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# EVALUATION OF FIVE COWPEA (*Vigna unguiculata* (L.) Walp) GENOTYPES FOR FODDER YIELD AND FODDER YIELD COMPONENTS

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## Abstract
*The present study was carried out to evaluate five cowpeas (Vigna unguiculata (L.) Walp) genotypes for fodder yield and fodder 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, Golam white, UAM09 1055-6 and UAM10 2021-1. The five cowpea varieties were obtained from the Molecular Biology Laboratory of the University of Agriculture Makurdi. Mean performance of varieties revealed highly significant differences among growth parameters like plant height, dry stem weight, dry leaf weight and number of branches per plant among the five different varieties of cowpea. Cowpea fodder yield correlated positively with days to first flowering (0.62), dry leaf weight (1.00), dry stem weight (1.00) and number of branches per plant (0.64). Total plant biomass was positive and highly significant correlated with days to first flowering (0.69), dry leaf weight (0.76), dry stem weight (0,76), number of branches per plant (0.75) and fodder yield kg/ha (0.76). 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 fodder yield. The results indicated that cowpea is important forage crop with their yield and quality. Therefore, there is need for new studies to determine fodder yield of different genotypes to improve high yielding forage type varieties in Makurdi. The varieties, IT89KD-288 and Golam white had the highest fodder yield over the others hence they are recommended to livestock farmers as animal feeds in Makurdi. Also, varieties UAM09 1055-6 and UAM09 1051-1 had the highest grain yield hence they are recommended to farmers for maximum yield and productivity in Makurdi.*

***Keywords****:* Cowpea, genotypes, fodder yield, correlation.

## Introduction
Cowpea (*Vigna unguiculata* (L.) Walp) is one of the most important pulse crops; native to Central Africa and belongs to the family *Fabaceae*; Cowpea is called vegetable meat due to high amount of protein in the grain with better biological value on dry weight basis (Withanage, 2005). Cowpea grain on dry weight basis contains 23.4 per cent protein, 1.8 per cent fat and 60.3 per cent carbohydrates and it is a rich source of calcium and iron (Gupta, 1988). Apart from this, cowpea forms excellent forage and it gives a heavy vegetative growth which covers the ground so well that it checks soil erosion. As a leguminous crop, it fixes about 70 – 240 kg per ha of nitrogen per year Cowpea is mainly grown in tropical and sub-tropical regions of the world for vegetable and seed purpose and to a lesser extent as a fodder crop (Gupta, 1988). It is a versatile pulse crop because of its smothering nature, drought tolerant characters, soil restoring properties and multi-purpose uses. As a pulse crop, cowpea fits well into most of the cropping systems. It has been estimated that the total pulse requirement for consumption by 2010

was 43 million tons (FAO, 2010). Among the different pulses grown in the world, area of production of cowpeas is approximately 10.1 million hectares (FAO, 2010), global cowpea grain production is now approximately 4.99 million tons (FAO, 2010) with a productivity of 387 kg/ha (FAO, 2008). The largest areas under cultivation are in Central and West Africa with Nigeria and Niger Republic being the leaders with a global yield of 2.9 million tons. In Nigeria grain yield is estimated at 340 kg for northern part; which is lower compared to the average grain production from Food and Agriculture Organization (FAO) for West Africa which is 387 kg/ha (FAO, 2008)

In spite of the fact that cowpea yields are low, cowpea continues to be a popular crop among farmers. This is because it can be grown even on marginal soil and can withstand any stress, the grains are consumed as food in many forms; young leaves, green pods and green seeds are used as vegetables; dry seeds are used in various food preparations (*'moimoi'* in Nigeria; '*kazolaki*', '*dankaida*', '*bairuwa*' in Niger Republic); It provides high protein to people especially children. The haulms are fed to livestock as nutritious fodder. It also has the unique ability to fix nitrogen even in very poor soils (Tarawali *et al.,* 1997*).*

Across developing world, there is an increasing emphasis on integrating crop and livestock production for sustainable agricultural system. In dry savannah of West and Central Africa, crop and livestock enterprises have integrated very closely (Adeyanju, 2008). Livestock are kept by farmers in these regions, and therefore cowpea cropping is an integral part of the cropping system. The cowpea haulms are used to feed the livestock while the latter provide manure (Tarawali *et al.,* 1997). Two types of cowpea varieties are usually intercropped in alternate rows with millet, maize and/or sorghum in West and Central Africa. A short duration cowpea variety (early maturity, 55-60 days) for grains and a long duration variety (late maturity 100-120 days) for fodder, but both are spreading type. The grain and fodder yield are poor due to low potential of the spreading variety and also due to early cessation of rains. According to Singh (2000), the grain cowpea and millet are harvested at the end of August or beginning of September while the late type is left in the field until the onset of the dry season (October-November).

Cowpea fodder is as important as the grain especially in dry savannah of West and Central Africa; farmers derive significant income from selling cowpea fodder to livestock owners. During the dry season, the cost of fodder per kg is as much as that of grain (Singh *et al.,* 2000). The farmers wait until the cowpea leaves show sign of wilting before they cut the cowpea plant at the base and tie it into bundles with all leaves still intact; these bundles are kept on rooftops or on tree fork for drying and sold in the peak of dry season when prices are high. On dry-weight basis, the price of cowpea haulms ranges between 50 and 80% of the grain price, and therefore, haulms constitute an important source of income (Langyintuo *et al.,* 2003). In case where there are rains in October/November, the fodder type cowpea produces some grains as well. There is no evidence that any farmer can grow cowpea for fodder alone (Langyintuo *et al.,* 2003*).*

This suggests that both grain and fodder are valuable therefore, the ratio of grain and the fodder is very important to support the crop-livestock integration system. It has been known that high levels of genetic variation for the ratio of grain to fodder exist in cowpea (Roquib and Patnaik, 1990). The variation exists in form of traits such as number of primary branches per plant, plant height, pod weight, leaf weight, seed weight, threshing percentage, biomass, leaf to stem ratio and harvest index (Roquib and Patnaik, 1990). The present study evaluates some cowpea varieties for fodder yield and its components in Makurdi, Benue State.

## Materials and Methods

The field experiment was carried out at the Teaching and Research farm of the University of Agriculture, Makurdi (latitude 7.41ºN; longitude 8.28 ºE; 108m Above sea level), during 2019 cropping season. Land was manually cleared with cutlass and ridges were made after clearing using a hoe. The land was marked out into plots. Each plot comprised 4 ridges measuring 4 meters long with a spacing of 0.75m giving a plot size of $12m^2$ ($4x4x0.75=12m^2$). The experiment was laid in a Randomized Complete Block Design (RCBD) with three replications and treatment comprised of five varieties of cowpea which included: IT89KD-288, UAM09 1051-1, Golam white, UAM09 1055-6 and UAM10 2021-1. The five cowpea varieties were obtained from the Molecular Biology Laboratory of the University of Agriculture Makurdi.

Seeds were planted on the 21st August, 2022 at a depth of 2.5-3.5cm and at the rate of three seeds per hill and later thinned to two per hill at 14 days after planting (DAP). An inter row spacing of 0.75m and intra row spacing of 0.25m was used for planting. Three seeds were sown per hill and were thinned to two per hill at 14 days after planting (DAP). Weeding was done twice manually at 4 and 8 weeks after sowing while 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 pests. Single Super Phosphate (SSP) fertilizer (30 kg/ha) was applied at planting using drilling method of fertilizer application.

Data was collected on the following parameters: **Number of branches:** Total number of branches was counted from three selected or tagged plants and average number of branches per plant was recorded. **Plant height:** The height in centimeters of the plant was measured from soil level to the tip of the main branch, at 21 and 35 days after planting. **Days to first flower:** The number of days taken from sowing to first flower opening. **Dry leaf weight at maturity:** Weight in grammes of all the leaves per plant. **Dry stem weight:** Weight in grammes of the dry shoot excluding leaves of each plant. **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 weight kg per hectare:** Weight in kilograms of all dry pods harvested was measured using a weighing balance and the weight expressed in kg per hectare. **Grain weight:** Total dry grain weight in grammes was measured using a weighing balance. **Fodder yield:** Weight in grammes of dried leaves, chaff, and dried stem was measured using a weighing balance. **Total biomass kg/ha:** Weight in kg of the dried leaves, dried pods and dried stems was measured using a weighing balance and the weight expressed in kg per hectare.

The data were subjected to Analysis of variance (ANOVA) using General Linear Model Procedure of Mini Tab package and means were separated using Fisher's Pairwise comparisons at 95% level of probability to compare the differences among the genotype means. Simple correlation analyses were done to find out traits that are positively correlated to Fodder yield.

## Results

### Mean Performance of Varieties on Growth Parameters

Mean performance of varieties revealed highly significant differences among growth parameters like plant height, dry stem weight, dry leaf weight and number of branches per plant among the five different varieties of cowpea as shown in Table 1. IT89KD-288 with 85.80cm recorded the tallest plant height followed by Golam white with 80.67cm while UAM09 1055-6 with 55.00cm recorded the shortest plant height. Results on dry stem weight ranged from 97.80g to 337.26g. IT89KD-288 recorded the highest dry stem weight of 337.26g followed by Golam white with 268.87g and

UAM10 2021-1 (238.74g) which were significantly different (P≤0.05) from UAM09 1051-1 (97.80g) and UAM09 1055-6 (104.79g).

Results on dry leaf weight ranged from 52.40g to 168.95g. IT89KD-288 gave higher dry leaf weight followed by Golam white with 134.43g and UAM10 2021-1 which differed significantly (P≤0.05) from UAM09 1051-1 and UAM09 1055-6. With regards to number of branches per plant, the result indicated that Golam white had the highest number of branches per plant (7.67) followed by IT89KD-288, UAM10 2021-1 and UAM09 1051-1 which were significantly different (P≤0.05) from UAM09 1055-6.

**Mean Performance of Varieties on Fodder Yield and its Components**

Mean performance of varieties revealed significant difference among yield components measured (Table 2). Results on days to first flowering shows that days to first flowered ranges from 37.33 days to 55.17 days after planting. UAM09 1055-6 flower earlier at 37.33 days after planting followed by UAM09 1051-1 with 42.00 days after planting while Golam white flowered last at 55.17 days after planting.

Results on number of pods per plant showed the range of 21.00 to 34.67. UAM09 1055-6 had the highest number of pods per plant (34.67) followed by UAM09 1051-1 with 30.00 pods per plant which were significantly different (P≤0.05) from IT89KD-288 and Golam white. Pod weight kg/ha which ranged from 488.30 to 912.37 kg/ha was however not significantly different (P≤0.05) across the genotypes evaluated.

Results on grain weight per plant ranged from 26.33g to 58.00g. UAM09 1055-6 had the highest grain weight of 58.00g followed by UAM09 1051-1 with 54.00g which was significantly different (P≤0.05) from UAM10 2021-1, IT89KD-288 and Golam white. Fodder yield per plot ranged from 293.39kg to 1012.34kg. IT89KD-288 recorded the highest fodder yield of 1012.34g/plot followed by Golam white with 807.09g/plot and UAM10 2021-1 (716.22g) which was significantly different (P≤0.05) from UAM09 1055-6 and UAM09 1051-1 (293.39g).

Total plant biomass ranged from 621.84kg/ha to 2814.17kg/ha. Golam white had the highest total biomass of 2814.17kg/ha followed by IT89KD-288 with 2141.29kg/ha which was significantly different (P≤0.05) from UAM09 1051-1 and UAM09 1055-6. Golam white also differed significantly from UAM10 2021-1.

**Pearson's Correlation Coefficient of Cowpea**

Pearson correlation coefficient of Cowpea is presented in Table 3. Result revealed that plant dry leaf weight was significantly and positively correlated with days to first flowering (0.62). A positive and highly significant correlation was observed between dry stem weight and days to first flowering (0.62) and dry leaf weight (1.00). A highly significant and positive correlation was observed between number of branches per plant and days to first flowering (0.81), dry leave weight (0.64) and dry stem weight (0.64).

Highly significant negative correlation was observed between number of pods per plant and days to first flowering (-0.69), number of pods per plant and number of branches per plant (-0.79). Also a negative but significant correlation observed between pod weight kg/ha and number of branches per plant (-0.59).

Highly significant correlation was observed between grain weight per plant and number of pods per plant (0.83), a negative but significant correlation was also observed between grain weight per plant and plant height (-0.52), days to first flowering (-0.77), dry leaf weight (-0.75), dry stem weight (-0.75) and number of branches per plant (-0.77).

Highly positive significant correlation was observed between fodder yield and days to first flowering (0.62), dry leaf weight (1.00), dry stem weight (1.00)

and number of branches per plant (0.64) while a negative but highly significant correlation was observed between fodder yield and grain weight per plant (-0.75).

Results on total plant biomass indicated that there was positive/highly significant correlation between total biomass and days to first flowering (0.69), dry leaf weight (0.76), dry stem weight (0,76), number of branches per plant (0.75) and fodder yield kg/ha (0.76). While a highly significant negative correlation was observed between total biomass and number of pods per plant (-0.84) as well as grain weight per plant (-0.91) Table 3.

**Discussion**

Fodders as a group of crops differ from food and commercial crops as they are primarily grown for the fresh green vegetative biomass, forage legumes like cowpea are rich sources of protein. The use of cowpea as fodder where green material is used for grazing, or, more commonly, cut and mixed with dry cereals for stall feeding. Dry cowpea haulms are not stored. Relwani, (1970) recommended the use of cowpea in combination with cereals and other crops in an intensive scheme for lactating cows, to maintain milk yields of > 5 L/cow/day. Although green cowpea pods are eaten by humans, if the crop is being grown for fodder, inclusion of the pods in the fodder is considered important to raise its nutritive value (Mital *et al.* I960).

In the present study, mean performance of varieties revealed highly significant differences among growth parameters like plant height, dry stem weight, dry leaf weight and number of branches per plant among the five different varieties of cowpea. Results on dry stem weight shows that IT89KD-288 recorded the highest dry stem weight of 337.26g. Also, result on dry leaf weight indicated that IT89KD-288 gave higher dry leaf weight of 168.95g. With regards to number of branches per plant, the result indicated that Golam white had the highest number of branches per plant (7.67). IT89KD-288 recorded the highest fodder yield of 1012.34kg these findings are in agreements with Tarawali *et al*. (1997) who in their study to determine the fodder potential of cowpea reported higher dry stem weight, dry leaf weight and fodder yield in some selected cowpea varieties.

Total plant biomass ranged from 621.84kg/ha to 2814.17kg/ha. Golam white had the highest total biomass of 2814.17kg/ha. This reported is consistent with that reported by Kheradam *et al*. (1975) where the total biomass (weight of above ground parts including seed weight) was highly significant within the both crosses they carried out, suggesting genetic variation for total biomass. They also indicated that fodder type parents (Kanannado brown and Biu local) possess high fodder yielding genes.

Correlation analysis gives a picture of association pattern of different yield related characters with fodder yield among themselves. Quantitative inheritance for fodder yield has been reported by Tyagi *et al*. (2000). In their study of the component analysis of green fodder yield in cowpea, they stated that fodder yield is a very complex trait influenced by many factors such as number of branches, days to flowering, leaf weight per plant, stem weight, leaf stem ratio etc. Grafius (1956) stated that to develop high yielding genotypes, selection for yield alone will not be very effective unless due regards is given to fodder component because the higher the dry matter accumulation brought in by long days to flowering, the higher the fodder yield and the lower the grain 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). In this investigation, cowpea fodder yield correlated positively with days to first flowering (0.62), dry leaf weight (1.00), dry stem weight (1.00) and number of branches per plant (0.64). Results on total plant biomass indicated that there was positive/highly significant correlation

between total biomass and days to first flowering (0.69), dry leaf weight (0.76), dry stem weight (0,76), number of branches per plant (0.75) and fodder yield kg/ha (0.76). 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 fodder yield.

## Conclusion

Cowpea can provide a valuable fodder resource, under appropriate management; good quality fodder for in situ grazing, silage (in combination with cereals) or hay to be stored can be produced. Cowpea can be grown exclusively for fodder, with no need to harvest grains from the same crop. Varieties for such systems would be late maturing with a long vegetative period, to ensure maximum herbage growth, and cutting should be timed to obtain the optimum fodder yield.

Over all the results indicated that cowpea is important forage crop with their yield and quality. Although the genotypes under test are not grown for forage purposes, their forage yields and quality are desirable. So, they can play an important role to fill forage gap by cutting for hay or by grazing when pasture yield is very low. Therefore, there is need for new studies to determine fodder yield of different genotypes to improve high yielding forage type varieties in Makurdi. The highest fodder yield obtained from genotypes, IT89KD-288 and Golam white indicates the potential for selection of superior and better adapted genotypes for fodder purpose. Also, there is scope for improving the output of the system by developing dual-purpose genotypes and management practices that will yield both fodder and grain, thereby maximizing the output from land and labour.

## Recommendations

The varieties, IT89KD-288 and Golam white had the highest fodder yield over the others hence they are recommended to livestock farmers as animal feeds in Makurdi.

Varieties UAM09 1055-6 and UAM09 1051-1 had the highest grain yield hence they are recommended to farmers for maximum yield and productivity in Makurdi.

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**Table 1:** Mean Performance of Varieties on Growth Parameters Evaluated in Makurdi.

| Genotypes | Plant Height | Dry Stem Weight | Dry Leaf Weight | Number of Branches |
|---|---|---|---|---|
| IT89KD-288 | 85.80$^{a}$ | 337.26$^{a}$ | 168.95$^{a}$ | 6.33$^{b}$ |
| UAM09 1051-1 | 57.33$^{ab}$ | 97.80$^{b}$ | 48.90$^{b}$ | 6.00$^{b}$ |
| UAM10 2021-1 | 62.33$^{ab}$ | 238.74$^{a}$ | 119.37$^{a}$ | 6.33$^{b}$ |
| UAM09 1055-6 | 55.00$^{b}$ | 104.79$^{b}$ | 52.40$^{b}$ | 4.00$^{c}$ |
| Golam White | 80.67$^{ab}$ | 268.87$^{a}$ | 134.43$^{a}$ | 7.67$^{a}$ |

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

**Table 2:** Mean Performance of Cowpea Varieties on Fodder Yield and its Components Evaluated in Makurdi.

| Genotypes | Days to First Flowering | Number of Pods Per Plant | Pod Weight (Kg/ha) | Grain Weight Per Plant | Fodder Yield Per Plot (g) | Total Biomass (Kg/ha) |
|---|---|---|---|---|---|---|
| IT89KD-288 | 46.33$^{b}$ | 21.00$^{c}$ | 451.59$^{a}$ | 35.00$^{b}$ | 1012.34$^{a}$ | 2141.29$^{ab}$ |
| UAM09 1051-1 | 42.00$^{c}$ | 30.00$^{ab}$ | 802.37$^{a}$ | 54.00$^{a}$ | 293.39$^{b}$ | 738.36$^{c}$ |
| UAM10 2021-1 | 55.00$^{a}$ | 24.00$^{bc}$ | 537.21$^{a}$ | 41.67$^{b}$ | 716.22$^{a}$ | 1598.94$^{b}$ |
| UAM09 1055-6 | 37.33$^{d}$ | 34.67$^{a}$ | 912.37$^{a}$ | 58.00$^{a}$ | 314.40$^{b}$ | 621.84$^{c}$ |
| Golam White | 55.17$^{a}$ | 5.90$^{d}$ | 488.30$^{a}$ | 26.33$^{c}$ | 807.09$^{a}$ | 2814.17$^{a}$ |

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

**Table 3:** Pearson's Correlation Coefficients of Fodder yield and its Components in Cowpea

| | PLTHT | DFF | DLW | DSW | NBPP | NPPP | PWT kg/ha | GWTPP | FYkg/ha | TPBkg/ha |
|---|---|---|---|---|---|---|---|---|---|---|
| PLTHT | | | | | | | | | | |
| DFF | 0.21 | | | | | | | | | |
| DLW | 0.21 | 0.62** | | | | | | | | |
| DSW | 0.21 | 0.62** | 1.00** | | | | | | | |
| NBPP | 0.24 | 0.81** | 0.64** | 0.64** | | | | | | |
| NPPP | -0.41 | -0.69** | -0.48 | -0.48 | -0.79** | | | | | |
| PWTkg/ha | -0.14 | -0.51 | -0.45 | -0.45 | -0.59* | 0.47 | | | | |
| GWTPP | -0.52* | -0.77** | -0.75** | -0.75** | -0.77** | 0.83** | 0.38 | | | |
| FYPPkg/ha | 0.21 | 0.62** | 1.00** | 1.00** | 0.64** | -0.48 | -0.45 | -0.75** | | |
| TPBkg/ha | 0.34 | 0.69** | 0.76** | 0.76** | 0.75** | -0.84** | -0.34 | -0.91** | 0.76** | |

**Pearson correlation: P<0.05**

**KEY:** *: significant correlation, **: highly significant correlation
PLTHT: Plant height, DFF: Days to first flowering, DLW: Dry leaves weight, DSW: Dry stem weight, NBPP: Number of branches per plant, PWTkg/ha: Pod weight kg/ha, GWTPP: Grain weight per plant, FYPPkg/ha: Fodder yield per plot kg/ha, TPBkg/ha: Total plant biomass kg/ha.