Forage Yield and Nutritive Quality of Haulm from Dual-Purpose Cowpea (*Vigna unguiculata* L Walp) Cultivars for Dry Season Feeding in Nigeria

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Forage yield and nutritive quality of haulm from dual-purpose cowpea (*vigna unguiculata* L Walp) cultivars for dry season feeding in Nigeria

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Abstract
The availability of high quality forage especially during the dry season remains a major challenge to ruminant livestock production in Nigeria and many parts of West Africa. Due to the prevailing mismatch between livestock population and supply of feed resources in the arid and semi arid Nigeria, the humid forest zone represents a potential source for crop residues, especially during the dry season due to longer rainfall duration and suitable climate. This study was conducted to evaluate forage yield and nutritive quality of haulm from selected dual purpose cowpea (Vigna unguiculata L. Walp.) cultivars in the humid rain forest zone of Nigeria. The forage and pod yields of twenty cultivars were evaluated in two cropping seasons of 2012 and 2013, in a randomized complete block design with three replications. Subsequently, five dual-purpose cultivars were selected based on forage and pod yields from previous trial, for determination of chemical and fibre compositions. The results revealed significant ($p<0.05$) differences in pod and forage yields among the twenty cowpea cultivars, with mean yields ranging from 0-1.5 t ha^{-1} and 0.1-4.5 t ha^{-1} for pod and forage respectively. The results also showed significant ($p<0.05$) differences in crude protein, ether extract, and non-fibre carbohydrates (NFC) contents amongst the five selected cultivars. The selected cultivars are recommended as dual-purpose cowpea for the zone. The result reveal wide implications for commercial production, processing and packaging of cowpea and other related forage crops for sale in Northern Nigeria where demand for dry season feedstuff outstrips supply. In addition, availability of feedstuff during the dry season is capable of promoting sedentarization of nomadic pastoralists and the attendant conflict associated with that system of livestock management.

Livestock is a critical component of the farming system and food security equation in sub-saharan Africa because of it's multiple roles in sustaining livelihoods especially for the rural populace. They serve as sources of protein through provision of meat and milk, fiber, draft power, savings and employment (FAO, 2009). Seasonal fluctuations in feed supply remains a major constraint to maximizing the potential from the small holder livestock production system in Nigeria and other parts of west Africa (Anele *et al*., 2011). Although forage is the cheapest and major nutritional component in the diet of ruminants, lack of and almost complete absence of forage conservation leads to huge depreciation in quality as forages that grow abundantly as natural pastures during the rainy season are allowed to mature and dry out by the onset of the dry season. Besides poor nourishment of the animals, poor feed quality during dry season, increases losses and susceptibility to diseases, reduction in palatability and digestibility, migration of flock and herd's men, overgrazing of available pasture lands, distress sales of animals, and higher cost of production (Lamidi et al. 2014).

In many areas of west Africa cowpea plays a critical role in the lives of millions of people and is a valuable and dependable commodity that produces income for farmers and merchants. Thus, in addition to its importance as food, it also serves as a source of animal feed and cash income. Cowpea haulms fetch 50% or more of the grain price (dry weight basis). The overall objective of this work was to evaluate the fodder yield and quality characteristics of cowpea cultivars in the humid ecological zone of Nigeria to select best bet dual-purpose cultivars for food and fodder for livestock farmers, especially during the dry season.

Materials and methods

The study were carried out at the Teaching and Research Farm of the Federal University of Technology, Owerri, Imo State, 5.48º N, 7.03º E, in 2012 and 2013. The seeds were planted at the spacing of 50 cm x 20 cm at three (3) seeds per hole and later thinned to two plants per stand. On the basis of grain and fodder yield samples from the top five cultivars, were prepared for chemical analysis after oven drying, by grinding to a particle size of 1mm according to the procedure of A.O.A. C (1995). Crude protein was estimateded as N x 6.25. Neutral Detergent Fiber (NDF) and Acid Detergent Fiber (ADF) were analysed according to Goering and Van Soest (1991)..All field and laboratory data collected were subjected to Analysis of Variance in accordance with the General Linear Model procedure of SAS (2002). The means were separated using Duncan's New Multiple Range Test (DMRT).

Results and Discussion

The forage biomass and pod yields are presented in Tables 1 and 2 respectively .and were significant ($P<0.05$) across years and among the cultivars. The correlation of pod yield and forage yield was 0.14 although not significant ($p > 0.05$) This confirms the claims by Grings *et al*. (2010a) that there was no negative correlation between grain and fodder yield among cowpea cultivars. This implies that selecting traits for high forage yield would not negatively affect grain yield. The proximate and fibre compositions of the selected cowpea cultivars are shown inTable 3. The contents of the dry matter were statistically similar ($p>0.05$). The content of crude protein was significantly ($p<0.05$) higher in the control 15.92 % (Kanannado) cultivar than the improved cultivars under study. The non-fibre carbohydrates was highest (12.43 %) in cultivar IT07K-293-3 and lowest (6.40 %) in the Kanannado cultivar. The range of forage yield, 0.1 to 5 t ha^{-1}, of the twenty cultivars in this study across two seasons, was similar to yields of 0.5-4 t ha^{-1} reported by Mullen (1999) under favourable conditions and 4 t ha^{-1} reported by Madamba *et al*. (2006) for cowpea hay under sole-cropping. They were also within the values of 1- 6 t ha^{-1} reported by Omokanye *et al*. (2003) and also 0-5 t ha^{-1} reported at Minjibir, Kano and by IITA (unpubished). However, they are lower than 3 -8 t ha^{-1} reported by Anele (2010) among improved and commercial cowpea cultivars in Abeokuta, and 0-8 t ha^{-1} reported at Ibadan by IITA (unpublished). The range of pod yield of 0-1.5 t ha $^{-1}$ is within the range of 0.5 -1.0 t ha $^{-1}$ recorded by Omokanye *et al*. (2003) at Shika, Zaria but higher than 0.3- 0.4 t ha $^{-1}$ reported by Anele (2010) at Abeokuta. The results of the proximate analysis are in agreement with results reported by (Grings *et al*., 2010b), but lower than that reported by (Anele et al.,, 2011) for improved cowpea varieties. The lower value of crude protein of the forage from this study could be attributed to the fact that no fertilizer was applied to the crops within the two years of study. IT07K-293-3, IT04K-405-5, IT06K-147-2, IT07K-194-3 and cluster 2; IT04K-227-4 , IT06K-139 , IT07K-187-55, IT07K-220-1, are dual purpose cultivars, based on higher yields of pod and forage. The high yielding cultivars are recommended for use in crop-livestock systems since many of the cultivars combine high fodder yield with high grain yield and early maturity.

Table 1: Average forage yield (kg ha^{-1} DM) of 20 cowpea cultivars in 2012 and 2013 cropping seasons

S/N	Variety	2012	2013	Mean	SEM
1	IT06K-147-1	464.28^{cd}	763.88^{de}	614.10^{ji}	118
2	IT00K-335-45	204.16^{d}	62.50^{e}	133.30^{j}	39
3	IT04K-227-4	1709.72^{bcd}	2500.00^{abcde}	2104.90^{defgh}	430
4	IT04K-267-8	2240.62^{bcd}	3361.11^{abc}	2800.90^{cdef}	358
5	IT04K-332-1	990.61^{bcd}	2597.22^{abcde}	1793.90^{fgh}	473
6	IT04K-333-2	1321.87^{bcd}	2347.22^{abcde}	1834.60^{fgh}	476
7	IT04K-334-2	2217.34^{bcd}	4027.77^{ab}	3122.60^{bcde}	457
8	IT04K-339-1	2614.58^{bc}	2816.66^{abcd}	2715.60^{cdefg}	319
9	IT04K-405-5	5028.27^{a}	3229.16^{abcd}	4128.70^{ab}	1087
10	IT06K-139	2774.03^{b}	1750.00^{bcde}	2262.00^{defg}	395
11	IT06K-147-2	2803.59^{b}	4822.22^{a}	3812.90^{abc}	896
12	IT07K-187-55	1508.33^{bcd}	2819.44^{abcd}	2163.90^{defgh}	369
13	IT07K-194-3	2567.42^{bc}	4097.22^{ab}	3332.30^{abcd}	454
14	IT07K-220-1-9	2004.58^{bcd}	2555.55^{abcde}	2280.10^{defg}	382

15	IT07K-292-10	2281.25^{bcd}	1354.16^{cde}	1817.70^{fgh}	279
16	IT07K-293-3	6591.66^{a}	2375.00^{abcde}	4483.30^{a}	1180
17	IT07K-297-13	887.03^{bcd}	2000.00^{bcde}	1443.50^{ghi}	266
18	IT07K-304-9	506.01^{cd}	4833.33^{a}	2669.70^{cdefg}	1256
19	IT07K-318-2	628.47^{bcd}	1305.55^{cde}	967.00^{hij}	152
20	Kanannado	2116.02^{bcd}	1799.60^{bcde}	1957.80^{efgh}	187
	Mean	**2072.99**	**2570.88**		
	SEM	**227.99**	**211.02**		

abcd: Means on the same column with different superscript are significantly ($p<0.05$) different. (Duncan, 1955)
SEM: Standard Error of the Means

Table 2: Average Pod yield (kg ha^{-1} DM) of 20 cowpea cultivars in 2012 and 2013 cropping seasons

S/N	Variety	2012	2013	Mean	SEM
1	IT06K-147-1	0.00^{h}	187.00^{cdef}	187^{fg}	62.50
2	IT00K-335-45	416.67^{efgh}	12.005^{ef}	300.00^{ef}	84.77
3	IT04K-227-4	791.60^{bcdef}	416.67^{cdef}	604.16^{cd}	99.04
4	IT04K-267-8	500.00^{defgh}	333.00^{cdef}	416.66^{def}	69.72
5	IT04K-332-1	437.00^{efgh}	875.00^{ab}	700.00^{bc}	211.39
6	IT04K-333-2	583.33^{cdefg}	583.00^{bcd}	583.00^{cd}	52.70
7	IT04K-334-2	750.00^{bcdef}	375/00^{cdef}	562.50 ^{cd}	135.97
8	IT04K-339-1	291.66^{fgh}	166.60^{def}	229.16^{fg}	59.65
9	IT04K-405-5	166.60^{gh}	333.00^{cdef}	250.00^{fg}	55.90
10	IT06K-139	833.30^{bcde}	350.00^{cdef}	591.66^{cd}	157.00
11	IT06K-147-2	1000.00^{bcd}	458.00^{bcde}	729.00^{bc}	149.00
12	IT07K-187-55	1041.00^{bc}	416.00^{cdef}	729.00^{bc}	197.00
13	IT07K-194-3	1791.66^{a}	1062.00^{a}	1500.00^{a}	223.00
14	IT07K-220-1-9	1083.30^{bc}	500.00^{bcde}	791.60^{bc}	150.23
15	IT07K-292-10	666.60^{cdefg}	625.00^{bc}	645.83^{bcd}	142.00
16	IT07K-293-3	1208.33^{b}	583.00^{bcd}	895.83^{b}	189 .00
17	IT07K-297-13	666.00^{cdefg}	416.60^{cdef}	541.66^{cde}	100.34
18	IT07K-304-9	500.00^{defg}	375.00^{cdef}	425.00^{def}	50.00
19	IT07K-318-2	708.33^{bcdef}	566.00^{bcd}	637.50^{bcd}	88.68
20	Kanannado	0.00^{h}	0.00^{f}	0.00^{g}	0.0
	Mean	**715.91**	**436.40**		
	SEM	**62.68**	**39.12**		

abcd: Means on the same column with different superscript are significantly ($p<0.05$) different.
SEM: Standard Error of the Means

Table 3: Proximate composition and fibre fractions (DM) of selected cowpea cultivars

	Proximate Composition					**Fibre fractions**				
Cultivars	**DM**	**CP**	**EE**	**Ash**	**NFC**	**NDF**	**ADF**	**ADL**	**HEM**	**CELL**
IT04K-334-2	86.00^{ab}	11.14^{c}	10.50^{b}	6.67	11.69^{ab}	60.00^{bc}	36.00^{c}	5.33^{b}	24.00^{a}	20.66^{b}
Kanannado	85.00^{ab}	15.92^{a}	11.00^{ab}	5.33	6.40^{c}	61.33^{b}	40.67^{b}	12.67^{a}	20.67^{a}	28.00^{b}
IT07K-293-3	89.00^{a}	10.49^{c}	11.5^{ab}	5.67	12.34^{a}	60.00^{bc}	42.67^{b}	10.67^{a}	17.33^{bc}	32.00^{b}
IT04K-194-3	88.00^{a}	11.14^{c}	10.50^{b}	6.00	7.39^{bc}	66.00^{a}	41.33^{b}	10.00^{a}	24.67^{a}	31.33^{b}
IT04K-405-5	86.00^{ab}	13.57^{b}	12.50^{a}	6.67	10.59^{abc}	56.67^{c}	44.00^{b}	12.67^{a}	12.67^{c}	31.33^{b}
IT06K-147-2	89.00^{a}	12.28^{bc}	11.50^{ab}	5.33	7.55^{bc}	63.30^{ab}	50.00^{a}	11.33^{a}	13.33^{c}	38.67^{a}

abcd: Means on the same column with different superscript are significantly ($p<0.05$) different.

DM: Dry matter; CP: Crude Protein; EE: Ether Extract; NFC: Non Fibre Carbohydrates; NDF: Neutral Detergent Fibre; ADF: Acid Detergent Fibre; ADL: Acid Detergent Lignin; HEM: Hemicellulose; CELL: Cellulose.

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