Original Research

Height and Mineral Composition of 12 Improved Tropical Forage Legume Species in the Southern Guinea Savanna of Nigeria

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Abstract

The study was conducted to evaluate the adaptability and performance of 12 improved forage legume species. The results showed significant (P<0.05) differences among the legume species for plant height. At 4 weeks after sowing (WAS), plant height ranged from 7.76 cm for Desmodium intortum to 43.10 cm for Mucuna pruriens (black seeded) in the field and results in the pot experiment were similar. Plant height at 16 WAS ranged from 104.95 cm to 398.56 cm for Gliricidia sepium and Lablab purpureus, respectively. Calcium content ranged from 0.77% in Cajanus cajan to 1.16% in Gliricidia sepium and Centrosema pascuorum. Phosphorus content ranged from 0.33% to 2.27% in Centrosema pascuorum and Aeschynomene americanum, respectively while potassium ranged from -0.32% to 0.27% for Gliricidia sepium and Cajanus cajan, respectively. It is recommended that Cajanus cajan, Lablab purpureus, Centrosema pascuorum, Centrosema pubescens and Mucuna pruriens (White and black seeded) be adopted by livestock farmers and pasture agronomists to establish ranches and produce seeds.

Key words: Forage, Height, Legumes, Minerals

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Introduction

Forage and fodder crops are central to the development of Nigeria's livestock industry. This feed resource, which consists mainly of grasses, legumes, browses, and cereal crop residues vary widely and are spread across the major agro-ecological zones of the country (Shiawoya and Tsado, 2011). Improved pastures produce more dry matter of high nutritive value and lead to greater animal productivity than do native pastures (Nuru, 1996). The need for improved legume forage species into the southern guinea savanna ecology cannot be overemphasized since the poor quality natural grassland largely contributes to the poor

animal performance. Given the prevailing economic conditions with high cost of other feed sources which are generally too high to be recommended for widespread use, Nigeria will have to rely heavily on intensive use of pastures to improve the nutritional status of livestock. Abayomi *et al.* (2001) have evaluated legume cover crops but this study has a wider scope of forage legume species for performance evaluation. This study was therefore designed with the aim of introducing and determining the growth performance and mineral composition of 12 tropical forage legume species for establishment.

Materials and Methods

The study was conducted from May to November, in 2015 to 2016 cropping seasons at the pasture field of the Livestock Teaching and Research Farm, College of Animal Science of the University of Agriculture, Makurdi, Nigeria. Makurdi is located on latitude 07º 41' N, longitude 08º 37'E and altitude 106.4 m (NIMET, 2016). Seeds of twelve (12) forage legume species: (*Cajanus cajan* (L) Millsp, *Stylosanthes hamata* (Verano), *Gliricidia sepium* (Gliricidia), *Centrosema pubescens* (Centro), *Mucuna pruriens*-white seeded, *Alysicarpus vaginalis, Leucaena leucocephala, Desmodium intortum, Lablab purpureus* (Rongai), *Mucuna pruriens*-black seeded, *Aeschynomene americanum and Centrosema pascuorum* (Centro) were obtained from feeds and Nutrition Research Programme of National Animal Production Research Institute (NAPRI), Shika, Zaria were used for the study.

The experimental land was well prepared to allow for good seed-to-soil contact which is essential to maintain adequate moisture near the seeds necessary for germination. Out of the twelve (12) forage legume seeds only *Mucuna pruriens* and *Lablab purpureus* were not scarified, seeds were harvested from the mature fruits which are usually viable for more than two years. Others were scarified using methods appropriate for each species to break seed dormancy before sowing. The twelve (12) line plots were arranged in a Randomized Complete Block Design (RCBD) with three (3) replicates for the field experiment, while a Completely Randomized Design (CRD) was adopted for the pot experiment and replicated three (3) times. Data generated were subjected to Analysis of Variance (ANOVA) using the Minitab Statistical Software (MSS) (Version 16) (2016) for both field and pot experiments. Means that showed significant differences were subjected to Means Separation using the Fisher's Least Significant Difference (LSD) of the MSS at the 5 % level of probability ($P \leq 0.05$). The total plot size was $36m^2$ with each Unit plot having a size of $0.75m^2$. The seeds were sown at 0.5cm – 2.5cm depending on the sowing depth specification for each legume species.

Results and Discussion

Increased plant height provides more green area for increased photosynthetic activities and assimilates needed for grain filling (Haseeb-ur-Rehman *et al.*, 2010). The results of the present study have shown that

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some of the evaluated species have the potential for rapid soil surface coverage. Following crop establishment, *Lablab purpureus*, *Mucuna pruriens* (black seeded), *Mucuna pruriens* (white seeded), *Centrosema pubescens* and *Centrosema pascuorum* grew faster which is attributed to their aggressive growth habit unlike other forages studied. These results agree well with the reports of Carsky (1993) in Cameroun and Marilla *et al.* (1992) in Brazil where ground cover was good with *Centrosema pascuorum* but were relatively slower in *Aeschynomene spp.*

Table 1: Mean squares for plant height (cm) at week 4, 8, 12, and 16 after sowing (field experiment)

Source of Variation	DF	(HT-WK 4)	(HT-WK 8)	(HT-WK 12)	(HT-WK 16)
Replication	2	0.082	0.42	0.3	2815.9
Treatment	11	375.809*	3119.62*	14844.4*	35800.6*
Error	22	0.313	1.14	0.3	2665.6

DF: Degree of Freedom; HT: Height; WK: Week

Table 2: Mean squares for plant height (cm) at week 4, 8, 12, and 16 after sowing (pot experiment)

Source of Variation	DF	(HT-WK 4)	(HT-WK 8)	(HT-WK 12)	(HT-WK 16)
Treatment	12	379.127*	3119.49*	14797.5*	39448*
Error	24	0.526	1.09	3.2	178

DF: Degree of Freedom; HT: Height; WK: Week

Table 3: Mean values of height of forage legume species at 4, 8, 12 and 16 weeks after sowing

Species	4 Weeks		8 Weeks		12 Weeks		16 Weeks	
	Field	Pot	Field	Pot	Field	Pot	Field	Pot
Cajanus cajan	29.73^{d}	33.23^{d}	96.41^{d}	107.22^{d}	177.77^{e}	182.69^{e}	251.92^{c}	260.42^{c}
Stylosanthes hamata	18.68^{e}	22.35^{e}	47.65^{g}	58.23^{g}	82.10^{gh}	92.90^{gh}	116.01^{de}	126.21^{de}
Gliricidia sepium	14.82^{f}	18.52^{f}	47.66^{g}	57.26^{g}	79.96^{hi}	88.90^{hi}	104.95^{e}	114.15^{e}
Centrosema pubescens	11.88^{h}	16.18^{h}	100.29^{c}	112.28^{c}	243.69^{a}	253.29^{a}	336.41^{b}	347.01^{b}
Mucuna pruriens (white)	33.87^{b}	39.57^{b}	100.38^{c}	111.48^{c}	197.78^{c}	205.78^{c}	332.81^{b}	345.01^{b}
Alysicarpus vaginalis	11.68^{h}	15.28^{h}	44.51^{h}	54.65^{h}	84.98^{g}	95.68^{g}	135.86^{d}	143.80^{d}
Leucaena leucocephala	14.32^{f}	19.84^{g}	54.09^{f}	65.16^{f}	97.87^{f}	108.07^{f}	134.83^{d}	144.02^{d}
Desmodium intortum	7.76^{i}	11.36^{i}	35.57^{i}	46.54^{i}	78.11^{i}	89.19^{i}	113.41^{de}	124.19^{de}
Lablab purpureus	32.57^{c}	38.17^{c}	131.02^{a}	139.92^{a}	245.22^{a}	255.52^{a}	398.56^{a}	409.41^{a}
Mucuna pruriens (black)	43.10^{a}	48.19^{a}	106.84^{b}	115.54^{b}	211.97^{b}	223.07^{b}	381.00^{a}	391.06^{a}
Aeschynomene americanum	12.25^{gh}	16.09^{gh}	44.42^{h}	54.92^{h}	70.98^{j}	81.58^{j}	119.52^{de}	129.41^{de}
Centrosema pascuorum	18.95^{e}	22.31^{e}	88.87^{e}	97.27^{e}	193.86^{d}	201.96^{d}	235.03^{c}	244.13^{c}
SEM	**0.554**	**0.725**	**1.066**	**1.04**	**0.545**	**1.8**	**51.63**	**13.35**

a, b, c = Means on the same column with different superscripts are significantly (P<0.05) different; SEM: Standard Error of Mean

Calcium and phosphorus concentrations in the legumes were higher than the suggested critical levels of 0.30% Ca and 0.25% P, necessary to meet ruminant requirements in the tropics (McDowell and Arthington, 2005). The levels of P in this study contrast to the sub-optimal levels of P commonly reported in grasses, legumes and browses of the savannas of Nigeria (Kallah, *et al*., 1999). The ranges of phosphorus in the

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forage legumes were 0.31% to 2.27%. These values were higher compared to the NRC recommendation of 0.15% for phosphorus (NRC, 1985). The -0.32% to 0.27% ranges of potassium values in the legumes, were lower than the NRC 0.80% recommendation for potassium (NRC, 1985).

Table 4: Mineral composition (%) at maturity

Species	Ca	Mg	P	Na	K
Cajanus cajan	0.77^{d}	0.075^{ab}	1.41^{c}	0.32^{fg}	0.27^{a}
Stylosanthes hamata	0.79^{d}	0.067^{bc}	1.85^{b}	0.45^{b}	-0.25^{e}
Gliricidia sepium	1.16^{a}	0.054^{e}	0.80^{e}	0.29^{g}	-0.32^{e}
Centrosema pubescens	0.96^{bc}	-0.004^{f}	0.33^{g}	0.37^{cde}	0.082^{c}
Mucuna pruriens (white)	0.89^{c}	0.070^{abc}	0.63^{f}	0.35^{def}	0.27^{a}
Alysicarpus vaginalis	1.12^{a}	0.065^{bcd}	0.90^{e}	0.39^{cd}	-0.16^{d}
Leucaena leucocephala	0.92^{c}	0.057^{de}	0.84^{e}	0.23^{h}	0.18^{b}
Desmodium intortum	1.01^{b}	0.077^{a}	1.10^{d}	0.33^{ef}	-0.31^{e}
Lablab purpureus	1.02^{b}	0.063^{cde}	1.76^{b}	0.54^{a}	-0.32^{e}
Mucuna pruriens (black)	0.95^{bc}	0.072^{abc}	0.51^{f}	$0.31f^{g}$	0.21^{ab}
Aeschynomene americanum	0.96^{bc}	0.068^{abc}	2.27^{a}	0.35^{def}	-0.31^{e}
Centrosema pascuorum	1.16^{a}	0.077^{a}	0.31^{g}	0.39^{c}	-0.32^{e}
SEM	**0.015**	**0.001**	**0.01**	**0.01**	**0.01**

a, b, c = Means on the same column with different superscripts are significantly (P<0.05) different; SEM: Standard Error of Mean, Ca: calcium, Mg: magnesium, P: phosphorus, Na: sodium, K: potassium

Most forage legume species appeared quite suitable for animal nutrition in terms of contents of Ca, P, Mg, and Na, although rather low in K for production. They appear deficient in potassium compared to animal requirements from the feeding standards of McDowell (1997) but can be supplemented using potassium chloride based salt lick. Grasses deficient in magnesium which animals suffer (grass staggers or tetany) as a result can be supplemented with legumes high in magnesium.

Conclusion and Recommendation

The results obtained in this study revealed that most of the forage legumes species have the potential to supply adequate nutrients for ruminant production. The foliage of the plants contained moderate to high in crude protein at maturity. It is recommended that *Cajanus cajan*, *Lablab purpureus*, *Centrosema pascuorum*, *Centrosema pubescens* and *Mucuna pruriens* (White and black seeded) be adopted by livestock farmers and pasture agronomists in this location to establish ranches, fodder banks and produce seeds based on their ability to adapt, establish well and to exceedingly meet nutrient requirements for ruminants.

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