ISSN 0189-0514
J. Anim. Prod. Res. (2018) 30(2):192-203

National Animal Production Research Institute
Ahmadu Bello University
P.M.B 1096, Shika-Zaria,
Kaduna State, Nigeria.
Email:japr@napri.gov.ng Url:journals.napri.gov.ng

EFFECT OF FERTILIZER RATES ON FORAGE YIELD AND QUALITY OF (*BRACHIARIA RUZIZIENSIS)*

[1]Ahmed, S. A., [1]Amodu., J. T., [2]Abdu, S. B., [1]Ishiaku, Y. M., [1]Abubakar, S. A., [1]Ibrahim, H., [1]Lasisi, O. T., [3]Usman, A. and [4]Salisu, S. G.

[1]National Animal Production Research Institute, P.M.B 1096, Ahmadu Bello University, Shika-Zaria, Nigeria.

[2]Department of Animal Science, Ahmadu Bello University, Shika, Zaria, Nigeria.

[3]Federal University Gashua,Yobe State, Nigeria

[4]Federal Colledge of Horticulture Dadin-kowa,Gombe State, Nigeria

Corresponding author: safiyanahmed2@gmail.com +2347069108385

ABSTRACT

The study was conducted to evaluate the effect of varying fertilizer levels (Compound fertilizer NPK 15:15:15) on the forage yield and nutritional quality of *Brachiaria ruziziensis,* in the Northern Guinea Savanna of Nigeria. The experiment was laid in a randomized complete block design (RCBD) in a 4x3 factorial arrangements comprising of four fertilizer doses (0, 20, 40 and 60 kg/ha) replicated three times and harvested at 10,12 and 14weeks. The growth components showed that plant height (74.9 cm) and leave length (33.3 cm) were significantly (P<0.05) higher at 60kg/ha and 40kg/ha, respectively. Number of tillers (23) were significantly higher (P<0.05) at 12 weeks after sowing (WAS). Varying levels of fertilizer significantly (P<0.05) affected fresh forage yield with the highest value recorded at 60kg/ha (15.8t/ha). Age of cutting also had significant (P<0.05) effect on yield fresh forage yield and dry matter yield. The highest significantly fresh weight yield (16.3t/ha) was recorded at 12 weeks after sowing (WAS), while and dry weight (4.3t/ha) was also recorded at 14 weeks after sowing (WAS) respectively. The proximate Compositions: Crude protein, Crude fiber and Nitrogen free extract were significantly (P<0.05) affected by the varying level of fertilizer, whereas DM, C.P, C.F, E.E, and NFE were also significantly (P<0.05) affected with different age of cutting. The highest DM (94.3%), CP (8.99%) and CF (39.39%) were recorded at 10, 12 and 12 weeks after sowing (WAS), respectively. EE (7.88%) and Ash (7.67%) were higher at 12 weeks after sowing. Calcium content of the forage material and Calcium (Ca): Phosphorus (P) ratio were significantly (P<0.05) affected as the level of fertilizer application varies with 60kg/ha rate recording the highest percentage (1.62%) and (6.23:1) respectively. Calcium (Ca), Phosphorus (P) and Ca: P ratio were similar (P>0.05) at different cutting intervals. It can be concluded from the result of this study that the use of NPK 15:15:15 compound fertilizer at 60 kg/ha on *Brachiaria ruziziensis* gave a better forage yield, Crude protein was higher when harvested at 12 weeks after sowing, mineral composition (Ca and P) was also optimum. Therefore, 60 kg/ha is recommended on *Brachiaria ruziziensis* for forage yield and nutrient composition for smallholder farmers and livestock owners in the Northern Guinea Savanna of Nigeria.

Keywords: *Brachiaria ruziziensis,* fertilizer rates, forage, yield, quality, minerals

INTRODUCTION

Feed scarcity is one of the major constraints to livestock production in the West African Sub-region (Glatzle, 1992). The poor quality of feed resources available to ruminants results into the low plane of nutrition (Doma *et al.,* 1999) and low productivity of our indigenous animals, (Otchere *et al.,* 1987). In Nigeria, one of the

major challenges to livestock production is ensuring adequate feed supply throughout the year in terms of quality and quantity (Kallah, *et al*, 1997). Ruminants depend largely on crop residues during the long dry periods of the year for maintenance as well as the production of meat, milk, skin, and fibre. Feeding grains to ruminants is questioned, because of stiff competition from man and industries as raw materials and also from monogastric animals. On the other hand, ruminants are characterized by their ability to convert low-quality roughage to products that are useful to man e.g. meat, milk natural fibers, leather, and manure.

The main feed resources for ruminant animals are pastures, crop residues, and other agro-industrial by-products. In the dry season and post-harvest periods, these feed resources become the main sources of energy for use by ruminants when poor quality forages from the range land prevail (Kibon and Ørskov, 1993). The quantity and quality of available feedstuffs are the major factors influencing the productivity of ruminants in many parts of the world, especially regions with high animal numbers. Crop residues are potential feed resources, especially during the dry season. However, cereals from these crop residues are generally low in digestibility, because of high fibre content and are deficient in nitrogen, minerals, and vitamins, the cell walls of low-quality roughages are generally high in indigestible fractions of lignin and silica (Jayasuriya, 1986). However, animal performance with such feedstuffs can be poor due to low voluntary intake and digestibility, which result from low protein concentrations and high levels of indigestible or slowly degradable fibre (Abdel Hameed *et al.*, 2013).

Brachiaria is one of the most important forage grasses grown for pastures in the tropics (Singh, 2009). *Brachiaria* is a species of grass originating from the Savanna of the Eastern part of Africa. The grass species is widely used as livestock feed. *Brachiaria* species are either annual or perennial grasses, with most of the species lacking rhizomes. The inflorescence has panicle branches composed of racemes and the entire plant usually do not grow higher than 1m. *Brachiaria* belongs to the C4 plants which tolerate drier conditions and more light exposure than many other plants (Watson and Dallwitz, 2008). In this context, Silva *et al*. (2004) reported that species of the genus *Brachiaria* are frequently used in no-till systems because these plants are highly adaptable and tolerant to limiting conditions that would affect other forage species negatively. *B. ruziziensi*s has a good nutritive value and is more palatable than most other *Brachiaria* spp. Its crude protein (CP) content commonly ranged from 7–13% and up to 20% with dry matter digestibility of 55–75%. For *B. ruziziensis* grass hay cut 45 days after seeding in northeast Thailand, the IVDMD, crude fibre, NDF and ME concentrations were 61%, 80.5%, 72.8% and 7.9 MJ/kg, respectively (Cook *et. al*, 2005). Selective grazing, heavy grazing pressure and the need for high soil fertility can result in the loss of *B. ruziziensis* grass (Schultze-Kraft and Teitzel, 1992).

MATERIALS AND METHOD

Experimental Site and Climate

This study was carried out at the Feeds and Nutrition Research Programme of National Animal Production, Ahmadu Bello University, Shika-Zaria, Nigeria. Shika is geographically located between latitude 11^0 12'N and longitude 7^0 33'E at an altitude of 660m above sea level, 22km North West of Zaria in the Northern Guinea Savannah zone of Nigeria. The wet season starts from April to Early-May and ends in Late-September to early October. Long-term annual rainfall ranges from 1110 to 1580 mm with a maximum temperature of 30^oC and relative humidity of approximately 70% (I.A.R, 2017).

Soil Sampling of the Experimental Plot, Land Preparation, and Experimental Design

A composite soil sample was taken from the experimental plots using a soil auger to collect soil samples to a depth of 15-30cm. The soil

samples were analyzed for texture, particle size, nitrogen, phosphorus, soil pH and cations exchange capacity (CEC). A total area of 120 m^2 was used for the experiment. The land was ploughed and harrowed to provide a good seedbed to enhance faster germination. An experimental field measuring 8m x 15m was divided into three (3) replicates with four (4) treatments in a Completely Randomized Design (C.R.D) in a factorial arrangement of (3 x 4) which consist of three age of cutting (10, 12 and 14 weeks) and four fertilizer rates (0, 20,40 and 60kg/ha), respectively. This was made up of twelve (12) sub-plots of (2m x 3m). *Brachiaria ruziziensis* grass was established using drilling method with 50cm distance in between the rows. A seeding rate of 20kg/ha was used and agronomic practices were adopted.

Data Collection

Agronomic parameters and growth components were recorded on phenological stages of the crop which include: Plant height, leave length, number of leaves, number of tillers and plant yield using a quadrate and growth parameters were taken at 6, 8,10, 12 and 14 weeks after sowing (WAS). Sampling of the forage materials was carried out at different stages of growth (10, 12 and 14) WAS to determine forage yield and dry matter production, sample of about one kilogram (1.0kg) of fresh forage was collected, weighed and subsample of about 150 – 200g was taken, oven dried and reweighed for the estimation of dry matter yield.

Chemical Analysis

A sub-sample from the bulked of harvested forage at different stages of cutting, experimental diet and faecal sample was obtained, dried and milled and analyzed for Nitrogen (N) for Crude Protein, Crude Fiber (CF), Ether Extract (EE), Nitrogen Free Extract (NFE) and Ash content using the (AOAC, 2005) Procedure. Neutral detergent fibre (NDF), Acid detergent fibre (ADF), Hemicellulose, Cellulose and Acid Detergent Lignin (ADL) by the method of (Van-Soest *et, al*., 1999), Mineral content of (Calcium and Phosphorus) was determined by AOAC (2005) Methods using the Atomic Absorption Spectrophotometer.

Statistical Analysis

All data collected were subjected to Analysis of Variance using Statistical Analysis Systems package (SAS, 2002) and the means were separated using Duncan's Multiple Rage Test (Duncan,1955).

Table 1: Weather observations, Temperatures, relative humidity and rainfall distribution at Shika and environs during the experimental period

Months	Max.Air Temp (^{0}C)	Min.Air Temp (^{0}C)	Rainfall (mm)	Relative Humidity (%)	Sunshine (Hours)
May	35.16	24.16	81.30(6)	66.39	7.83
June	31.40	23.20	133.30(14)	75.50	7.12
July	30.84	22.94	218.40(10)	80.39	5.90
August	30.55	21.90	268.80(16)	81.94	6.68
September	32.46	25.45	344.10(15)	77.28	6.31
October	33.23	18.23	-	58.45	8.16
Mean	32.27	22.65	209.18(12)	73.33	7.00

A number of rainy days is in parenthesis

Source: IAR, 2017

Table 2: Soil physical and chemical properties of the study area

Physical properties :	Soil depth	
Particle size (%)	0-15cm	15-30cm
Clay	16.00	16.20
Silt	30.00	29.60
Sand	54.00	54.20
Textural class	Sandy loam	Sandy loam
Chemical properties :		
pH (0.01MCaCl)	4.80	4.70
Total Nitrogen (%)	0.175	0.190
Organic Carbon (%)	0.67	0.62
Phosphorus (ppm)	23.28	22.01
Exchangeable bases: (Cmol/Kg):		
Ca^{++}	4.00	3.91
Mg^{++}	1.50	1.43
K^{+}	0.64	0.62
Na^{+}	0.32	0.31
Cation Exchange Capacity: (CEC)	8.20	8.00

RESULTS AND DISCUSSIONS

Effect of fertilizer rates on yield components

Table 3: Showed significant (P<0.05) difference in the plant height. Plant height increases significantly (P<0.05) with an increase in the level of fertilizer rate. Fertilizing rate at the 60kg/ha (74.90 cm) and 40kg/ha (73.40 cm) had statistically (P<0.05) higher but similar plant height. Leaf length was significantly (P<0.05) affected by fertilizer rating. But leaf width and number of tillers were not affected significantly by the rate of fertilizer application. Age has an effect on the growth parameters plant height at 14 weeks (105.56cm) differ significantly (P<0.05) from the other weeks of age 6 (34cm), 8wks (49.73cm), 10 weeks (75.13cm) and 12wks (91.37cm) respectively. Leave length at 14wks,12wks and 10wks were not significantly different from each other (P>0.05) but they differ significantly (P<0.05) from 6 and 8 weeks after sowing (WAS). Leave width at different ages were 1.3, 2.3, 2.0, 2.2 and 1.8 at 6, 8, 10, 12and 14, (WAS) respectively were not significantly different (P>0.05) from each other. Numbers of Leave at different age differed significantly (P<0.05) at 12wks (11) and 14wks (12) from 6wks, 8wks and 10wks after sowing, Number of tillers was significantly (P<0.05) higher as the fertilizer application increase at 60kg/ha rate (20) and lower at 0kg/ha (18) of application. It was also higher (P<0.05) with age, at 12 and 14 (WAS) (23 and 22, respectively) and lower at 6 and 8 WAS (16 and 15) respectively. Leaf area index (LAI) show a significant (P<0.05) difference at 0 and 40 kg/ha rate of fertilizer application (0.56 and 0.44, respectively) while the least LAI was recorded at 20kg/ha rate of fertilizer application (0.35). Age also has significant (P<0.05) effect on the LAI. It was higher at 12weeks of age (0.60) and lower at 6 WAS (0.28). Hazrat *et al*. (2004) found that plant height generally depends on internode expansion which caused an increase in height with an increase in water depth resulting in the taller plant. Narongrit (1999) reported that the numbers of tillers in plants usually show a general increase at the initial growth stage and then declines at the final growth stage.

Table 3: Effect of fertilizer rates and age of cutting on yield component of *Brachiaria ruziziensis.*

Fertilizer rate(kg/ha)	Plant height	Leaf length	Leaf width	No. of leaves	No. of tillers	Leaf Area Index
0	65.7^{b}	27.2^{b}	2.04	7	18	0.56^{a}
20	70.6^{b}	28.7^{b}	2.1	8	19	0.35^{c}
40	73.4^{a}	33.3^{a}	1.9	8	19	0.44^{ab}
60	74.9^{a}	31.7^{a}	1.8	7	20	0.42^{b}
SEM	2.28	0.90	0.2	0.63	1.69	0.06
LOS	*	*	NS	NS	NS	*
Age of plant (weeks)						
6	34.0^{c}	26.8^{b}	1.4^{b}	4^{c}	16^{c}	0.28^{c}
8	49.7^{c}	28.8^{b}	2.3^{a}	5^{c}	15^{c}	0.46^{b}
10	75.13^{c}	30.6^{ab}	2.0^{a}	8^{b}	21^{ab}	0.46^{a}
12	91.4^{b}	33.5^{a}	2.2^{a}	11^{a}	23^{a}	0.60^{a}
14	105.6^{a}	31.4^{ab}	1.9^{a}	10^{ab}	22^{a}	0.45^{b}
SEM	1.83	0.72	0.16	0.5	1.35	0.04
LOS	**	*	*	*	**	*
Interactions(p-value)						
FxA	0.92	0.77	0.46	0.58	0.78	0.99

P.H= plant height, LAI=leaf area index. LL= leaf length, L.W = leaf width, F= fertilizer rate, A = age of plant. a, b, c: Means with different superscript within a row differ significantly (P<0.05). SEM=Standard error of the mean, LOS= level of significance**,** * significant at 5%

Effect of fertilizer rates and age of cutting on yield

The results of fertilizer rate and age of cutting on the yield of *B.ruziziensis* grass are presented in table 4. Fresh forage yield was similar (P>0.05) at 20, 40 and 60 kg/ha fertilizer rate (14222, 15778, and 15889 kg/ha respectively) but significantly (p<0.05) higher than 0kg/ha fertilizer rate (13222). Dry matter yield as affected by fertilizer rate was significantly higher at 40 and 60 kg/ha (3579.8 and 3534.1 kg/ha) which were similar but differ significantly from 0 and 20 kg/ha fertilizer rate (2578.6 and 3194.6 kg/ha) which were similar. Age of cutting had a significant effect on both fresh and dry matter yield, the highest fresh forage yield of (16333 and 15333kg/ha) and dry matter yield of (3240.4 and 4275.1 kg/ha) were recorded at 12 and 14 weeks after sowing (WAS) respectively. The lowest fresh forage yield and dry matter yield (12667 and 2149.8kg/ha) were recorded at 10 WAS. The result obtained for the fresh and dry matter yield was lower than that obtained by Sani *et, al.* (2015) at 12 weeks after sowing but similar to what was obtained by Ezenwa *et, al* (1996) for *B.ruziziensis* grown in the sole stand with nitrogen fertilizer when harvested at 24 WAS. This indicates that the stage of growth influenced the yield of the plant (Mickan, 2006) and hence, dry matter yield increase as the plant age increases. Cook *et, al.* (2005), also reported that DM production is strongly influenced by soil fertility and ranges from 7–34 t/ha/year. The above authors also reported that in Fiji, unfertilized *humidicola* grass produced an annual DM yield of 11 t/ha DM, whereas DM increased to 34 t/ha with the application of 452 kg/ha N and in humid-tropical Vanuatu, annual yield declined from 28 t/ha DM, to 17 t/ha DM as fertility declined. Annual DM yields of 7 t/ha and

5–9 t/ha were reported from Paraguay and Brazil, respectively. The principal effect of nitrogen fertilizer on tropical grasses is to increase forage yield, usually through the production of more photosynthetic apparatus (Loch, 1980).

Table 4: **Effect of fertilizer rates and cutting age on the yield of *Brachiaria ruziziensis.***

Fertilizer rate (kg/ha)	Freshforage weight (kg/ha)	Dry weight (kg/ha)
0	13222[b]	2578.6[b]
20	14222[a]	3194.6[b]
40	15778[a]	3534.1[a]
60	15889[a]	3579.8[a]
SEM	1171.12	301.12
LOS	*	*
Ages of Cutting (weeks)		
10	12667[b]	2149.8[b]
12	16333[a]	3240.4[a]
14	15333[a]	4275.1[a]
SEM	1561.5	401.5
LOS	*	*
Interactions p- value		
FxC	0.9	0.6

a, b, c: means with different superscript within a row differ significantly (P<0.05). SEM= Standard error of mean, F= fertilizer rate, C = age of cutting. * significant at 5%

Chemical Composition of *Brachiaria ruziziensis*

The result of the proximate composition of *B.ruziziensis* is presented in table 5. The result showed that the dry matter and Ash were not significantly (P>0.05) affected by fertilizer rates but Crude protein (7.94,8.25,8.32,8.12), ether extract (7.99,7.94,6.87,6.75) crude fibre (36.72,37.93,37.18,35.53) and N.F.E (40.35,39.34,40.80,42.90) differ significantly (P<0.05) at varying level of fertilizer rate (0, 20, 40 and 60kg/ha) respectively. Age of cutting significantly (P<0.05) affect the proximate fractions at 10, 12, and 14 weeks after sowing. The highest DM was recorded at 10 and 14 weeks (94.30% and 94.12%) and crude protein (8.42% and 8.99%) were recorded at 10 and 12 WAS respectively. C.F, E.E, and Ash were higher at 12 WAS (39.39%, 7.88%, and 7.67%) respectively, the lowest C.P, Ash, and E.E was recorded at 14 WAS (7.06%, 5.89% and 6.80%) respectively. C.F was also low at 10 and 14 WAS, this is as a result of less maturity and lignification of the plant tissues at 10 and 14 weeks. The CP content must be equal to or higher than 7.0%. Crude protein content from all the plant materials analyzed met the minimum requirements for ruminants (>7%), i.e., 6.9 % for maintenance, 10.0 % for beef production and 11.9 % for milk production; Similar contents were also obtained by (Villela,2008), who found that the *Brachiaria decumbens* had CP content of 11.69%,11.08%, 9.43% and 8.93% in spring, summer, autumn, and winter, respectively, showing the reduction of CP content during the winter period due to the maturity of the plant. These nutrients in forages vary according to many factors such as forage species and climate (Baron and Belanger, 2007). This trend in CP content has been reported by other studies by

Kidunda *et al.* (1990); Seyoum *et al*. (1998) and Tessema *et al*. (2002) and is mainly attributable to dilution of the CP contents of the forage crops by the rapid accumulation of cell wall carbohydrates at the latter stages of growth (Van Soest, 1994). Vega *et al.* (2006) stated that other factors like the maturity of the grass can be the source of declining CP also Whitehead (2000), who found that the CP content of grasses depends on soil N availability and that N fertilization increases it.

Table 5: Proximate Composition of *Brachiaria ruziziensis* as affected by fertilizer rate and age of cutting.

Fertilizer Rates (kg/ha)	Dry Matter	Crude protein	Crude fibre	Ash	Ether Extract	Nitrogen Free Extract
0	93.84	7.94^{c}	36.72^{a}	6.99	7.99^{a}	40.35^{b}
20	93.76	8.25^{a}	37.93^{a}	6.82	7.94^{a}	39.34^{c}
40	93.93	8.32^{a}	37.18^{a}	6.70	6.87^{b}	40.80^{b}
60	94.03	8.72^{b}	35.53^{b}	6.54	6.75^{b}	42.90^{a}
SEM	0.151	0.26	0.89	0.25	0.27	1.12
LOS	NS	*	*	NS	*	*
Ages of Cutting (weeks)						
10	94.30^{a}	8.42^{b}	33.00^{b}	6.73^{b}	7.49^{a}	44.36^{a}
12	93.24^{b}	8.99^{a}	39.39^{a}	7.67^{a}	7.88^{a}	36.07^{b}
14	94.12^{a}	7.06^{c}	38.13^{a}	5.89^{c}	6.80^{b}	42.12^{ab}
SEM	0.08	0.13	0.48	0.15	0.36	1.04
LOS	*	*	*	*	*	*
Interactions						
FxC	**0.0002**	**0.0002**	**0.0004**	**0.0013**	**0.4075**	**0.012**

a, b, c: Means with different superscript within a row differ significantly (P<0.05). SEM=Standard error of mean, LOS= level of significance,E.E=Ether extract,NFE= Nitrogen free extract. F= fertilizer rate, C = age of cutting. * significant at 5%.

Effect of fertilizer rates on mineral composition

There was no significant (p>0.05) difference among the varying levels of fertilizer application for ash at week 0, 20,40 and 60 kg/ha rate as shown in Table 7. The ash content shows a significant (p<0.05) difference at different age of cutting with the highest value 7.67% recorded at 12 weeks and the lowest 5.89% at 14 weeks after sowing, Ca content of the forage material and Ca:P ratio where significantly different (p>0.05) as the level of fertilizer application varied, with 60kg/ha rate recording the highest percentage (6.22%) and the lowest was recorded at 20kg/ha rate (3.90%), but P level was similar (p>0.05). Ca, P and Ca: P ratio were similar (p>0.05) at different cutting intervals. The Ca content in the tested grass was high, and was similar to the results of Collins and Fritz (2003) who reported that the Ca content in Orchard grass *(Dactylis glomerata L)* was 2.3%. In addition, some researchers on tropical grasses also found that Ca content in the grasses was sufficient to meet cattle and sheep's requirement for the Ca mineral (Youssef and Braithwaite, 1987). These authors confirmed the Ca content in tested grasses in meeting the Ca requirements for cattle. However, according to McDowell and Valle (2000), some forage grasses and legumes collected from different regions of Latin America and Africa showed low concentrations of Ca (< 0.3%). Also Nguku *et al.* (2015) reported that *B. brizantha*

cultivars showed higher calcium (0.104-0.267%DM) content than the other *Brachiaria* cultivars (with an exception of *Brachiaria* hybrid Mulato II) as the production phase progressed. This shows that the results of this study on Ca were higher than those reported by these authors. It is likely that the grass tested will be able to meet the Ca and P requirements of most ruminant animals.

Table 6: Effect of fertilizer rates on mineral composition of *Brachairia ruziziensis* at different age of cutting

Fertilizer rates (kg/ha)	Ash	Ca	P	Ca : P ratio
0	6.99	1.05^{b}	0.19	$5.01:1^{b}$
20	6.82	0.83^{d}	0.25	$3.85:1^{d}$
40	6.70	0.99^{c}	0.23	$4.96:1^{c}$
60	6.54	1.62^{a}	0.28	$6.23:1^{a}$
SEM	0.25	0.17	0.023	0.80
LOS	NS	*	NS	*
Ages of Cutting (weeks)				
10	6.73^{b}	1.11	0.24	4.50:1
12	7.67^{a}	0.95	0.24	4.75:1
14	5.89^{c}	1.31	0.24	5.80:1
SEM	0.15	0.23	0.03	1.03
LOS	*****	NS	NS	NS
Interaction				
FxC	**0.0013**	**NS**	**NS**	**NS**

a, b, c: means with different superscript within a row differ significantly (P<0.05). SEM=Standard error of mean, LOS= level of significance, F= fertilizer rate, C = age of cutting. * significant at 5%

CONCLUSIONS

The following conclusions were drawn from the findings of this study;

I. Application of NPK 15:15:15 at 60kg/ha rate on *Brachiaria ruziziensis* gave a higher Fresh forage yield of 15.9t/ha and Dry matter yield of 3.6t/ha.

II. Harvesting at 12 weeks after sowing also gave a higher fresh forage yield 16.3t/ha, dry matter yield 3.2t/ha yield, a Crude protein of 8.99 and mineral composition ratio (Ca:P) 4.75:1%.

RECOMMENDATIONS

I. It is recommended that small-scale pasture producers and livestock farmers can use up to 60kg/ha of NPK 15:15:15 on *Brachiaria ruziziensis* and harvest for ruminant feeding at 12 weeks after sowing for higher forage yield and quality.

II. Further findings on the use of NPK 15:15:15 on the production of *Brachiaria ruziziensis* is hereby recommended in the Northern Guinea Savannah of Nigeria

REFERENCES

Abdel Hameed, A. A., Fedel Elseed, A. M. and Salih, A. M. (2013). Growth Performance and Rumen Fermentation of Lambs Fed Untreated or Urea Treated Groundnut Hull with Different Protein Sources. *Journal of Animal Production Advances*, 3(3): 86–96.

Agricultural Research Council (ARC, 1984). The nutrient requirements of ruminant's livestock, Supplement No. 1. CommonWealth Agricultural Bureau, Farnham Royal, U.K. P.45.

Alawa, J. P., and Umunna, N. N. (1993). Alternative feed formulation in developing countries: Prospects for utilization of agro-industrial by-product. *Journal of Animal Production Resource*, 13 (2): 63-98.

AOAC, (2005). Official Method of Analysis, 17th edition. Association of Analytical Chemists, 24th edition. Washington, DC. USA. 200-210.

Babayemi, O. J (2009). Silage quality, dry matter intake and digestibility by West African dwarf sheep of Guinea grass (*Panicum maximum cv Ntchisi*) harvested at 4 and 12-week regrowths. *African Journal of Biotechnology*, 8 (16): 3983-3988.

Bamikole, M. A., Akinsoyinu, A. O., Ezenwa, I., Babayemi, O. J., Akinlade, J. and Adewuni, M. K. (2004). Effect of six- weekly harvests on the yield, chemical composition and dry matter degradability of *Panicum maximum and Stylosanthese hamata* in Nigeria, *Grass and Forage Science*, 59: 163-357.

Baron, V.S., Belanger, G. (2007). Climate and forage adaptation. In R. J. Barnes, (ed) *Forages The science of grassland agriculture. 6th edition,* (pp. 83-104). Iowa State Press, USA 2: Blackwell publishing.

Bogoro, S. E., (1997). Effect of protein-energy supplementation on rumen kinetics, metabolites profile and growth performance of rams fed high fiber diets. Ph.D. thesis, Abubakar Tafawa Balewa University, Bauchi, Nigeria.

Collins M, Fritz J.O (2003). Forage quality. In: Barnes RF, Jerry CN, Collins M, Moore KJ (eds) Forages *an introduction to grassland agriculture.* Volume 1, 6th edition, Iowa Sate Press, USA. pp 363–390.

Centro Internacional de Agricultura Tropical (CIAT, 1978) Beef program Report at International Institute for Tropical Agriculture centre, Pp35.

Doma, U. D., Mohammed, L. K. and Umeh, A. P. (1999). Observation on the characteristics of smallholder sheep and goat management practice in old Bauchi State. *Tropical Journal of Animal Science*, *2*: 125–130.

Doma, U.D., Adegbola T.A., Bamgbose, A.M. and Umeh, P.A. (1999). Utilization of Cowpea Shell and Maize Cobs in Diet of Rabbit. *Tropical Journal of Animal Science*, 2(1):27-32.

Duncan, D.B. (1955). Multiple range and multiple F-test. *Biometric.* 11, 1-42.

Eugène, M. Sauvant, D. Weisbecker, J.L. and Archimède, H. (2010). Effects of defaunation on digestion of fresh *Digitaria decumbens* grass and growth of lambs. *Animal Science journal.*4: 439–455. doi: 10.1017/S1751731109991194.

Eugène, M., Sauvant, D., Weisbecker, J. L. and Archimède, H. (2010). Effects of defaunation on digestion of fresh *Digitaria decumbens* grass and growth of lambs. *Animal Science Journal*.4: 439–455. doi: 10.1017/S1751731109991194.

Ezenwa, O., Aribisale, A. and Aken'ova, M. E. (1996). Dry matter yields of *Panicum maximum* and *Brachiaria* with nitrogen fertilization or *Pueraria* in an oil palm plantation. *Tropical Grassland Journal.* 30: 414-417.

Fadel Elseed, A. M. A. (2004). Effect of supplemental protein feeding on ruminal characteristics and microbial N production in sheep fed treated rice straw. *Small Ruminants Research*.57:11-17. http://www.elsevier.com/locate/smailrurnes. 3/1/2014.

Fadel Elseed, A. M. A. (2005). Effect of supplemental protein feeding frequency on ruminal characteristics and microbial N production in sheep fed treated rice straw. *Small Ruminant Research, 57*(1), 11–17.

Fadel. R., Rosa B., Oliveira,I.P.de: Orsine, G.F., and Dias, I.D.(2004). Nutritive value of rice straw ammoniated for sheep Cie^ncia *Animal Brasileira.*, 5(1):19-25.

FDLPCS (1992): Federal Department of Livestock and Pest Control Services.National Livestock National Synthesis. *Federal Ministry of Agriculture Abuja.*

Ferdous, M. R., Khan, M. J., Rashid, M. A. and Kamruzzaman, M. (2011). Effect of different levels of concentrate supplementation on the performance of Black Bengal goat. *Bangladesh Journal of Animal Science,* 40 (1-2): *40-45.*

Food and Agricultural Organization (FAO, 2006). FAO, Statistics on ruminant animal livestock population in Nigeria. Rome, Italy. Pp. 61.

Glatzle, A. (1992). Feed Resources in the Sahel. *Animal Research and Development*, 35. 43–58.

Gobius N.R., Phaikaew.C. Pholsen, P. Rodchompoo O., AND Susena.W. (2001). Seed yield and

its components of *Brachiaria decumbens* cv.Basilisk, *Digitaria milanjiana* cv. Jarra and *Andropogon gayanus* cv. Kent in north-east Thailand under different rates of nitrogen application. *Journal of Tropical Grassland 35,26-33.*

Hazrat, M. A., Mahmuda, K. M., Lun, G. M. (2004). Influences of various level of water depth on rice growth in Rice-Fish culture under Wetland Rice Eco-systems. *Journal of Geo-Environment* 4: 23-30.

Kallah, M. S., Baba, M., Alawa, J. P., Muhammad, I. R. and Tanko, R. J. (1997). Ensiling quality of Columbus grass (*Sorghum almum*) growth in northern Nigeria. *Animal Science and Technology*, 68: 153 – 163.

Kibon, A. and. Ørskov, E. R. (1993). The use of degradation characteristics of browse plant to predict intake and digestibility of goats. *Animal Production*, 57: 247-251.

Kidunda, R.S, Lowga, A.B, and Mtengeti E.J (1990). Utilization of research results on forage and agricultural by-products as animal feed resources in Africa. PANESA/ARNAB (Pasture Network for Eastern and Southern Africa/African Research Network for Agriculture By-products), pp. 36 - 56. Proceedings of the first joint workshop held in Lilongwe, Malawi, 5-9 December 1988, PANESA/ARNAB, Addis Ababa, Ethiopia.

Kopu, M. M. (1975). The natural forage for Northern Nigeria 2. Nitrogen and mineral composition of grasses and browse from northern Guinea savannah and standing hay from different savannah zones. *Nigerian Journal of Animal Production*, 2: 235-246.

Loch D.S., Rethman N.F.G. and Van Niekerk W.A. (2004). Rhodes Grass. In B. G. Cook, *Warm-Season (C4) Grasses, Agronomy Monograph Vol. 45* (pp. 833-871). Madison, Wisconsin:

McDowell RL, Valle G (2000). Major minerals in forages. In: Givens DI, Owen E, Axford RFE and Omed HM (eds) Forage evaluation in ruminant nutrition. CAB International Publishing. Pp. 373–397.

Mickan, F. (2006). Forage cereals: harvest and storage. When to cut for whole-crop cereal

silage. Department of Primary Industry, Victoria Gov., Ag, Note 1243.

Miles, J. W., and do Valle, C. B. (1996). Manipulation of apomixis in *Brachiaria* breeding. In: J. Miles, B. L. Maass and C. B. do Valle (Eds.). *Brachiaria*: Biology, Agronomy, and Improvement. Pp. 164-177.

Miles, J. W., Do Valle, C. B., Rao, I. M. and Euclides, V. P. B. (2004). Brachiaria grasses In.L.E Moser B.L Burson Y.L.E Sollenberger (eds). Warm – season (C4) grasses. Agron monogr 45, ASA, CSSA, SSSA, Madison WI, USA 2004. 745-783.

Miles, J. W., Maass, B. L., Kumble, V. and do Valle, C.B. (1996) *Brachiaria* : Biology, Agronomy and Improvement. Joint publication by Centro Internacional de Agricultura Tropical (CIAT), Cali-Colombia and Embrapa/CNPGC, Campo Grande, MS, Brazil. Pp 161-162.

Narongrit, W. (1999). Effect of cutting, nitrogen, closing date, and water on herbage and seed production in Ruzi grass (*Brachiaria ruziziensis* Germain and Everard). Plant Science (Seed technology) at Massey University, New Zealand.

National Research Council *(2007). Nutrient Requirements for various classes of sheep and goat, Update 2007. National Academy Press, Washington, DC.*

Ndikumana J.; Leeuw de P.N. (1996). Regional Expertice with Brachiaria: Sub-Saharan Africa. In Miles, John W; Maass, Brigitte L; Valle, Cacilda Borges do; Kumble, Vrinda (eds). *Brachiaria: Biology, Agronomy, and Improvement.* Centro internacional de Agricultura Tropical (CIAT) Campo Grande, BR: Empresa Brasileira de Pesquisa Agropecuaria (EMBRAPA), Centro Nacional de Pesquisa de Gado de Corte (CNPGC), Cali, CO Pp 247-257. (CIAT publication no 259).

Nguku, S. A. (2015). An evaluation of Brachiaria grass cultivars productivity in semi-arid Kenya. MSc research thesis southeastern Kenya University.

Ørskov, E. R. (1998): Feed Evaluation with emphasis on fibrous roughages and fluctuating supply of nutrients. 1. A review. *Small Ruminant Research*, 28: 1-8.

Ørskov, E. R. (1999). How can agricultural scientist contribute to rural poverty alleviation? In: Promoting Sustainable Small-Scale Livestock Production towards Reduction of Malnutrition and Poverty in Rural and Sub-Urban Families in Nigeria Eds. FACE PAM/ATBU Publications, Nigeria, Pp: 13-23.

Otchere, E. D., Ahmed, H. H., Adenowo, T.K., Kallah.M.S., Bawa.E.L.K., Olurunju.S.A., and Voh. A.A.Jr.(1987).Sheep and Goat Production in the Traditional Fulani Agropastoral Sector.*Wold Animal Review*, 64:50-55

Ovi maps (2012). Ovi location map: Ovi earth imagery data.

Risopoulos, S. A. (1966). Management and use of grasslands, the Democratic Republic of the Congo. 1st edition, Published 1966 by Food and Agriculture Organization of the United Nations in Rome.

SAS (2005). Statistical Analysis System. Guide for personal computers. Version 9.SAS Institute, Inc. Carry, New York City, USA.

Schultze-Kraft, R. and Teitzel, J. K. (1992) *Brachiaria ruziziensis* Germain & Evrard. In'tMannetje, L., and Jones, R.M. (eds) *Plant Resources of South-East Asia No. 4. Forages* (Pudoc Scientific Publishers, Wageningen, the Netherlands). Pp. 65–67

Seyouma, E.T. Batteseb, G.E. and Fleming, E.M. (1998). Technical efficiency and productivity of maize producers in eastern Ethiopia: a study of farmers within and outside the

Sasakawa-Global 2000 project 19: 341-348.

Singh, R. J. (2009). *Genetic resources, chromosome engineering, and crop improvement: Forage crops.* CRC Press, Florida, U. S. A. Pp 8-12.

Smith, B. L., and Miles, C. O. (1993). A role for *Brachiaria decumbens* in hepatogenous photosensitization of ruminants. *Veterinary and Human ToxicologyJournal*, 35: 256-257.

Tarawali, S. A., Tarawali, G., Larbi A., and Hanson, J. (1995). Initial Screening Methods. In G. T. S. A. Tarawali, (eds) *Methods for the Evaluation of Forage Legumes, Grasses and Fodder Trees for Use as Livestock Feeds* (pp. 10-11). Nairobi Kenya: International Livestock Research Institute.

Umunna, N.N. Nshalai., I.V. and. Osuji, P.O. (1995). Degradability of protein forage supplement and their effects on the kinetics of digestion and passage, *Small Ruminant Research*. 17: 145-152.

Valerio, J. R., Lapointe, S. L., Kelemu, S., Fernandes, C. D. and Morales, F. J. (1996). Pest and Diseases of *Brachiaria Species*. *Brachiaria*: Biology, Agronomy, and Improvement. (CIAT & Embrapa) Pp.87-105.

Valle do, C. B. and Savidan, Y. H. (1996). Genetics, Cytogenetics, and Reproductive Biology of *Brachiaria. Brachiaria*: Biology, Agronomy, and Improvement. (CIAT & Embrapa). Pp.16-35 and Pp.147-163.

Van Soest, P. J., Robertson, J. B., and Lewis, B. A (1991). Method for directory Neutral detergent fibre and Non- Starch polysaccharides in relation to Animal Nutrition, *Journal of Dairy Science*, 74: 3583-3597.

Vega, E.M., Ramírez de la Ribera, J., Leonard Acosta I. and Igarza, A. ((2006).). Dry matter yield, chemical characterization and digestibility of Brachiaria decumbens in the edapho-climatic conditions of the valley of Cauto. *Revista Electrónica de Veterinaria REDVET*, http://www.veterinaria.org/revistas/redvet/n050506.html

Watson, L. and Dallwitz, M. J. (2008). The grass genera of the world: Descriptions, illustrations, identification and information retrieval; including synonyms morphology, anatomy, physiology, phytochemistry, cytology, classification, pathogens, world and local distribution and references. *The Grass Genera of the World. Retrieved from* http://www.tropicalforages.info/key/Forages/Media/Html/glossary.html. 2011-11-07

Whitehead, D. C. (2000) Nutrient Elements in Grasslands. Soil-Plant-Animal relationships. CABI. Wallingford, UK 135 pp.

Youssef F. G., Brathwaite RAI (1987). The mineral profile of some tropical grasses in Trinidad. *Tropical Agriculture*. (Trinidad), 64: 122-128.