Effect of Fertilizer Rate and Age at Harvest on the Growth and Dry Matter Yield of *Brachiaria ruziziensis*

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ABSTRACT

The objective of this study was to investigate the influence of age at harvest and different level of nitrogen fertilizer (N: P: K 20:10:10) on the growth and dry matter yield of *Brachiaria ruziziensis*. The experiment was arranged in a 3x3 factorial experiment using split spot design making nine treatments with three replications. The main plot was the three levels of nitrogen fertilizer applied (NPK 20:10:10; 0, 100 and 200 kgN/ha) and sub plot was the three ages at harvest (3, 6, and 9 weeks after cutback [WAC]). The fertilizer was applied using broadcasting method and the harvest was done at 10 cm above the ground level. The results obtained in the study showed that the plant height was significantly ($p<0.05$) influenced by the fertilizer rate and age at harvest with the Ruzi grass at 9 WAC been the tallest (83.11 cm) and the grass to which 100 kgN/ha as well being the tallest (67.89 cm). The leaf length and leaf width were only affected by the age with the grass at 9 WAC having the longest and widest leaf. There was no significant difference in the number of leaves at the 6 and 9 WAC. The tiller density as influenced by the age ranged from 123.56 tillers/m^2 at 3 WAC to 275.56 tillers/m^2 at 9 WAC. The fertilized was significantly better than the unfertilized in terms of tiller production. The dry matter yield was affected by the age at harvest and fertilizer rate. In could be concluded that nitrogen fertilizer is essential in pasture production as it favors herbage accumulation with maturity.

(Keywords: fertilizer, grass, growth, nitrogen, yield)

INTRODUCTION

There is a projection that the human population might raise to 9.6 billion by 2050 (UN, 2013) and with this, it is expected that the global standard of living increases, making the demand for agricultural products skyrocket as well during same period (FAO, 2009) as much as 70%. Food and Agriculture Organization (FAO, 1991; 1992), recommended that an individual takes 35 g per caput of animal protein per day for sustainable growth and development from 70 g per caput of total protein.

Ruminant animals have been a major contributor to meeting this requirement especially in the tropics; this class of livestock derives their nutrition from forages which could either be natural or sown pasture. Sown pastures are known to have high carrying capacity (Dele, 2008; 2012) especially when inorganic or organic fertilizers are applied. To battle the livestock feed deficiency, the use utilization of improved forage plants or sowing of purposefully managed forages as a feed source is recommended (Dele, 2012; FAO, 2016).

Brachiaria is one of the most important forage grasses for pastures in the tropics (Singh, 2009). Brachiaria grass accepts critical parts in soil disintegration control and natural modifying. Moreover, the Brachiaria has high capacity of producing high yield when dried (Pratt and Gwynne, 1997). Extra points of interest of utilizing the Brachiaria grass in the organized procedure are that the species produce profuse roots which add to the grouping of water, soil accumulation and air circulation (Kluthcousk *et al.*, 2004).

Nitrogen is a macronutrient that partakes in the structure of several organic compounds, for example proteins and enzymes, and, consequently, have direct activity on the metabolic capacity, through the adjustment of the declaration of nucleic acids and furthermore in light of the fact that it is one of the primary segments of chlorophyll, because of this the Nitrogen accelerates the formation and development of new leaves by increasing the vigor of regrowth after defoliation (Dourado *et al.,* 2015; Da Silva *et al*., 2017) and, subsequently, can advance the improvement of the economic performance of rural properties (Zanine *et al.,* 2015).

Nitrogen is necessary for rapid growth of forage and is an essential component of plant proteins (Batista *et al.,* 2014). Nitrogen fertilizer can be effectively used to increase forage productivity in pastures, as needed (Hancock *et al.,* 2011). Nitrogen is quickly consumed into plants and development is invigorated by means of progress of root system and photosynthetic movement (Batista *et al*., 2014). Reactions of grasses to nitrogen shift as indicated by a few factors, for example, sort of Nitrogen applied, application rate and timing (Sun *et al*., 2008).

The activity of the Nitrogen in the soil and grasses can help in pasture utilization and increases the effectiveness of this nutrient, particularly realizing that the decrease of Nitrogen accessibility is a significant reason for tropical pasture degradation (Cao *et al*., 2012). Beyond the nutrient management, the frequency of cut/stage at which the grass is harvested also assumes a critical part in the pasture management process. This is based upon the premise that an increase in the plant's stage of growth increased the variability in the dry matter content, causing significant differences in the quality of the nutrient in plants (Demirel *et al*., 2011). Studies (Opsi *et al*., 2013) have definite that the cutting phase of a plant should be considered, and famers should guarantee that and increment in yield of the plant with development doesn't compromise quality. The examination was led to assess the impact of age at harvest and nitrogen rate on the growth and yield productivity of *Brachiaria ruziziensis.*

MATERIALS AND METHODS

Experimental Site

The study was carried out at the Pasture Unit, Directorate of University Farms (DUFARMS) and the laboratory of Department of Pasture and Range Management, Federal University of Agriculture, Abeokuta (FUNAAB), Ogun State Nigeria. FUNAAB is situated in the derived savanna zone of the south western Nigeria on latitude 7^{0}26'11.98"E (Google Earth, 2018).

Souring of Fertilizer and Application

NPK 20:10:10 fertilizer was used as the fertilizer source in this study and was sourced from a reputable agro-allied store located within Abeokuta metropolis. Two weeks after cut back, the fertilizer was applied at dosages of 0, 100 and 200 kgN/ha to the soil surface of each plot.

Planting Source

Brachiaria ruziziensis from already established pasture source will be cut back to 10cm above the ground level to maintain uniformity. The plant will be allowed to re-generate for two weeks under full sunlight after cut back before been shaded.

Experimental Design

The research was carried out as a 3 × 3 factorial experiment carried out in a split plot design. This consist of 3 nitrogen rates (0, 100, and 200 kg N/ha) as the main plot and 3 Age at harvest (3, 6, and 9 weeks after cutback) as the sub plot.

The grasses were harvested at 3, 6, and 9 weeks after cutback using a 0.5 × 0.5 m quadrat. In each quadrat area samples, the above ground vegetative plant material will be harvested from 10 cm above ground level using a sickle. Following harvesting, the fresh weight will be recorded and sub-samples of the harvested herbage mass was oven dried at 65^{o}C until constant weight is attained to obtain the dry matter percentage.

Data Collection

Agronomy Data: Collection of data was done 3, 6 and 9 WAC

Tillers number, plant height, leaf number, leaf length, leaf width: The tillers number was determined by counting the number of tillers that falls within the quadrant and used for data analysis. The plant height was determined by taking the measurement of plant from the deck to the tip of the plant using a meter rule. The leaf number was determine by counting the number of leave per stand and the leaf length was determine by taking the measurement of the leaf from the ligule to the tip of the leaf using measuring tape while leaf width is estimated by leaf area as a function of length × width.

Estimation of Total Yield

The estimation of total dry matter yield will be laid out by harvesting the forage materials within a 0.5 m × 0.5 m quadrat. The dry matter percentage will be estimated as:

Dry matter percentage = Weight of dry sample/weight of fresh sample x 100

While dry matter yield will be estimated as:

Dry matter yield = dry matter percent x total fresh sample from 1 m^2.

This will be extrapolated in tonnes per hectare, while dry matter yield will be estimated as:

Dry matter yield = dry matter percent x total fresh sample from 1 m^2.

This will be extrapolated in tones per hectare.

RESULTS AND DISCUSSION

Figure 1: Shows there was notable difference ($p<0.05$) in plant height *of B. ruziziensis* between 3 weeks after cut back (31.06 cm) and 6 weeks after cut back (81.06 cm), while there was no significant difference in plant height between 6 and 9 weeks after cut back (83.11cm). According to Wassie *et al.* (2018) and Adnew *et al*. (2019) there was significant difference in plant height as plant age increases. The increment in Plant height at last stage with progression in harvesting age in all plots might be due to full development of stem and leaf. This result is in agreement with Asmare *et al*. (2017) and Taye *et al.* (2007) who revealed similar qualities for Desho and Napier grass, respectively.

The plant fertilized with 100kgN/ha and 200kgN/ha fertilizer rate had the highest plant height (67.88cm and 67.0cm) which was significantly different from the unfertilized 0kgN/ha (60.33cm) with the lowest height. This is in line with the findings of Ahmed Safiyanu Abdullahi (2011), Marco *et al.* (2012) which indicate that plant height increases significantly with an increase in fertilizer rate level.

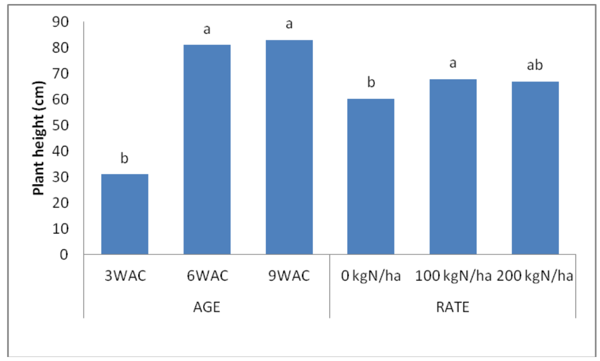

Figure 1: Effect of Age at Harvest and Fertilizer Rate on the Plant Height of Ruzi Grass.

There was notable difference ($p<0.05$) in the leaf length for 3, 6, and 9 weeks after cut back respectively (Figure 2). The leaf length for 9 weeks after cut back has the height value (30.764cm) followed by 6 weeks after cut back (25.183cm) while the 3 weeks after cut back has the lowest value (18.994cm) of leaf length of *B. ruziziensis*. This show that there is increment in *B. ruziziensis* leaf length as plant age increases. According to Genet *et al.* (2017) there was significant difference in leaf length as plant age increase. Leaf length in grasses it plays an essential role in shaping the physical structure of the grass canopy and consequently on competition for light within the sward (Adnew *et al.,* 2019).

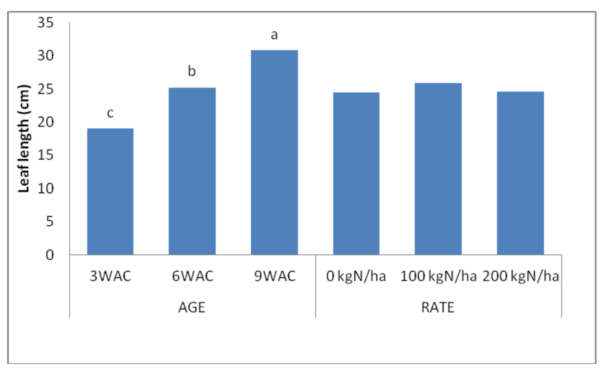

Figure 2: Effect of Age at Harvest and Fertilizer Rate on the Leaf Length of Ruzi Grass.

Fertilizer rate has no significant difference ($p> 0.05$) for 0kgN/ha, 100kgN/ha and 200kgN/ha respectively in leaf length of B. *ruziziensis.* This is in contraction against Ahmed Safiyanu Abdullahi (2011) which reported that with an increase in the level of fertilizer rate, leaf length was significantly affected.

Plant age show there was notable differentiation ($p<0.05$) in *B. ruziziensis* leaf width for 3, 6, and 9 weeks (1.17cm, 1.86cm, and 20.3cm) after cut back, respectively (Figure 3). Ahmed Safiyanu Abdullahi (2011) and Sema *et al.* (2019) recorded there was significant difference in leaf width as plant age differs. The Extent of Specific Leaves is significantly influenced by plant growth phase. Gusmayant *et al.* (2015) while leaf width is not affected by fertilizer rate Where there was no significant difference in 0kgN/ha, 100kgN/ha and 200kgN/ha (1.63cm, 1.69cm and 1.73cm) of *B. ruziziensis,* respectively, which is in line with the research of Ahmed Safiyanu Abdullahi (2011).

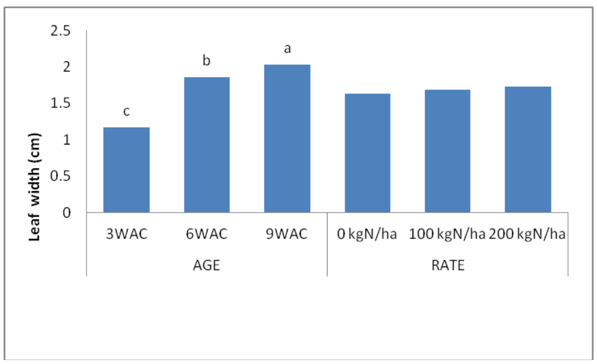

Figure 3: Effect of Age at Harvest and Fertilizer Rate on the Leaf width of Ruzi Grass.

Figure 4 show there was significant differences ($p<0.05$) in the leaf number of 3 weeks (3.83) after cut back compared to 6 and 9 weeks after cut back, the graph shows there was no significant difference in 6 and 9 weeks (5.56 and 5.11) after cutback this is in line with the research of Wubetie *et al.* (2018) harvesting age have significant effect on the leaf number. There was no significant difference in leaf number as affected by fertilizer rate applied to *B. ruziziensis* , although there is a slight difference in leaf number numerically of 0kgN/ha, 100kgN/ha, and 200kgN/ha (4.72, 5.22, and 4.55), respectively. Ahmed Safiyanu Abdullahi (2011) also reported similar result concluding that number of leave was not affected significantly by fertilizer rate.

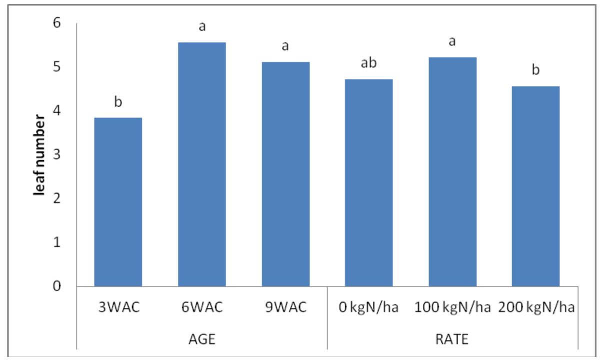

Figure 4: Effect of Age at Harvest and Fertilizer Rate on the Number of Leaves of Ruzi Grass.

Figure 5 showed that there were significant differences ($p<0.05$) in tiller density for 3, 6, and 9 weeks after cutback re., 3 weeks (30.89) had the lowest number of tiller density followed by 6 weeks (45.72), while 9 weeks (68.889) had the highest number of tiller density. This is in line with Adnew *et al*. (2019) The number of tillers per plant in studied grasses were significantly ($P<0.05$) increased in relation to the advance in harvesting age of plant as the result of the development of new shoot bearing on each plant result in higher number of tiller as the plant matures.

Fertilizer rate was significantly different in tiller density for 0kgN/ha compared to 100kgN/ha and 200kgN/ha. The graph shows that 100kgN/ha and 200kgN/ha had the highest tiller density. The *B. ruziziensis* grass show that when nitrogen was lacking, the growth of tillers was reduced, but when nitrogen was added the tiller number increased. In collation with the research of Karina *et al*. (2014) which shows that there was inhibited in tiller number when nitrogen was deficient.

In Figure 6, there was notable differentiation ($p<0.05$) in the leaf stem ratio of *B. ruziziensis* for 3, 6, and 9 weeks age at harvest respectively; 3 weeks have the highest leaf stem ratio with the value (2.89) followed by 6 weeks age at harvest (2.17) and 9 weeks age at harvest (1.19), the stem ratio increases as the week increases. At 9 weeks of harvest, there was reduction in leaf and stem ratio. This was in agreement with Ramirez *et al.* (2008), Solomon and Beemnet (2011) and by Beemnet *et al*. (2011) where they reported that leaf to stem ratio decreased with higher maturity.

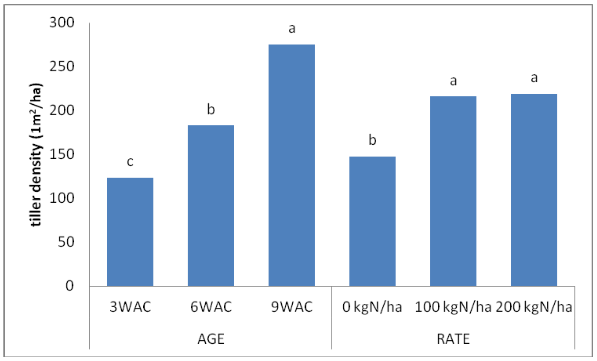

Figure 5: Effect of Age at Harvest and Fertilizer Rate on the Tiller Density of Ruzi Grass.

Batista *et al.* (2014), the leaf/stem ratio in the growth of the Ruzi grass did not exhibit differences between the absence of fertilization and the application of fertilizer. The absence of contrasts in leaf/stem proportion is brought about by speeding up in the development rate with reaction regarding herbage aggregation, described by the corresponding increment of leaves and stems in the herbage mass (Pereira *et al.,* 2010).

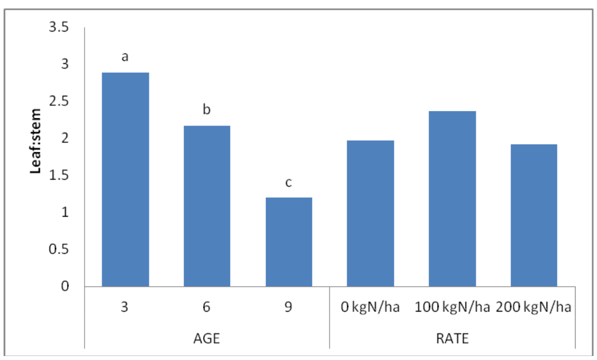

Figure 6: Effect of Age at Harvest and Fertilizer Rate on the Leaf:Stem Ratio of Ruzi Grass.

Figure 7 showed that there was notable differentiation ($p<0.05$) in the dry matter yield of *B. ruziziensis* for 3, 6, and 9 weeks of age at harvest, respectively, the 9 weeks have the height DM yield value (3.96 tons/ha) followed by 6 weeks (2.07 tons/ha) while the 3 weeks have the lowest DM yield (0.83 tons/ha). While there was notable contrast ($p<0.05$) in dry matter yield of *B. ruziziensis* between unfertilized plant and fertilized plant, the graph shows there in increase in yield of *B. ruziziensis* when N fertilizer is added to the plant, although there was no significant difference in plant yield between 100kgN/ha and 200kgN/ha of *B. ruziziensis*. Unfertilized plant have the lowest value (1.96tons/ha) while 100 and 200kg N/ha have 2.42 tons/ha and 2.48 tons/ha respectively. The observed DM yield at the end of the harvesting period was in concurrence with research of Hare *et al.* (2013), Njarui *et al.* (2004) and Ondiko *et al.* (2016) on Brachairia grasses in various countries. Researchers indicate that the time of harvesting has higher influence on the dry matter yield.

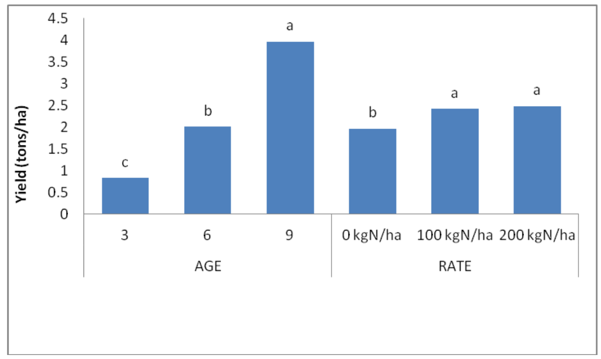

Figure 7: Effect of Age at Harvest and Fertilizer Rate on the Dry Matter Yield of Ruzi Grass.

CONCLUSION

The fertilizer rate of 100kgN/ha and 200kgN/ha applied to the *Brachairia* grass enhance increase in the tiller density plant height and dry matter yield. Also the harvesting age affect the plant height, leave number, leaf width, tiller density, leaf length, yield and leaf stem ratio.

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