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AGRONOMIC EVALUATION OF SOME LANDRACE COWPEAS (*VIGNA UNGUICULATA (* L.) WALP) AND THEIR WILD RELATIVE (DEKINDTIANA *VAR. PUBESCENS*) FOR INCORPORATION INTO COWPEA BREEDING PROGRAMME

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ABSTRACT: *Eleven cowpea landraces and their wild relative, Dekindtiana var. pubescens, were evaluated for growth and yield attributes in Bauchi, Northern Guinea Savannah Agroecology. The eleven cowpea landraces and their wild relative, making a total of 12 genotypes, were replicated four times in a randomized complete block design on a field in Bar-Arewa village in Bogoro Local Government Area of Bauchi State, Nigeria. The results of the study showed that the cowpea genotypes evaluated varied significantly (p< 0.05) in all the growth and yield attributes observed. Pod number per plant positively and highly correlated with height per plant (r = 0.93), number of leaves per plant (r= 0.95), number of branches per plant (r= 0.93), number of peduncles per plant (r= 0.92), but was negatively correlated with length of pod (r= -0.51). Seed yield per plant was positively correlated with hundred seed weight (r- 0.71), number of leaves per plant (r= 0.41), number of branches per plant (r= 0.42), number of peduncles per plant (r= 0.49), length of pod per plant (r= 0.41). However, hundred seed weight was negatively correlated with all the traits except the length of pod per plant (r = 0.78). It is, therefore, recommended that genotypes with longer pods, large seed size, high number of peduncles and pods be explored further for selection and incorporation into cowpea breeding programme for yield improvement.*

KEY WORDS: agronomy, breeding programme, evaluation, landrace cowpea, wild cowpea,

INTRODUCTION

Evaluation may be defined as the scoring of traits that are easily detected, controlled by one or more genes and estimated to be important in breeding programmes or for direct use. A survey by Williams (1986) showed that the reason why breeders were not making regular use of the data and materials from gene banks was that the important information required was not always available. This important information includes pest and disease resistance data, stress tolerance and adaptation of maturity, yield potential, plant height measurements, any rare or interesting data and some morphological information (Hawkes, 1967).Generally, evaluation is the first step in the utilization of germplasm. Screening of collected germplasm materials and full documentation allow for efficient utilization (Ado, 2008). In determining the characters of the highest priority, it is essential for the breeder to clearly understand the requirements of consumers, be they farmers, manufacturers or end- users.

High yield is usually a preferred characteristic as well as medium plant height and medium time of maturity depending on ecology. In cultivar development, new populations are developed from elite parents that have the most diverse ancestry possible, to increase the chance of obtaining a superior progeny with different favourable alleles from all the selected parents (Ado, 2008).The key to successful crop improvement is a continued supply of genetic variability and beneficial traits contained in this diversity, and wild relatives of modern crops are the source of much of this novel diversity, providing genes with improved nutritional quality, resistance to pests and diseases, as well as those with traits adapted to drought and extreme temperature (Dwivedi *et al.,* 2008).. The potentials of landraces which serve as the basis of improvement have to be established through evaluation trials. This gives the breeder the opportunity to directly observe the responses of the germplasm to the particular environment in which the material is being tested for adaptation and subsequent improvement (Hedge *et al.,* 2008)

Hedge *et al.* (2008) noted that landraces are important sources of genetic variability for pod/plant, pod/peduncle, pod filling ability (seed index), grain yield per plant as well as drought and heat tolerance and rust resistance in the cowpea.The results of a study on genetic diversity within cowpea landraces at the molecular level by Iseghohi (2015) showed that landraces from the Guinea Savannah zone were more diverse, forming two main clusters and six sub-clusters while landraces from the derived savannah zone formed one cluster with five sub-clusters. This provides a further evidence that landraces obtained from this agroecology are diverse and are very important for effective breeding programme.

The results of this study also showed that cowpea landraces from the derived and Guinea Savannah zones of Nigeria had a narrow genetic base which is prone to depressed yield, insect pests, diseases and abiotic stress. There is, therefore, the need to broaden the genetic base by introgressing target genes from the wild varieties.

Cowpea is one of the most valued crop to humans and livestock for food and nutrition, health and the environment; its grain yield per hectare in Nigeria is very low (FAOSTAT, 2015). National and international research institutes have released improved varieties to farmers to increase grain yield per hectare. This trend is gradually substituting the landrace cultivars, which may lead to loss in the plant diversity and their disappearance (genetic erosion) in the future. Similarly, their wild relatives such as dekindtiana *var. pubescens* which is high- yielding with morphological features that indicate protection against insect pests (Joshua, 2009) have been threatened by forest clearing for farm lands, poor cultivation and farming systems as well as over-grazing of the grasslands and wild fires, leading to erosion. This is not desirable because the landrace cultivars and their wild relatives may have useful characters which are not yet explored or known.Hence, there is the need for collection and agronomic evaluation of landrace cowpea varieties and their wild relative: dekindtiana *var. pubescens* for incorporation into cowpea breeding programme.

MATERIALS AND METHODS

An evaluation study of the landrace cowpeas and their wild relative was conducted on a field in Bar Arewa village which is situated seven kilometres south of Tafawa Balewa town and five kilometres North of Bogoro town in Bauchi State, Nigeria during the wet season of 2015. Bauchi is located at 10^0 22 N and 9^0 46"E and at 609 metres above sea level. Bauchi lies in the Northern Guinea Savannah zone of Nigeria

Materials used in this study consisted of eleven landrace cowpeas and one wild relative (Dekindtiana *Var. pubescens*). The landraces namely: Achi shiru, Kanannado, Mbereru, Nafyali, Yaro da kokari, Yar dunga, Yar ja and Yar wuri were collected locally in Bauchi State, while NGB 00746, NGB 00765 and NGB 00769 were obtained from the National Centre for Genetic Resources and Biotechnology, Ibadan, Oyo State. The wild relative (*Var. pubescens*) was obtained from the International Institute of Tropical Agriculture, Kano sub-station, Kano State, Nigeria.
The land used for the field evaluation was planted with cowpea the previous year. The dry vegetation in the field was burned using a chemical herbicide with active ingredients: Paraq (1–dimenthyl bipyridylum dichloride…24% ww paraquat dichloride (with emetic, dye and stench). The shrubs were felled using cutlass and the left- over grasses and trashes were removed from the experimental field using rake, and were burned using fire. Thereafter, the land was ploughed using cattle- drawn ridger.

The entire experimental field measured 58.0 m x 25.0 m which was then marked out using a measuring tape into four blocks of 13.5 m x 25 m each. The blocks were then divided into 12 plots each measuring 13.5 m x 0.8 m. Relays between adjacent blocks measuring 2.0 m and I.5 m served as discards between adjacent plots. These were clearly separated using pegs. The 12 genotypes were laid out in a randomized complete block design with four replications.

Sowing of the seeds was done on July 28, 2015, following a heavy rainfall the previous day. Seeds free of any physical defect were used. Seed scarification was used for the wild parent (*var. pubescens*) to break dormancy and to allow for prompt germination. Inter- and intra-row spacing was 0.8 m and 0.75 m, respectively. Two seeds were sown about 2.0 cm per hole for all the genotypes except the wild parent in which three seeds were sown in 1.0 cm depth because of the small seed size. The seedlings were later thinned to one plant per stand two weeks after emergence. Hand- weeding was employed using small hoe at four weeks after sowing. This was repeated at eight weeks after sowing. Anthills were controlled using Permethrin 0.60% (dust) at the rate of 25 g per anthill by dusting. This was done before sowing to avoid damage to young seedlings. Pre- and post- flowering insecticides were sprayed to control and manage damage by insect pests on leaves, flowers and pods. The broad-spectrum insecticide called Sharp shooter (Profenofos 40%+Cypermethrin 4%) at the rate of 1 litre : 120 litres of water was used.

Pods were harvested at full maturity. Maturity was observed when pods changed from green colour to the characteristic pod colour of the genotype as yellow, pink or grey. Pod shattering was observed in the wild genotype. Pods from five randomly sampled plants in each plot of the four

replications were harvested separately in well-labeled polyethylene bags. Harvesting operation commenced on September 18, 2015 and was completed on November 10, 2015.

The parameters that were observed and data collected include plant height, leaf number, number of branches, number of peduncles, days to first flower and pod maturity, number of pods, length of pod, number of seeds per pod, number of seeds per plant, 100-seed weight and yield per plant. All data collected during this study were subjected to one or more of the various forms of analytical tools available in System Analytical Statistics (SAS) Software; some data were manually computed using the scientific calculator. Plant height and the number of leaves per plant, number of branches and number of peduncles per plant, days to first flower and days to first pod maturity, number of pods and length of pods per plant, number of seeds per pod, number of seeds per plant, one hundred (100) seed weight and seed yield per plant were subjected to the analysis of variance (ANOVA) to test for significant difference among the genotypes using SAS system, the Generalised Linear Model (GLM) procedure. Where significant differences occurred among treatment means, Least significant Difference (LSD) was used to separate the treatments means.

Correlation analysis was carried out among the following characters: plant height, number of leaves, number of branches, number of peduncles per plant, days to flower, days to pod maturity, number of pods per plant, length of pod, number of seeds per pod, number of seeds, one hundred seed weight, seed yield per plant and seed yield per hectare using the GENSTAT 13th Edition.

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RESULTS AND DISCUSSION

Table 1: Characteristics of the cowpea genotypes evaluated

	Genotypes											
Character	Mbereru,	Yar Ja	Nafyali	Yarwuri	Ngb00746	Ngb00769	Kanannado	Ngb00765	Yaro da kokari	Yar dunga	Achi shiru	Var. pubescens TVNU110-3A
Growth Habit	Spreading	Spreading	Spreading	Semi-erect	Spreading	Spreading	Spreading	Erect	Spreading	Spreading	Semi-erect	Spreading
Flower colour (Standard)	Pale purple	Pale purple	Pale purple	White with purple margin	pale purple	Pale purple	Pale purple	Purple	White with purple margin	Pale purple	Purple	Purple
Stem hairiness	Non-hairy	Non-hairy	Non-hairy	Non-hairy	Non-hairy	Non-hairy	Non-hairy	Non-hairy	Non-hairy	Non-hairy	Fairly-hairy	Hairy
Pod hairiness	Non-hairy	Non-hairy	Non-hairy	Non-hairy	Non-hairy	Non-hairy	Non-hairy	Non-hairy	Non-hairy	Non-hairy	Fairly-hairy	Hairy
Pod dehiscent	Non-dehiscent	Non-dehiscent	Non-dehiscent	Non-dehiscent	Non-dehiscent	Non-dehiscent	Non-dehiscent	Non-dehiscent	Non-dehiscent	Non-dehiscent	Semi-dehiscent	Dehiscent
Pod colour	Yellow	Yellow	Yellow	Yellow	Yellow	Yellow	Yellow	Yellow	Yellow	Yellow	Yellow	Dark brown
Pod shape	Bored	Bowed	Bowed	Slightly Bowed	Slightly Bowed	Slightly Bowed	Slightly Bowed	Coiled	Slightly	Slightly Bowed	Straight	Slightly straight
Seed coat colour	White	Brown	White	White	White	White	Red	White	White	White	Light brown	Black
Hilum colour	Brown	White	Narrow	Black	Conspicuous black	Narrow dark brown	Light brown	Narrow White	Black	Conspicuous black	White	Dull White
Seed coat texture	Rough	Rough	Rough	Rough	Rough	Rough	Rough	Smooth	Rough	Rough	Smooth	Smooth
Mean seed weight (g)	0.15	0.19	0.18	0.19	0.23	0.10	0.20	0.07	0.11	0.24	0.09	0.02
Photosensitivity	Sensitive	Sensitive	Sensitive	In-Sensitive	Sensitive	In-Sensitive	Extreme Sensitive	In-Sensitive	Sensitive	In- Sensitive	In-Sensitive	Sensitive
Mean days to first flower	59.0	58.0	57.0	47.0	66.0	57.0	68.0	44.0	59.0	59.0	47.0	59.0
Mean days to first pod maturity	77.0	76.0	75.0	65.0	84.0	75.0	86.	62.0	77.0	77.0	65.0	77.0

Source: Cowpea Germplasm Field Evaluation Results 2015.

Achi shiru

Kanannado

Nafyali

NGB 00765

NGB 00769

Yaro da kokari

Yar dunga

Yar ja

Yar wuri

Var. Pubescens

Fig. 1. Photos of the cowpea seed coat colours studied

Table 2: Mean plant height (cm), number of leaves, number of branches and number of peduncles per plant of some cowpea genotypes and a wild relative grown in Bar-Arewa in 2015

S/n	Genotype	Plant height	Number of leaves	No. of branches	No. of peduncles
1	Mbereru	58.20	78.85	5.00	14.50
2	Yar ja	60.43	77.35	4.85	12.75
3	Nafyali	54.15	89.80	5.70	19.25
4	Yar wuri	26.63	27.10	2.85	17.00
5	NGB 00746	63.30	85.40	4.65	21.00
6	NGB 00769	35.60	59.95	4.75	14.25
7	Kanannado	66.25	88.25	5.35	28.50
8	NGB 00765	13.03	18.88	2.30	6.50
9	Yaro da kokari	66.98	109.20	5.00	32.00
10	Yar dunga	51.55	70.40	4.90	17.75
11	Achi shiru	25.88	25.00	2.60	9.00
12	Wild (*var pubescens*)	189.75	167.50	8.28	38.00
	LSD (P = 0.05)	11.29	25.56	1.28	3.37

Table 3: Mean number of pods, hundred seed weight, seed yield per plant and yield per hectare of some cowpea genotypes and a wild relative grown in Bar- Arewa in 2015

S/N	**Genotype**	**Number of pods**	**100- seed weight (g)**	**Seed yield plant^{-1} (g)**	**Seed yield hectare^{-1} (kg)**
1	Mbereru	34.05	15.00	54.48	896.50
2	Yar ja	30.35	19.00	50.98	816.60
3	Nafyali	45.15	18.00	84.18	1402.60
4	Yar wuri	25.05	19.00	42.88	714.40
5	NGB 00746	33.10	23.00	16.63	1276.80
6	NGB 00769	31.40	10.00	31.33	522.00
7	Kanannado	52.60	20.00	113.18	1881.50
8	NGB 00765	7.25	7.00	4.88	68.70
9	Yaro da kokari	54.35	11.00	74.28	1237.60
10	Yar dunga	32.25	24.00	85.78	1429.20
11	Achi shiru	9.65	9.00	8.50	141.60
12	Wild *(var. pubescens).*	99.38	2.38	34.00	566.50
	LSD (P=0.05)	15.00	1.31	37.78	627.45

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Table 4: Matrix correlations amongst yield and yield- related characters

	Plant height 6 WAS	Plant height 8 WAS	Numbers of leaves 8 WAS	Number of leaves 8 WAS	Number of branches 8 WAS	Peduncles plant^{-1}	Length of pod	Pods plant^{-1}	Seeds pod^{-1}	Seeds plant^{-1}	Hundred seed weight (g)	Seed yield plant$^{-!}$ (g)	Seed yield hectare^{-1} (Kg)
Plant height 6 was													
Plant height 8was	0.88**												
Number of leaves 6 WAS	0.90**	0.95**											
Number of leaves 8 WAS	0.92**	0.92**	0.96**										
Number of branches 8 WAS	0.83**	0.89**	0.93**	0.92**									
Peduncles plant^{-1}	0.85**	0.81**	0.81**	0.87*	0.79**								
Length of pod	-0.40	-0.57	-0.66	-0.48	-0.47	-0.29							
Pods plant^{-1}	0.87**	0.93**	0.94**	0.95**	0.93**	0.92**	-0.51						
Seeds pod^{-1}	0.48*	0.55*	0.41	0.46	0.42	0.49*	-0.04	0.49*					

Seeds plant^{-1}	0.86**	0.96**	0.95**	0.93**	0.90**	0.91**	-0.56	0.99**	0.54*			
Hundred seed weight (g)	-0.13	-0.33	-0.34	-0.16	-0.11	-0.12	0.78	-0.26	-0.33	-0.35		
Seed yield plant^{-1}(g)	0.34	0.14	0.21	0.41	0.42	0.49*	0.41	0.34	-0.01	0.24	0.71**	
Seed yield hectare^{-1} (Kg)	0.35	0.14	0.21	0.41	0.42	0.49*	0.41	0.34	-0.01	0.24	0.71**	0.99**

* Significant at P= 0.05, ** Significant at P= 0.01.

Table 1 shows the results of the evaluation studies carried out in 2015. The genotypes varied in all the traits scored. This is very important in any plant breeding programme. The highest plant height of the cowpea genotypes evaluated was observed in the wild (*var. pubescens)* with 60.40 cm and 189.75 cm followed by Yaro da kokari (47.20 cm and 66.98 cm), respectively, at both weeks of measurement. On the other hand, the lowest plant height was observed in NGB00765 with 12.60 cm and 13.03 cm at both weeks of measurement (Table 2). The result shows that plant height in the cowpea was influenced by genotype.

The result of the number of leaves per plant at eight weeks after sowing as presented in Table 2 shows a similar trend with that of the plant height. However, the genotype Achi shiru had the lowest number of leaves at weeks 6 and 8 after sowing. This shows a departure from the results observed in other genotypes where there was either marginal or high increase in the number of leaves per plant from week six to week eight after sowing. The genotype NGB 00765 is an early-maturing genotype. The early senescence of the plant at this period may have accounted for the reduction in the number of leaves per plant from week six to eight after sowing.The significant and wide variation observed in plant height and number of leaves per plant ($p< 0.05$) is an indication that the genotypes differed with respect to these traits (Agbogidi *et al.*, 2012; Joshua *et al*., 2015).

The highest number of branches per plant and the number of peduncles per plant were observed in the wild (*var. pubescens*), while the highest length of pod per plant was observed in the genotype Yar dunga. The lowest number of branches per plant and number of peduncles per plant were observed in the genotype NGB 00765 while the wild (*var. pubescens*) had the lowest length of pod per plant. These results show that these traits are genotypically influenced. The results also suggest that the number of branches per plant and the number of peduncles per plant are related.

The number of pods per plant varied among the genotypes; the highest number of pods per plant was observed in the wild (*var. pubescens*) while the lowest was observed in the genotype NGB 00765. The results show that the number of pods per plant is a genotypic trait. The number of peduncles and the number of pods are related as observed in the results of correlation analysis. Therefore, the lower the number of branches, the lower will be the number of peduncles and pods per plant.

The number of seeds per pod of the genotypes used in this study varied significantly (P=0.05). The results of the number of pods and seeds per plant are in conformity with those reported by Agbogidi *et al*. (2012) and Joshua *et al.* (2015). The genotypes differed significantly in one hundred seed weight with Yar Dunga and NGB 00746 having the highest seed weight of 24.00 g and 23.00 g, respectively. The wild (*var. pubescens*) had the lowest seed weight of 2.38 g. The result of the seed yield per plant showed that Kanannado had the highest seed yield per plant of 113.18 g while NGB 00765 had the lowest yield of 4.88 g per plant. . The same trend was observed in seed yield per hectare, where Kanannado had the highest seed yield of 1881.50 kg ha^{-1} while NGB 00765 had the lowest seed yield of 68.70 kg per hectare. The outstanding performance of Kanannado in seed weight, seed yield per plant and seed yield per hectare confirms the report of Joshua *et al*. (2015) who observed that the genotype had a high yield potential.

The observed significant and wide variabilities among the genotypes evaluated with respect to the traits studied show that there are potentials for yield improvement in the cowpea since variabilities are the main raw materials for farmers and crop breeders (Henry, 2004).The result of the correlation among yield and yield- related characters is presented in Table 4. Pod number per plant positively and highly correlated with height per plant eight weeks after sowing (r=0.93), number of leaves per plant eight weeks after sowing (r=0.95), number of branches per plant (r=0.93), number of peduncles per plant (r=0.92), but was negatively correlated with length of pod per plant (r= -0.51). Seed yield per plant was correlated positively with one hundred seed weight (r=0.71), number of leaves eight weeks after sowing (r=0.41), number of branches per plant (r=0.42), number of peduncles per plant (r=0.49) and number of pods per plant (r=0.34). However, one hundred seed weight was negatively correlated with all the traits studied. The positive correlations observed between some growth and yield parameters with yield may serve as an index in future selection of traits in breeding programmes aimed at improving seed yield of cowpea.

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