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Evaluation of Cowpea Germplasm by using Agro-Morphological Characters

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ABSTRACT

Background: Cowpea (*Vigna unguiculata* L.) is the most important and diverse grain legume crop grown in tropics and subtropics. Assessment of local and regional plant genotypes is important for identifying diversity among germplasm and for crop improvement. The objective of present study was to characterize cowpea accessions collected from various households of western Maharashtra, India by using morphological traits.

Methods: The field experiments were conducted on cowpea (*Vigna unguiculata* L.) at BAIF-CRS Urulikanchan, during *Kharif* 2018 and summer 2019. The experiments were arranged in row design with minimum 10 individuals of each accessions spaced at 60 x 30 cm. Recommended package of practices were adopted throughout experimentation.

Result: Traits such as semi-prostrate habit (41.9 percent), determinate growth (77.4 percent), straight pod (51.6 percent), smooth seed (71.0 percent), elliptic shape (67.7 percent) and yellowish-white seed colour (37.6 percent) were dominant in studied accessions. Time for first flowering ranged from 28 to 65 days; pod length ranged between 9.60 cm to 27.48 cm; seeds per pod observed between 7.20 to 16.40; 100-seed weight ranged between 12.00 to 36.00 g. Analysis of variance showed that all the characters were highly significant among the accessions. Results revealed that studied accessions are valuable germplasm for future breeding programs.

Key words: Cowpea, Characterization, Germplasm.

INTRODUCTION

Vigna Savi is a large pantropical genus with 104 species (Lewis *et al*., 2005). India is represented with 24 species of *Vigna* (Sanjappa, 1992) and probable secondary centre of species diversification. Cowpea (*Vigna unguiculata* L.) is the most important grain legume crop grown in tropical and subtropical regions of the world (Deshpande *et al*., 2018). Cowpea is important legume grown over 12 million hectares worldwide (FAO 2017). India is one of major grower of the cowpea as it grown in an area of about 3.9 million hectors. (Kalpana, 2000). The cowpea seeds are most often consume but young leaves, fresh or dry seeds and young pods served as valuable source of protein in human diets. The seeds contain 1.8% fat and 60.3% carbohydrates and a rich source of calcium and iron (Mafakheri, *et al*., 2017). Cowpea is also cultivated as a fodder and it has vigorous vegetative growth and covers the ground so well that it checks the soil erosion.

Assessment of local and regional plant genotypes is important for identifying diversity among germplasm and for crop improvement (Mafakheri, *et al*., 2017). Documentation, characterization and exploitation of traditional local populations could contribute to their conservation and utilization as sources of desirable characteristics (Lazaridi *et al*., 2017). Moreover, the characterization data on various morphological traits is fundamental to handling germplasm at seed banks. The objective of present study was to characterize cowpea accessions collected from various households of western Maharashtra, India by using morphological traits.

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MATERIALS AND METHODS

Thirty-one accessions of cowpea (Table 1) were collected from various villages in Palghar, Sindhudurg, Ahmednagar and Satara districts of Maharashtra during 2016-2017. The field experiments were conducted at BAIF Central Research Station Urulikanchan, during July to October (*Kharif*) 2018 and March to June (summer) 2019. The experiments were arranged in row design with minimum 10 individuals of each accessions spaced at 60 cm row to row and 30 cm plant to plant. Recommended package of practices were adopted throughout experimentation.

The visual observations were recorded on 15 qualitative traits (growth habit, growth pattern, stem pigmentation, leaf colour intensity, raceme position, pod twisting, pod curvature, pod color intensity, pod pigmentation pattern, pod texture, seed texture, seed shape, seed main color, seed secondary color, hilum colour. The quantitative traits *viz*. leaf length, leaf width, pods per inflorescence, pod length, pod width,

Table 1: Details of cowpea landrace collection.

#	Accession code	Local denomination	Collection localities	Habit
1.	CP-1	*Halvi Chavali*	Jawhar, Palghar	Bush
2.	CP-2	*Kalya Danyacha Chavala*	Jawhar, Palghar	Bush
3.	CP-3	*Gabra Lamb Chavali*	Jawhar, Palghar	Bush
4.	CP-4	*Bangadi Chavali*	Jawhar, Palghar	Bush
5.	CP-5	*Bhajichi Chavali*	Jawhar, Palghar	Bush
6.	CP-6	*Nimgaravi Barik Chavali*	Jawhar, Palghar	Bush
7.	CP-7	*Gara Chavala*	Jawhar, Palghar	Bush
8.	CP-8	*Madkasarya Chavala*	Jawhar, Palghar	Climber
9.	CP-9	*Rabi Khuchi Chavali*	Jawhar, Palghar	Bush
10.	CP-10	*Para Chavala*	Jawhar, Palghar	Climber
11.	CP-11	*Jambada Gara Chavali*	Jawhar, Palghar	Bush
12.	CP-12	*Jadi Chavali*	Kudal, Sindhudurg	Bush
13.	CP-13	*Madhyam Chavali*	Kudal, Sindhudurg	Bush
14.	CP-14	*Mothi Chavali*	Kudal, Sindhudurg	Climber
15.	CP-15	*Dagade Wal*	Kudal, Sindhudurg	Climber
16.	CP-18	*Butake Wal*	Kudal, Sindhudurg	Climber
17.	CP-19	*Safed Wali*	Kudal, Sindhudurg	Climber
18.	CP-20	*Lal Wal*	Kudal, Sindhudurg	Climber
19.	CP-21	Local collection -21	Khatav, Satara	Bush
20.	CP-22	Local collection -22	Khatav, Satara	Bush
21.	CP-23	Local collection -23	Khatav, Satara	Bush
22.	CP-24	Local collection -24	Khatav, Satara	Bush
23.	CP-25	Local collection -25	Khatav, Satara	Bush
24.	CP-26	Local collection -26	Khatav, Satara	Bush
25.	CP-27	Local collection -27	Khatav, Satara	Bush
26.	CP-28	Local collection -28	Khatav, Satara	Bush
27.	CP-29	Local collection -29	Khatav, Satara	Bush
28.	CP-30	*Kali Chavali*	Akole, Ahmednagar	Bush
29.	CP-31	*Safed Chavali*	Akole, Ahmednagar	Bush
30.	CP-32	*Gabari Chavali*	Akole, Ahmednagar	Bush
31.	CP-33	*Lal Chavali*	Akole, Ahmednagar	Bush

seeds per pod, seed length, seed width, seed thickness and 100 seed weight were recorded in five replicates. Analyses of variance performed on each morphological data to test the significance of variation between accessions by using ANOVA. Principle component analysis (PCA) was performed by using PAST software to investigate and summarize the underlying trends of variation.

RESULTS AND DISCUSSIONS

Qualitative characters

Among studied accessions semi-prostrate (41.9 percent) was dominant habit followed by semi-erect (29.0 percent), climber (12.9 percent), erect (9.7 percent) prostrate (6.5 percent). Ngompe-Deffo *et al*., 2017 also reported semi-prostrate habit was dominant trait represented by 27 percent Cameroon accessions. Majority of accessions had determinate growth (77.4 percent). Most of accessions (80.6 percent) had slightly pigmented stem followed by dark pigmented (9.7 percent) and moderately pigmented stem (9.7 percent).

Most of accessions showed dark green coloured leaves and raceme covered under canopy (80.6 percent) while 19.4 percent accessions had medium green coloured leaves and exposed racemes. Only *Lal wal* accession collected from Kudal area showed pod twisting, remaining all thirty accessions were without twisting. Straight pod (51.6 percent) was dominant trait followed by slightly curved 45.2 pods, coiled (3.2 percent) pods and curved (3.2 percent) pods. Coiled pod trait was morphological marker for *Bangadi chavali* collected from Jawhar area.

Dark green colour pods was dominant trait (45.2 percent) over medium green pods (35.5 percent) and light green pods (19.4 percent), however Rambabu *et al*., (2017) reported light green colour as dominant trait. Most of accessions pod were without any pigmentation (64.5 percent) pattern while 25.8 percent accessions showed pigmentation at only tips; irregular splashes of pigment were observed in 6.5 percent accession while only one accession (*Mothi chavali*) was observed with uniformly pigmented pods. The pod texture varies as smooth (45.2 percent), slightly

rough (29.0 per cent), moderately rough (19.4 per cent) and rough (6.5 per cent).

Among studied accessions, smooth seed texture (71.0 per cent) was dominant trait over wrinkled seed. Seed shape varies as elliptic, curved and kidney shaped; among which elliptic shape was dominant (67.7 per cent) however Rambabu *et al*., (2017) reported kidney seed shape was dominant. Seed colour was most varied character among evaluated accessions; yellowish white (37.6 per cent) was most dominant seed colour followed by brownish yellow (22.6 per cent) and purplish brown (9.7 per cent). Black and reddish brown seed colour observed in 6.5 percent accessions. Yellowish purple, yellowish brown, gray, brown and purplish yellow seed color were shown by each single accession. Blotchy pattern on seed surface was observed in 16.1 per cent accessions while 83.9 per cent showed uniform seed main color. However, area around hilum showed brown colour in narrow area (48.4 per cent), black colour in narrow area (19.4 per cent) black colour in wider area (3.2 per cent) brown colour in wider area (3.2 per cent) and 25.8 per cent accessions are without distinct colour at hilum.

Principal components analysis (PCA) performed for all multivariate data derived from qualitative characters with respect to each accession. The studied 31 accessions forms three groups based on PCA as shown in Fig 1. The analysis revealed that accessions CP-14, CP-12, CP-21, CP-22, CP-23, CP-25 (Group I) while CP-9, CP-19, CP-27, CP-31, CP-

Table 2: Quantitative characters of cowpea accessions.

Landrace	Leaf Length (cm)	Leaf Width (cm)	Petiole Length (cm)	Pod Length (cm)	Pod Width (cm)	Seeds/ Pod	Seed Length (cm)	Seed Width (cm)	Seed Thickness (cm)	100 Seed Weight (g)
CP-1	9.82	7.28	9.38	15.62	0.74	14.00	0.68	0.56	0.40	15.60
CP-2	11.28	6.88	10.40	11.96	0.88	9.00	0.68	0.62	0.50	15.00
CP-3	11.34	7.30	8.70	10.38	0.82	11.40	0.64	0.56	0.44	17.80
CP-4	10.06	4.66	5.50	12.92	0.72	8.80	0.68	0.58	0.52	12.80
CP-5	12.98	9.62	10.50	14.26	0.68	10.20	0.74	0.56	0.50	12.40
CP-6	10.90	7.60	9.40	13.74	0.60	7.20	0.74	0.56	0.46	18.00
CP-7	10.56	7.72	12.20	16.20	0.72	15.80	0.72	0.60	0.46	21.80
CP-8	12.30	8.90	8.20	13.18	0.98	13.60	0.66	0.62	0.54	19.00
CP-9	8.00	5.74	9.00	12.58	0.68	13.20	0.74	0.60	0.52	19.80
CP-10	10.36	8.50	9.90	16.30	0.64	15.80	0.66	0.58	0.50	18.40
CP-11	10.46	5.60	8.10	13.70	0.70	12.80	0.62	0.52	0.40	17.20
CP-12	10.66	6.86	8.10	16.14	0.88	8.60	0.96	0.62	0.58	20.60
CP-13	10.30	6.50	7.50	12.76	0.86	8.60	1.00	0.70	0.54	15.00
CP-14	8.76	4.98	7.48	15.46	0.76	11.40	0.98	0.74	0.60	19.60
CP-15	10.68	7.00	6.44	25.70	0.98	14.60	1.04	0.74	0.54	15.80
CP-18	10.70	7.14	8.50	27.48	1.06	14.80	1.18	0.74	0.48	36.00
CP-19	8.52	5.70	6.80	23.00	0.84	15.80	0.82	0.54	0.40	23.80
CP-20	9.72	6.50	7.40	27.46	0.86	13.00	1.12	0.70	0.48	18.40
CP-21	8.64	5.88	6.70	11.80	0.70	10.20	0.66	0.52	0.44	12.00
CP-22	8.32	5.42	7.50	11.10	0.64	12.40	0.58	0.48	0.42	19.60
CP-23	10.32	7.98	8.48	11.78	0.70	13.40	0.68	0.56	0.40	20.60
CP-24	7.70	5.86	8.16	13.32	0.48	14.60	0.46	0.40	0.36	19.60
CP-25	10.86	9.06	7.20	20.80	0.68	16.20	0.82	0.56	0.40	23.20
CP-26	9.36	7.10	8.70	9.60	0.58	12.20	0.62	0.48	0.42	19.20
CP-27	9.58	7.66	12.20	14.28	0.56	12.60	0.72	0.60	0.44	19.80
CP-28	9.20	7.48	10.16	12.98	0.62	11.20	0.72	0.56	0.40	16.60
CP-29	9.24	7.08	7.70	13.58	0.76	9.80	0.78	0.64	0.52	24.80
CP-30	9.34	7.60	10.44	22.56	0.58	15.60	0.70	0.46	0.42	20.20
CP-31	10.86	7.94	8.36	24.36	0.90	16.40	0.62	0.65	0.43	19.60
CP-32	13.08	8.38	14.88	19.70	0.84	14.60	0.64	0.54	0.42	20.00
CP-33	9.50	7.94	12.36	17.64	0.68	16.20	0.66	0.56	0.46	21.40
Range	7.7-13.08	4.66-9.62	5.5-14.88	9.6-27.48	0.48-1.06	6.8-16.4	0.46-1.18	0.4-0.74	0.36-0.6	12.4-34.8
Mean	10.06	7.05	8.77	16.87	0.75	12.80	0.77	0.59	0.46	19.68
SE m ±	0.13	0.11	0.19	0.49	0.01	0.27	0.01	0.01	0.01	0.39
CV %	16.91	19.83	28.23	37.21	19.73	26.90	24.03	16.78	16.09	25.55

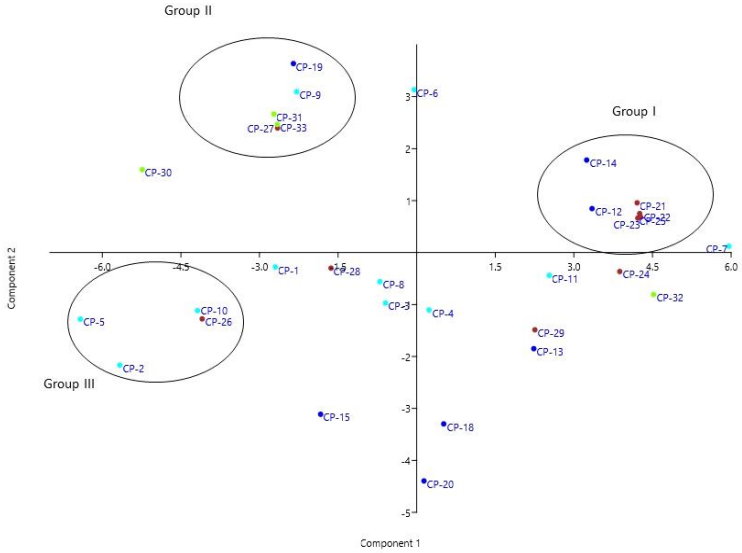

Fig 1: Principle component analysis of cowpea accessions.

33 (Group II) and CP-2, CP-5, CP-10, CP-26, (Group III) groups together and shown no association with specific vectors. Remaining accessions CP-1, CP-3, CP-4, CP-8 CP-7, CP-11, CP-13, CP-15, CP-18, CP-20, CP-24, CP-28, CP-29, CP-30 and CP-32 remains scattered with no specific association.

Quantitative characters

The mean values of quantitative characters of cowpea accessions are given in Table 2. The results of present study showed that pod length was most varied trait (37.21 per cent), followed by petiole length (28.23 per cent) and seeds per pod (26.90 per cent). Among the studied traits, seed thickness showed the lowest variation (16. 09 per cent). Analysis of variance showed that all the characters were highly significant among the accessions. The studied accessions showed leaf length ranged between 7.70 cm (CP-24) to 13.08 cm (CP-32) and leaf width ranged between 4.66 cm (CP-4) to 9.62 cm (CP-5). Petiole length ranged between 5.50 cm (CP-4) to 14.88 cm (CP-32).

Time for first flowering ranged from 28 days (CP-25) to 65 days (CP-28). Porbeni *et al*., (2016) found 40 to 60.28 days required for first flowering in Nigerian mutant lines. Pods per inflorescence ranged from 1 to 4; accessions CP-25, CP-23, CP-24 and CP-28 were found with maximum pods per inflorescence. The longest and widest pods observed in CP-18 i.e. 27.48 cm and 1.06 cm while CP-26 had shortest pod (9.60 cm) and CP-24 had narrowest pod (0.48 cm). Maximum seeds per pod observed in accession CP-31(16.40) while CP-6 had minimum (7.20) seeds per pod. Tripathi *et al*., (2019) reported longest pod (53 cm) while Patil *et al*., (2015) reported pod length between 11.16 to 17.47 cm and seeds per pod ranged between 10.36 to 14.05 in cowpea accessions collected from Sardarkhushinagar, Gujarat. The accession CP-18 exhibit longest (1.18 cm) and widest (0.74 cm) seeds while accession CP-14 had more (0.60 cm) seed thickness. The shortest (0.46 cm), narrowest (0.40 cm) and least seed thickness (0.36 cm) was observed in accession CP-24. The highest 100 seed weight was 36.00 g (CP-18) and lowest 12.00 g (CP-21). Tripathi *et al*., (2019) the 100-seed weight ranged between 4.3 to 24.42 g among studied 4,922 accessions. Depending on yield contributing characters like 100 seed weight, pod size, seeds/pod, pods per inflorescence accession CP- 25, CP-31, CP-33 found top three promising accessions. These traits are useful in varietal developmental programs and may be explored by plant breeders and researchers. Moreover, some additional studies on specific traits like stress tolerance and resistance to pest and disease may also be undertaken in future.

CONCLUSION

It could be concluded that studied cowpea accessions were morphologically distinct from each other and showed genetic diversity in many characters like growth habit, growth pattern, pod colour, pod curvature, pod length, seed colour, seeds per pod and 100 seed wt. Some accessions showed desirable characters like more pod/ inflorescence (CP-25, CP-23 CP-24 and CP- 28) profuse branching (CP-31, CP-33 and CP-30); longer pods (CP-20, CP-15 and CP-18); seeds per pod (CP-31, CP-33 and CP-25). This diverse genepool could be further useful for plant breeder in developing cowpea variety with specific traits. Moreover, the findings of the study are useful for researchers in developing Distinctness, Uniformity and Stability (DUS) testing guideline for cowpea.

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