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Regrowth potential of *Panicum maximum* (Ntchisi) and *Andropogon tectorum* as affected by fertilizer types during late rainy-season in Abeokuta, derived Savanna zone of Nigeria

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Abstract

Fertilizer applications has been widely utilized to improve soil fertility, and consequently enhanced plant productivity. Yet, the best fertilizer type for late rainy season forage production is rarely tested in Nigeria. Hence, an experiment was conducted to investigate the regrowth potential of two tropical grasses during late rainy season in Abeokuta, derived Savanna zone of Nigeria. This experiment comprised four fertilizer treatments [Nitrogen Phosphorous Potassium 20: 10: 10 fertilizer (NPK), Aleshinloye organo-mineral fertilizer (AOM), Poultry manure (PM), no fertilizer (control)] and two grass species (Panicum maximum var Ntchisi and Andropogon tectorum). This experiment was a 4 × 2 factorial arrangement laid out in a split plot design, forming 8 treatments that were replicated three times. Data were collected on agronomic parameters such as plant height (PH), plant length (PL), leaf length (LL), leaf width (LW), number of tillers/stand (TN) and number of leaves/stand (NL) for the period of 6 weeks after cutback at an interval of 2 weeks. The results revealed that NPK fertilized P. maximum var Ntchisi had higher LL than others. In the case of TN and NL, fertilized P. maximum var Ntchisi performed better than other grass. Poultry manure fertilized P. maximum var Ntchisi gave a greater TN and NL in relation to other treatments group. Therefore, it could be concluded that P. maximum var Ntchisi fertilized with NPK and PM fertilizers had better regrowth performance during the late rainy season in Abeokuta. For high pasture productivity during dry season, P. maximum var Ntchisi fertilized with Poultry manure fertilizer should be adopted by farmers.

Keywords: Fertilizer, late rainy season, regrowth, tropical grasses

Potentiel de repousse de panicum maximum (Ntchisi) et d'Androopogon tectorum comme affecté par des types d'engrais pendant la saison des pluies tardive à Abeokuta, une zone de savane dérivée du Nigéria

Résumé

Les applications d'engrais ont été largement utilisées pour améliorer la fertilité des sols et, par conséquent, une productivité des plantes améliorée. Pourtant, le meilleur type d'engrais pour la production de forage de la saison des pluies tardifs est rarement testé au Nigéria. Par conséquent, une expérience a été menée pour enquêter sur le potentiel de repousse de deux herbes tropicales pendant la fin de la saison des pluies à Abeokuta, une zone de savane dérivée du Nigéria. Cette expérience comprenait quatre traitements d'engrais [Engrais de potassium de phosphore d'azote 20: 10: 10 (NPK), engrais organo-minéral Aleshinloye (EOA), fumier de volaille (FV), sans engrais (contrôle)] et deux espèces d'herbe (Panicum

maximum var Ntchisi et andropogon tectorum). Cette expérience a été une disposition factorielle de 4 × 2 dans une conception de tracé divisée, formant 8 traitements reproduits trois fois. Les données ont été collectées sur des paramètres agronomiques tels que la hauteur de la plante (HP), la longueur de la plante (LP), la longueur des feuilles (LF), la largeur de la feuille (LF), le nombre de barreurs (NB) et le nombre de feuilles (NF) pour la période de 6 semaines après la réduction à un intervalle de 2 semaines. Les résultats ont révélé que la NPK Fertilisée P. Maximum Var ntchisi avait plus de LF que d'autres. Dans le cas de Nb et NF, P. Fertilisé Var ntchisi a fonctionné mieux que d'autres herbes. Licure de volaille Fertilisée P. maximum var ntchisi a donné un plus grand NB et NF par rapport à d'autres types de traitements. Par conséquent, on pourrait en conclure que P. Var ntchisi Fertilisé avec NPK et les engrais FV avaient une meilleure performance de repousse pendant la fin de la saison des pluies à Abeokuta. Pour une productivité élevée de pâturage pendant la saison sèche, P. Var ntchisi Fertilisé avec un engrais de fumier de volaille doit être adopté par des agriculteurs.

Mots-clés: Engrais, saison des pluies en retard, repousse, herbes tropicales

Introduction

Livestock production contributes 6-8% of the Gross Domestic Products (GDP) and 20-25% of the Agricultural GDP in Nigeria (Aishat, 2016). One of the major constraints militating against high contribution of livestock production to GDP in Nigeria is the shortage of quality forages during dry season (Lamidi and Ologbose, 2014). In order to minimize this challenge, there is need to sow and harvest quality forage with high biomass production in the late wet season, so that adequate forage materials would be conserved for dry season feeding of the animals. Soil nutrient deficiencies is a major factor restricting high biomass production in the tropics (Fageria and Baligar, 2005), as availability of soil nutrients is one of the key factors that determine plant growth and development. This prompt the usual application of inorganic and organic fertilizers to pastures at the beginning of growing seasons (Ewetola *et al*., 2016, Olanite *et al*., 2010). While organic and inorganic fertilizers differ in their timing and mechanisms of nutrient mineralization and release how and when their positive impacts on plant growth prevail during the growing season is rarely tested in Nigeria. Thus, there is need for more comparative studies on effects of inorganic and organic fertilizers on plant growth in Nigerian sown pastures. Plants tend to grow rapidly and become lignified towards the end of the wet season (Zhang *et al*., 2020). Cutback of the sward could be practiced during the late wet season to assess high quality and quantity forage for conservation. The cutback will stimulate both the regrowth and emergence of old and new shoots and tillers respectively (Merrigan, 2021), depending on soil nutrient availability (Smethurst, 2004). Yet, there is little or no comparative studies on how inorganic and organic fertilizers determine plant regrowth potential in late wet season in Nigeria. In this study, we assessed how application of organic and inorganic fertilizers during early wet season could influence the regrowth potential of two tropical grasses in the late wet season. We hypothesized that the inorganic fertilizers would rapidly release the nutrients to the soil during the early period of the season and aid rapid plant growth while remnant nutrients are loss to leaching. On the other hand, we hypothesized that the organic fertilizers would gradually release nutrients and could possibly extend to subsequent growing season due to their slow mineralization or

immobilization (Smethurst, 2004).

Materials and methods

Experimental site

The study was conducted at the Teaching and Research unit of Directorate of University Farms (DUFARMS) and the Laboratory of the Department of Pasture and Range Management, Federal University of Agriculture, Abeokuta, Ogun State, Nigeria. The site lies within the savanna agro-ecological transition zone, Southwest Nigeria (latitude7.2^{0}N, longitude 3.5^{0}E) (Google Earth, 2015) and experiences average annual rainfall of 1037mm.

Experimental design

This experiment comprised four fertilizer treatments (mineral fertilizer, organo-mineral fertilizer, poultry manure, no fertilizer i.e., control) and two grass species (*P. maximum* var Ntchisi and *A. tectorum*). The field was laid out with a 4 × 2 factorial arrangement in a split plot design, forming total 8 treatments that were replicated three times. The plots were established during early rainy period in the year 2016 with the application of the fertilizers, which were applied at the rate of 120 kgN/ha based on their nitrogen content. The field was cutback during late rainy season of the same year.

Data collection

Two weeks after cutback, the data were taken at intervals of two weeks for six weeks on agronomic parameters (plant height- PH, plant length- PL, leaf length- LL, leaf width- LW, number of tillers/stand- TN and number of leaves/stand- NL).

Plant height (cm)

Estimation of the height of grasses was done by measuring from the base of the plant to where the last leaf on the stem appeared with the aid of a meter rule on ten randomly selected stands per plot representing 20% of the plants in each plot.

Tiller number/stand

Estimation of tiller number per stand was done by counting the number of tillers in ten randomly selected stands in each plot.

Leaf number/stand

This was estimated by counting the number of leaves in each stand from ten randomly selected stands in each plot.

Leaf length (cm)

This was estimated by measuring distance from the ligule to the tip of the leaf for ten stands that were randomly selected from each plot.

Leaf width (cm)

This was estimated by measuring the distance from one end to the other end at the middle of the leaf.

Statistical analysis

The agronomic and laboratory data collected were subjected to analysis of variance using SAS (R) package (2009) and significant means were separated using Duncan's Multiple Range Test (Duncan, 1955) at 5% level.

Experimental model

$Y_{ijkl} = \mu + F_i + G_j + (FG)_{ij} \Sigma_{ijk}$

μ = population mean

$F_{i=}$ effect of fertilizer type

$G_{j=}$ effect of grass species

$(FG)_{ij}$ = interaction of fertilizer type and grass species effects

$\Sigma_{ijk=}$ Residual error estimate

Results and discussion

Effects of fertilizer types on plant height and length of Panicum maximum and Andropogon tectorum estimated during late rainy- season

The plant height (PH) and plant length (PL) of *Panicum maximum* (Ntchisi) and *Andropogon tectorum* as affected by fertilizer types during late rainy season are shown in Table 1. The mean values of PL were not different (P>0.05). At 6 WAC, the highest (P<0.05) PH (97.00 cm) was observed in control treatment, while the lowest (P<0.05) PH (77.00 cm) was

recorded in PM. In the case of grass species, at 4 WAC, the highest (P<0.05) PH was observed in *P. maximum* and the lowest (P<0.05) PH was recorded in *A. tectorum*. Interaction effects of fertilizer types on plant height and plant length of *P. maximum* and *A. tectorum* estimated during late rainy season showed that there were no significant differences among the mean values recorded (Table 2). Table 3 presents the leaf length (LL) and leaf width (LW) of *P. maximum* and *A. tectorum* as affected by fertilizer types in the late rainy-season. The mean values presented in the result indicated that only LL was significantly influenced as a result of grass species. Higher (P<0.05) LL (47.20, 58.01 and 61.80 cm) were observed in *P. maximum* at 2, 4 and 6 WAC, respectively. Interaction effects of fertilizer types and grass species on leaf length (LL) and leaf width (LW) of *P. maximum* and *A. tectorum* are expressed in Table 4. The highest (P<0.05) LL (49.11 cm) was observed in *P. maximum* planted without fertilizer at 2 WAC, while the lowest (P<0.05) LL at 2 WAC was observed in *A. tectorum* fertilized with NPK.

Table 1: Main effects of fertilizer types on plant height and plant length of *A. tectorum* and *P. maximum* during late rainy season

Factors	**Plant height** (cm)			**Plant length** (cm)		
	2weeks	4weeks	6weeks	2weeks	4weeks	6weeks
Fertilizer types						
Control	59.89	76.71	97.00[a]	71.11	92.18	106.94
AOM	58.72	70.50	90.67[ab]	66.67	84.44	102.78
NPK	60.44	72.39	83.22[ab]	67.33	88.39	93.94
PM	56.17	76.18	77.00[b]	67.00	90.82	93.44
SEM	4.08	3.73	5.90	4.20	3.82	6.30
Grass species						
A. tectorum	54.81	69.15[b]	89.86	64.67	86.85	103.69
P. maximum	62.81	78.33[a]	84.50	71.39	90.81	94.94
SEM	2.80	2.53	4.32	2.89	2.73	4.42

[a, b:] means in the same column with different superscripts are significantly different (P<0.05)
SEM: Standard error mean
AOM=Aleshinloye organo-mineral fertilizer
PM=Poultry manure
NPK=N.P.K. 20:10:10

Table 2: Interaction effects of fertilizer types and grass species on plant height and plant length of *A. tectorum* and *P. maximum* during late rainy season

Treatments		**Plant height** (cm)			**Plant length** (cm)		
		2weeks	4weeks	6weeks	2weeks	4weeks	6weeks
Grass species	**Fertilizer types**						
A. tectorum	Control	57.56	75.75	101.89	71.78	95.00	113.56
	AOM	56.33	63.67	88.89	63.00	79.33	106.56
	NPK	55.56	68.11	84.67	61.00	85.11	93.22
	PM	49.78	69.88	84.00	62.89	89.13	101.44
P. maximum	Control	62.22	77.56	92.11	70.44	89.67	100.33
	AOM	61.11	77.33	92.44	70.33	89.56	99.00
	NPK	65.33	76.67	81.78	73.67	91.67	94.67
	PM	62.56	81.78	68.00	71.11	92.33	83.14
SEM		5.69	5.06	8.19	5.83	5.40	8.72

[a,b] means in the same column with different superscripts are significantly different (P<0.05)
SEM: Standard error mean
AOM=Aleshinloye organo-mineral fertilizer
PM=Poultry manure
NPK=N.P.K. 20:10:10

Table 3: Main effects of fertilizer types on leaf length and leaf width of *A. tectorum* and *P. maximum* during late rainy season

Factors	**Leaf length** (cm)			**Leaf width** (cm)		
	2weeks	4weeks	6weeks	2weeks	4weeks	6weeks
Fertilizer types						
Control	37.86	45.88	51.10	1.36	2.64	3.95
AOM	35.06	41.83	46.17	1.09	2.51	2.76
NPK	36.25	45.24	51.85	1.61	3.28	3.66
PM	40.29	49.24	49.69	1.94	2.52	2.79
SEM	3.78	4.19	3.37	1.50	0.57	0.43
Grass species						
A. tectorum	27.53[b]	32.24[b]	34.27[b]	1.81	3.09	3.51
P. maximum	47.20[a]	58.01[a]	61.80[a]	1.94	2.56	2.85
SEM	2.07	2.00	1.44	1.04	0.54	0.35

[a,b] means in the same column with different superscripts are significantly different (P<0.05)
SEM: Standard error mean
AOM=Aleshinloye organo-mineral fertilizer
PM=Poultry manure
NPK=N.P.K. 20:10:10

However, the highest (P<0.05) LL (61.26 cm and 54.89 cm) were observed in *P. maximum* (Ntchisi) fertilized with NPK at 4 and 6 WAC, respectively, and the lowest (P<0.05) LL (29.22 and 28.81cm) were recorded in *A. tectorum* fertilized with NPK at 4 and 6 WAC, respectively. Meanwhile, the highest (P<0.05) LW was observed in *A. tectorum* fertilized with NPK at 4 WAC and the lowest (P<0.05) LW was obtained in *A. tectorum* fertilized with AOM.

Effects of fertilizer types on number of tillers and leaf number of A. tectorum and P. maximum during late rainy-season

Table 5 presents the main effects of fertilizer types on number of tillers (TN) and leaf number (LN) of *A. tectorum* and *P. maximum* during the late rainy-season. The highest TN (21.22 and 33.86 tillers/stand) was observed in *P. maximum* at 2 and 6 WAC, respectively. Similarly, the highest LN (44.64 and 94.36) was recorded in *P. maximum* at 2 and 6 WAC respectively.

The mean values of TN and LN were significantly affected by interaction of fertilizer types and grass species (Table 6). At 4 WAC, there were no differences (P>0.05) among the mean values presented. The highest TN (25.11 and 35.22 tillers/stand) was observed in *P. maximum* fertilized with PM at 2 and 6 WAC, respectively. *Andropogon tectorum* under control treatment recorded the lowest TN (13.67 tillers/stand) at 2 WAC, while *A. tectorum* fertilized with PM obtained the lowest TN (14.50 tillers/stand) at 6 WAC. Moreover, the highest LN (45.22) was observed in *P. maximum* fertilized NPK, but statistically similar to *P. maximum* fertilized with other fertilizer treatments at 2 WAC, and the lowest LN at 2 WAC was observed in *A. tectorum* under control treatment, but statistically similar to that of *A. tectorum* fertilized with PM. Conversely, the highest LN (105.33) was obtained in *P. maximum* under the control treatment at 6 WAC and the lowest LN (39.13) was obtained in *A. tectorum* fertilized with PM.

Table 4: Interaction effects of fertilizer types grass species on leaf length and leaf width of *A. tectorum* and *P. maximum* during the late rainy season

Treatments		Leaf length (cm)			Leaf width (cm)		
		2weeks	4weeks	6weeks	2weeks	4weeks	6weeks
Grass species	**Fertilizer types**						
A. tectorum	Control	26.61^{c}	33.13^{b}	32.72^{b}	1.30	2.75^{b}	3.50
	AOM	26.94^{c}	29.78^{b}	29.33^{b}	1.33	2.47^{b}	2.99
	NPK	25.00^{c}	29.22^{b}	28.81^{b}	1.67	3.90^{a}	2.53
	PM	31.58^{bc}	37.50^{b}	30.22^{b}	2.22	2.56^{b}	3.02
P. maximum	Control	49.11^{a}	57.22^{a}	49.48^{ab}	1.41	2.53^{b}	2.40
	AOM	43.18^{ab}	53.89^{a}	51.00^{ab}	1.44	2.56^{b}	2.53
	NPK	47.50^{a}	61.26^{a}	54.89^{a}	1.50	2.67^{b}	2.78
	PM	49.00^{a}	59.67^{a}	51.86^{ab}	1.46	2.48^{b}	2.49
SEM		4.11	3.87	2.87	2.09	0.61	0.47

$^{a, b, c:}$ means in the same column with different superscripts are significantly different (P<0.05)
SEM= Standard error of means
AOM=Aleshinloye organo-mineral fertilizer
PM=Poultry manure
NPK=N.P.K. 20:10:10

Table 5: Main effects of fertilizer types on number of tillers and number of leaves of *A. tectorum* and *P. maximum* during late rainy season

Factors	Number of tillers/stand			Number of leaves/stand		
	2weeks	4weeks	6weeks	2weeks	4weeks	6weeks
Fertilizer types						
Control	16.94	23.22	26.24	31.39	59.11	80.06
AOM	16.44	18.83	26.00	38.44	55.22	64.89
NPK	18.33	22.11	25.50	35.72	72.22	76.61
PM	19.56	24.38	25.47	31.61	56.88	67.06
SEM	2.20	3.33	3.70	4.32	8.96	10.02
Grass species						
A. tectorum	14.42^{b}	20.86	17.26^{b}	23.94^{b}	55.53	48.56^{b}
P. maximum	21.22^{a}	23.35	33.86^{a}	44.64^{a}	66.74	94.36^{a}
SEM	1.44	2.37	2.06	2.52	6.34	5.41

^{a,b} means in the same column with different superscripts are significantly different (P<0.05)
SEM: Standard error mean
AOM=Aleshinloye organo-mineral fertilizer
PM=Poultry manure
NPK=N.P.K. 20:10:10

Table 6: Interaction effects of fertilizer types and grass species on number of tillers and number of leaves of *A. tectorum* and *P. maximum* during late rainy season

Treatments		Number of tillers/stand			Number of leaves/stand		
		2weeks	4weeks	6weeks	2weeks	4weeks	6weeks
Grass species	**Fertilizer types**						
A. tectorum	Control	13.67^{b}	18.67	16.25^{c}	18.56^{b}	40.44	51.63^{bc}
	AOM	16.33^{ab}	16.67	19.78^{bc}	32.44^{ab}	47.44	47.00^{bc}
	NPK	13.67^{b}	17.11	18.11^{c}	26.22^{b}	65.44	55.78^{bc}
	PM	14.00^{b}	31.00	14.50^{c}	18.56^{b}	68.78	39.13^{c}
P. maximum	Control	20.22^{ab}	27.78	35.11^{a}	44.22^{a}	77.78	105.33^{a}
	AOM	16.56^{ab}	21.00	32.22^{ab}	44.44^{a}	63.00	82.78^{ab}
	NPK	23.00^{ab}	27.11	32.89^{ab}	45.22^{a}	79.00	97.44^{a}
	PM	25.11^{a}	15.86	35.22^{a}	44.67^{a}	41.57	91.89^{a}
SEM		2.81	3.98	4.16	4.95	11.19	10.79

$^{a, b, c:}$ means in the same column with different superscripts are significantly different ($P<0.05$)
SEM: Standard error mean
AOM=Aleshinloye organo-mineral fertilizer
PM=Poultry manure
NPK=N.P.K. 20:10:10

In the late rainy season, *P. maximum* (Ntchisi) fertilized with NPK and PM were observed to have recorded improved leaf length, leaf width and tiller number which was an indication that the fertilizer treatment had exerted positive influence on the re-growth performances of the planted grasses. This observation might be attributed to release of sufficient amounts of nitrogen by the NPK fertilizer and PM which could have enhanced the genetic potential of *P. maximum* (Ntchisi) leading to production of more tillers and increased leaf area. This indicates that nitrogen mineralized and released during the late rainy season has improved the growth performance of *P. maximum* (Ntchisi) over *A. tectorum*. This agrees with Burhan and Hago (2000) who reported that nitrogen plays an important role in plant growth and physiological processes, as nitrogen enters all enzymes composition and enhances vegetative growth. Similarly, Karina *et al*. (2014) observed increased number of tillers in the second year of Ruzi grass growth which indicated inhibition of development of the tillers when nitrogen supply was deficient in the first year, but when supply of nitrogen to the plants increased in the second year, the number of tillers per plant increased. Likewise, applied nitrogen increased the number of tillers, the rate of emergence of new tillers, the proportion of tiller buds which developed into tillers and the proportion of relatively young tiller buds that developed (Wilman and Pearse, 2009). Conversely, the findings by Abederahman (2007) showed that no significant effect due to nitrogen fertilizer was detected on mean value of plant height in the first and second cuts and this conforms with the observation made in this study. Meanwhile, the result of study conducted by Chen *et al*. (2013) revealed that the other plant characteristics such as plant height, leaf area, seed setting rate and seeds yield were influenced significantly by nitrogen addition in the both seasons

except spikelet number. The superior tillers production exhibited by *P. maximum* (Ntchisi) also shows its ability to withstand moisture stress than *A. tectorum*. *Panicum maximum* (Ntchisi) has been reported to adapt to a wide range of soil types but responds readily to fertilizer, particularly nitrogen (Ademosun, 1973). This observation is consistent with the findings by Ewetola *et al.* (2014) that *P. maximum* (Ntchisi) fertilized with animal manure had highest crown diameter, tiller density and number of leaves.

Conclusion

It was concluded that *P. maximum* var Ntchisi fertilized with NPK and PM fertilizers had better regrowth performance during the late rainy season in Abeokuta. For high pasture productivity during dry season, *P. maximum* var Ntchisi fertilized with PM fertilizer should be adopted by farmers.

References

Abdu, S. B., Jafar, A. S., Hassan, M. R., Adamu, H. Y., Yashim, S. M. and Mijinyawa, M. A. 2016. Influence of west Soya waste on nutrient utilization by red Sokoto goats fed Digitaria (*Digitaria smutsii*) hay. *Nigerian Journal of Animal Science* 18 (1): 154-161.

Abdelrahman, F. I. 2007. Effect of seed rate and NPK fertilization on growth and yield of forage quality of Rhodes grass (*Chloris gayana* L. Kunth). M.Sc. thesis. Faculty of Agriculture, University of Khartoum, Sudan.

Ademosun, A. A. 1973. Nutritive evaluation of Nigerian forages: The effect of stage of maturity on the nutritive value of Guinea grass (*Panicum maximum*). *Nigerian Agricultural Journal* 10: 170-177.

Aishat, O. 2016. Retreat on livestock and dairy development in Nigeria. Keynote address delivered by the Hon. Minister of agriculture and rural development, Chief Audu Ogbeh at the retreat on livestock and dairy development in Nigeria, held at Musa Yar' Adua centre, Abuja, on 7th to 8th June, 2016.

Burhan, H. and Hago, T. E. 2000. Principle of crop production. University of Khartoum printing press, Sudan (Arabic addition) page 40.

Chen, J. S., Zhu, R. F and Zhang, Y. X. 2013. The effect of Nitrogen addition on seed yield and yield components of legumes Chinensis in Singnen plain, China. *Journal of Soil Science and Plant Nutrition*.13 (2): pp22

Duncan, D. B. 1955. Multiple range and multiple F-Test. *Biometrics,* 11, 1-5.

Ewetola, I. A., Olanite, J. A., Oni, O. A., Dele, P. A., Olasupo, I. O., Idowu, J. O. and Adekeye, A. B. 2014. Effect of animal manure on re-growth potential of *Panicum maximum* and *Brachiaria decumbens* in South western Nigeria. *Organic agriculture research: A catalyst for sustainable national agricultural transformation agenda*. **Proceedings of the 10th national conference on organic agriculture (OAPTIN) held on 17th -20th November, 2014 at Ladoke Akintola University of Technology, Ogbomoso, Nigeria. Pp 35-47.**

Ewetola, I. A., Olanite,J. A., Oni, O. A. Dele, P. A. Ojo, V. O. A. Olasupo, I. O. Idowu J. O. Jimoh, S. O. and Adekeye, A. B. 2016. Effect of organic manure

sources from different animal wastes on re-growth potential of *Panicum maximum* and *Brachiaria decumbens* in South Western Nigeria. *International Journal of Organic Agriculture Research and Development* 12: 40-60.

Fageria, N. K. and Baligar, V. C. 2005. Nutrient Availability in Encyclopedia of Soils in the Environment. Accessed online at https://www.sciencedirect.com

Google Earth. 2015. Directorate of University Farms, Federal University of Agriculture, Abeokuta. Retrieved from http://www.google.com/maps/place/Federal+University+of+Agriculture+Abeokuta/@7.2342797,3.4389292,20z/data=!4m2!3m1!1s0x103a37c0008d6809:0x62771eac522d2734.

Lamidi, A. A. and Ologbose, F. 2014. Dry season feeds and feeding: A threat to sustainable ruminant animal production in Nigeria. *Journal of Agriculture and Social Research, 14(1): 17-30.*

Karina B., Alessandra A. G., Luciana G., Waldssimiler T. M., Maria T. C and Ivani P. O. 2014. Influence of nitrogen on the production characteristics of ruzi grass. *African Journal of Agricultural Research* 9(5):533-538.

Merrigan, S. 2021. Grass Growth: Rangeland Vegetation. The Rangeland Partnership at Rangelands Gateway. Accessed online at https://rangelandsgateway.org

Muenchen, R. A. 2009. R for SAS and SPSS users. Doi:10.1007/978-0-387-09418-2 Edition: 1st. Publisher: Springer. ISBN: 978-0-387-09417-5.

Olanite, J. A., Anele, U. Y., Arigbede, O. M., Jolaosho, A. O. and Onifade, O. S. 2010. Effect of plant spacing and nitrogen fertilizer levels on the growth, dry-matter yield and nutritive quality of Columbus grass (*Sorghum almum* stapf) in southwest Nigeria. *Journal of the British Grassland Society/ the official Journal of the European Grassland federation. Grass and Forage Science* 65: 369-375.

Smethurst, P. 2004. Tree Physiology/ Nutritional Physiology of Trees in Encyclopedia of Forest Sciences. Accessed online at https://www.sciencedirect.com

Wilman, D. and Pearse, P. J. 2009. Effects of applied nitrogen on grass yield, nitrogen content, tillers and leaves in field swards. *The Journal of Agricultural science* 103 (1): 201-211.

Zhang, J., Zuo, X., Zhao, X., Ma, J. and Medina-Roldan, E. 2020. Effects of rainfall manipulation and nitrogen addition on plant biomass allocation in a Semiarid Sandy grassland. Science Report 10, 9026 (2020).https://doi.org/10.1038/s41598-020-65922-0.

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