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ASSESSMENT OF GROWTH, DRY MATTER YIELD AND NUTRITIVE VALUE OF SOME FORAGE LEGUMES IN THE SEMI- ARID ZONE OF NIGERIA

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ABSTRACT

An Experiment was conducted to assess growth, dry matter yield and nutritive content of *Lablab purpureus* (T_1), *Mucuna prupriens* (T_2), *Centroscema pascuorum* (T_3) and *Cajanus cajan* (T_4). The legumes were planted at the beginning of rainy season at Teaching and Research Farm, Faculty of Agriculture, University of Maiduguri which covered a land area of $280m^2$ divided into four blocks with three sub plots each measuring 4×3m with 0.5m border between the plots and 0.1m between the blocks, replicated three times in a randomized complete block design. Forages were harvested at different stages of growth, from week five up to fifteen. Plant growth in height was measured weekly while dry matter yield and nutritive contents were determined subsequently by taking sub samples from each forage legume species at two weeks interval for oven drying to constant weight at 60^0C for 48 hours followed by proximate analysis respectively. The results showed that maximum growth was observed during weeks 5 to 9 which coincided with the period of high rain fall (July to August). T1 recorded higher ($p<0.05$) growth (7.4-224cm) followed by T2 (6.25-231cm), T3 (8.2-155cm) and then T4 (3.01-115cm). Dry matter yield differed significantly ($p< 0.05$) for all the legumes at different stages of growth: T1 (2,609.25-3,187.50), T2 (2,855.86-3,147.10), T3 (2,723.26-3,006.70) and T4 (2,556.85–2,900) kg/Dm/ha. Nutritive contents of the forages showed that while crude protein and ether extracts decreases, dry matter, crude fiber and ash contents increases with the stages of growth, from week 5 to 15. It was concluded that the legumes could best be harvested between weeks 9 and 13 when the yield and quality reached peak to meet both the dry matter and nutritive requirements of animals for higher productivity.

Keywords: Growth; Nutrient contents; Dry matter yield

INTRODUCTION

Forage legumes are the basis of many livestock operation that purports to be truly sustainable. It is especially important as the livestock sector continue to experience extraordinarily high fuel and other input costs. Legume-based production systems offer farmers and ranchers the ability to let the ruminant's environment and immune system work together, thereby gaining an acceptable level of production while naturally maintaining the integrity of the ecological connections between ruminants, soil and pasture plants (Ganya *et al.*, 2004). The current trends show that they are greatly overstocked and existing grazing areas are gradually shrinking to encroachment for 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; which are characterized by 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 rarely fulfil maintenance requirement of livestock for essential nutrients (Melaku, 2004 and Tolera and Frik, 2000). Although crop residues can significantly contribute to livestock feed production, but residue-based feeding practices are without appreciation of production responses that could be achieved with supplementation or treatment (Leng, 2005). Another strategy is to produce high quality sown forages such as leguminous fodder that has been found to provide adequate nutrients supplementation in the dry season and to improve productivity of grazing animals.

Legumes can be sown solely in protein bank or with other 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 legumes 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. Legumes such as *Lablab*, *Mucuna*, *Centrocema or Cajanus cajan* combine great number of qualities such as being 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 tons of dry matter per hectare (Murphy *et al.*, 1999). However, the productivity of these legumes during rainy or dry season has not been evaluated in most areas in the north eastern part of Nigeria for herbage yield and nutritive values. This study assessed growth, herbage yield and nutritive content of four leguminous species in Borno State, Nigeria.

MATERIALS AND METHODS

Experimental site

The experiment was conducted at the Teaching and Research Farm, Faculty of Agriculture, University of Maiduguri. The research farm is located at latitude 11^0 49ˈ 59.9988" N and longitude 13^0 9ˈ 0.0000"E in the Sahel savannah zone of Nigeria. The area has a mean annual rainfall of about 552.1mm during the year of study (2008). The wettest month is August (193.2mm). Driest months are January, February and November (0mm). The highest average low temperature was in May (25.5^{o}C) and the lowest in January (12.6).

The highest average high temperature was in April (40.1^{o}C) while the lowest was in January (31.9^{o}C). The soil type of the study area is sandy loam.

Table 1: Mean monthly rainfall and temperature (high and low) of the study area during 2008

Month	Average rainfall(mm)	Average temperature (^{o}C)	
		High	Low
January	0	31.9	12.6
February	0	34.6	15.
March	0.3	37.8	19.7
April	13	40.1	21.9
May	30.5	39.4	25.5
June	73.8	36.4	24.5
July	147.1	33.2	22.9
August	193.2	32.0	22.3
September	83	33.7	22.4
October	11.1	36.4	20.7
November	0	34.2	16
December	0.1	32.3	13.1

Source: Meteorological Station, University of Maiduguri, Borno, State

Treatment and Experimental Design

A land area of 280m^2 was cleared, ploughed and harrowed using a tractor. Following the harrowing, the land was sub-divided into sub-plots of 4m ×3m with 0.5m within blocks and 1.0m between the blocks. It was laid out in a Randomized Complete Block Design (RCBD). The four different species of forage legumes used as treatments in the experiment were *Lablab purpereus, Mucuna prupriens, Cajanus cajan* and *Centrosema pascuorum.*

Measurement

The parameters measured during the experiment were plant height, dry matter yield and chemical composition.

Growth: The plant height was measured in centimeters (cm) at two weeks interval from week five after germination to week fifteen (5, 7, 9, 11, 13 & 15) using a measuring tape.

Yield: Forage yield was determined by cutting sample per plot beginning from week five and subsequently at two weeks interval up to week fifteen. Sub - samples were taken from the cut forage at different stages of growth for each treatment. The samples were oven dried at 60^{0}C for 48 hours until a constant weight is obtained. This is for the estimation of dry matter yield.

Chemical analysis: The dried Samples from the cut forage at different stages of growth were analysed for crude protein (CP); using the standard Kjeldahl method, crude fibre (CF); using trichloro acetic acid (T. C. A) digestion method, ether extract (EE); by dry soxhlet method, fat extraction using ether while Ash content determination was carried out by complete combustion in a furnace at 550^{o}C for four hours.

Statistical Analysis

The data obtained from the study were subjected to analysis of variance of a randomized complete block design (Steel and Torrie, 1980) while the means were separated using Least significant difference (LSD) test at (P< 0.05).

RESULTS AND DISCUSSION

The growth pattern of *Lablab purpureus*, *Mucuna pruriens*, *Centrocema pubescens* and *Cajanus cajan* is presented in Figure 1. The growth ranged from 10.4 to 250 cm (*lablab purpureus*), 7.25cm to 240cm (*Mucuna pruriens*), 5.01 to 152cm *(Centrosema pubescens)* and 8.2 to131cm (*Cajanus cajan*). Higher growth was recorded with *Lablab purpureus* (250cm) followed by Mucuna pruriens (240cm) and Centrosema pubescens (152cm) while it **is** least with Cajanus cajan (131cm). The growth was generally slow with all the legumes from week 1 to week 3 and increased gradually to maximum value at week 13. The decline in growth at weeks 6 and 7 could be due to decline in rainfall but pick up at week 8 when the rainfall normalizes until the growth finally declined at weeks 13 and 14. This scenario was also observed by Mbahi *et al.* (2005; 2010). The author observed that legumes exhibits slow growth at early stages but the growth increases with time. Tessema (2008) reported that significant growth was observed in monocropping system that reduces competition for nutrients and sunlight.

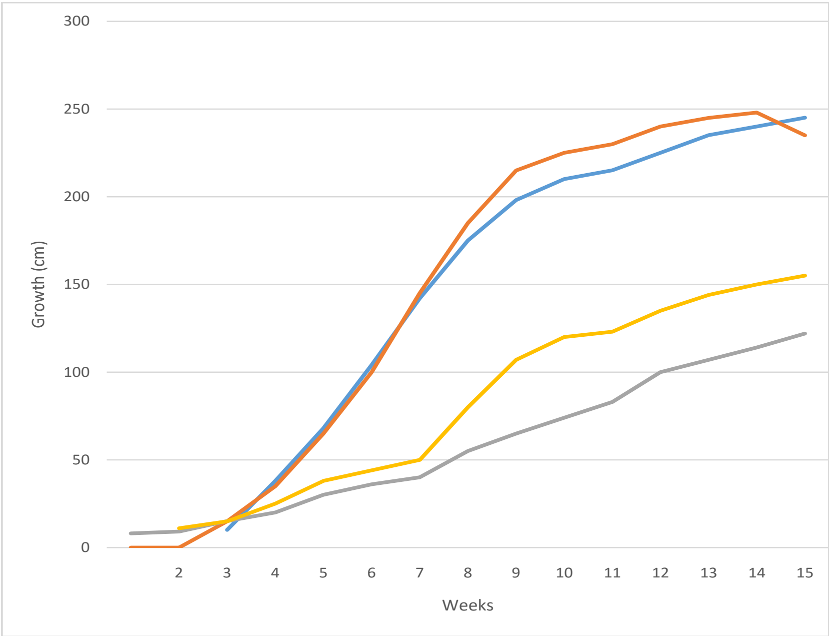

Figure 1: Δ Lablab ΔMucuna
ΔCentrosema Δ Cajanus cajan

Table 3: Dry matter yield (kg/Dm/ha) of *Lablab purpureus*, *Mucuna pruriens*, *Centrosema pubescens and Cajanus cajan* in Maiduguri, Borno state, Nigeria

Weeks after germination	*Lablab purpureus*	*Mucuna pruriens*	*Centrosema pubescens*	*Cajanus cajan*	LSD
5	2855.86[a]	2609.25[ab]	2723.26[ab]	2556.85[b]	12.31*
7	2903.44[a]	2742.02[ab]	2796.26[ab]	2610.32[b]	6.16*
9	2982.61[a]	2879.25[b]	2873.44[b]	2644.98[c]	7.18*
11	3059.74[a]	3015.42[a]	2921.99[b]	2773.11[c]	4.13*
13	3098.93[ab]	3149.60[a]	2969.57[ab]	2862.88[b]	6.86*
15	3147.10[a]	3187.50[a]	3006.70[b]	2900.00[b]	6.42*

The result on dry matter yield of the forages is presented in Table 3. There was significant ($P<0.05$) differences among the treatment means. The differences could be attributed to their growth associated with height and sizes at maturity. Nworgu and Ajayi (2005) reported similar result when legumes were planted but obtained higher dry matter yield with *Lablab purpureus* (14.70 and l3.l0t/ha/yr). Uden *et al.* (2007) also obtained 4.08t/ha/yr and 4.26t/ha/yr of forage legume dry matter yield. Mbahi (2010) in a separate study reported a range value of 1.76 to 3.74t/ha/yr during rainy season. Dry matter yield of mucuna in the present study is similar to what was reported by Malunga *et al.* (2008) in maize intercrop while 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. The differences (low dry matter yield) obtained in this study could be due to low rainfall distribution pattern and soil fertility level in the study area (North eastern zone of Nigeria), much shedding of leaves and non-application of fertilizer.

The result of nutritive value of forage legumes are presented in Table 2. Crude protein content of lablab obtained in the present study ranged from 9.03 to 14.90% CP and is higher than the range value of 7.79 to 10.50% CP reported by Mbahi *et al.* (2006). The author further reported a range value of 9.00 to 10.35% CP in a separate study in 2010 using same location, species and age but with a different method (intercrop with sorghum). The crude protein content of *Centrosema pubescens* in this study ranged from 10.00 to 12.90% CP. The maximum value is similar to 10.4% at weeks 8 reported by Aletor and Omodara (1994) but lower than 13.6 to 23.2% obtained by Nworgu (2004). Ralnawaty *et al.* (2013) observed a range value of 8.19 to 28.03% at different stages of production. Crude protein content of mucuna obtained in the present study is lower than 16.3 and 16.6% CP reported by Muinga *et al.* (2003) and Mbuthia and Gachuiri (2003) at a peak of production while Nyambati and Sollenberger (2003) reported 17.5 % CP at stage of seed production. The differences could be attributed to stage of harvest and or soil fertility. Ash content of ranged from l0.88 to 13.04% which is higher than 6.66% obtained by Nworgu and Ajayi (2005) but within the range of 11.97 to 13.5% reported by Mhahi *et al.* (2006). The author in a separate study in 2010 reported a range values of 9.90 to 13.50% which is attributed to difference in 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% similar to the range values obtained in the present study. The ash content of *Centrosema pubescens* which ranged ranged from 8.45 to 11.86% is higher than 6.01% reported by Nworgu and Ajayi (2005). Geleti (2013) reported a similar value (7.3 to 9.0%) for five different varieties. The differences could be due to stage of harvest, rainfall or shedding of leaves. Ether extract content of lablab in this study (5.51 to 7.56 %) is higher than 4.02% reported by Nworgu and

Ajayi (2005). In another study, Mbahi (2006) reported lower range values (0.16 to l.42%). Differences in values were further attributed to soil types and shedding of leaves. The fibre content of mucuna 32.5% and 37.4% reported by Nyambati and Sollenberger (2003) and Malunga *et al.* (2008) respectively were lower than the range values of 54.45 to 63.53% obtained in this study. These variations could be as a result of different cultivars on different soils with various rainfalls ranges and the stage of maturity.

Table 2: Chemical composition of *lablab purpureus*, *Mucuna pruriens*, *Centrosema pubescens* and *Cajanus cajan* (%Dm)

Weeks	Treatment	DM	CP	CF	ASH	EE
5	T1	37.72	14.90	11.16	7.56	9.45
	T2	36.83	15.17	12.89	12.81	6.73
	T3	35.16	12.90	11.70	11.27	8.45
	T4	33.50	12.86	15.01	13.34	10.56
7	T1	38.93	13.86	15.01	13.34	10.56
	T2	37.11	13.02	14.O1	11.51	7.01
	T3	36.77	11.97	12.34	9.01	8.98
	T4	35.10	11.00	17.11	11.11	10.96
9	T1	41.02	12.00	17.84	6.81	11.21
	T2	39.10	11.73	16.39	9.40	9.34
	T3	38.88	11.97	14.41	8.91	9.33
	T4	37.11	10.88	21.06	10.13	11.06
11	T1	58.02	10.01	23.08	6.11	11.46
	T2	48.04	11.00	24.44	8.27	9.98
	T3	46.91	10.11	22.01	6.71	9.84
	T4	44.30	9.98	29.92	9.77	11.56
13	T1	73.13	9.78	37.21	5.81	12.12
	T2	69.83	10.11	39.01	6.17	11.02
	T3	68.97	9.42	38.43	5.34	11.00
	T4	65.07	9.37	36.02	7.43	12.94
15	T1	88.40	9.03	41.23	5.51	13.14
	T2	86.51	9.00	43.13	5.11	11.97
	T3	80.77	10.00	46.01	3.23	11.86
	T4	79.92	8.23	40.11	5.31	13.72

CONCLUSION

Growth of *Lablab purpureus* and *Mucuna pruriense* were higher with similar trend followed by *Centrosema pubescens* and *Cajanus cajan. Lablab purpureus* produced highest dry matter yield. Dry matter, fibre and ash content increases with stage of maturity. The legumes are better harvested at between week 10 and 12.

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