

## Productivity of Maize-Elephant Grass and Lablab-Mucuna mixtures in the Northern Guinea Savannah of Nigeria

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### Abstract

Pasture and forage crops remain the primary sources of feed for ruminants in Nigeria. However, acute shortage of forage materials, especially green nutritious fodder crops, which is the major cause of low productivity in livestock keeping. This experiment was conducted in 2016 and 2017 Cropping Seasons at the Experimental Field of Feeds and Nutrition Research Programme, National Animal Production Research Institute (NAPRI) Shika, to evaluate the productivity of two grasses (Maize and Elephant grass) and two forage legumes (Mucuna and Lablab). One hectare of land each was used for both the grasses and the legumes. The study was laid in a Randomized Complete Block Design with three replications. Plant height, number of leaves per plant, number of branches per plant, leaf length and leaf width were measured at 4, 8 and 12 weeks after sowing (WAS) for both mixtures and the two cropping seasons. Forage yield of the species was also determined. Results showed that plant height of maize was significantly ( $P < 0.05$ ) higher than Elephant grass at 4 and 8 WAS (68.25cm vs. 49.95cm - 94.15 cm vs. 73.20 cm) but, lower at 12 WAS (163.20 cm vs. 175.60 cm) in 2016 cropping season. However, in 2017 cropping season, Elephant grass was significantly ( $P < 0.05$ ) higher than maize from 4 – 12 WAS (77.60 cm vs. 44.80 cm - 215.53 cm vs. 165.006 cm). The number of leaves and leaf length (8.46 - 35.33, 7.73 - 13.80) and (64.64 cm – 104.93 cm; 50.86 cm - 79.73 cm) were significantly ( $P < 0.05$ ) higher in Elephant grass but lower in terms of leaf width (1.8-3.79cm vs. 5.42-8.25cm) in both years. The plant spread of the legumes, number of leaves per plant, numbers of branches per plant, leaf length and leaf width of Lablab were significantly ( $P < 0.05$ ) higher than those of Mucuna in both years. The dry matter yields of grasses were better in 2017 with a significantly ( $P < 0.05$ ) higher yield (10.34 t/ha) in Elephant grass than Maize (7.35t/ha). Similarly dry matter yield of 2016 for legumes was significantly ( $P < 0.05$ ) higher for Mucuna (9.43 t/ha) than Lablab (4.08t/ha). Higher profit value was recorded in Elephant grass fodder with ₦25, 458.60 per hectre when compared with Maize fodder value gain with ₦19, 457.50. Similarly, Mucuna fodder yield recorded higher profit margin of ₦44, 194.00 compared to Lablab fodder value gain of ₦30, 748.00. It can also be concluded from this trial, that Elephant grass and Mucuna legume can successfully replace Maize and Lablab in terms of fodder yield, even though Maize-Lablab silage mixture produces silage of better quality.

**Keywords:** Maize, Elephant grass, Mucuna, Lablab, Dry matter yield, Northern Guinea savannah.



## Productivité de deux graminées (maïs et paille d'éléphant) et de deux légumineuses fourragères (lablab et mucuna) dans la savane de Guinée septentrionale au Nigeria

### Résumé

*Les pâturages et les cultures fourragères restent les principales sources d'alimentation des ruminants au Nigeria. Cependant, la pénurie aiguë de matières fourragères, en particulier de cultures fourragères vertes et nutritives, constitue la cause principale de la faible productivité de l'élevage. Cette expérience a été menée au cours des saisons de culture 2016 et 2017 sur le champ expérimental du Programme de recherche sur l'alimentation animale et la nutrition de l'Institut national de recherche sur la production animale (NAPRI) à Shika, afin d'évaluer la productivité de deux graminées (maïs et paille d'éléphant) et de deux légumineuses fourragères (mucuna et lablab). Un hectare de terre a été utilisé pour chacune des graminées et des légumineuses. L'étude a été menée selon un plan en blocs aléatoires complets avec trois répétitions. La hauteur des plantes, le nombre de feuilles par plante, le nombre de branches par plante, la longueur et la largeur des feuilles ont été mesurés 4, 8 et 12 semaines après le semis (WAS) pour les deux mélanges et les deux saisons de culture. Le rendement fourrager des espèces a également été déterminé. Les résultats ont montré que la hauteur des plants de maïs était significativement ( $P < 0,05$ ) supérieure à celle de l'herbe à éléphant à 4 et 8 SAP (68,25 cm contre 49,95 cm - 94,15 cm contre 73,20 cm), mais inférieure à 12 SAP (163,20 cm contre 175,60 cm) au cours de la saison de culture 2016. Cependant, au cours de la campagne agricole 2017, la hauteur de l'herbe à éléphant était significativement ( $P < 0,05$ ) supérieure à celle du maïs entre 4 et 12 jours après le semis (77,60 cm contre 44,80 cm - 215,53 cm contre 165,006 cm). Le nombre de feuilles et la longueur des feuilles (8,46 - 35,33, 7,73 - 13,80) et (64,64 cm - 104,93 cm ; 50,86 cm - 79,73 cm) étaient significativement ( $P < 0,05$ ) plus élevés chez l'herbe à éléphant, mais plus faibles en termes de largeur des feuilles (1,8 - 3,79 cm contre 5,42 - 8,25 cm) au cours des deux années. L'étalement des légumineuses, le nombre de feuilles par plante, le nombre de branches par plante, la longueur et la largeur des feuilles du lablab étaient significativement ( $P < 0,05$ ) supérieurs à ceux du mucuna au cours des deux années. Les rendements en matière sèche des graminées ont été meilleurs en 2017, avec un rendement significativement ( $P < 0,05$ ) plus élevé (10,34 t/ha) pour l'herbe à éléphant que pour le maïs (7,35 t/ha). De même, le rendement en matière sèche de 2016 pour les légumineuses était significativement ( $P < 0,05$ ) plus élevé pour le Mucuna (9,43 t/ha) que pour le Lablab (4,08 t/ha). Un bénéfice plus élevé a été enregistré pour le fourrage de paille d'éléphant, avec 25 458,60 ₦ par hectare, par rapport au bénéfice du fourrage de maïs, qui s'élevait à 19 457,50 ₦. De même, le rendement fourrager du Mucuna a enregistré une marge bénéficiaire plus élevée de 44 194,00 ₦ par rapport au gain de valeur fourragère du Lablab de 30 748,00 ₦. On peut également conclure de cet essai que l'herbe à éléphant et la légumineuse Mucuna peuvent remplacer avec succès le maïs et le lablab en termes de rendement fourrager, même si le mélange de maïs et de lablab produit un ensilage de meilleure qualité.*

**Mots-clés :** Maïs, herbe à éléphant, Mucuna, lablab, rendement en matière sèche, savane du nord de la Guinée.

### Introduction

Pasture and forage crops remain the primary sources of feed for ruminants in Nigeria. There, however, acute shortage of forage materials, especially green nutritious fodder crops, which is

the major cause of low productivity in livestock keeping (Migongo-Bake, 1991). In view of the constraints in fodder production and in order to overcome the gap between demand and supply, emphasis needs to be given on several steps for

augmenting fodder production. Under the tropical pattern of pasture production in the Savannah, sustainable supply of feeds can be achieved through judicious choice of suitable plant species, soil fertility and management (Kallah, 1990). Sown improved tropical pasture grasses and legumes are capable of producing much higher yield of quality herbage than the native or natural grazing land.

Maize (*Zea mays*) is the third most important crop in the world (Bilal, 2008), it is usually grown in all continents of the world and many countries making it available for livestock feeding. Forage maize provide high quality yield of palatable forage, high dry matter yield, low buffering capacity and high concentration of water-soluble carbohydrates (Griffiths *et al.*, 2004). Elephant grass (*Pennisetum purpureum*) is another grass forage crop considered an important forage in animal production due to the high growth rate, draught tolerance, high biomass yield, ease of propagation and broad ecological adaptation (Trisha-Collins, 2010) and can provide average crude protein content of 9% and fresh weight close to 40 tons per hectare (Lellesi, 2000; Trisha-Collins, 2010).

Legumes are considered as superior animal feeds to grasses because of higher voluntary intake of digested nutrients (Goering *et al.*, 1991; Thomson *et al.*, 1991). The search for forage legumes as dry season feeds for ruminant animals is a continuous one. Great interest is often attached to those forage legumes referred to as dual purpose in a crop livestock farming system. However, the available research reports are on the potential use of some indigenous and exotic non dual purpose legumes (Larbi *et al.*, 1996). *Lablab* (*Lablab purpureus*) is a sweet fodder legume that combines a great number of qualities that can be used successfully under various conditions. It is palatable and possesses the ability to out yield other crops especially during the dry season and serves as cover crops (Murphy and Colucci, 1999). *Mucuna* (*Mucuna pruriens*) is an

underutilized tropical legume (Iyayi and Egharevebe, 1998) and is regarded as a good cover crop. *Mucuna* forage has not been fully incorporated into the ruminant dry season feeding strategy.

The constraints posed by long time dry season in the Northern part of Nigeria causes a serious limitation to grazing and pasture production. The dry season therefore, predisposes ruminants feed with standing hay and low protein roughages to consistent weight loss and low milk production (Babayemi and Bamikole, 2006). About 80 – 90% of tropical livestock depend on poor quality and low yielding grasses. The most highly productive grasses and legumes have been over grazed and are not readily available to sustain ruminants throughout the year (Muhammad *et al.*, 2008). Therefore, further studies to carry out to compare the high productive grasses such as Maize, Elephant grass and other dual purpose legumes like *Lablab* and *Mucuna* had become necessary.

Elephant grass (*Pennisetum purpureum*) is the most popular perennial fodder recommended for small holder farmers who practice integrated farming system, most especially in Kenya where 80% of the Nation milk is produced through ruminant animals. Is of high nutritive value for dairy cattle particularly when supplemented with high quality feed such as legumes forage (Nyambati *et al.*, 2010). Elephant grass produces greater dry matter yield than the other tropical grasses. (Skerman and Riveros, 1990). Furthermore, its record dry matter yield of 5-15t/ha and exceptional high dry matter yield up to 85t/ha have been reported when high rates of Nitrogen Fertilizer were applied to napier grass (Skerman and Riveros, 1990).

Silage making offers a means of improving the utilization of pasture such as Gamba grass and Elephant grass silage, which serve as a means of enriching fodder and its optimum conservation (Muhammad *et al.*, 2009). Silage is the based method of preserving fresh forage with minimal

losses, when the proper ensilage techniques are used; silage will have a high nutritive value and hygiene quality (Yitbarek *et al.*, 2014). The legume improve silage such as crude protein, Vitamin A and essential minerals, soil ecology and reduced incidence of plant disease (Ashbell *et al.*, 1997).

The shortage of quality feed for ruminant animals can be overcome through cultivation of forage with better nutritional value than existing natural feed resources by the establishment of leguminous forage. High yielding leguminous fodder such as *Lablab purpureum* and *Mucuna pruriens* have been found to provide adequate dry season supplementation and improve the productivity of ruminant and serve as cover crop (Abubakar, 2012). Despite the importance of these leguminous fodders, there is scarcity of information in comparing their yield component and dry matter yield. Therefore, it is very necessary and important to carry out agronomic evaluation of these two grasses (Maize and Elephant grass) and the legumes (*Lablab* and *Mucuna*) on growth parameters, yield and profit margin in two seasons. The main objective is to investigate the growth pattern, biomass yield of these two grasses and legumes in two cropping season.

## **Materials and Methods**

### ***Description of Experimental Site:***

A study was carried out at the Experimental Field of Feeds and Nutrition Research Programme (FNRP), National Animal Production Research Institute, Shika. Shika is located on Latitudes 11°12'W Longitude 07° 33' E and altitude 660m above sea level in the Northern Guinea Savannah of Nigeria (Ovi maps, 2016). Wet season starts from April to early - May, ends in late - September to early - October.

### ***Field layout and experimental designs***

A total land measuring two hectares was ploughed and harrowed twice using bull-drawn implement to provide a clean seedbed for easy germination. Prior to planting, soil samples were

randomly collected with the aid of soil auger at three different locations. Sampling was carried out diagonally at 15cm depth. The soil sample collected were bulked and sub - samples taken for physical and chemical properties analyses during the two cropping season. The land was divided into three sub plots with 0.5ha for Maize, 1ha for both *Lablab* and *Mucuna* . The sub plots were further divided into three sub plots (16m x 8m) with 2m pathways. The plots for elephant grass (0.5ha) was taken from already established field and cut back to 15cm height at ten days after sowing the Maize, *Lablab* and *Mucuna* seeds. The trial was carried out in two growing seasons (2016 and 2017). The experimental plot was laid out in a Randomized Complete Block Design and replicated three times.

### ***Sources of Experimental Materials and Crops Establishment***

The *Lablab* and *Mucuna* seeds and already established elephant grass regrowth were sourced from Pasture Seed Unit of Feeds and Nutrition Research Programme of NAPRI. Seeds of open pollinated maize variety SAMMAZ 17 variety were sourced from the Seed Unit of Institute for Agriculture Research, Ahmadu Bello University, Samaru, Zaria. Crown split of the elephant grass was obtained with 2 tillers each of elephant grass at a height of 15cm per stand after ten (10) days of planting maize at spacing of 75cm between rows and 25cm within. The seeds of *Lablab* (Highworth Black) and *Mucuna* (black seed) were planted manually at 2 seeds per hole (seed rate of 15kg/ha) at spacing of 90cm between rows and 30cm within rows. N.P.K. fertilizer (20:10:10) was applied at the rates of 150kg/ha in three doses: planting, after first and second weeding of the grasses. Super Phosphate of 30kg/ha for legumes was applied at planting.

Agronomic data on growth parameters were observed at 4, 8 and 12 weeks after sowing for the grasses and legumes. Data were collected on 5 Maize/elephant grass stands per plot on plant height, leaf width and leaf length with a

measuring tape. Number of leaves and tillers per plant were taken for Elephant grass. The plant height of the grasses and legumes were determined by measuring from the base of the plant to where the last leaf on the stem emerges with the aid of a tape rule on five randomly selected stands per plot at 4, 8 and 12 weeks after sowing. Leaf length of both grasses and legumes were estimated by measuring from the tip to the base of the ligule with the aid of tape rule from five randomly selected plants stands per plot. Leaf width was determined by measuring the length of the leaf half way or midpoint of the leaves with the aid of 30cm meter rule on five randomly selected plants stands per plot (Tarawali *et al.*, 1995). Numbers of leaves per plant were counted for each of the five (5) randomly selected stands of both the grasses and legumes forages. Dry matter yield was determined by harvesting of the grasses and legumes with the aid of a sickle for each sub plot in a 0.5m<sup>2</sup>quadrant. Fresh samples were cut, weighed and sub samples of (150-200g) were oven dried at 65<sup>0</sup> C for 48hours and reweighed to constant weight to estimate dry matter yield.

#### **Statistical analysis**

The data were subjected to Analysis of Variance using the General Linear Model Procedure of SAS, (2005). Significant (P<0.05) differences among treatment means were compared using the Duncan's Multiple Range Test as applicable using the SAS package.

#### **Cost Benefit Analysis**

The cost benefit analysis of the grasses and legumes production was carried out based on

prevailing current prices on cost of land preparation, seed, planting, weeding, fertilizer and fertilizer application, harvesting, and storage during the two year trials of the experiment. Cost of fodder production was based on current price of grass and legume hay.

**The model for the Experiment is presented below:**

$$Y_{ijk} = \mu + T_i + B_j + E_{ijk}$$

$$i = 1, 2$$

$$j = 1, 2, 3$$

$Y_{ijk}$  = Observation from grass  $i$  or legume  $i$  and block  $j$

$\mu$  = grand mean

$T_i$  = Effect of treatment (G1, 2; L 1, 2)

$B_j$  = Effect of block  $j$

$E_{ijk}$  = random error term with mean 0 and variance  $\sigma^2$

$T$  is either G (grass) or L (legume)

## **Results and Discussion**

### **Plant height**

Table 1 shows the growth component of maize and elephant grass at different stages of growth during the two years' trial. In 2016, plant heights of maize plant at 4 WAS and 8 WAS were significantly (P<0.05) higher than elephant grass. But, at 12 WAS plant height of elephant grass was found to be significantly higher (P<0.05). In 2017 plant height of elephant grass ranged from 77.60cm - 215.53 cm and exceeded that of maize (44.80cm - 165cm) at 4 to 12 WAS.

**Table 1: Growth component of maize and elephant grass at different stages of growth during the two cropping season**

Parameters	Plant species	2016			2017		
		4WAS	8WAS	12WAS	4WAS	8WAS	12WAS
Plant height (cm)	Maize	68.25 <sup>a</sup>	94.15 <sup>a</sup>	163.20 <sup>b</sup>	44.80 <sup>b</sup>	160.06 <sup>b</sup>	165.00 <sup>b</sup>
	Elephant grass	49.95 <sup>b</sup>	73.20 <sup>b</sup>	175.60 <sup>a</sup>	77.60 <sup>a</sup>	172.13 <sup>a</sup>	215.53 <sup>a</sup>
	SEM	8.96	5.62	3.35	3.26	3.70	6.59
No of leaves/plant	Maize	7.73	7.13 <sup>b</sup>	11.40	7.20	11.33	13.80 <sup>b</sup>
	Elephant grass	8.46	13.80 <sup>a</sup>	9.40	8.46	12.53	35.33 <sup>a</sup>
	SEM	1.29	1.04	1.19	1.25	1.62	7.40
Leaf length/plant(cm)	Maize	58.69 <sup>b</sup>	51.86 <sup>b</sup>	52.86 <sup>b</sup>	50.86 <sup>b</sup>	79.73 <sup>b</sup>	77.82 <sup>b</sup>
	Elephant grass	64.64 <sup>a</sup>	104.93 <sup>a</sup>	93.40 <sup>a</sup>	69.10 <sup>a</sup>	101.60 <sup>a</sup>	103.80 <sup>a</sup>
	SEM	2.36	3.51	2.93	4.12	3.01	3.45
Leaf width/plant(cm)	Maize	5.42 <sup>a</sup>	6.02 <sup>a</sup>	7.46 <sup>a</sup>	5.75 <sup>a</sup>	7.90 <sup>a</sup>	8.25 <sup>a</sup>
	Elephant grass	1.80 <sup>b</sup>	2.21 <sup>b</sup>	2.30 <sup>b</sup>	2.50 <sup>b</sup>	2.48 <sup>b</sup>	3.79 <sup>b</sup>
	SEM	0.91	0.76	0.92	1.09	0.93	0.98

<sup>abc</sup>= Means bearing different superscript differ significantly (P<0.05) along the column, SEM= Standard Error of means, WAS= Weeks after sowing

The highest plant heights of maize and elephant grass were recorded at 12 WAS. The values obtained in this trial agree with report of Munza *et al.* (2018) and Ishiaku *et al.* (2016) who reported an increasing trend in all the growth components of sorghum at advanced stage of harvest. The increase in plant height at 12 WAS might be due to the increase in the number of leaves which tends to increase photosynthesis, thus enhancing the effective uses of growth resources. Similarly, plant height value obtained for maize was also in agreement with a report of Hassan *et al.* (2014) in his 3 years maize trial cultivated under irrigation in Kadawa, Kano-state Nigeria. The perimeter of plant height of maize recorded throughout was higher than result obtained by Yakub Onur (2016) average range of 109.0cm - 111.2cm. The height of Elephant grass was found to be in contrast with Aganga *et al.* (2005) and Henna () and Monsoon (1988) who recorded lower plant height in a silage experiment with Elephant grass.

Highest plant height was recorded in elephant grass compared to maize. This might be attributed to the fact that elephant grass is a bunch type perennial grass which attains heights up to 2 - 6m and a diameter up to 3cm (Akinola, 2018). It could also be as a result of the variety of maize planted. In addition, the higher significant plant height recorded in elephant grass, might be as the result of the response to the presence of Nitrogen-Fixing entophytic bacteria (*Gluconace bacteria diazotrophicus*) which has been found to contribute significant amount of nitrogen to sugarcane a crop of the same family with Elephant grass (Singh *et al.*, 2013). The result obtained in this study agreed with Masuda *et al.*, (1991) who found out that growth rate of elephant grass is superior to that of maize.

**Number of leaves**

The number of leaves produced in 2016 and 2017 from both fodder crops were not significantly different (P>0.05), but were found to be significantly (P<0.05) different at 8WAS and

12WAS in years 2016 and 2017, respectively. Similarly, at these two stages in 2016 and 2017, the average number of leaves produced by elephant grass and maize were 13.80 and 7.13, respectively. Number of leaves produced by maize in this trial recorded a lower number compared to the result obtained by Amodu *et al.* (2020) and Giza (2020) in two different experiments when two maize accessions of SHIMAZ and WASA1 were evaluated for forage yield, although it was in contrast with result obtained by Hassan. (2010).

The lower number of leaves recorded in this trial might be linked to the genetic make-up of the varieties used. Highest leaf production obtained in elephant grass (12 WAS) is an important component of yield, thereby playing a vital role in increasing green forage yield due to accumulation of sunlight intercept on the leaf, which increases the photosynthetic activity of the plant (Oyenire *et al.*, 2018). Higher number of leaves is a desirable attribute in forage species as leaves have higher nutritive quality in addition to being generally more digestible thereby eliciting higher animal intake (Ojo *et al.*, 2014).

#### **Leaf Length and width**

Average leaf length of elephant grass ranged (64.64cm - 104.93cm) was found to be significantly ( $P < 0.05$ ) higher than the average leaf length of maize at week 12 (50.86cm - 79.73cm) in both cropping season. In contrasts to

the result obtained on leaf length of the two forages, average leaf width per plant for maize was significantly ( $P < 0.05$ ) higher than that of elephant grass in both cropping season. This result agreed with Muhammad (2016) but higher than what was obtained by Singh *et al.* (2013) who recorded 61.2cm in a trial conducted on growth habit of elephant grass. This result is in agreement with the findings of Dumkhane and Ekemube (2020) in their studies of chemical and biological parameters in treatment options who recorded longer leaf length of elephant grass (130cm) compared to 60cm leaf length of maize, in an experiment of untreated drill cutting with soil and grasses treatment. Similar results were recorded when Dumkhane and Ekemube (2020) observed maize and elephant grass leaf width in treatment of uncontaminated soil plus maize treatment option at 8 weeks after sowing.

#### **Plant Spread of the Legumes**

Table 2 shows the spread of *Mucuna* and *Lablab* at different stages of growth during the two years' trial is presented in Table 2 The spread of the legumes ranged from 18.06cm at 4 WAS to 190.50 cm at 12 WAS in the first year. There were no significant differences ( $P > 0.05$ ) in plant spread of *Mucuna pruriens* and *Lablab purpureum* during the two years trials across all the treatments except at 4 WAS (18.06 vs. 79.06) first cropping season and (44.36 vs 78.99) second cropping season.

**Table 2: Growth component of *Mucuna* and *Lablab* at different stages of growth during the two cropping season**

		2016			2017			
		Plant species	4WAS	8WAS	12WAS	4WAS	8WAS	12WAS
Plant spread (cm)		<i>Mucuna</i>	18.06 <sup>b</sup>	83.80	153.33	44.36 <sup>b</sup>	147.67	156.40
		<i>Lablab</i>	79.06 <sup>a</sup>	81.53	190.90	78.99 <sup>a</sup>	151.40	151.40
		SEM	3.81	7.16	7.22	4.28	5.91	4.94
No. of leaves/plant		<i>Mucuna</i>	2.50 <sup>b</sup>	37.00 <sup>a</sup>	13.26 <sup>b</sup>	10.46	13.06 <sup>b</sup>	21.66 <sup>b</sup>
		<i>Lablab</i>	8.13 <sup>a</sup>	12.53 <sup>b</sup>	35.06 <sup>a</sup>	10.93	21.66 <sup>a</sup>	28.00 <sup>a</sup>
		SEM	2.02	2.60	2.61	1.09	2.53	2.86
No. of branches/plant		<i>Mucuna</i>	0.66 <sup>b</sup>	9.13 <sup>a</sup>	4.13 <sup>b</sup>	2.00	5.20 <sup>b</sup>	5.20 <sup>a</sup>
		<i>Lablab</i>	2.00 <sup>a</sup>	5.06 <sup>b</sup>	11.86 <sup>a</sup>	2.46	15.93 <sup>a</sup>	3.93 <sup>b</sup>
		SEM	0.88	1.36	1.55	0.91	1.83	0.40
Leaf length/plant (cm)		<i>Mucuna</i>	7.21 <sup>b</sup>	10.17 <sup>b</sup>	10.31 <sup>b</sup>	9.22	9.19 <sup>b</sup>	11.99
		<i>Lablab</i>	10.33 <sup>a</sup>	14.46 <sup>a</sup>	14.57 <sup>b</sup>	9.92	11.99 <sup>a</sup>	8.97 <sup>b</sup>
		SEM	1.05	1.10	1.17	1.04	1.29	1.28
Leaf width/Plant (cm)		<i>Mucuna</i>	5.96	8.38	9.05	8.19	7.98	8.05
		<i>Lablab</i>	6.40	9.98	8.65	6.54	8.24	8.24
		SEM	1.05	1.10	1.17	1.04	1.29	1.28

<sup>abc</sup> = Means bearing different superscripts differ significantly (P<0.05) along columns, SEM= Standard Error of means, WAS – Weeks after sowing

Faster growth and more spread (P<0.05) were observed in *Lablab* as compared to *Mucuna* at 4 WAS during the two years' trials. These results agree with ILRI. (2013) that *Lablab* is a fast growing legume that can provide fodder in less than 3 months after sowing. The result obtained was also in line with FAO (2014) and Akinola (2019) that described *Lablab* as an upright herbaceous plant that can grow up to a length of 3 - 6m. The average value (190 cm) of *Lablab* spread obtained was higher than, the average value of 101cm recorded by Girgiri *et al.* (2019) who studied the influence of phosphorus fertilizer on growth components and dry matter yield of *Lablab* in a semi-arid environment.

**Number of leaves in *Lablab* and *Mucuna***

In both years of the study recorded, *Lablab* leaves (8 - 35) per plant were significantly higher (P<0.05) compared to the number of leaves per plant in *Mucuna* (2.5 - 21.66) with the exception of the value 8WAS obtained in year 1 where *Mucuna* recorded the highest number of leaves (37). The result obtained was lower than the values obtained by Girgiri *et al.* (2019) on a trial on effect of phosphorus fertilizer rates at different weeks. Recorded number of leaves obtained in this trial agrees with Abubakar (2012) who recorded an average 11.4 leaves per plant of *Lablab* and 14 leaves for *Mucuna* plant in his experiment of growth indices of some tropical

legumes grown in the Northern Guinea Savannah of Nigeria.

**Leaf length and width of Lablab and Mucuna forages**

The leaf length of the herbaceous legume *Lablab* was significantly higher ( $P < 0.05$ ) 8.97 - 14.57, across all the treatments except at 4 WAS in the second year of the trial where they were at par and also *Mucuna* (7.21 - 11.99cm) having higher leaf length at 12 WAS in the second year of the experiment. Width of plants leaves were higher ( $P < 0.05$ ) in *Lablab* at 4 and 8 WAS respectively for year 2. The result agreed with the findings of Cook (2005) and FAO (2014) that *Lablab* leaf is long with average of 7.5 - 15cm. Girgiri *et al.* (2019) recorded lower leaf length of *Lablab* in their studies on characteristics of growth indices

of *Lablab* at different weeks of sowing producing the highest length at 12 WAS (8.09cm - 8.30cm). Akinola (2018) had a similar result when he described *Lablab* as trifoliate leaf consists of large, ovate rhomboid leaflets which measure 3.0 - 15.0 cm long and 1.5 - 15.0 cm width. Skerman *et al.* (1988) recorded higher leaf length of *Mucuna* (12.5 cm) against the leaf length of this study (9.05cm). The results of *Mucuna* leaf length and width obtained in this study were lower than what was obtained by Wilijarm *et al.* (1997)

**Forage Dry matter yield of grasses and legumes at the harvesting stage**

Table 3 shows the yield of the two grasses (maize and elephant grass) harvested at 12 WAS during the two years of trial.

**Table 3: Forage yield (Dry matter yield (t/ha) of grasses and legumes at the harvesting stage during the two years trial**

Plant Species	2016	2017	Pooled
Maize	4.49 <sup>b</sup>	7.35 <sup>b</sup>	5.92
Elephant grass	6.20 <sup>a</sup>	10.34 <sup>a</sup>	8.27
SEM	0.77	0.82	
LS	*	*	
<i>Mucuna</i>	9.43 <sup>a</sup>	2.27 <sup>a</sup>	5.85
<i>Lablab</i>	4.08 <sup>b</sup>	1.75 <sup>b</sup>	2.92
SEM	0.56	0.59	
LS	*	*	

Means bearing different superscripts differ significantly ( $P < 0.05$ ) along columns, SEM= Standard error of mean

The elephant grass (6.20t/ha - 10.34t/ha) was significantly higher ( $P < 0.05$ ) in dry matter yield compared to maize crop (4.49t/ha - 7.35t/ha) during the two years' trial. The forage yield of elephant grass in this study agrees with the report of Akinola (2019) on elephant grass forage yield which ranged from 2t/ha without nitrogen to 10t/ha of high rates of Nitrogen use.

The result of the maize yield obtained was lower than the report of Griffiths *et al.* (2004) who in a trial tested for potential forage yields of forage maize varieties that range from 12 to 15t/ha. Maize yield result recorded was by far below 25.1t/ha and 26.3 t/ha recorded by Amodu *et al.*

(2020) when comparing forage dry matter yield of two varieties of forage maize SHIMAZ (26.3t/ha) and WASA 1 (25.1t/ha).The result is in agreement with Hassan *et al.* (2013) and Adegbite *et al.* (2019) who recorded maize fodder yield of 2.30 - 4.54t/ha planted maize under irrigation and 5.16 t/ha respectively.

The result agrees with Masuda *et al.* (1991) who found growth rate of Elephant grass to be superior to that of Maize (*Zea mays*) and finally dry weight yield of Elephant grass was twice that of maize. In addition, Cheng (1991) compared the yield and chemical composition of Elephant grass and Maize with three other tropical grasses

Pangola grass (*Digitaria decumbens*), Pigeon grass (*Sideries phecelate*) and Guinea grass (*Panicum maximum*), both tall and dwarf tall Elephant grass produced significantly higher fresh and dry matter yield than other three tropical grasses.

The result obtained agrees with the report of Ra *et al.* (2012) who conducted research on the comparison of the annual biomass yield of seven grass species viz, Johnson grass, switch grass, sugar cane, maize, sorghum and elephant grass and found elephant grass to out- yield others by a significant margin. In the same vein, elephant grass possessed the ideal ideotype for large biomass accumulation (Kubota *et al.* 1994). The discrepancies in the forage yield might be due to species difference, management practices, maturity states, correct stage of harvest and duration of cultivars.

**Dry matter yield of legumes (*Lablab* and *Mucuna*) in two years**

Table 3 shows the dry matter yield of *Lablab* and *Mucuna* during the two years trials. Forage dry matter yield of *Mucuna* was 9.43 t/ha in year 1 and 2.27t/ha in year 2 was significantly higher than (P<0.05) *Lablab* with fodder yield of 4.08t/ha in year 1 and 1.75t/ha year 2, respectively. The result obtained was lower than

the report of Adebisi and Bosch (2004) who recorded average *Lablab* dry matter yield of between 6-9t/ha, when *Lablab* was cultivated alone for fodder and harvested at the flowering stage or at the early green fruiting stage. The result obtained in dry matter fodder yield of *Lablab* in 2016 and 2017 was slightly lower than observed values of Hassan *et al.* (2013), who recorded 5.55 t/ha yield of *Lablab* grown under irrigation. However, within range reported by Amodu (2003) of 3.5DMt/ha. The forage dry matter yield value of *Mucuna* in this study was lower than the report of Eco Crop (2011) who obtained 3.2-16.4t/ha forage yield of the velvet beans. However, the result was in agreement with result obtained by Vissoh *et al.* (2003) of 7-9 t/ha of dry matter yield of *Mucuna*.

**Costs benefit analysis of yield of grasses (*maize/Elephant grass*) and legumes (*Lablab/Mucuna*)**

Table 4 shows the total expenditure acquired during the two trials of grasses and legumes. The result indicates that during the 2016 trial total estimate of production cost of the grass per hectare was ₦18,550 and ₦17,550 for maize and elephant grass produced respectively. However, lower than the cost of production in 2017 of both the Maize (₦20,600) and Elephant (₦18, 900).

**Table 4: Cost benefit analysis of forage productivity of grasses and legumes for the two years’ trials**

Forage species	2016			2017		
	Total Expenditure (₦)	Total Revenue (₦)	Profit (₦)	Total Expenditure (₦)	Total Revenue (₦)	Profit (₦)
Maize	18, 550.0	24, 470.5	5, 920.5	20, 600.0	40, 57.5	19, 57.5
Elephant grass	17, 550.0	26, 598.0	9, 048.0	18, 900.0	44, 358.6	25,458.6
<i>Mucuna</i>	10, 500.0	54, 694.0	44,194.0	11, 600.0	18, 350.0	6, 750.0
<i>Lablab</i>	12, 500.0	43, 248.0	30, 748	14, 500.0	13, 166.0	1, 566.0

The result further indicates that higher gain was recorded in Elephant grass production (₦9.048 and ₦25,458.6) compared to profit margin recorded in Maize (₦5,920.5 and ₦19, 57.5) for the two years record as indicated in the table. This

can be the result of higher biomass yield obtained in Elephant grass.

The highest gain recorded in production of the legumes was in *Mucuna* (₦44,194.00) in 2016 compare with *Lablab* value of gain (₦30,748.00). This is due to highest accumulation of biomass

yield on *Mucuna* (9.43t/ha). However, the value of gain recorded during 2017 was the lowest over the years in comparison with 2016 and *Mucuna* recorded higher gain of ₦6,750 compare to *Lablab* with ₦1,334 per hectare

### Conclusion

It can be concluded from the result of this study that Elephant grass (6.20-10.34 t/ha) and *Mucuna* (2.27-9.43 t/ha) can be successfully replace maize (4.49 – 7.35 t/ha) and *Lablab* (1.75-4.08 t/ha) at 12 WAS for higher biomass yields. Elephant grass and *Mucuna* recorded higher profit gain than Maize and *Lablab*.

### Recommendations

- Livestock owners should be encouraged to establish Elephant grass and *Mucuna* for high fodder production.
- Livestock farmers should establish elephant grass and legume such as *Mucuna* for higher profitability and economic gain.

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