43.01	9.60	58.40	16.55	15.39	555.40
13	VCG13	3.72	5.05	11.78	8.29	54.50	74.30	40.55	12.84	51.50	17.91	20.31	660.25
14	VCG14	4.31	4.15	13.73	9.93	44.20	61.20	41.19	9.74	65.05	15.51	20.51	635.25
15	VCG15	4.38	5.00	12.78	10.66	43.60	60.00	39.02	10.68	85.35	15.97	19.29	910.45
16	VCG16	4.75	4.85	12.24	9.58	45.30	60.70	27.97	6.22	83.60	15.26	20.93	520.65
17	VCG17	4.08	4.70	13.00	9.80	51.60	62.80	31.54	10.61	59.10	15.99	22.33	625.20
18	VCG18	4.46	4.25	13.60	9.93	55.20	67.00	33.36	8.66	36.65	16.11	20.11	315.25
19	VCG19	3.39	5.05	10.54	10.39	42.10	66.00	46.13	12.08	44.15	15.75	15.04	527.30
20	VCG20	4.64	4.85	11.42	9.05	44.40	71.90	51.95	12.03	52.20	14.97	17.55	606.20
21	VCG21	4.43	5.55	11.89	9.24	44.00	71.60	48.14	11.13	86.45	13.03	20.05	908.45
22	VCG22	4.95	6.25	12.07	10.21	46.10	70.20	59.50	19.13	72.50	16.86	22.29	1374.15
23	VCG23	4.10	6.15	11.74	9.87	44.00	65.60	55.64	10.57	105.50	16.04	20.39	1183.55
24	VCG24	4.72	5.30	11.14	9.61	51.80	78.40	46.87	13.31	91.60	13.06	23.56	1262.45
25	VCG25	4.86	4.95	12.33	9.10	51.00	77.60	48.77	14.09	48.80	13.61	20.61	697.50
26	VCG26	3.95	4.65	13.13	11.20	48.70	62.50	51.01	13.94	64.10	13.61	19.84	783.10
27	Vijayanthi	2.90	6.15	11.13	10.95	50.70	72.00	47.23	10.75	50.70	12.94	23.21	408.60
28	A Garima	1.00	5.20	10.00	10.89	42.90	64.60	51.40	10.95	71.30	12.20	21.96	707.80
29	A Suman	1.05	5.10	9.39	10.09	45.90	65.00	54.28	12.07	65.20	13.05	19.94	635.45
	CD(0.05)	0.61	6.60	0.82	0.71	3.06	3.98	3.36	1.63	7.36	1.92	1.62	123.72

Table 2. Range, mean, PCV, GCV, heritability and genetic advance for twelve quantitative characters in vegetable cowpea

Characters	Mean ± SE _m	Range	Phenotypic variance	Genotypic variance	PCV	GCV	Heritability (%)	Genetic advance (%)
Plant height	4.170±0.210	1.00 - 6.29	2.31	2.22	36.45	35.74	96.19	72.21
No of 1 ^o branches	5.29±0.24	4.10 - 8.25	1.59	1.47	23.81	22.95	92.92	45.58
Leaf length	11.73±0.29	9.39 - 13.73	2.41	2.25	13.24	12.79	93.28	25.44
Leaf width	9.29±0.25	6.46 - 11.19	2.69	2.57	17.64	17.25	95.55	34.73
Days to 1 st flowering	47.98±1.06	42.10 - 56.15	33.88	31.64	12.13	11.72	93.40	23.34
Days to 1 st harvest	66.99±1.38	57.60 - 78.40	67.72	63.95	12.28	11.94	94.43	23.89
Pod length	44.12±1.16	27.97 - 64.69	142.48	139.79	27.06	26.80	98.12	54.69
Pod weight	12.09±0.56	6.22 - 35.52	51.48	50.85	59.31	58.94	98.77	120.67
No of pods/plant	70.45±2.54	36.65 - 147.80	967.57	954.66	44.17	43.86	98.67	89.75
No of seeds/pod	14.99±0.66	12.20 - 17.91	4.48	3.60	14.11	12.66	80.43	23.38
100 seed weight	20.25±0.56	13.45 - 27.23	20.50	19.88	22.36	22.02	96.96	44.67
Yield per plant	827.48±42.72	315.25 - 2070.45	303498.45	299849.38	66.58	66.18	98.79	135.49

Table 3. Analysis of Variance for Different traits in Vegetable Cowpea germplasm of Goa

Sources of Variation	d.f.	Mean Sun of Squares											
		Plant height	No of branches	Leaf length	Leaf width	Days to 1 st flowering	Days to 1 st harvest	Pod length	Pod weight	Pods per plant	No of seeds per pod	100 seeds weight	Pod yield per plant
Treatments	28.00	64.67*	44.42	67.53	75.31	948.59*	1896.24	3989.55*	1441.39*	27091.81	125.41	97956.69	574.08*
Replications	1.00	0.47	0.08	0.07	0.05	0.03	0.38	1.32	0.65	0.02	1.07	1383.77	0.21
Residual	28.00	2.47	3.15	4.54	3.35	62.58	105.70	75.19	17.72	361.41	24.55	2174.08	17.48

*Significant at 1% level



Table 4. Clustering pattern of vegetable cowpea genotypes

Cluster No.	Number of genotypes	Constituent genotypes
I	5	VCG1, VCG2, VCG3, VCG9, VCG15
II	2	A Suman , A Garima
III	2	VCG6, VCG13
IV	2	VCG18, VCG17
V	2	VCG11, VCG14
VI	2	VCG25, VCG20
VII	2	VCG10, VCG12
VIII	2	VCG7, VCG19
IX	2	VCG24, VCG21
X	2	Vijayanthi, VCG26
XI	2	VCG23, VCG22
XII	2	VCG5, VCG16
XIII	1	VCG4
XIV	1	VCG8

Table 5. Phenotypic correlation coefficient among different quantitative characters in vegetable cowpea

Traits	Plant height	No of 1 ^o branches	Leaf length	Leaf width	Days to 1 st flowering	Days to 1 st harvest	Pod length	Pod weight	No of pods/plant	No of seeds/pod	100 seed weight	Yield per plant
Plant height	1.000	-0.176*	0.688**	0.345*	0.150**	0.060	-0.076	0.360*	0.104	0.239	0.008	0.425*
No of 1 ^o branches	1.000	1.000	-0.373	-0.286	0.061	0.201	0.084	-0.130	0.083*	-0.093	0.219	-0.046
Leaf length	1.000	1.000	1.000	0.829	0.033	-0.141	-0.297	0.047	0.064	0.258**	-0.022	0.135
Leaf width	1.000	1.000	1.000	1.000	-0.164	-0.157	-0.073	0.063	0.050	-0.022	-0.024	0.109
Days to 1 st flowering	1.000	1.000	1.000	1.000	1.000	0.567**	-0.229	-0.080	-0.469	0.280*	0.242*	-0.318*
Days to 1 st harvest	1.000	1.000	1.000	1.000	1.000	1.000	0.237*	-0.039	-0.326	0.013	0.220*	-0.195
Pod length	1.000	1.000	1.000	1.000	1.000	1.000	1.000	0.700**	-0.077	-0.390**	0.055	0.489*
Pod weight	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	-0.083*	-0.267	0.044	0.737**
No of pods/plant	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	-0.099	0.072*	0.596**
No of seeds/pod	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	-0.139**	-0.203*
100 seed weight	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	0.096

* Significant at 5 % level; ** Significant at 1 % level

improvement. High heritability coupled with high genetic advance for above characters in vegetable cowpea has been reported by Resmi (1998) and Narayanankutty *et al.* (2003). Other characters *viz.*, days to first flowering, days to first harvest, number of seeds per pod and leaf length has recorded high heritability of more than 90 per cent but their genetic advance is very low (<30%) indicating the non additive gene action for these traits. This implies improvement of above traits by pyramiding desirable genes through suitable hybridization programmes.

The success of any hybridization programme depends on the genetic diversity present in the parents. In the present study, the twenty nine genotypes could be grouped in to fourteen clusters based on genetic distance (Table 4). The cluster I was the largest comprising of five genotypes and remaining clusters had two genotypes each except thirteen and fourteen that had one genotype each.

The clustering pattern in the present study did not follow any uniform pattern. The clustering pattern was irregular and the same type of distribution was earlier

reported by Patil and Bhapkar (1987) and Narayanankutty *et al.* (2005).

The correlation studies provide reliable information on the nature and extent of relationship for bringing about improvement in yield and other traits. The estimates of correlation coefficients is presented in Table 5. Characters showing positive and highly significant correlation with yield per plant were pod weight (0.737) and number of pods per plant (0.596). On the other hand, yield had negative and significant correlation with days to first flowering (-0.318) and number of seeds per pod (-0.203). This is in accordance with the results of Narayanankutty *et al.* (2005).

In the present study, high coefficient of variation was observed for pod yield per plant, pod weight, number of pods per plant and pod length indicating their significant contribution in determining the inter cluster distances. Hence, selection of parents differing in traits such as pod weight, pod yield per plant, number of pods/plant and pod length will be more useful in future breeding programmes.

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(Received on 22.11.2019 and accepted on 05.01.2020)