

## Effect of stage of harvest on dry matter yield and nutritive value of *lablab purpureus*, *Centrosema pubescens* and *Mucuna pruriens* as fodder in Adamawa State, Nigeria

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### Abstract

An experiment was conducted to evaluate the effect of growth, biomass yields and nutritive value of *Lablab purpureus*, *Centrosema pubescens* and *Mucuna pruriens* under rain fed condition in Yola, Adamawa State, Nigeria. The field experiment was laid in a randomized complete block design with the plot divided into three main plots and replicated three times measuring 5x5m with inter and intra row spacings of 0.5m. The five harvesting stages are 6, 8, 10, 12 and 14 weeks, respectively. The growth in height increases with stage of growth and declined with reduction in rainfall. Higher growth were recorded in T3 (3.8 -354.8cm) followed by T2 (2.96-260.20cm) and then T1 (1.50-213.00cm) and the results were presented graphically. The result of the chemical composition of all the legumes showed that the crude protein decreases with stage of growth from weeks 6 -14 (14.40, 12.26, 10.65-10.08, 6.79, 6.49) and ADF and NDF (25.20, 32.15, 27.35-42.13, 40.33, 36.50 and 32.20, 54.45, 47.00-51.24, 63.53, 66.33), respectively. The biomass yields were significantly different ( $P < 0.05$ ) for all the legumes at different harvesting stages T1 (2744.53-3186.93), T2 (2696.47-3006.70) and T3 (2843.73-3147.63). It is therefore concluded that legumes could best be harvested between weeks 10 and 12 when the yield and quality are at levels to sustain the animals both for maintenance and production.

**Keywords:** Stage of harvest, Dry matter, Nutritive, *Lablab*, *Centrosema*, *Mucuna*

### Introduction

The livestock sector is a vital constituent of agriculture in most countries of the world and play a considerable role as a strategic subsector to offset the wide spread of social and economic consequences of poverty (Behnke and Metaferia, 2011). The productivity of this sector has been hindered due to poor nutrition and inadequacy of good quality feed (Lamidi *et al.*, 2005) despite the contribution of indigenous pastures to livestock as feed. The current trends indicate that they are greatly overstocked and existing grazing areas are gradually shrinking to encroachment to crop production which is induced by the need to feed the increasing human population especially in the developing countries (Leng, 2004 and Melaku, 2004). Crop residues are now used in most developing countries as livestock

feed but are characterized by their low crude protein and energy levels and high concentration of cell wall fractions (Tolera and Frik, 2000). As a result, their intake is limited and barely fulfill even the maintenance requirements of the animals for essential nutrients (Melaku, 2004 and Tolera and Frik, 2000). Though the crop residues can significantly contribute to livestock production improvement, but residues based feeding practices are without appreciation of production responses that could be achieved with supplementation or treatment (Leng, 2005 and BARC, 2003). Also, another strategy is to produce high quality sown forages such as leguminous fodder which has been found to provide adequate dry season supplementation and improve the productivity of the grazing animals. The legume can be sown pure stand in protein

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bank or undersown in food crops. It can be grazed, harvested and fed fresh or stored as hay or silage (Harricharan *et al.*, 1988). As a consequence of different biochemical pathways of carbon fixation during photosynthesis, nitrogen fixing legume have higher concentration of cellular protein than tropical grasses (Bjorkman *et al.*, 1976) and such tropical legumes are rich in protein which is limiting nutrient in tropical animal diets most especially during the dry season.

A legume such as *lablab*, *centrocema* or *mucuna* combines great number of qualities such as more digestible and enhance dry matter intake by grazing animals or during feeding. These crops have advantages like adaptability and not only drought resistant, but able to grow in diverse range of environmental conditions worldwide. The crop remained green during the dry season and has been known to provide up to six tones of dry matter per hectare (Murphy *et al.*, 1999). However, the productivity during rainy or dry season

(Adu *et al.*, 1992) has not been evaluated in most areas in northern part of Nigeria to determine the herbage yield and nutritive values of these legumes. Therefore, this study was undertaken to assess the herbage yield and nutritive values of the three leguminous species in Adamawa State, Nigeria.

#### **Materials and methods**

##### ***Experimental site***

The experiment was carried out at the Department of Crop Production, Teaching and Research Farm, Modibbo Adama University of Technology, Yola. It is located within latitude 7<sup>0</sup> and 110 North and longitude 110 and 14<sup>0</sup> East and altitude of about 185.9m above sea level and lies within Northern Guinea Savanna zone of Nigeria (Bashir, 2002). The soil is sandy loam and Yola has a tropical climate marked by rainy and dry seasons. Maximum temperature can reach 40<sup>0</sup>c particularly in April, while minimum temperature can be as low as 18<sup>0</sup>c with annual rainfall of less than 1000mm.

**Table 1: Mean annual rainfall and temperature of the study area during 2015 season**

Month	Rainfall(mm)	Temperature (°c)	
		Max	Min
January	0.00	25.0	21.0
February	0.00	29.5	23.4
March	0.00	37.2	25.0
April	9.25	34.7	28.3
May	25.40	37.0	26.5
June	80.15	31.6	25.0
July	130.04	28.0	23.0
August	150.85	30.0	24.0
September	130.28	31.0	25.5
October	21.15	34.0	26.1
November	0.00	35.2	22.0
December	0.00	30.0	20.5

Source: Meteorological Station, Modibbo Adama University of Technology, Yola, Nigeria

##### ***Land preparation and experimental layout***

A land area of 20x20m was cleared, ploughed and harrowed for the ease of planting and germination. The plot was divided into three main plots and then

replicated three times measuring 5x5m with inter and intra row spacing of 0.5m in a randomized complete block design (RCBD).

**Measurements**

The growth of the crops were measured on weekly basis using a meter rule- taking 10 samples per plot starting from week 1 after germination to week 14.

**Biomass yield (kg DM/ha)**

The biomass yield was determined by cutting samples per plot starting from week 6 of growth and sub-sequently at two weeks interval up to week 14. Sub-samples were taken for oven drying at 60°C for 48 hours until constant weight for the estimation of the dry matter yield.

**Chemical analysis**

Forage were collected, processed and analysed for dry matter by oven drying at 60°C for 48hours. Crude protein (CP) was determined by Kjeldahl method, ash by burning in a furnace at 550°C for 3 hours and crude fat by soxhlet extraction according to A.O.A.C. (2004) method. Acid detergent fiber (ADF) and neutral detergent fiber (NDF) were determined according to Van Soest and Robertson (1991) method.

**Statistical analysis**

The results obtained were subjected to analysis of variance of a randomized block

design (Steel and Torrie, 1980). The treatment means were separated using least significant difference (LSD).

**Growth pattern of *Lablab purpureus*, *Mucuna pruriens* and *Centrosema pubescens***

The growth pattern of three legume species (*lablab purpureus*, *centrosema pubescens* and *mucuna pruriens*) is presented in Figure1. The growth in height ranged from 1.50 to 213.00cm (*lablab purpureus*), 2.96cm to 260.20cm (*mucuna pruriens*) and 3.8cm to 354.8cm (*centrosema pubescens*). There were significant differences ( $P<0.05$ ) in growth between treatments. Higher growth was recorded with centrosema pubescens (354.8cm) followed by mucuna pruriens (260.20cm ( while it is least with the lablab purpureus (213.00cm). The growth was generally slow with all the legumes from weeks 1 to 3 and increases gradually to maximum values at week 13 and there was no further increase at week14. There was decline in growth at weeks 6 and 7 which could be due to decline in rainfall and picks up at week 8 when the rainfall normalizes and was consistent until when it finally declined at weeks 13 and 14 in October, 2014 of the year.

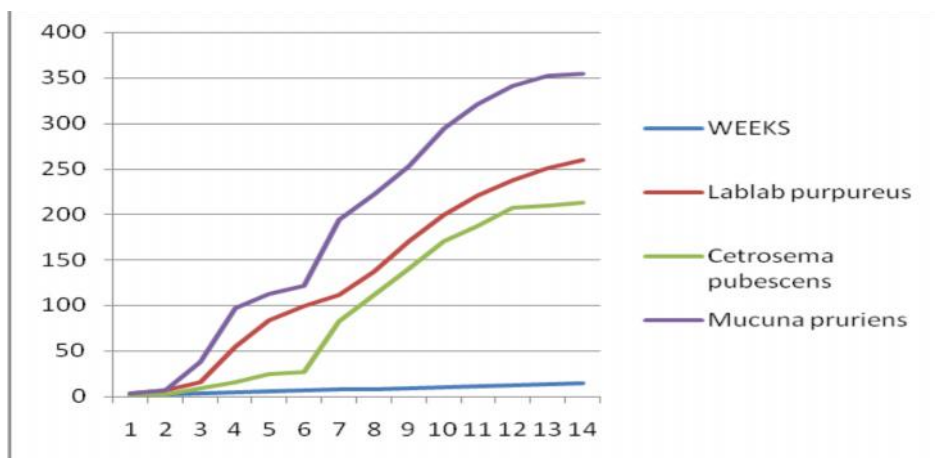


Fig. 1: Growth pattern of *Lablab purpureus*, *Mucuna pruriens* and *Centrosema pubescens* (cm).

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**Dry matter yield**

The data on dry matter yield is summarized in Table 2. Dry matter yield ranged from 2696.47 to 3186.93(T1), 2696.47 to 3006.70(T2) and 2843.73 to 3147.63Kg

DM/ha. The dry matter yields for all the treatments increases with stage of growth to a maximum values at week 14 and declined. There was significant difference (P<0.05) in dry matter yields across all the treatment groups.

**Table 2: Biomass Yield of *Lablab purpureus*, *Mucuna pruriens* and *Centrosema pubescens* (Kg/DM/ha)**

Weeks	Lablab purpureus	Mucuna pruriens	Centrosema pubescens	LSD
6	2744.53 <sup>b</sup>	2696.47 <sup>c</sup>	2843.73 <sup>a</sup>	11.62*
8	2880.20 <sup>b</sup>	2827.60 <sup>c</sup>	2967.07 <sup>a</sup>	5.30*
10	3016.53 <sup>b</sup>	2910.00 <sup>c</sup>	3053.60 <sup>a</sup>	4.38*
12	3152.43 <sup>a</sup>	2950.47 <sup>c</sup>	3115.23 <sup>b</sup>	7.89*
14	3186.93 <sup>a</sup>	3006.70 <sup>c</sup>	3147.63 <sup>b</sup>	7.88*

***Chemical composition of Lablab purpureus, Mucuna pruriens and Centrosema pubescens***

The result of the chemical composition of *Lablab purpureus*, *Mucuna pruriens* and *Centrosema pubescens* is presented in Table 3. Dry matter content numerically increased from 31.73 to 89.89, 30.80 to 88.89 and 27.70 to 77.10% from week 6 to maximum values at week14 for all the legumes. Crude protein content ranged from 10.08 to 14.40%, 6.79 to 12.36% and 6.49 to 10.65%. The crude protein content of the legumes also numerically decreases with

stage of maturity. Ash content ranged from 10.88 to 13.04%, 5.74 to 9.01% and 7.36 to12.26%. The ash content also increases with stage of maturity. Ether extract ranged from 0.25 to 1.60%, 7.26 to 13.37% and 5.82 to 11.59% and decreases with stage of maturity. ADF content ranged from 25.20 to 42.13%, 32.15 to 40.33% and 27.35 to 36.50% and increases with stage of maturity and NDF content followed the same trend which ranged from 32.20 to 51.24%, 54.45 to 63.53% and 47.00 to 66.33% and also increases with stage of maturity.

**Table 3: Chemical Composition of *Lablab purpureus*, *Mucuna pruriens* and *Centrosema pubescens* (%DM)**

WK	Treatment	DM	CP	ASH	EE	ADF	NDF
6	T1	31.73	14.40	10.88	1.60	25.20	32.20
	T2	30.80	12.26	5.74	13.37	32.15	54.45
	T3	27.70	10.65	7.36	11.59	27.35	47.00
8	T1	39.51	13.10	11.76	1.48	35.12	40.16
	T2	38.15	11.36	6.50	11.56	33.34	56.60
	T3	37.67	9.63	8.40	10.56	29.59	48.20
10	T1	63.90	12.08	12.31	0.36	37.26	42.61
	T2	71.72	10.47	7.52	9.60	35.17	59.09
	T3	55.00	8.51	8.73	8.90	31.00	51.60
12	T1	85.50	11.60	12.52	0.29	38.27	44.99
	T2	88.13	9.32	8.87	9.74	37.37	61.29
	T3	68.00	7.17	10.63	6.86	32.33	62.13
14	T1	89.89	10.08	13.04	0.25	42.13	51.24
	T2	88.89	6.79	9.01	7.26	40.33	63.53
	T3	77.10	6.49	12.26	5.82	36.50	66.33

## **Discussion**

The growth pattern of *Lablab purpureus*, *Mucuna pruriens* and *Centrosema pubescens* in the study was consistent but slow at the early stages from weeks 1 to 3 and thereafter increases gradually to a peak values at week 13 and declined gradually at week 14 as a result of seed production with all the legumes and coupled with the declined in rainfall in the state. This is similar to the reports by Murtagh and Dougherty (1968); Mbahi *et al.* (2005; 2010) that legumes exhibits slow growth at early stages and increases with time in the season. Also in similar studies with other fodder crops (Hong *et al.*, 1987; Ibrahim *et al.*, 2006; Tessema, 2008) significant growth were recorded because the crops were not planted in mixture which reduces competition for nutrients and sunlight. The dry matter yield increases with stage of growth and there were significant differences ( $P < 0.05$ ) between the treatments. The differences in dry matter yields among the legumes could be associated to the plants height and sizes at maturity. A similar finding was reported by Nworgu and Ajayi (2005) with *lablab purpureus* but obtained higher dry matter with *lablab purpureus* of different varieties (14.70 and 13.10t/ha/yr). Skerman *et al.* (1988) in Brazil also reported higher values with *centrosema pubescens* (40.00t/ha/yr to 4.95t/ha/yr). Uden *et al.* (2007) also reported 4.08t/ha/yr and 4.26t/ha/yr for two seasons. Mbahi (2010) in a separate study in Yola reported a range value of 1.76 to 13.74t/ha/yr. Dry matter yield of *mucuna* in this study is similar to 2.060kg reported by Malunga *et al.* (2008) in maize intercrop while Carsky *et al.* (1998) and Eilitta and Sollenberger (2002) reported higher range values of 7 to 9kg and 4.900kg to 7.900kgDM/ha, respectively in rainfall Zone of West Africa, while 4000kgDM/ha was reported in Zimbabwe by Maasdorp

and Titterton (1997). The differences could be due to low rainfall distribution pattern and soil fertility level, much shedding of leaves and that no fertilizer was used. Crude protein content of *lablab* in this study ranged from 10.08 to 14.40% and is higher than the range value of 7.79 to 10.50% reported by Mbahi *et al.* (2006) with a range value of 9.00 to 10.35% also reported in another study by the same author in year 2010 The crude protein content of *Centrosema pubescens* in this study ranged from 6.49 to 10.65% and the maximum value is similar to 10.4% reported by Aletor and Omodara (1994), but lower than 13.6% an 23.2% reported Akinola and Agishi (1989) and Nworgu (2004), while Ratnawaty *et al.* (2013) also reported a higher range values of 8.19 to 28.03%. Crude protein content of *mucuna* in this study is lower than 16.3%, 16.6% and 17.5% reported by Muinga *et al.* (2003), Mbuthia and Gachuiiri (2003) and Nyambati and Sollenberger (2003). The differences could be due to stage of harvest or soil fertility. Ash content of *lablab purpureus* ranged from 10.88 to 13.04% and is higher than 6.66% reported by Nworgu and Ajayi (2005) but within the range values of 11.97 to 13.5% reported by Mbahi *et al.* (2006), while Mbahi (2010) in another study reported a range values of 9.90 to 13.50% and attributed the slight difference as a result of rainfall, soil fertility and shedding of leaves. The ash content of *mucuna* reported by Malunga *et al.* (2008) and Nyambati and Sollenberger, (2003) were 6.8% and 9.4% which falls within the range values obtained in this study. The ash content of *Centrosema pubescens* in this study ranged from 7.36 to 12.26% and higher than 6.01% reported by Nworgu and Ajayi (2005) while Geleti (2013) reported a similar range values of 7.3 to 9.0% for five different varieties and stated that the differences could be due to stage of harvest,

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rainfall or shedding of leaves. Ether extract content of lablab in this study ranged from 0.25 to 1.60% and is lower than 4.02% reported by Nworgu and Ajayi (2005) while Mbahi (2006) in another study reported close range values of 0.16 to 1.42%. Differences in values were attributed to soil types and shedding of leaves. The NDF content of mucuna (32.5% and 37.4%, respectively) reported by Malunga *et al.* (2008) and Nyambati and Sollenberger (2003) were lower than the range values of 54.45 to 63.53% obtained in this study.

### Conclusion

Growth was higher with mucuna *prureins* followed by *lablab purpureus* and least with *Centrosema pubescens*. *Centrosema pubescens* produced the highest dry matter and least with *mucuna prureins*. Crude protein and ether extract reduces while ADF and NDF increase with stage maturity. The legumes could best be harvested between weeks 10 and 12 when dry matter and nutritive values are moderate before leaf shattering and drop in quality.

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