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EVALUATION OF COWPEA (*Vigna unguiculata* (L.) Walp) VARIETIES FOR YIELD AND YIELD COMPONENTS IN MAKURDI

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Abstract
The present study was carried out to evaluate cowpea (Vigna unguiculata (L.) Walp) varieties for yield and yield components. The experiment was conducted at the Teaching and Research Farm of the Joseph Sarwuan Tarka University Makurdi, Benue State, Nigeria (Latitude 7.41°N and Longitude 8.39°E). The experiment was a Randomized Complete Block Design (RCBD) with three replications during the 2022 growing season. The treatment comprised of five varieties of cowpea which included: IT89KD-288, UAM09 1051-1, UAM09 1055-6, IT99K-573-2-1 and UAM10 2021-1. The five cowpea varieties were obtained from the Molecular Biology Laboratory of the University of Agriculture Makurdi. The results show that cowpea genotypes evaluated were significantly different in almost all the yield parameters evaluated. This implies that they could be valuable as breeding materials for improvement of farmers preferred varieties. This study shows that cowpea seed yield per plant revealed positive correlation with number of pods per plant (0.447). Negative correlation was observed between seed yield per plant and days to first flowering (-0.197), days to 50% flowering (-0.094), pod length (-0.015), number of seeds per pod (-0.450) and 100 seed weight (-0.121). Positive correlation was observed between yield kg/ha and seed yield per plant (0.171). On the other hand, a negative correlation was observed between yield kg/ha and days to first flowering (-0.480), days to 50% flowering (-0.529), pod length (-0.082), number pods per plant (-0.209), number of seeds per pod (-0.446) and 100 seed weight (-0.310). Even though this correlation was not significant at P=0.01, the result suggests that these traits may be used as indirect selection criteria for yield. UAM09 1051-1 had the highest grain yield (1090.22kg/ha) followed by UAM09 1055-6 with 987.56 kg/ha among five cowpea genotypes evaluated. These varieties should be widely cultivated in order to ensure maximum yield. From the findings of this study the improved varieties of cowpea tested were found suitable in Makurdi and are therefore, recommended for Benue farmers.

Keywords: Cowpea, variety, yield, correlation.

Introduction

Cowpea is the most economically important indigenous African legume crop and has a wide variety of uses as a nutritious component in the human diet as well as nutritious livestock feed (Langyintuo et al. 2003). It is usually the first crop harvested before the cereal crops are ready and therefore is referred to as "hungry-season crop". With more than 25% protein in dry seeds as well as in young leaves (dry weight basis), cowpea is a major source of protein, minerals and vitamins in daily diets and is equally important as nutritious fodder for livestock (Singh et al. 2003).

The crop plays a considerable role in the nutritional balance and economy of the rural population in West African Sub-region (Krasova-Wade et al., 2006). West African sub-region is responsible for about 80% of the world cowpea production, with the principal producers being Nigeria and Niger (Ogbonnaya et al., 2003). World cowpea production stands at 5.72 million tonnes from an estimated 11.32 million hectares, while production in Africa stands at 5.42 million tonnes from an estimated 11.08 million hectares (FAO Statistics, 2014). Nigeria produces over 2.5 million tonnes, which accounts for over 43.2% of the total

world production (FAO Statistics, 2014). Although the West African sub-region accounts for over 80% of world cowpea production, it has been reported that the yield obtained is lower than that in the USA and in Australia (Quin, 1997) and very often inconsistent (Krasova-Wade et al., 2006). The low productivity has been attributed to non-availability of high yielding genotypes, short duration plant types and resistant cultivar for biotic and abiotic stresses.

Cowpea is a unique crop because of the significant role it plays in the diets of the people of West Africa, coupled with its importance in world agriculture, but the yield potential in this crop is yet to be fully exploited. A number of constraints militating against the production of the crop have been identified. These range from insect pests and diseases, parasitic weeds to other physiological problems.

Another challenge with yield improvement is to determine whether the percentage of variability of yield and its components is heritable i.e. under genetic control. Heritability of a character is important for the cowpea breeder because it provides him an idea of the extent of genetic control for the expression of a particular character (Chopra, 2000).

An understanding of yield and yield components of different cowpea varieties will be valuable for future strategies in the development of high yielding cowpea for farmers. Although increased success has been made in finding effective resistance and tolerance to pests and disease as well as parasitic weeds, a greater understanding of the variability of quantitative characters that affect yield potential is critical in realizing full yield potential of the crop. To achieve this aim, correlation studies between yield and other traits will be of immense help in selecting suitable cowpea genotype. The objective of the were to determine the genetic variability for yield and yield components in cowpea.

Materials and Methods

Five (5) cowpea genotypes used for this study were obtained from the Molecular Biology Laboratory of the University of Agriculture, Makurdi. The experiment was conducted at the Teaching and Research Farm, Joseph Sarwuan Tarka University Makurdi, Benue State, Nigeria during 2022 wet season. The location falls within the Southern Guinea Savanna Zone of Nigeria (Latitude 7.41oN and Longitude 8.39oE). The experiment was to evaluate cowpea for yield and yield components in Makurdi and it was laid out in a randomized complete block design with three replications. Each plot consisted of 2 rows each of 5m in length with row to row distance of 0.75m and intra row spacing of 20cm (in between stands). The crop was grown under rainfed conditions.

Three seeds of cowpea genotypes were sown per hole. After germination, plants were thinned to two plants per stand at two weeks after planting. NPK fertilizer was applied at the rate of 27:13:13. At planting, a mixture of pendilin (500g/l pendimethalin and paraquat (1:1-dimethyl-4, 4- bipyridinum dichloride) at a rate of 3L/ha was applied using a knapsack sprayer. This was followed by hoe weeding just before flowering. Insecticides, karate (50g/l lambda-cyhalothrin mixed with Nugor (40% W/V dimethoate at the rate of 1 L/ha was sprayed and delivered with a knapsack sprayer during each time of spraying to control insect pest.

Normal cultural practices for raising a successful crop were followed uniformly throughout the experiment.

The field layout used for the study comprised three blocks of four plots each, altogether giving twelve experimental observations

The Experimental field previously filled with old crop residues was cleared for use in 2019 cropping season. Ridges were prepared manually using hoes. The total field size was 19mx25m (475m2) and the plot size was 5mx5m (25m2).

Data were collected on the following parameters; Plant height: Height was measured in centimetre (cm) from the ground level to the tip of main stem at 8weeks using a metre rule. Days to first Flowering: This was taken as the first flower that appeared on a plant in a plot. Days to 50% flowering: The days at which half of the plants in a plot had flowered. Days to 95% maturity: This was observed as 95% of the pods attained the maturity stage evidenced by pod drying. Number of pods per plant: The number of pods per plant was taken by counting the pods in each tagged plant from each net plot and the value obtained was averaged to determine the number of pods per plant. Pod length: Pod length in centimetre (cm) was obtained by averaging the length of five randomly selected pods per plot at the time of harvest.

Number of seeds per pod: Number of seeds per pod was obtained as mean number of seeds of the randomly selected pods per plot at the time of harvest. 100 seed weight: Weight of hundred seed in grams (gm) was recorded per plot. Biomass weight: This was calculated as fodder yield in kg/ha. The plant biomass was obtained by taking the fresh weight of five plants randomly sampled per plot at harvest. The five plants were dried and weighed to obtain total biomass. Dry weight was then subtracted from fresh weight. Number of peduncles per plant: Number of peduncles per plant was obtained as mean number of peduncles of randomly selected plants at the time of harvest. Grain yield per plot: Weight of seeds in grams (gm) of each plot was recorded at the time of harvest (total yield per plot.

The collected data were subjected to analysis of variance (ANOVA) using General linear model procedure of Mini Tab. Significance was further analyzed statistically using Fisher's Pairwise comparisons at 5% probability level to compare the differences among the genotype means. Simple correlation analyses were done to find out traits that are positively correlated to yield.

Results

Mean Performance of Varieties for Growth and some Biomass Parameters

Mean performance of varieties for growth and biomass parameters are presented in Table 1. In this study, plant height which ranged between 40.60cm to 75.67cm showed no-significant difference among the genotypes. Results on days to first flowering indicated a significant difference among the genotypes, the result ranged from 37.00 to 44.00 days after planting. Genotype UAM09 1055-6 flowered earlier with 37.00 days after planting which was significantly different ($P \leq 0.05$) from UAM10 2021-1 and this was followed by genotype UAM09 1051-1 with 41.67 days after planting. Days to 50% flowering ranged between 41.00 to 54.33 days after planting. Genotype UAM09 1055-6 was the first to reach 50% flowering with 41.00 days which was significantly different ($P \leq 0.05$) from UAM09 1051-1 with 45.33 days. Genotype IT89KD-288 was the last to reach 50% flowering, though it was not significantly different from UAM09 1051-1, UAM10 2021-1 and IT99K-573-2-1.

Result on days to 95% maturity indicated that genotype UAM09 1055-6 was the first to attained 95% maturity with 59.00 days followed by genotype UAM09 1051-1 (67.00 days) which differed significantly which IT89KD-288 (71.67 days) and UAM10 2021 (71.00 days) and UAM10 2021 (71.00 days). Results on number of branches per plant ranged between 4.00 to 11.33. Genotype IT99K-573-2-1 had the highest number of branches per plant (11.33) which was significantly differently different ($P \leq 0.05$) from the other four genotypes.

Result on plant biomass showed that the mean values ranged between 2.00 g to 3.00g. Genotypes, UAM09 1051-1, UAM10 2021-1, UAM09 1055-6, IT99K-573-2-1 and IT89KD-288 were significantly different ($P \leq 0.05$) from one another.

Mean Performance of Five Cowpea Varieties for Yield and Yield Components

Mean performance of varieties for yield and yield components are presented in Table 2. The results on number of peduncles per plant, showed a range of 14.33 to 21.22. The genotype, IT99K-573-2-1 had the highest number of peduncles per plant 21.22 which was significantly different (P≤0.05) from genotype UAM10 2021-1 (19.00), UAM09 1055-6, UAM09 1051-1 and IT89KD-288. Result on number of pods per peduncle showed no-significant difference, this ranged between 0.31 to 20.39.

With regards to pod weight per plot, significant differences were observed for pod weight per plot among the genotypes, the results ranged from 0.66kg/plot to 0.98kg/plot. Genotype UAM09 1051-1 weighed higher (0.98kg/plot) followed by genotype UAM09 1055-6 with 0.95kg/plot which differed significantly different (P≤0.05) from genotypes, IT89KD-288 and UAM10 2021-1 with the least pod weight of 0.66kg/plot. Pod length which ranged between 15.33cm to 17.33cm, was not significantly different (P≤0.05) across all the genotypes.

Results on number of pods per plant, ranged between 25. 33 to 72.67. Genotype IT99K-573-2-1 had the highest number of pods per plant (72.67) followed by UAM09 1055-6 (30.67) while IT89KD-288 recorded least number of pods per plant. With regards to number of seeds per pod the result indicated a range of 8.93 to 13.67, genotype UAM09 1055-6 had the highest number of seeds per pod (13.67) which was significantly different (P≤0.05) from all the other four genotypes. Result on 100 seed weight indicated a significant difference among the genotypes. Mean values ranged from 15.33g to 22.00g. Genotype UAM10 2021-1 weighed higher (22.00g) followed by UAM09 1051-1 (19.33g) which differed significantly (P≤0.05) from IT89KD-288 and UAM09 1055-6 g.

Result on seed yield per plant showed significant difference among the varieties, the result ranged from 44.33 to 58.83g. Genotype IT99K-573-2-1 had higher seed yield per plant (58.83g) followed by genotype UAM09 1051-1 with 54.00g which was significantly different (P≤0.05) from IT89KD-2888 and UAM10 2021-1 with lower seed yield per plant (44.33g). Yield kg per hectare ranged from 640.00 to 1090.22kg/ha. Genotype UAM09 1051-1 gave highest seed yield per hectare (1090.22) followed by genotype UAM09 1055-6 (987.56kg/ha) which was significant different (P≤0.05) from the other three genotypes.

Pearson's Correlation Coefficient of Yield and Yield Parameters of Cowpea

Pearson's correlation coefficients of five cowpea genotypes are presented in Table 3. Result revealed days to 50% flowering was significantly and positively correlated with days to first flowering (0.857). Negative correlation was observed between pod length and days to first flowering (-0.520). A positive correlation was observed between number of pods per plant and pod length (0.139). Also, a negative correlation was observed between number of pods per plant and days to first flowering (-0.263), and days to 50% flowering (-0.280).

Positive correlation was observed between number of seeds per pod and pod length (0.360), a negative correlation was observed between number of seeds per pod and days to first flowering (-0.505), days to 50% flowering (-0.412) and number of pods per plant (-0.547). Positive correlation was also observed between 100 seed weight and days to first flowering (0.668), days to 50% flowering (0.281) and number of pods per plant (0.104) while a negative correlation between 100 seed weight and pod length (-0.240), as well as number of seeds per plant (-0.540) was observed.

Results on seed yield per plant revealed positive correlation with number of pods per plant (0.447). Negative correlation was observed between seed yield per plant and days to first flowering (-0.197), days to

50% flowering (-0.094), pod length (-0.015), number of seeds per pod (-0.450) and 100 seed weight (-0.121). For Yield kg/ha, a positive correlation was observed between yield kg/ha and seed yield per plant (0.171). On the other hand, a negative correlation was observed between yield kg/ha and days to first flowering (-0.480), days to 50% flowering (-0.529), pod length (-0.082), number pods per plant (-0.209), number of seeds per pod (-0.446) and 100 seed weight (-0.310).

Discussion

The highly significant difference on yield components implied that there is discernable evidence of inherent genetic variability among the cowpea genotypes with respect to number of pods per plant, number of seeds per pod, 100 seed weight and seed yield per plant among the five different genotypes of cowpea evaluated. This indicates that, the varieties used for this study are of diverse origin or different parental sources. This result is consistent with findings of Nwofia et al. (2014) that reported highly significant differences among the yield components of 12 cowpea varieties. The researcher however, reported no significant difference in the number of pods per plant among the evaluated varieties of cowpea. On the contrary, number of pods per plant in this study was significant.

The significant differences in almost all growth parameters in this research agree with the findings of Achakzai and Panizai (2007) as well as Suganthi and Murugan (2007). In their separate researches, both studies reported significant differences among some growth parameters such as number of leaves per plant and number of branches per plant among cowpea genotypes and concluded that, crop improvement to an extent depends on magnitude of such varieties. IT99K-573-2-1 with the highest number of branches per plant (11.33) did not produce the highest seed yield (693.53kg/ha). This is consistent with the report of Ekpo et al. (2012) that number of branches per plant has been associated with high solid contents but not with high number of seed.

UAM09 1055-6 recorded the lowest number of days to 95% maturity (59.00) followed by UAM09 1051-1 (67.00) while IT89KD-288 (71.67). The short duration between flowering and maturity among these varieties implies that, these varieties must fill their seeds very fast and this is an important trait in areas where water availability is very low making these varieties more suitable in drought prone areas. This finding is consistent with Futuless and Bake (2010) who reported that early maturing cowpea genotypes have been shown to yield as much as or more than the late maturing varieties with added advantage of being suitable in areas with unreliable rainfall in terms of total amount, distribution and duration where crop failure is often attributed to early cessation of rains and thereby making it adaptive to different agro ecological environments in Nigeria.

Correlation analysis gives a picture of association pattern of different yield related characters with grain yield and yield parameters. Yield is a complex quantitative character governed by a large number of genes. For the rational approach towards the improvement of the yields, selection has to be made for the components of the yield. The correlation pattern is expected to differ with material that is studied, since it is a reflection of the genetic makeup of the population (Withanage, 2005).

This study shows that cowpea seed yield per plant revealed positive correlation with number of pods per plant (0.447). Negative correlation was observed between seed yield per plant and days to first flowering (-0.197), days to 50% flowering (-0.094), pod length (-0.015), number of seeds per pod (-0.450) and 100 seed weight (-0.121). Positive correlation was observed between yield kg/ha and seed yield per plant (0.171). On the other hand, a negative correlation was observed between yield kg/ha and days to first flowering (-0.480),

days to 50% flowering (-0.529), pod length (-0.082), number pods per plant (-0.209), number of seeds per pod (-0.446) and 100 seed weight (-0.310). Even though this correlation was not significant at P=0.01, the result suggests that these traits may be used as indirect selection criteria for yield. Suma, (2001) stated improvement on yield should be based on selection for number of pods, while Patil, (1989) concluded that improvement of yield in cowpea should be based on selection for number of pods per plant and seeds per pod.

Conclusion and Recommendation

This study evaluated the performance of five cowpea genotypes in Makurdi in terms of plant height, days to first flowering, days to 50% flowering, days to 95% maturity, number of branches per plant, plant biomass, number of peduncles per plant, number of pods per peduncle, pod weight, number of pods per plant, pod length, number of seeds per pod, 100 seeds weight, seed yield per plant and yield kg/ha. The results show that cowpea genotypes evaluated were significantly different in almost all the yield parameters evaluated. This implies that they could be valuable as breeding materials for improvement of farmers preferred varieties. UAM09 1051-1 had the highest grain yield (1090.22kg/ha) followed by UAM09 1055-6 with 987.56 kg/ha among five cowpea genotypes evaluated. These varieties should be widely cultivated in order to ensure maximum yield. From the findings of this study the improved varieties of cowpea tested were found suitable in Makurdi and are therefore could be recommended for Benue farmers.

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Table 1: Mean Performance of Five Cowpea Varieties for Growth and Some Biomass Parameters Evaluated in Makurdi.

Genotypes	Plant Height	Days to First Flowering	Days to 50% Flowering	Days to 95% Maturity	Number of Branches/ Plant	Plant Biomass
IT89KD-288	75.67[a]	44.00[b]	54.33[a]	71.67[a]	6.33[b]	2.00[e]
UAM09 1051-1	56.67[a]	41.67[bc]	45.33[ab]	67.00[b]	6.00[b]	3.00[c]
UAM10 2021-1	56.67[a]	53.33[a]	54.00[a]	71.00[a]	6.33[b]	3.00[a]
UAM09 1055-6	64.00[a]	37.00[c]	41.00[b]	59.00[c]	4.00[b]	3.00[b]
IT99K-573-2-1	40.60[a]	43.33[b]	51.00[ab]	67.33[b]	11.33[a]	3.00[d]

Means followed by the same letter are not significantly different (P>0.05)

Table 2: Mean Performance of Five Cowpea Varieties for Yield and Yield Components Evaluated in Makurdi.

Genotypes	Number of Peduncles	Number of pods/Peduncle	Pod Weight/Plot	Pod Length	Number of Pods Per Plant	Number of Seed/Pod	100 Seed Weight	Seed Yield Per Plant	Yield (Kg/ha)
IT89KD-288	16.67[b]	1.01[a]	0.66[b]	17.33[a]	25.33[b]	12.00[b]	17.33[c]	46.00[c]	656.89[b]
UAM09 1051-1	15.67[b]	0.29[a]	0.98[a]	16.33[a]	29.33[ab]	12.00[b]	19.33[b]	54.00[ab]	1090.22[a]
UAM10 2021-1	19.00[b]	0.80[a]	0.66[b]	15.33[a]	26.33[b]	10.33[c]	22.00[a]	44.33[c]	640.00[b]
UAM09 1055-6	14.33[b]	0.31[a]	0.95[a]	17.00[a]	30.67[ab]	13.67[a]	15.33[d]	48.00[bc]	987.56[a]
IT99K-573-2-1	63.67[a]	20.39[a]	0.81[ab]	16.50[a]	72.67[a]	8.93[c]	18.63[bc]	58.83[a]	693.53[b]

Means followed by the same letter are not significantly different (P>0.05)

Table 3: Pearson's Correlation Coefficients of Yield and Yield Parameters of five Cowpea Genotypes Evaluated in Makurdi

	Days to First Flowering	Days to 50% Flowering	Pod Length (cm)	Number of Pods Per Plant	Number of Seeds/Pod	100 Seed Weight (g)	Seed Yield/ Plant (g)	Yield (Kg/Ha)
Days to first flowering								
Days to 50% Flowering	0.857**							
Pod Length (cm)	-0.520*	-0.387						
Number of Pods/Plant	-0.263	-0.280	0.139					
Number of Seeds/Pod	-0.505	-0.412	0.360	-0.547*				
100 Seed Weight (g)	0.668**	0.281	-0.240	0.104	-0.540			
Seed Yield /Plant (g)	-0.197	-0.094	-0.015	0.447	-0.450	-0.121		
Yield Kg/ha)	-0.480	-0.529*	-0.082	-0.209	-0.446	-0.310	0.171	

Pearson's correlation: P<0.05