

MORPHOLOGICAL CHARACTERIZATION OF COWPEA GENOTYPES COLLECTED FROM DIFFERENT PARTS OF INDIA

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ABSTRACT

An investigation was carried out on the genetic diversity in twenty genotypes of cowpea collected from the different parts of India at Sardarkrushinagar (Gujarat). Analysis of variance indicated significant difference among the genotypes for different morphological characters. On the basis of D^2 analysis, the twenty genotypes could be grouped into 6 clusters. Cluster II had the highest number of genotypes (8) followed by cluster I (5). The cluster III and IV included 3 genotypes each. Remaining clusters were monogenotypic. The highest intra-cluster distances were recorded in cluster II followed by cluster III. Among the 20 genotypes, C-152 showed the highest cluster mean for days to maturity. The characters 100- seed weight (71.58%) was the main contributor to the total genetic divergence. Biological yield per plant (9.47%), pod length (5.26%), number of branches per plant (5.26%), plant height (4.21%) and days to flowering (2.63%) contributed moderately and pods per plant shown small contribution, while the characters days to maturity, seeds per pod and harvest index showed 0.00 % contribution towards total genetic divergence.

Key words: Cowpea, D^2 , genetic diversity

INTRODUCTION

Cowpea (*Vigna unguiculata* (L.) Walp (2n=22) is one of the most important legume crops of India because of its high protein content. In Gujarat, it is cultivated in an area about 0.26 lakh ha with 0.16 lakh tonne production and 615 kg k ha⁻¹ productivity. In addition to its use as human food, cowpea hay is an important source of animal fodder using the dry season in many parts of India. The plant is generally drought tolerant and when used in rotation with cereals, its ability to fix nitrogen helps restore soil fertility (Prasanthi *et al.* 2012). The major components of grain yield such as pods/ plant, pod length, seeds/pod and seed size improve cowpea yield potential. The variability of these morphological traits has been reported from different workers (Patil and Baviskar 1987, Sardana *et al.* 2001, Mishra *et al.* 2002, Carnide *et al.* 2007). Despite the effectiveness of the use of molecular markers in diversity studies (Tan *et al.* 2012, Tanhuanpaa and Manninen 2012) morphological and agronomic traits remain imperative to plant breeders (Krichen *et al.* 2012). Morphological characterization is used routinely by plant breeders for the initial description and classification of germplasm in order to select genotypes for cultivation by farmers or in breeding programmes (Krichen *et al.* 2012). In addition the desired traits must express in the target environment and this makes morphological characterization crucial in plant breeding. Knowledge on the key traits of the germplasm helps in making decision of parent

selection for breeding purposes and reduces the number of germplasm that a researcher would have selected for initial screening. The objective of the study therefore, was to assess the diversity of 20 cowpea genotypes assembled based on 11 morphological traits and to identify genotypes with unique traits for breeding purposes.

MATERIALS AND METHODS

Field experiment was conducted at the Centre of Excellence for Research on Pulses, Sardarkrushinagar. Sardarkrushinagar which is situated at 24.12 °N latitude and 72.12 °E longitude with an elevation of 154.52 meters above the mean sea level. Total 20 populations of *V. unguiculata* (L.) Walp were used in this study. Twenty cowpea accessions from different origin were used to assess genetic diversity. Seven cowpea accessions (GC-3, GC-4, GC-5, GC-601, GC-706, GC-505, GC-516) were from S. D. Agricultural University, Sardarkrushinagar (Gujarat), eight (PGCP-5, PGCP-6, PGCP-11, PGCP-12, PGCP-13, PGCP-14, Pant Lobia-1, Pant Lobia-23) from G. B. Pant University of Agriculture and Technology, Pantnagar, Uttarakhand, four (KM-5, C-152, TVX-944, IT-38956-1) from University of Agricultural Sciences, Bangalore, Karnataka and one (RC-101 from S. K. Rajasthan Agricultural University, Bikaner, Rajasthan). Twenty genotypes of cowpea were sown in summer, 2012 in a randomized block design with three replications. Each entry was accommodated in a three rows of 4.0 m length with a spacing of 45 x 10

cm. Uniform irrigation schedule was followed at all the sites to maintain similar moisture condition throughout the growth of plants. The observations were recorded days to flowering, days to maturity, plant height, number of branches per plants, pod length, number of seed per pod, 100- seed weight, biological yield per plant, grain yield per plant, harvest index. The data obtained from each character were statistically analyzed. Phenotypic coefficients of variation (PCV) and genotypic coefficients of variation (GCV) were estimated according to Burton (1952). D2-analysis (Mahalanobis 1936) and grouping of genotypes in different clusters was done by using Tocher's method Rao (1952).

RESULTS AND DISCUSSION

Morphological diversity

The results revealed highly significant difference among the genotypes for all the traits except days to maturity (Table1). The difference between genotypes was significant for all the characters indicating presence of genetic variation for different characters in the genetic material. The mean value for days to flowering was 57.0 days and ranged between 51 and 62 days. The genotypes, PGCP-13 (51), PGCP-14 (51), PGCP-5 (51.33), GC-5 (52) and PGCP-11 (52.66) were the earliest in flowering while genotypes, Pant Lobia-2 (63.33), KM-5 (62), TVX-944 (61.66), IT-38956-1 (61.66) and C-152 (61) took more number of days to flowering. The range of maturity period was from 74.3 to 78.6 days with a mean value of 76.2 days. The genotypes, GC-601 (74.33), PGCP-13 (74.33), PGCP-5 (74.66), GC-3 (75.00) and GC-5 (75.33) were the earliest in maturity

while genotypes C-152 (78.66), KM-5 (78.00), IT-38956-1 (77.33), TVX-944 (77.66) and Pant Lobia-2 (76.66) took more number of days to maturity.

Table 1: Analysis of variance (ANOVA) showing mean sum of squares for 11 morphological characters in cowpea

Source of variation	Replication	Genotypes	Error
d.f.	2.00	19	38
Days to flowering	2.06	52.65**	3.08
Days to maturity	0.20	4.75	3.55
Plant height	7.44	155.2**	7.80
Number of branches per plant	0.0035	1.66**	0.10
Pod per plant	3.16	49.43**	3.34
Seeds / pod	0.48	3.35**	0.37
Pod length	1.64	10.71**	0.51
100-Seed weight	1.91	29.48**	0.15
Biological yield	0.22	87.45**	5.94
Grain yield / plant	0.27	19.30**	1.87
Harvest index	0.91	39.51**	8.27

The plant height ranged between 34.95 and 57.78 cm with a mean value of 44.83 cm. The genotype C-152 (57.78) was tallest while genotype PGCP-14 (34.95) was dwarf. The mean and range for number of branches per plant was 5.2 and 3.8 to 6.5, respectively. The maximum numbers of branches were recorded in genotype C-152 (6.5) and genotypes, PGCP-12 (3.8) and KM-5 (3.8) had minimum number of branches. Pods per plant depicted 15.02 mean values and ranged between 8.00 and 21.90.

Table 2: Range, Mean, S.Em, C.D. and coefficient of variance of different characters in cowpea

Characters	Range	Mean± S.Em	C.D.	C.V.
Days to flowering	51.00 – 64.00	57.06 ± 1.013	2.90	3.07
Days to maturity	74.33 - 78.66	76.2 ± 1.087	3.11	2.47
Plant height (cm)	34.95 - 57.78	44.83 ± 1.612	4.61	6.22
Number of branches / plant	03.80 -0 6.50	5.28 ± 0.189	0.54	6.20
Pods / plant	80.00 - 21.90	15.02 ± 1.055	3.02	12.17
Seeds / pod	10.36 - 14.05	12.02 ± 0.353	1.01	5.08
Pod length (cm)	11.16 - 17.47	14.33 ± 0.414	1.18	5.01
100 Seed weight (g)	07.40 -19.66	13.56 ± 0.224	0.64	2.80
Biological yield / plant(g)	28.44 - 49.74	40.53 ± 1.407	4.02	6.01
Grain yield / plant (g)	11.6- 21.44	16.43 ± 0.79	2.26	8.30
Harvest index (%)	34.82-47.44	40.71 ± 1.660	4.75	7.06

The genotype GC-5 (21.90) possessed maximum number and genotype PGCP-13 (8.00) minimum number of pods per plant. The range of seeds per pod was from 10.36 to 14.05 with a mean value of 12.02. The genotype PGCP-6 (14.05) had highest and PGCP-13 (10.36) lower number of seeds

per pod. The mean value for pod length was 14.33 cm and ranged between 11.16 to 17.47 cm. The genotype PGCP-11 (17.47) had long pod as compared to genotypes GC-516 (16.97), PGCP-13 (16.80) and genotype GC-5 (11.16) had short pod followed by GC-3 (11.92). The mean value for 100-seed weight

was 13.56 g and ranged in between 7.49 to 19.66 g. It was highest for genotype PGCP-13 (19.66) and lowest in genotype GC-5 (7.49). The mean value for biological yield per plant was 40.53 g which ranged from 28.44 to 49.74 g. Maximum biological yield was

observed in genotype IT-38956-1 (49.74) lower in genotypes GC-3 (28.44). The range of grain yield per plant was from 21.44 to 14.4 with a mean value of 16.43 g. The harvest index ranged from 34.82 to 47.44% with a mean value 40.71%.

Table 3: Mean performance of 11 characters in 20 genotypes of cowpea

Genotypes	DF	DM	PH	BP	PP	SP	PL	SW	BY	GY	HI
GC-3	56.0	75.0	45.0	4.7	11.3	12.4	11.9	9.8	28.4	11.6	40.5
GC-4	56.0	76.0	43.1	6.0	21.6	11.8	12.6	13.9	43.2	20.1	46.5
GC-5	52.0	75.3	51.2	5.7	21.9	12.2	11.1	7.4	38.8	18.2	46.8
GC-601	55.0	74.3	51.3	6.1	18.4	11.9	14.8	11.7	47.2	18.8	39.7
GC-706	59.0	78.0	40.9	5.3	15.2	11.7	13.0	12.1	40.8	15.7	38.7
GC-505	57.0	76.3	49.6	5.6	15.7	10.8	13.6	15.6	43.0	20.1	46.7
GC-516	64.0	77.0	39.8	6.0	18.1	13.5	16.9	12.9	47.1	17.6	37.3
PGCP-5	51.3	74.6	36.2	4.6	10.2	11.0	13.5	15.4	36.7	13.6	36.9
PGCP-6	57.3	76.3	43.8	5.6	11.8	14.0	16.7	11.0	37.0	16.1	43.6
PGCP-11	52.6	75.6	41.2	5.7	18.8	13.2	17.4	16.0	42.4	16.4	38.9
PGCP-12	55.6	75.6	35.7	3.8	11.4	12.1	16.2	18.3	37.0	14.7	39.6
PGCP-13	51.0	74.3	47.1	5.0	8.0	10.3	16.8	19.6	36.3	14.1	38.8
PGCP-14	51.0	75.3	34.9	5.4	12.9	11.8	13.1	16.4	38.2	14.8	39.4
Pant Lobia-1	56.6	75.6	35.4	5.6	12.0	10.6	12.7	16.1	37.1	15.2	41.1
Pant Lobia-2	63.3	76.6	36.0	5.0	16.9	11.2	15.9	13.9	40.4	16.3	40.3
RC-101	57.0	76.0	48.4	4.0	11.5	10.3	12.2	13.7	35.9	13.8	38.4
KM-5	62.0	78.0	54.0	3.8	11.8	12.4	15.4	10.0	36.0	14.4	40.1
C-152	61.0	78.6	57.7	6.5	21.1	13.3	14.5	10.0	45.2	21.4	47.4
TVX-944	61.6	77.6	55.5	5.4	15.4	13.4	13.8	11.1	49.4	18.6	37.7
IT-38956-1	61.6	77.3	48.9	5.3	16.0	11.4	14.1	15.3	49.7	16.6	34.8

DF- Days to flowering, DM- Days to maturity, PH- Plant height, BP- Number of branches per plant, PP- Pods per plant, SP- Seeds per pod, PL- Pod Length, 100 SW- 100 Seed weight, BY- Biological yield per plant, GY- Grain yield per plant, HI- Harvest index

D2-analysis grouped the 20 accessions into six clusters. Based on observations of 11 characters the Mahalanobis's D^2 statistics was analyzed for all probable $n(n-1)/2 = 190$ pairs of genotypes in order

to assess the genetic diversity present among the genotypes under study. The inter and intra-cluster distances are shown in Table 5.

Table 4: Cluster means for 11 characters in 20 genotypes of cowpea

Cluster	DF	DM	PH	BP	PP	SP	PL	100 SW	BY	GY	HI
I	53.7	75.5	39.5	5.4	13.9	11.5	14.0	15.9	39.5	16.0	40.6
II	59.1	76.6	44.0	5.4	16.2	12.0	14.5	13.1	42.6	16.9	39.9
III	61.5	78.1	55.7	5.2	16.1	13.0	14.6	10.4	43.6	18.1	41.7
IV	53.3	75.0	41.4	4.4	9.7	11.2	16.5	19.0	36.6	14.4	39.2
V	56.0	75.0	45.0	4.7	11.3	12.4	11.9	9.8	28.4	11.6	40.5
VI	52.0	75.3	51.2	5.7	21.9	12.2	11.1	7.5	38.8	18.2	46.8

DF- Days to flowering, DM- Days to maturity, PH- Plant height, BP- Number of branches per plant, PP- Pods per plant, SP- Seeds per pod, PL- Pod Length, 100 SW- 100 Seed weight, BY- Biological yield per plant, GY- Grain yield per plant, HI- Harvest index

Cluster mean analysis

Comparison of cluster mean for different characters (Table 4.) indicated considerable differences between clusters for all the characters. Maximum mean for days to flowering (61.56) was observed in cluster III followed by cluster II (59.17), and minimum (52.00) in cluster VI. Tallest plants height were recorded in cluster III (55.78 cm) followed by cluster VI (51.27 cm), and dwarf (39.52

cm) in cluster I. Branches per plant were maximum in cluster VI (5.73), and minimum (4.43) in cluster IV. The highest number of pods per plant was recorded in cluster VI (21.90) and lowest in cluster IV (9.73). Cluster IV had maximum (16.53 cm) pod length and minimum (11.93 cm) in cluster V. Number of seeds per pod has recorded maximum in cluster III (13.09) and minimum (11.23) in cluster IV. The 100-seed weight was maximum in cluster IV (19.03 g)

Table 5: Average inter and intra cluster distance ($D=\sqrt{D^2}$) values in 20 genotypes of cowpea

	I	II	III	IV	V	VI
I	8.55	13.53	22.12	13.20	19.01	25.78
II		9.89	13.50	21.92	13.67	18.31
III			9.36	30.83	13.56	13.55
IV				8.52	28.42	36.07
V					0.00	10.50
VI						0.00

minimum (7.50 g) in cluster VI. Cluster I showed maximum (43.60) biological yield per plant and minimum (28.44) in cluster V. Cluster VI showed highest mean (18.21 g) grain yield and lowest (11.60

g) in cluster V. Maximum mean (46.81) of harvest index was recorded in cluster VI and minimum (39.26) in cluster VI.

Contribution of different characters to divergence

The characters 100- seed weight (71.58%) was the main contributor to the total genetic divergence. Biological yield per plant (9.47%), pod length (5.26%), number of branches per plant (5.26%), plant height (4.21%) and days to flowering (2.63%) contributed moderately and pods per plant showed small contribution, while the characters days to maturity, seeds per pod and harvest index showed 0.00 % contribution towards total genetic divergence.

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