EFFECTS OF STAGES OF GROWTH ON DRY MATTER YIELD AND NUTRIENT COMPOSITION OF STYLOSANTHES IN THE YEAR OF ESTABLISHMENT IN VOM, NIGERIA

*Akpensuen, T.T[1]., Namo, O.A.T[2]. and Amodu, J.T[3].
[1]Department of Animal Production, Faculty of Agriculture, University of Jos.
[2]Department of Plant Science and Technology, Faculty of Natural Sciences, University of Jos.
[3]National Animal Production Research Institute, Ahmadu Bello University, Zaria

ABSTRACT
An experiment was conducted in Jos to evaluate the effects of stages of growth on dry matter yield and nutrient composition of Stylo (*Stylosanthes guianensis* cv. Cook) in the year of establishment. Five stages of growth (5, 9, 13, 17 and 21) weeks after sowing (WAS) were the treatments arranged in a Randomized Complete Block Design replicated four times. The land was divided into twenty plots of 5m X 3m. The spacing between each block was 1m and 0.5m along the rows and columns, respectively. Growth components and DM yield were measured at the various stages of growth. There was no significant difference in plant height at 17 (99.90cm) and 21 (101.90cm) WAS. However, the two stages were significantly (P>0.01) higher than the other stages of growth. Leaf to stem ratio was however, significantly higher at 5WAS (1.86) compared to the other stages of growth, while 21WAS had the least value of 0.27. Forage DM yield was higher (P<0.01) at 17 WAS (14.15 t ha^{-1}) compared with the other stages of growth. Crude protein content at 9WAS (18.98%) was higher (P<0.01) than the other stages of growth,while 21 WAS had the lowest value of 114.37 %. Crude protein content decreased from 9 to 21 WAS, while the fibre fractions increased from 9 to 21WAS. The legume grown in early June on Vom, Jos Plateau should be harvested at 17 WAS when the DM yield is maximum and crude protein content could also meet the requirements for ruminant animals.
Key words: Growth stage, nutrient composition, *C. molle*, Dry matter, yield
*Corresponding author's e-mail: atersur@gmail.com , Phone no.: +2348058828892

INTRODUCTION
Stylosanthes guianensis cv. Cook is one of the forage legume well suited to the sub-humid tropical zone with a marked dry season (Heuzé,*et al*., 2015). It is a tropical herbaceous perennial legume, primarily used for pasture in humid tropical regions and over sowing the crop improves the quality of tropical rangeland and it can also be used as a cover crop, green manure crop and as fallow crop (Mannetje, 1992). It is fairly palatable to livestock when mature, can be easily established on very low fertile soils with yield between 10 - 20 t DM ha^{-1} (Heuzé,*et al*., 2015) ,while dry matter and crude protein digestibilities in West Africa Dwarf sheep were reported to be 71.82 and 71.80%, repectively (Ogunbode and Akinlade, 2012). Different locations have been found to influence the yield and quality of forage crops, but the stage of growth at which a forage crop is harvested for livestock feeding is also important when the overall forage yield and quality are considered. As forage crop matures, the dry matter content increases, but digestibility of NDF, starch, sugar and crude protein contents, are all reduced (Kilcer *at al*., 2003). Therefore, there should be a growth/maturity stage to harvest in order to obtain optimum dry matter yield and forage quality in different environments. It has become important to evaluate forage yield and quality of Stylo (*Stylosanthes guianensis*cv. Cook) at different stages of growth to determine the optimum stage of growth for which the forage crop could be harvested for livestock feeding either as pasture, hay or silage. The study was therefore designed to examine the effect of stages of growth on dry matter yield and nutrient composition of Stylo (*Stylosanthes guianensis* cv. Cook) in the year of establishment in Vom, Jos Plateau, Nigeria.

MATERIALS AND METHODS
Location of the Study:

The experiment was carried out at the Nigerian Institute for Trypanosomiasis Research (NITR), Vom, (Lat 9° 43' 60N, Long 8° 46' 60E and 1,223m above sea level), (Ovimaps, 2014), Vom, Nigeria. The area is characterised by two major seasons (rainy and dry seasons). The rainy season starts in late-May and ends in early-October each year, while the dry season starts from late-October and ends in early- May. Peak of the rain is normally observed in the month of August each year. The soil is classified as sandy-clay loam. It is low in total nitrogen (0.33%), phosphorus (7.53 mg/litre), but fair in potassium (247.2 mg/litre)

Land Preparation and Experimental Design:

The land was ploughed and harrowed twice using tractor mounted implements. The field was levelled and all debris were removed to provide a clean seedbed. Five stages of growth (5, 9, 13, 17 and 21 weeks after sowing) were the treatments arranged in a Randomized Complete Block Design and replicated four times. The land was divided into twenty plots of 5 m X 3m each. The spacing between each block was 1m and 0.5m along the rows and columns, respectively. Growth components and dry matter (DM) were measured at the various stages of growth.

Pasture Establishment and Yield Measurement:

The trial was conducted when the rains were well established in the first week of June, 2015 rainy season. Seedrate was calculated using the method and formular provided by Karki (2013) as follows:

PLS Index = (% Germination x % Purity) ÷ 10,000

Kg of Seed per hectare = Recommended Seeding Rate ÷ PLS Index

Where; Kg= kilogram and PLS= Pure live seeds

Recommended planting spacing and depth were used. The seeds were drilled along the rows. Prior to planting, Single Superphosphate (SSP) fertiliser (18% P_2O_5) was applied at a rate of 30 kg ha^{-1} in both cropping seasons. The plots were manually weeded three times throughout the duration of the experiment using hoes. Five (5) plants in the middle of a row in each plot were tagged and used to determine the growth components which were plant height, number of leaves per plant and number of branches per plant at each stage of growth. The height of the tagged plants were measured from the ground level to the top of the plant with the aid of graduated meter rule. The number of leaves per plant and branches of the tagged plants were counted. Other five plants within a row in each plot were harvested to determine leaf to stem ratio by separating the leaves of the harvested plants from the stem. The leaves and the stem were wighed immediately in the field after separation, and were thereafter oven-dried at a temperature of 65^{o}C for 48 hours and weighed again until a constant weight was attained. Thereafter, the leaf dry weight was divided by stem dry weight to determine leaf to stem ratio (Tucak *et al*., 2013). Plants within 0.5 m^2 quadrat placed in the middle rows of the plots at pre - determined points were cut at 5cm above the ground level to determine the forage yield at 9, 13, 17 and 21 WAS using 0.5 m^2 quadrat. The cut forages samples were immediately weighed to determine fresh weight after which sub-samples were oven dried at a temperature of 65^{o}C for 48 hrs to determine the dry matter yields. Forage dry matter yields were calculated as shown below;

$$\frac{\text{Sub-sample dry weight}}{\text{Sub-sample fresh weight}} \times 100 \times \text{Total Harvest} = Z$$

Z X *40,000 = Dry matter yield per hectare. *There are 40,000 quadrats (0.5m^{-2}) per hectare

Analyses of Samples and Data:Proximate analysis (CP, ash, CF, EE and NFE) and mineral composition (Ca, P, Mg, K and Na) of the samples were determined using the method of (AOAC, 1990). All data generated were subjected to analysis of variance (ANOVA). The General Linear Model of SAS (2002). Statistical Software was used for the analyses and means were separated (Tukey, 1949).

RESULTS AND DISCUSSION

Growth components and dry matter yield of the legume at different stages of growth is presented in Table 1. Plant height was significantly higher at the later stages of growth compared to the early stages. The difference in height at 17(99.20 cm) and 21 (101.90 cm) WAS was not significant. The plant height obtained in this study was similar to the result reported by Njarui and Wandera (2004) in Kenya, but lower than 135 cm reported by Kiyothong *et al.* (2005) in Indonesia, probably due to difference in location. Number of leaves was higher ($P<0.01$) at 17 WAS (133.25), while 5WAS produced least value with 10.57. There was no record of number of branches at 5 WAS because, the legume was at the establishment stage. The plant produced significantly higher number of branches at 17WAS (35), while 9WAS had the lowest value (5.25). Leaf-to-stem ratio was significantly higher at 5WAS (1.86), and the lowest value of 0.83 was recorded at 21WAS. The decrease in leaf to stem ratio (5 – 21 WAS) observed in this study agrees with Ramírez *et al.* (2008) that leat-to-stem ration decrease as plant matures. The DM yield of the legume relatively increased from 9 WAS, reached a peak at 17 WAS, and then decreased at 21 weeks after sowing. Forage DM yields were significantly higher at 17 WAS (14 t ha^{-1}) decreasing to 10.41 t ha^{-1} at 21 WAS. The DM yield of 14.15 t ha^{-1} in *S. guianensis* was within the range of 10 - 20 t DM ha^{-1} reported by Cook et al. (2005), but higher than 4.2 t ha^{-1} reported by Kiyothong *et al.* (2005) in Australia. During the growth stage and as the plant undergo morphological changes, leaf growth becomes slower, the stem increases in length and proportion of dry matter increases reaching a peak, and then decreases.

Table 1: Growth components and forage dry matter yield of *Stylosanthes guinensis* at different stages of growth

Parameter	Weeks after sowing					SEM
	5	9	13	17	21	
Plant height (cm)	15.20^{d}	29.73^{c}	64.40^{b}	99.20^{a}	101.90^{a}	2.92
Number of leaves per plant	10.75^{c}	23.75^{c}	54.75^{c}	133.25^{a}	123.75^{b}	1.64
Number of branches per plant	-	5.25^{d}	25.00^{c}	35.00^{a}	34.25^{b}	0.83
Leaf to stem ratio	1.86^{a}	1.18^{b}	0.72^{c}	0.43^{d}	0.27^{e}	0.02
Forage DM yield (t/ha)	-	1.17^{d}	5.75^{c}	14.15^{a}	10.41^{b}	0.14

^{abcd}means with different superscripts on the same row are significantly different.

Table 2 shows the nutrient composition at different stages of growth. Crude protein, ether extract and ash contents were significantly higher at 5 WAS with 18.98, 2.76 and 9.80 compared to 14.37, 1.03 and 7.13 % at 21 WAS, respectively. However, crude fibre fraction was significantly higher at 21 WAS. Similarly, NDF and ADF contents were significantly higher at 21 WAS (40.29 and 30.42 %) compared to 49.44 and 39.42 % recorded at 5WAS, respectively. The CP, NDF and ADF contents were similar to the result reported by Valarini and Possenti (2006), while ash (6.8%) was lower than the value obtained in this study. Ajayi and Babayemi (2008) at Ibadan in Southwestern Nigeria reported similar CP, EE and ash, higher NDF (50.66%), but lower ADF (28.52%) and NFE (25.54%) as compared to the result obtained in this study. All the mineral elements analysed were significantly higher at 9 WAS compared to 21 WAS. The forage legume can meet the Ca (0.3 - 0.8%) and Mg (0.18 - 0.4%) required for growth and all productive/physiological functions of small ruminants (Rashid, 2008). The legume could also meet requirements of 0.53 - 0.67% Ca, 0.22 - 0.44% P, 0.18 - 0.21 % Mg and 11% K for lactating cows (NRC, 2001).

Table 2: Effect of different stages of growth on nutrients composition *Stylosanthes guianensis*

Parameter	Stages of growth				SEM
	9 WAS	13 WAS	17 WAS	21 WAS	
		%			
Crude protein	18.98^{a}	17.68^{b}	16.22^{c}	14.37^{d}	0.12
Crude fibre	29.42^{d}	32.60^{c}	33.59^{b}	36.86^{a}	0.13
Ether extract	2.76^{a}	2.10^{b}	1.44^{c}	1.03^{d}	0.04
ash	9.80^{a}	8.02^{b}	7.70^{c}	7.13^{d}	0.06
Nitrogenfree extract	33.55^{d}	34.20^{c}	35.68^{b}	36.82^{a}	0.19
Neutraldetergent fibre	40.29^{d}	43.41^{c}	46.85^{b}	49.44^{a}	0.32
Acid detergent fibre	30.42^{d}	33.95^{c}	36.12^{b}	39.42^{a}	0.25
		g/kg			
Calcium	12.16^{a}	11.83^{b}	10.15^{c}	9.80^{d}	0.03
Phosphorus	3.51^{a}	3.17^{b}	2.75^{c}	2.39^{d}	0.07

Magnessium	3.39[a]	3.07[b]	2.16[c]	1.54[d]	0.10
Potassium	19.54[a]	18.27[b]	17.78[c]	17.03[d]	0.04
Sodium	0.74[a]	0.53[b]	0.44[c]	0.28[d]	0.02

[abcd]means with different superscripts on the same row are significantly different

CONCLUSION

It is therefore concluded that stage of growth has influence on *Stylosanthes guianensis* DM yield and nutrient composition. The legume grown in early June on Jos Plateau should be harvested at 17 WAS when the DM yield is at maximum and crude protein content could also meet the requirements for ruminant animals.

ACKNOWLEDGEMENT

The authors are grateful to the management of Nigerian Institute for Trypanosomiasis Research, Vom, Plateau State who provided land for this research. National Animal Production Research Institute, Shika, Zaria supplied the legume seeds and Tertiary Education Trust Fund (TETFund), Nigeria funded this project.

REFERENCES

Ajayi, F.T. and Babayemi, O.J. (2008). Comparative *In-vitro* evaluation of mixtures of *Panicum maximum*cv Ntchisi with stylo (*Stylosanthes guianensis*), Lablab (*Lablab purpureus*), Centro (*Centrosema pubescens*) and Histrix (*Aeschynomene histrix*). *Livestock Research for Rural Development*, 20 (6)

A.O.A.C. (1990).*Official Method of Analysis*.15th edition. Assocition of Official Analytical Chemists. Washington DC, U.S.A. Pp. 200-210.

Heuzé, V., Tran G., Bastianelli, D., Boudon A., Lebas F. (2015). *Stylo (Stylosanthes guianensis)*. Feedipedia.org. A programme by INRA, CIRAD, AFZ and FAO. http://www.feedipedia.org/node/251.

Kiyothong, K., Satjipanon, C.and Namsilee, R. (2005). Effect of dates of closing cut on seed yield andseed quality of *Stylosanthes guianensis* CIAT 184. *Songklanakarin Journal of Science and Technology*, 25(7):183-191.

Kilcer, T. F., Ketterings, Q. M., Cherney, J. H., Cerosaletti, P., and Barney, P. (2003).Optimum stand height for forage brown midrib sorghum x sudangrass in North- eastern USA. *Journal of Agronomy and Crop Science*, 191:35-40.

Mannetje, L.'t.and Lones, R.M. (1992). Plant Resources of South-East Asia. No 4, Forage, Bogor, Indonesia

Njarui, D.M.G. and Wandera, F.P. (2004). Effect of cutting frequency onproductivity of five selected herbaceous legumes and five grasses insemi-arid tropical Kenya. *Tropical Grasslands*, 38:158-166.

NRC, Nation Research Council. (2001). *Nutrient Requirements of Dairy Cattle*. Seventh Revised Edition. Sub-committee on Dairy Cattle Nutrition Committee on Animal NutritionBoard on agriculture and Natural Resources National Research Council National Academy Press, Washington, D.C. Retrieved on 12 May, 2017 from http://www.nap.edu

Ogunbode, S. M. and Akinlade, J. A. (2012). Effect of Three Species of Stylosanthes on The Performance of West AfricanDwarf Sheep. *Fountain Journal of Natural and Applied Sciences*, (1)1: 36 - 40

Ovimaps (2014). Ovi location map: Ovi earth imagery data. Retrieved on November 3rd, 2014.

Ramírez de la Ribera, J.L., Kijora, C., Acosta, I. L., Cisneros López, M. and Tamayo S. W. (2008). Effect of age and growing season on DM yield and leaf to stem ratio of different grass species and varieties growing in Cuba. *Livestock Research for Rural Development*, (20):9

Rashid, M. (2008). Goats and their nutrition. Manitoba Agriculture, Food and Rural Initiatives Retrieved 08 July, 2017 from www.manitobagoats.ca

S.A.S. 2001. *Statistical Analysis System, Users Guide. 7th Eedition*. North Carolina,U.S.A

Tucak, M., Popović, S., Čupić, T., Španić, V., and Meglič, V. (2013). Variation in yield, forage quality and morphological traits of red clover (*Trifolium pratense* L.) breeding populations and cultivars. *Zemdirbyste-Agriculture*, 100 (1): 63–70. UDK 633.321:636.085 / DOI 10.13080/z-a.2013.100.009

Tukey, J.W. (1949). Comparing individual means in the analysis of variance. *Biometrics*, 5(2): 99-114.

Valarini, M.J. and Possenti, R.A. (2006). Research note: Nutritive value of a range of tropical forage legumes. *Tropical Grasslands,* 40:183 –187.