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Morphological Characterization of Some Cowpea Accessions for Yield Improvement

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Abstract: *Study was conducted at the screen house of the International Institute for Tropical Agriculture (IITA) Kano Station to investigate the morphological characterization of twenty (20) cowpea accession sourced from different part of the world namely; Nigeria, Cameroon, Togo, USA and India for both qualitative and quantitative traits. The experiment was replicated thrice in a Completely Randomize Design (CRD) with the sole aim of determining the morphological characteristics of cowpea accessions for yield improvement. Data were collected on seed color, seed shape, seed texture, growth habit, growth pattern, leaf color, number of branches, leaf area, seed area, 100 seed weigh, shoot weight and root weight, days to emergence, plant height at 4-12 WAS. Significant variations were observed with plant height at 4-12 WAS. Among the tested accession 100% had determinant pattern of growth. Similarly, among the evaluated accessions, 4 had ovoid shaped seeded, whereas others had kidney and rhomboid shaped. Among all 11 were intermediate seeded, 6 had rough while others have smooth seed texture, with over 80% having white seed color. A positive correlation was observed between seed area and 100 seed weight as the seed area is contributing to 77% of 100 seed weight. As the seed area increased seed weight also increased. Seed area is positively associated with root weight as seed area is contributing 33% of root weight. Genotypes TVu-16467, TVu-7598 and TVu-3718 were showed to have good vegetative trait and could be used as parent breeding material. In terms of 100 seed weight and seed area TVu-10032 has good grain potential. TVu-10032, TVu-16467, TVu-3718 and TVu-7598 obtained in the research can further be exploited for the improvement of cowpea in Nigeria.*

Keywords: *Morphological, traits, cowpea, genotypes, yield.*

INTRODUCTION

Cowpea (*Vigna unguiculata* [L.] Walp) is an annual herbaceous legume of *Fabaceae* family grown predominantly in Africa and is an important staple crop providing the protein need of the ever-increasing human population that can't afford meat and milk (Muranaka *et al.,* 2016; Owolabi *et al.,* 2012). However, it differs with genotype (Ravelombola *et al.,* 2016). Cowpea productions vary to some extent according to Agro-ecological zones and genotypic attributes, with Nigeria and Niger been the highest producers respectively (Quinn, 1999; Timko & Singh, 2008). Nigeria alone produced 45% of the world cowpea on 44 million hectares of cultivated land (Dugje *et al*., 2009). Its production is under threat due to effect of some biotic and abiotic factors. Insect pest, diseases, Striga infestation, drought and heat can be considered as the major constraints to its production (Singh & Emechebe, 1997; Singh *et al*., 2002). Though some varieties are drought tolerant than others which also pose a threat to both grain and fodder yield. Morphological and physiological characteristics of seeds attributes plays a vital role towards diversification of cowpea crop which may lead to unstable production of the cowpea within its accession's genotypes. There is need to determine the extent of the diversity, screen and asses the morphological traits of the crops in order to identify high yielding, pest and disease tolerant varieties, so as to obtain a desirable

trait for farmers as well as breeding purposes that suits a particular ecology. Hence the study was conceived with the aim of determining the morphological characteristics of cowpea genotypes for yield improvement.

MATERIALS AND METHODS

A screen house experiment was carried out at the International Institute of Tropical Agriculture (IITA) Kano station, it lies at the latitude 11°30'N and longitude 8°30'E of the equator within the Sudan savanna agro ecological zone. Twenty (20) cowpea accessions obtained from different part of the world namely Nigeria, Cameroun, USA, India and Togo through International Tropical IITA station were used for the experiment which were laid out in completely randomize design (CRD) and replicated three times. Plastic pots, each measuring 15 and 18cm in diameter and depth respectively were each filled with sterilized sieved sand and top soil (sandy loam) by ratio of 2:1 (mixture of river sand and top soil). The pots were clearly labeled and arranged as per treatments basis. Prior to sowing, the pots were irrigated with water to field capacity. Single Super Phosphate fertilizer was applied at 1g pot^{-1}. Two cowpea seeds were sown per pot at depth of 3 cm and later thinned to one stand per pot at 7 days after sowing (DAS). Data on recovered lines were recorded. All other agronomic and protection practices such as weeding, insect and pathogenic organism were control as at when required. Weeding was done by hand pulling of weed species, insects and disease organisms were control by application of appropriate pesticide. Data were collected on quantitative (days to emergence, plant height at 4-12 WAS, leaf area, seed area, 100 seed weight, root weigh and shoot weight) and qualitative traits (seed color, seed shape, seed texture, growth habit, growth pattern, leaf color). Data collected were subjected to analysis of variance (ANOVA) using Statistical Analysis Software (SAS Version 9.3) and means were separated using Student Newman Keuls (SNK) test at 5% probability level. Correlation was performed to ascertain the degree of association between the characters measured.

RESULTS AND DISCUSSION

The mean performances for the morphological characterization of cowpea accessions were represented in Table 1-3. The mean performance for emergence across the genotype ranged from 1-7 days. This variation may be due to climatic conditions or genetic make-up of the cowpea accessions. Cowpea genotypes differ in days to emergence due to the differences in the thickness of the seed coat and tissue layers among the genotypes (Onyishi *et al.,* 2013). Genotype TVu-10032 produced the tallest plants (5.50 cm) while the shortest plants (3.00 cm) was recorded in TVu-3710 for plant height at 4 WAS (Table 1). At 6 WAS, genotype TVu-3717 produced the tallest plant (7.00 cm) while TVu-10032 and TVu-16467 each produced the shortest plant (3.50 cm). At 8 WAS, TVu-4, TVu-12415, TVu-12470 produced the tallest plant (9.50 cm) while the shortest (6.00 cm) plant heights were recorded with TVu-3718, TVu-10032, TVu-7598, TVu-10037 and TVu-16467. The TVu-4 accession produced the tallest plant (14.00 cm) while the shortest plant was TVu-3818 (8.00 cm) at 10 WAS. TVu-12415 and TVu-7456 recorded the tallest and shortest plant (23.30 cm & 13.75 cm) respectively at 12 WAS (Table 1).

Table 1: Mean performance of quantitative trait of cowpea accession evaluated at IITA Kano during 2020 raining season under screen house.

S/N	Accession	Days to emergence	Plant height (cm)				
			Weeks after sowing (WAS)				
			4	6	8	10	12
1	Tvu-4	5.00	4.00	6.25	9.50	14.00	19.75
2	Tvu-3710	1.00	3.00	5.50	6.50	9.50	15.50
3	Tvu-3717	7.00	4.00	7.00	9.00	11.50	16.75
4	Tvu-3718	5.00	5.00	5.50	6.00	10.50	21.60
5	Tvu-3818	10.00	4.00	5.00	6.50	8.00	17.00
6	Tvu-4275	2.00	4.00	5.00	6.50	13.00	19.80
7	Tvu-7456	5.00	4.00	3.75	6.50	9.00	13.75
8	Tvu-7509	2.00	3.85	6.50	9.00	11.50	18.85
9	Tvu-7560	7.00	5.00	5.75	9.00	11.00	15.50
10	Tvu-7562	5.00	4.50	6.00	8.50	10.50	18.00
11	Tvu-7598	1.00	4.00	4.50	6.00	9.00	16.85
12	Tvu-7605	3.00	4.50	5.50	8.50	11.50	21.00
13	Tvu-8016	3.00	4.50	5.50	7.50	10.50	20.50
14	Tvu-10032	5.00	5.50	3.50	6.00	9.00	14.00
15	Tvu-10033	2.00	4.00	5.50	7.50	13.50	24.80
16	Tvu-10037	3.00	5.00	4.00	6.00	9.50	20.50
17	Tvu-12415	7.00	4.50	6.00	9.50	10.00	23.30
18	Tvu-12470	7.00	5.00	6.00	9.50	11.00	19.85
19	Tvu-16467	5.00	3.50	3.50	6.00	8.50	17.90
20	Tvu-16510	6.00	5.00	6.00	8.00	11.00	20.30
	Mean	4.55	4.342	5.312	7.575	10.600	18.775
	SE±	0.509	0.131	0.213	0.293	0.346	0.623

Number of branches ranges between 4-17 with TVu-7605 and TVu-4 recorded the highest and least value respectively (Table 2). Leaf area was highest and lowest (101.26 cm & 29.28 cm) with TVu-3718 and TVu-3717 genotypes respectively. Variation in plant height observed at 4-12 WAS may be as a result of the environmental changes because the cowpea accessions are gotten from different parts of the world. The differences in plant height could be attributed to genetic effect of individual varieties as reported by Magani & Kuchinda, (2009). Further, TVu-12470 had the highest seed area (60.85 cm) while TVu-3717 had the least seed area (22.69 cm). The mean performance for 100 seed weight among the genotype ranged from 3-23.00 where higher mean value was observed in TVu-10032 while lowest mean was observed in TVu-3717. Shoot weight was highest (30.0 g) with TVu-3818 and lowest (3.0 g) with TVu-12470. Root weight was also highest (4.04 g) with TVu-7560 while it was lowest (0.07g) with TVu-7562.

Table 2**:** Mean performance of some quantitative traits of cowpea accession evaluated at IITA Kano during 2020 raining season under screen house.

S/N	Accession	Number of branches	Leaf area (cm^2)	Seed Area (cm)	100 seed weight (g)	Shoot weight (g)	Root weight (g)
1	TVu-4	4.00	54.00	38.45	15.00	9.00	2.61
2	TVu-3710	9.00	74.20	40.89	14.00	12.00	0.59
3	TVu-3717	11.00	29.28	22.69	3.00	11.00	0.53
4	TVu-3718	6.00	101.26	37.53	12.00	23.00	1.80
5	TVu-3818	7.00	60.00	57.00	17.00	30.00	5.54
6	TVu-4275	10.00	70.00	22.56	5.00	19.00	0.89
7	TVu-7456	6.00	61.20	49.31	17.00	20.00	0.56
8	TVu-7509	5.00	72.00	47.51	13.00	7.00	1.11
9	TVu-7560	6.00	72.00	51.13	20.00	19.00	4.04
10	TVu-7562	5.00	48.60	42.77	14.00	31.00	0.07
11	TVu-7598	9.00	100.00	43.99	10.00	23.00	0.99
12	TVu-7605	17.00	86.45	40.27	14.00	17.00	1.05
13	TVu-8016	6.00	44.00	37.63	16.00	19.00	0.66
14	TVu-10032	10.00	44.00	50.58	23.00	14.00	0.63
15	TVu-10033	8.00	55.20	50.60	14.00	8.00	0.80
16	TVu-10037	9.00	70.35	30.78	12.00	19.00	0.43
17	TVu-16467	6.00	93.60	45.70	7.00	26.00	0.38
18	TVu-16510	9.00	37.26	52.26	21.00	19.00	1.47
19	TVu-12415	10.00	68.00	45.85	18.00	15.00	0.59
20	TVu-12470	5.00	69.30	60.85	22.00	3.00	0.81
	Mean	7.900	65.535	43.417	14.350	17.200	1.278
	SE±	0.668	4.451	2.251	1.195	1.671	0.301

Of all the genotypes tested, nine (9) originated from Nigeria, while Togo, Cameroun and USA each had three (3) genotypes and India had two (2) from their shows (Table 3). For the cowpea genotypes tested, fourteen (14) had white seed color while others are between brown and variegated seed color. Greater proportion (> 50%) of the genotypes tested had kidney-shape, followed by rhomboid shape (35%) while the least (15%) was those with ovoid shape. Seed texture ranges from smooth, rough to intermediate. This was in line with the findings of Timko and Singh, (2008) & Doumbia (2012) who reported variation in seed coat texture (such as smooth, rough, or wrinkled), and color (white, cream, green, buff, red, Brown, black), and uniformity (solid, speckled, or patterned) of cowpea genotypes. Of all the genotypes tested in the current study 40%, 38%, 10%, 10%, 2% had erect, climbing, semi-erect, prostrated, acute erect growth habits respectively (Table 3). This corroborates the findings of Cobbinah *et al.* (2011) who reported that the erect accessions have potentials for good returns in high intercrop adaptability and high reproductive efficiency.

For growth pattern, 100% of the genotypes are determinate; with four (4) had pale green leaves and the rest had intermediated to dark green leaves (Table 3). The growth habit of cowpeas is an important attribute in agronomic practices to be adopted by farmers as reported by Bannet-Lartey and Ofori, (1999). Similarly, the noticeable variation on leaf like darker green leaf color of treated plants of both accessions may be as a result of higher level of chlorophyll present in the plants, which was similar to what was obtained by Babu *et al*. (1997). The same author further attributed those changes in net photosynthetic rate and leaf area to be correlated with chlorophyll content. Furthermore, a positive correlation was observed between seed area and 100 seed weight as the seed area is contributing to 77% of 100 seed weight. As the seed area increased seed weight also increased. The higher the seed area the higher the seed weight and vice versa. Seed area is positively associated with root weight as seed area is contributing 33% of root weight.

CONCLUSION

The findings of this study revealed a significant difference among the 20 cowpea genotypes in terms of quantitative and qualitative traits. All the genotypes had determinate growth pattern of growth which shows that they have a strong relationship between them. A positive correlation was obtained between seed area and 100 seed weight in which seed area is contributing to about 77% of 100 seed weight. TVu-16467, TVu-7598 and TVu-3718 were showed to have vegetative trait and these genotypes could be used as parent breeding lines. In terms of 100 seed weight and seed area genotype TVu-10032 has good grain potential.

Table 3: Mean performance of qualitative traits of cowpea genotypes evaluated at IITA Kano during 2020 raining season under screen house.

S/N	Genotype	Origin	Seed color	Seed structure	Seed texture	Growth habit	Growth pattern	Leaf color
1	TVu-4	Nigeria	White	Kidney	Rough	Semi-erect	Determinate	Dark green
2	TVu-3710	Nigeria	White	Kidney	Rough	Climbing	Determinate	Dark green
3	TVu-3717	Nigeria	Variegated	Kidney	Smooth	Climbing	Determinate	Pale Green
4	TVu-3718	Nigeria	White	Kidney	Rough	Climbing	Determinate	Dark green
5	TVu-3818	Nigeria	White	Kidney	Rough	Erect	Determinate	Dark green
6	TVu-4275	Nigeria	Variegated	Kidney	Smooth	Climbing	Determinate	Dark green
7	TVu7456	Nigeria	White	Ovoid	Intermediate	Semi-erect	Determinate	Dark green
8	TVu-12415	Nigeria	Variegated	Ovoid	Smooth	Prostrate	Determinate	Intermediate green
9	TVu-12470	Nigeria	Brown	Ovoid	Smooth	Semi-erect	Determinate	Pale Green
10	TVu-7509	Togo	White	Rhomboid	Intermediate	Erect	Determinate	Dark green
11	TVu-7560	Togo	White	Kidney	Intermediate	Prostrate	Determinate	Intermediate green
12	TVu-7562	Togo	White	Kidney	Intermediate	Erect	Determinate	Dark green
13	TVu-7598	USA	White	Kidney	Intermediate	Semi-erect	Determinate	Intermediate green
14	TVu-7605	USA	White	Kidney	Intermediate	Climbing	Determinate	Intermediate green
15	TVu-8016	USA	Brown	Rhomboid	Smooth	Acute erect	Determinate	Dark green
16	TVu-10032	Cameroun	White	Rhomboid	Intermediate	Erect	Determinate	Pale Green
17	TVu-10033	Cameroun	White	Rhomboid	Intermediate	Prostrate	Determinate	Pale Green
18	TVu-10037	Cameroun	White	Ovoid	Smooth	Erect	Determinate	Dark green
19	TVu-16467	India	White	Rhomboid	Intermediate	Erect	Determinate	Dark green
20	TVu-16510	India	Brown	Rhomboid	Intermediate	Acute erect	Determinate	Intermediate green

Table 4: Correlation between qualitative and quantitative traits of cowpea accession evaluated at IITA Kano during 2020 raining season under screen house.

	C1	C2	C3	C4	C5	C6
C1	1.000					
C2	0.0468	1.000				
C3	-0.3209	0.0380	1.000			
C4	-0.1821	-0.2278	0.7769	1.000		
C5	-0.0320	0.2070	-0.0495	-0.1626	1.000	
C6	-0.2031	0.0369	0.3388	0.2655	0.2353	1.000

C1= Number of branches; C2= Leaf area; C3= Seed area; C4= 100 seed weight; C5= Shoot weight; C6 = Root weight.

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