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CHARACTERISATION OF COWPEA GENOTYPES BASED ON QUANTITATIVE DESCRIPTORS

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ABSTRACT
An experiment was conducted to characterise 35 cowpea genotypes using different quantitative descriptors at plant level. Highly significant differences were obtained among the genotypes for all characters under study. Based on the variation obtained, 35 genotypes were grouped into different categories. All characters were found stable and reliable for classification except for characters number of pods per peduncle and seed yield per hectare. Hence, it's reliable to consider these stable characters in future breeding programmes of cowpea crop and quality seed production and also in protection in plant variety.

INTRODUCTION

Cowpea (*Vigna unguiculata* (L.) Walp.), a member of the family *Fabaceae*, is a crop grown throughout the tropics and the substropics covering Africa, Asia, South America, parts of Southern Europe and the United States (Singh *et al*., 1997). It has been estimated that the total production of cowpeas for dry seeds is 5.5 million tones and the total area grown was 10.5 million hectare (Anonymous, 2010).

Cowpea is chiefly a vegetable and grain crop for human who values it as a nutritional supplement to cereals and an extender of animal proteins, it provides a very safe fodder for livestock animals. Cowpea has vast utility in the food culture of both man and animal (Tarawali *et al*., 2002; Diouf and Hilu, 2005; Fang *et al*., 2007).

Increasing major components of grain yield such as pods/ plant, pod length, seeds/pod and seed size will allows improving cowpea yield potential. The variability of these morphological traits has been reported from different authors, as Patil and Baviskar (1987), Sardana *et al*. (2001), Mishra *et al*. (2002), Carnide *et al*. (2007).

Sarutayophat *et al*. (2007) characterized 13 cowpea accessions based on growth habit, days to 50 per cent flowering, pod colour, pod length, number of pods per plant, seed yield per plant. Stoilova and Pereira (2013) had used 24 different morphological descriptors in order to identify accessions with specific behaviour that could be exploited by plant breeders and they found that descriptors like pod length, number of seeds per pod, seed thickness and 100 seed weight were the most stable traits and they concluded these characters can be used in characterisation.

Exchange of seeds is essential for plant breeder to improve genetic variability of available germplasm for recombination and selection of desired traits. Characterization and identification of plant varieties are thus, fundamental to the development, release and popularization of the crop varieties. In this context, varietal description for identification of crop variation has attained a critical importance in national and international seed programmes and there is considerable need for the development of reliable methods and identifiable characters for identification purpose.

Plant morphological characters have been recognized as the universally undisputed descriptors for protection and varietal characterization of crop varieties**.** Use of morphological descriptors in sequential fashion is useful and convenient to discriminate the different varieties (Joshi *et al*., 2011). Characterisation can be done by using morphological characteristics or molecular markers, or both. Morphological descriptors have traditional significance and one can immediately accessible on the spot without the need of equipment. Although has its limitations like environmental influence and time consuming but this has been universally adopted as classical taxonomic approach.

On the other hand any new crop variety is registered if it is distinct from other varieties, uniform in its characteristics and genetically stable. Identification of variety serves an important role in seed production. Keeping in view all above facts, the present investigation was carried out to characterise and identify the stable diagnostic characteristics based on quantitative characteristics.

MATERIALS AND METHODS

The field experiment was conducted at Main Agricultural Research Station (latitude 15^0 26^1 N, longitude 75° 07' E, altitude 678 m), University of Agricultural Sciences, Dharwad during *kharif* 2009. The seeds of 35 cowpea genotypes (Table 1) were obtained from the Department of Genetics and Plant Breeding, College of Agriculture, Dharwad. Sowing was done with spacing of 60 cm between rows and 30 cm between the plants. Before sowing the seeds were treated with thiram @ 2 g per kg of seed to control seed borne disease. Thinning was done 15 days after sowing to retain one plant per hill. Each entry was sown in 5 m length in four rows and field experiment was laid out in a Randomized Completely Block Design (RCBD) with three replications.

Five plants were randomly selected in each genotype and replication. The following quantitative characters were studied viz., days to 50 per cent flowering, plant height (cm), number of primary branches per plant, number of clusters per plant, number of pods per peduncle, number of pods per plant, days to maturity, pod length (cm), number of seeds per pod, seed yield per plant (g) and seed yield per hectare (kg). The mean values of the genotypes in each replication were used for analysis of variance. Results and values were subjected to randomized complete block design as per the method out lined by Sundarraj *et al*. (1972). Critical differences were calculated at five per cent level. Based on the variation obtained, genotypes were grouped according to International Board for Plant Genetic Resources (IBPGR) descriptors for cowpea (Anonymous, 1983).

RESULTS AND DISCUSSION

The accurate description and identification of cowpea varieties are crucial for variety protection. The identity/profiles of cowpea varieties were established by using a set of morphological characteristics prescribed in the cowpea descriptors. These characteristics are useful to establish

Table 1: Grouping of cowpea genotypes based on 50 per cent flowering, plant height and number of primary branches per plant

S. no.	Genotypes	Days to 50% flowering	Group	Plant height (cm)	Group	Number of primary branches per plant	Group
1	IC257413	53.33	Late	22.36	Medium	6.67	High
2	IC97787	51.67	Medium	21.05	Medium	5.33	Medium
3	IC198323	50.33	Medium	17.50	Medium	6.00	Medium
4	IC198326	46.67	Early	14.67	Dwarf	5.00	Medium
5	IC198333	48.67	Medium	15.80	Medium	5.50	Medium
6	IC198335	49.00	Medium	22.07	Medium	5.84	Medium
7	IC198349	52.67	Late	17.62	Medium	5.66	Medium
8	IC198361	52.67	Late	9.93	Dwarf	4.34	Medium
9	IC198701	51.33	Medium	16.85	Medium	4.69	Medium
10	IC201087	49.33	Medium	21.98	Medium	4.50	Medium
11	IC202789	50.33	Medium	16.50	Medium	7.00	High
12	IC202806	46.00	Early	23.00	Medium	5.00	Medium
13	IC202867	50.00	Medium	16.80	Medium	5.34	Medium
14	IC202868	49.33	Medium	19.03	Medium	5.00	Medium
15	IC202881	51.00	Medium	22.60	Medium	5.83	Medium
16	IC214757	50.67	Medium	25.93	Medium	4.17	Medium
17	IC219574	46.00	Early	13.20	Dwarf	5.75	Medium
18	IC219599	50.00	Medium	21.37	Medium	7.17	High
19	IC212871	46.33	Early	20.82	Medium	4.83	Medium
20	IC212872	47.33	Early	19.22	Medium	4.67	Medium
21	IC249583	48.33	Medium	16.58	Medium	6.08	High
22	IC253181	50.33	Medium	24.50	Medium	6.75	High
23	IC253268	50.00	Medium	13.87	Dwarf	5.50	Medium
24	IC253270	47.33	Early	19.40	Medium	5.59	Medium
25	IC253273	47.67	Early	23.75	Medium	5.00	Medium
26	IC253275	49.33	Medium	21.84	Medium	5.08	Medium
27	IC257407	50.33	Medium	22.73	Medium	6.50	High
28	IC259159-1	47.67	Early	21.25	Medium	4.80	Medium
29	IC259159-2	45.33	Early	18.08	Medium	5.42	Medium
30	IC202784	49.67	Medium	20.00	Medium	6.42	High
31	IC4506	50.00	Medium	20.47	Medium	4.80	Medium
32	IC5969	49.33	Medium	18.52	Medium	5.50	Medium
33	Mumbai local	45.67	Early	24.28	Medium	3.67	Less
34	Bailhongal local	49.33	Medium	25.55	Tall	6.60	High
35	C-152	55.67	Late	29.88	Tall	5.67	Medium
Mean		49.39		19.97		5.47	
SEm ±		0.88		1.55		0.45	
CD (0.05)		2.48		4.45		1.31	

Days to 50 per cent flowering
Early : ≤ 48 DAS
Medium : 48 - 52 DAS
Late : > 52 DAS

Plant height (cm)
Dwarf : ≤ 15 cm
Medium : 15 - 25 cm
Tall : > 25 cm

Primary branches/plant
Less : ≤ 4
Medium : 4 - 6
High : > 6

Table 2: Grouping of cowpea genotypes based on number of clusters per plant, number of pods per peduncle and number of pods per plant

S. no.	Genotypes	Number of clusters per plant	Group	Number of pods per peduncle	Group	Number of pods per plant	Group
1	IC257413	42.33	Medium	2.00	Few	63.33	High
2	IC97787	47.08	More	2.75	More	78.67	High
3	IC198323	45.75	More	2.00	Few	81.92	High
4	IC198326	32.33	Medium	2.00	Few	59.17	Moderate
5	IC198333	43.17	Medium	1.80	Few	65.34	High
6	IC198335	31.97	Medium	2.10	More	51.44	Moderate
7	IC198349	25.58	Medium	2.45	More	45.59	Moderate
8	IC198361	23.30	Less	2.00	Few	34.58	Less
9	IC198701	36.20	Medium	1.80	Few	53.60	Moderate
10	IC201087	26.59	Medium	2.15	More	47.25	Moderate
11	IC202789	46.10	More	3.00	More	105.25	Very high
12	IC202806	62.55	More	1.80	Few	77.33	High
13	IC202867	27.39	Medium	1.80	Few	38.25	Less
14	IC202868	20.50	Less	2.30	More	45.40	Moderate
15	IC202881	35.34	Medium	2.84	More	63.50	High
16	IC214757	29.17	Medium	2.33	More	46.50	Moderate
17	IC219574	53.00	More	2.17	More	82.42	High
18	IC219599	34.75	Medium	1.33	Few	55.00	Moderate
19	IC212871	38.83	Medium	1.83	Few	61.84	High
20	IC212872	30.92	Medium	1.83	Few	47.25	Moderate
21	IC249583	47.33	More	2.42	More	85.75	High
22	IC253181	57.50	More	2.00	Few	95.50	Very high
23	IC253268	34.17	Medium	1.50	Few	43.67	Moderate
24	IC253270	69.83	More	2.17	More	107.00	Very high
25	IC253273	35.50	Medium	2.00	Few	52.83	Moderate
26	IC253275	32.84	Medium	1.67	Few	46.75	Moderate
27	IC257407	28.16	Medium	2.50	More	62.08	High
28	IC259159-1	37.55	Medium	2.20	More	62.50	High
29	IC259159-2	25.59	Medium	2.17	More	51.17	Moderate
30	IC202784	40.63	Medium	2.00	Few	55.50	Moderate
31	IC4506	35.40	Medium	2.10	More	74.90	High
32	IC5969	34.83	Medium	2.00	Few	64.17	High
33	Mumbai local	17.67	Less	1.33	Few	23.47	Less
34	Bailhongal local	33.74	Medium	2.13	More	57.00	Moderate
35	C-152	39.85	Medium	2.00	Few	56.17	Moderate
Mean		37.24		2.07		61.20	
SEm ±		2.09		0.18		6.27	
CD (0.05)		6.02		0.52		18.03	

Number of clusters/plant
Less : ≤ 25
Medium : 25 - 45
More : > 45

Number of pods/peduncle
Few : < 2
More : > 2

Number of pods/plant
Less : ≤ 40
Moderate : 40 - 60
High : 60 - 90
Very high : > 90

distinctiveness, uniformity and stability of a variety, based on which the variety is given protection.

The range and mean for number of days to 50 per cent flowering of the genotypes studied are presented in Table 1. Ten genotypes were the first to flower within 48 days suggesting early (<48 DAS). The genotype IC259159-2 flowered first in 45.33 days after sowing (DAS). Four genotypes registered the longest days to flower, they were late (>52 DAS). Among the four genotypes that flowered late (>52 DAS), genotype C-152 recorded the longest time of flowering (55.67 DAS). Remaining all were medium (48-52 DAS) in days to 50 per cent flowering. The mean value of 49.39 days to flowering recorded in present study. Similar type of classification also was used by Stoilova and Pereira (2013) in cowpea. Reasons attributed for difference in days to flowering among the genotypes is that, the character is dependent on a minor gene complex (Weiss, 1971) and Adu-Dapaah *et al*. (1988) also observed tendency for dominance of early flowering in cowpea. The environmental conditions also have selective influence on flowering.

The plant height is one of the important characteristic, which helps in differentiating the genotypes. Based on this character, the genotypes were grouped under dwarf, medium and tall. The cowpea genotypes exhibited significant variability in plant height ranging from 9.93 cm (IC198361) to 29.88 cm (C-152) with a mean height of 19.97 cm. The genotypes C-152 and Bailhongal local were in tall; four were dwarf and remaining genotypes were medium in height. The results are in accordance with Nkouannessi (2005) and Lingaraj (2009) in cowpea. Wide variation in plant height was due to genetic characters of the varieties and also might be influenced by agronomical and environmental conditions.

The number of primary branches determines ultimately, the pod bearing ability of plant which will intern contributes to the yield, hence identification and selection of genotypes with more branching ability is necessary. In the present study, the genotypes exhibited varied branching ability ranging from 3.67

Table 3: Grouping of cowpea genotypes based on days to maturity, pod length and number of seeds per pod

S. no.	Genotypes	Days to maturity (DAS)	Group	Pod length (cm)	Group	Number of seeds per pod	Group
1	IC257413	87.33	Medium	18.27	Medium	16.55	Medium
2	IC97787	87.67	Medium	18.03	Medium	15.40	Medium
3	IC198323	97.00	Late	18.07	Medium	16.88	Medium
4	IC198326	84.00	Early	19.93	Medium	16.08	Medium
5	IC198333	86.00	Medium	15.30	Medium	16.06	Medium
6	IC198335	85.00	Early	19.77	Medium	20.08	High
7	IC198349	89.00	Medium	17.70	Medium	18.13	High
8	IC198361	90.33	Medium	20.10	Long	18.50	High
9	IC198701	89.00	Medium	19.27	Medium	17.25	Medium
10	IC201087	87.33	Medium	17.50	Medium	15.00	Medium
11	IC202789	93.00	Medium	17.10	Medium	18.85	High
12	IC202806	94.00	Medium	17.43	Medium	16.50	Medium
13	IC202867	97.33	Late	16.23	Medium	15.50	Medium
14	IC202868	84.67	Early	20.30	Long	15.25	Medium
15	IC202881	94.00	Medium	18.20	Medium	17.00	Medium
16	IC214757	87.00	Medium	14.37	Short	9.53	Low
17	IC219574	83.33	Early	18.63	Medium	18.52	High
18	IC219599	87.67	Medium	25.77	Long	14.62	Medium
19	IC212871	84.67	Early	19.43	Medium	17.75	Medium
20	IC212872	84.00	Early	20.80	Long	14.04	Medium
21	IC249583	87.33	Medium	24.00	Long	17.53	Medium
22	IC253181	93.33	Medium	16.80	Medium	16.75	Medium
23	IC253268	96.33	Late	19.07	Medium	15.13	Medium
24	IC253270	90.00	Medium	18.33	Medium	17.25	Medium
25	IC253273	90.67	Medium	22.37	Long	15.03	Medium
26	IC253275	95.33	Late	24.77	Long	15.75	Medium
27	IC257407	91.67	Medium	18.40	Medium	15.01	Medium
28	IC259159-1	92.33	Medium	14.70	Short	13.25	Low
29	IC259159-2	96.33	Late	16.30	Medium	13.75	Low
30	IC202784	90.67	Medium	18.60	Medium	15.00	Medium
31	IC4506	82.33	Early	12.53	Short	14.75	Medium
32	IC5969	90.00	Medium	15.27	Medium	15.25	Medium
33	Mumbai local	85.67	Medium	21.13	Long	14.50	Medium
34	Bailhongal local	85.00	Early	20.37	Long	18.85	High
35	C-152	96.00	Late	17.60	Medium	17.62	Medium
Mean		89.58		18.64		16.08	
SEm ±		1.27		0.42		0.52	
CD (0.05)		3.60		1.17		1.50	

Days to maturity
Early : ≤ 85 DAS
Medium : 85 - 95 DAS
Late : > 95 DAS

Pod length (cm)
Short : ≤ 15 cm
Medium : 15 - 20 cm
Long : > 20 cm

Number of seeds/pod
Low : ≤ 14
Medium : 14 - 18
High : > 18

(Mumbai local) to 7.17 (IC219599) with a mean branches of 5.47. Based on this, 35 genotypes grouped into less (<4), medium (4-6) and high (>6). Only one genotype Mumbai local had less, eight genotypes were high and remaining genotypes were medium. From the study it was clearly indicated that most of genotypes were bearing high number of branches. Similar observations were reported by Nkouannessi (2005) and Lingaraj (2009) in cowpea. The variation in the branches was mainly due to genetic factors and it also affected by environmental condition, sowing seasons, seed rate and spacing (Weiss, 1971).

The grouping of genotypes was made based on the number of clusters per plant, number of pods per peduncle and the number of pods per plant as given in Table 2. The number of clusters per plant varied significantly among all the genotypes and ranged from 17.67 (Mumbai local) to 69.83 (IC253270). Based on this character, the genotypes were grouped as less (IC198361, IC202868 and Mumbai local), medium (24 genotypes) and more (eight genotypes). The number of pods per peduncle also varied significantly among the genotypes and ranged from 1.33 (Mumbai local) to 3.00 (IC202789) with mean number of 2.07. Based on this variation, fair grouping was made as few (<2.0) and more (>2.0). The number of pods per plant varied among the genotypes with highest pods noticed in the genotype IC253270 (107.00) and least was observed in genotype Mumbai local (23.47). Based on this character, the genotypes were grouped as less (<40), moderate (40-60), high (60-90) and very high (>90) pod bearing types. The genotypes IC202789 (105.25), IC253181 (95.50) and IC253270 (107.00) recorded superiorly very high number of pods per plant. Similar variations were observed by Nkouannessi (2005), Sarutayophat *et al*. (2007), Stoilova and Berova (2009), Lingaraj (2009) in cowpea; Yadav and Srivastava (2002), Gnyandev (2009) in chickpea. The variation in these characters may be due to genotypic ability of plant itself and varied response to environmental conditions and

Table 4: Grouping of cowpea genotypes based on seed yield per plant and seed yield per hectare

Sl. no.	Genotypes	Seed yield per plant (g/plant)	Group	Seed yield per hectare (kg/ha)	Group
1	IC257413	73.90	High	1683.8	High
2	IC97787	51.19	Moderate	1380.9	Moderate
3	IC198323	59.79	Moderate	1677.2	High
4	IC198326	45.53	Moderate	1006.6	Low
5	IC198333	47.95	Moderate	1378.3	Moderate
6	IC198335	77.02	High	1982.8	High
7	IC198349	63.16	Moderate	1365.0	Moderate
8	IC198361	74.96	High	2068.7	Very high
9	IC198701	51.24	Moderate	944.5	Low
10	IC201087	47.59	Moderate	1447.1	Moderate
11	IC202789	87.00	High	1761.3	High
12	IC202806	53.13	Moderate	1420.6	Moderate
13	IC202867	27.16	Low	1035.7	Low
14	IC202868	38.51	Low	911.4	Low
15	IC202881	104.86	Very high	3194.4	Very high
16	IC214757	44.03	Moderate	1041.0	Low
17	IC219574	108.11	Very high	2218.3	Very high
18	IC219599	77.88	High	1648.1	High
19	IC212871	32.96	Low	828.5	Low
20	IC212872	45.97	Moderate	910.0	Low
21	IC249583	37.32	Low	1035.7	Low
22	IC253181	110.01	Very high	1764.0	High
23	IC253268	54.43	Moderate	1751.3	High
24	IC253270	71.00	High	1614.8	High
25	IC253273	61.35	Moderate	1460.3	Moderate
26	IC253275	46.15	Moderate	1141.5	Moderate
27	IC257407	45.53	Moderate	1338.6	Moderate
28	IC259159-1	38.43	Low	1138.9	Moderate
29	IC259159-2	34.44	Low	1228.8	Moderate
30	IC202784	36.04	Low	697.6	Low
31	IC4506	43.94	Moderate	1457.7	Moderate
32	IC5969	61.39	Moderate	1783.1	High
33	Mumbai local	20.94	Low	564.1	Low
34	Bailhongal local	63.75	Moderate	1480.1	Moderate
35	C-152	62.59	Moderate	2078.0	High
Mean		57.69		1405.4	
SEm ±		7.35		121.0	
CD (0.05)		21.12		347.7	

Seed yield/plant (g)
Low : ≤ 40 g
Moderate : 40 - 70 g
High : 70 - 100 g
Very high : > 100 g

Seed yield/hectare (kg/ha)
Low : ≤ 1100 Kg/ha
Moderate : 1100 - 1600 Kg/ha
High : 1600 - 2000 Kg/ha
Very high : > 2000 Kg/ha

nutritional status of the soil to some extent.

The mean and range of days to maturity of genotypes studied is given in Table 3. It took between 82.33 (IC4506) to 97.33 (IC202867) days after sowing for all the genotypes to attain full maturity. The results indicated that eight were grouped as early (<85 days), six were grouped as late (>95 days) and remaining all were grouped as medium (85-95 days). Similar type of variation and grouping was reported earlier by Stoilova and Berova (2009) in cowpea; Tarasatyavathi *et al*. (2004) in soybean; Yadav and Srivastava (2002) in chickpea. Though the duration of the crop growth is a genetically controlled character, it is also influenced by the environment and crop growth conditions such as soil moisture *etc*. The pod length varied among the genotypes. Based on this variation in pod length, the genotypes were grouped as short (<15 cm), medium (15-20 cm) and long (>20 cm). The largest was recorded in IC219599 (25.77 cm) and shortest was in IC4506 (12.53 cm) with mean pod length of 18.64 cm. Among the 35 genotypes, three were short, nine were long and remaining genotypes were medium. Similar grouping was reported by Jain and Khare (2002) in green gram. Cobbinah *et al*. (2011) opined that cowpea accessions with longer pods were easily visible and firmly held during harvesting. Attention should therefore be paid to such accessions since they enhance the rate of harvesting of cowpea.

The variation in number of seeds per pod also found significant. Based on variation, cowpea genotypes were grouped into low (<14), medium (14-18) and high (>18) number of seeds per pod. The highest number of seeds were recorded in IC198335 (20.08) and lowest in IC214757 (9.53). Similar difference in seed number was noticed by Nkouannessi (2005), Naima *et al*. (2010) in cowpea. Singh *et al*. (1997) reported that the number of seeds per pod is moderately to highly heritable with an average habitability value of 64 per cent.

The seed yield per plant and per hectare was also varied

significantly with genotypes (Table 4). Based on seed yield per plant and per hectare, the genotypes were grouped into four categories as low, moderate, high and very high. With respect to seed yield per plant concern, the seed yield ranged from 20.94 g (Mumbai local) to 110.01 g (IC253181) with mean of 57.69 g, while seed yield per hectare concern, it ranged from 564.1 kg (Mumbai local) to 3194.4 kg (IC202881) with average yield of 1405.4 kg. Similar variation and classification was reported earlier by Sarutayophat *et al*. (2007), Stoilova and Berova (2009) in cowpea.

Among the descriptors used for characterization all were found stable and reliable for classification except for characters number of pods per peduncle and seed yield per hectare.

It may be concluded that the morphological descriptors can be effectively used for identification and grouping of varieties and characters which are stable and reliable could be used for protection plant varieties for obtaining Plant breeders and Farmers' rights. However, morphological descriptors alone may not be sufficient. Hence, some other markers/descriptors could be considered for complementing the morphological descriptors.

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