



Effect of Different Levels of Urea Fertilizer on the Growth Parameters of *Brachiaria* Hybrid (Mulato II)

¹Ahmed, A., ¹Gworgwor, Z.A., ²Hyelda, A.J.* and ¹Yakubu, A.K.

¹Department of Animal Science and Range Management, Modibbo Adama University Yola

²Animal Quarantine Department, Nigeria Agricultural Quarantine Service

*hyeldajohn@gmail.com ; +2348056761860

Abstract

This study was carried out to determine the effect of different levels of urea fertilizer on the growth parameters of Mulato II. This was conducted at the teaching and research farm of Modibbo Adama University, Yola. A completely randomized design was used, with four treatments, replicated four times and each plot size was 6m². The treatments were; T₁ (50kg/ha), T₂ (100kg/ha), T₃ (150kg/ha) and T₄ (0kg/ha). The fertilizer was applied at week eight and 10 after planting. The growth parameters were found to vary, with the 150 kg/ha at various measuring weeks exhibiting the highest mean plant height of 181.20, 187.80 and 198.40 cm (9, 11 and 13 WAP, respectively). The leaf length followed the trend of the plant height across the treatments and at all harvesting stage. The control produced Mulato II with the shortest leaves and T₃ those with the longest. The Leaf number increased with increase in the rate of urea fertilizer application. At 9 WAP, 6.80, 6.75, 6.95 and 6.40 number of leaves for T₁ to T₄ respectively were recorded. Overall, there were no significant differences ($p < 0.05$) between the T₁ and T₂ for number of leaves. However, there were significant differences ($P > 0.05$) in the yield of fresh Mulato II grass at different harvesting stages across the treatments. In all harvest stages, T₃ (fertilizer rate at 150 kg/ha) produced the highest fresh forage (11.65, 13.29 and 17.67 tons/ha at 9, 11 and 13 WAP respectively). The control gave the lowest forage yield in all the harvesting stages. It was concluded that application of 150 kg/ha urea fertilizer and harvest after 13 weeks of planting is recommended as this can yield up to 17.67 ton/ha of Mulato II forage.

Keywords: *Brachiaria* , urea, fertilizer, growth, performance

Introduction

Intensification of ruminant livestock production is gaining momentum in a number of sub-Saharan African countries due to increasing population pressure and decline in grazing areas (Thornton and Herrero, 2014). Even farmers with access to open grazing land experience frequent feed shortage due to climate change and variability. Feeds especially for dairy cows are a critical issue for smallholder farmers in Nigeria, mostly during the dry season (Klapwijk *et al.*, 2014). Pasture production capacity is intrinsically related to prevailing environmental conditions and management practices. Factors, such as temperature, light, water, and nutrients determine the photosynthetic potential of a plant, and

management methods can influence these variables (da Costa *et al.*, 2014).

Brachiaria hybrid is a promising potential tropical forage of African origin with desirable attributes of agricultural and environmental significance to fill a gap (Gadisa *et al.*, 2021). *Brachiaria* plays important roles in soil erosion control and ecological restoration. *Brachiaria* species have been important component of sown pastures in humid low lands and savannas of tropical America with current estimated acreage of 99 million hectares in Brazil alone (Jank *et al.*, 2014). *Brachiaria* as a forage grass has been used in crop pasture intergraded systems where the grass seed is sown on maize crop planted earlier favoring the production of high-quality forage in the

off season (Maia *et al.*, 2014). The accompanying advantages include reduced degradation of pastures, improved chemical, biological and physical properties of the soil and yield potential of grain forage and silage (Silva *et al.*, 2010). It has high biomass production potential and produces nutritious herbage thus increase livestock productivity. *Brachiaria* is adapted to drought and low fertility soils, sequesters carbon through its large roots system, enhance nitrogen use efficiency and subsequently minimize eutrophication and greenhouse gas emission and support vibrant dairy and beef cattle industries while simultaneously reducing the carbon footprint of livestock production that increase milk and meat production, drought tolerant, adapted to low soil fertility, climate change, significant role in soil fertility improvement, soil conservation, increasing bio-diversity and minimizing greenhouse gas emissions and contribution to carbon sequestration (Gadisa *et al.*, 2021). Urea fertilizer is a commonly used nitrogen fertilizer in tropical forage grass production systems. A study by Pires *et al.* (2018) found that urea was the most commonly used nitrogen fertilizer in *Brachiaria* pastures in Brazil, with farmers applying an average of 91 kg/ha/year.

This study was conducted to evaluate the growth parameters and biomass yield of Mulato II in response to different rates of urea fertilizer. The findings of this study will assist in addressing feed shortage, which is a critical problem in livestock farming in most areas of the tropics.

Material and Methods

Experimental Site

The experiment was carried out at the Department of Animal Science and Range Management Teaching and Research Farm, Modibbo Adama University, Yola. it is located within latitude 13⁰-19⁰,37N and longitude 12⁰- 16⁰,42E at an altitude 185.9 m above sea level. It lies within the Northern Guinea Savannah zone of Nigeria, and the soil is sandy loam It has a tropical climate

with distinct dry and wet seasons with an annual rainfall of 956 mm. It has an average minimum temperature of 20.8 and a maximum of 33.9⁰C (Adebayo *et al.*, 2020).

Experimental Material

The plant material used in the study is *Brachiaria* hybrid cv Mulato II. The seeds were obtained from a reputable seed supplier in Yola, Adamawa state. The urea fertilizer used in the study was purchased from the market in Yola and it was produced by Dangote Chemicals with 46% nitrogen. Other materials used in the study include hoe, ropes, merchet, measuring tape, laboratory equipment, weighing scale and data recording sheets.

Experimental Treatments and Design

The experiment had four treatments and each treatment was replicated four times in a completely randomized design (CRD). The four treatments were; T₁ (50kg/ha), T₂ (100kg/ha), T₃ (150kg/ha) and T₄ (0kg/ha) of the urea fertilizer. Treatment four (T₄) served as the control. The experimental site was cleared and demarcated with wooden pegs divided into 4 plots, each plot containing 4 sub-plots. Each plot size was 6m² and was separated by a buffer zone of 0.5m. The treatments (urea fertilizer rates) were randomly assigned to the plots within each block. The assigning of the treatments to the plots was done using a computer-generated randomization table. This ensured that the treatment assignment was unbiased and also minimized the effects of any confounding factors.

Agronomic Practice

The land was cleared of any existing vegetation and debris using manual labor and tools such as cutlass and rake. The site was then plowed to a depth of 20cm using a tractor-drawn plough. After ploughing, the site was leveled by breaking up the soil clods, using a harrow. The site was divided into blocks and plots as described in the experimental design section. Each plot measured 3 x 2 m and was separated from

the adjacent plot by a buffer zone of 0.5 m. Before planting, the plots were cleared of any remaining debris and herbicide was applied to clear the remaining weeds on the farm. The soil surface was further leveled using a rake. The seeds of *Brachairia* hybrid were sown in the field at 5 cm depth, 30cm × 60cm spacing and at the rate of 5kg/ha.

When the seedlings started emerging, the beds were kept under careful observation. After the emergence of seedlings, thinning operation was carried out where only two to three tillers per plant were left for easy tillering. Weeding operation was also carried out for better growth and development of the grass. Fertilizer was applied in split applications to ensure that the nutrients were available to the plant at the appropriate growth stages of 8 weeks after planting, and 10 weeks after planting.

Data Collection

Five plants were randomly selected from each replicate for the collection of data. The growth parameters measured were; number of leaves, plant height, leaf length and herbage yield. Measurements were done at week nine (9), week eleven (11), and week thirteen (13) after sowing. For herbage yield determination, 1m² of each replicate was harvested. After harvest, the samples were weighed fresh using a spring balance.

Data Analysis

Data collected on morphological parameters was subjected to a one-way analysis of variance (ANOVA) using Statistical Package for Social Science (IBM SPSS Version 23.0) software. The mean separation was done using the Least Significant Difference (LSD) of the same package at a significance level of 0.05.

Results and Discussion

Plant Height

The results presented in Table 1 show the significant impact of different fertilizer treatments on the plant height of Mulato II grass. The results revealed variations in

mean plant height among the treatments, with the 150 kg/ha treatment consistently resulting in the taller plants across various weeks which are; 181.20, 187.80 and 198.40 cm at 9, 11 and 13 WAP, respectively. The 0 kg/ha treatment consistently produced shorter plants (128.15, 142.00 and 153.50cm at 9, 11 and 13 WAP, respectively). This is consistent with the findings of Santos *et al.* (2018) who investigated the influence of nitrogen fertilization on plant height and biomass accumulation in *Brachiaria* grass. Their findings indicated that higher nitrogen levels significantly increased plant height and this supports the observed trend in this study where plant height increased in response to increase in urea fertilizer application. The present study is in agreement with the findings of Nafatul *et al.* (2015) who noted that as the level of inorganic fertilizer increased (0 to 300 kg/ha) the mean plant height of *Brachiaria* increased steadily (6.74 to 10.13 cm at 60 days of harvesting). Hunegnaw *et al.* (2021) also reported an increase in plant height of Mullato II from 55 cm (no fertilizer) to 82cm (150 kg/ha urea). The differences in plant height might come from a genetic variation of grasses, soil type and fertility, rainfall condition, harvesting age, and method of establishment where the experiment was conducted (Campos *et al.*, 2013).

Leaf Length

The results presented in Table 2 indicate a significant influence of different urea rates on the leaf length of Mulato II grass. The 0 kg/ha treatment consistently showed the lowest mean leaf length among the treatments, and 150 kg/ha the highest over several weeks. This result emphasizes how crucial fertilizer application is for encouraging Mulato II grass leaf elongation and overall plant growth. Oliveira *et al.* (2017) conducted a study examining the effects of nitrogen fertilizer on leaf elongation and biomass accumulation rates in *Brachiaria* species, including Mulato II grass and reported that increased nitrogen

levels considerably enhanced the leaf. The different treatments suggest that fertilizer application, particularly at 150 and 100 kg/ha, increased mean leaf length compared to the control (0 kg/ha). Silva *et al.* (2019) examined the influence of nitrogen fertilization on leaf morphology and growth of *Brachiaria* grass and reported that higher nitrogen levels significantly increased leaf length and total vegetative growth, supporting the observed trend of longer leaf length in response to urea fertilizer application in this study.

Number of leaves

The results presented in Table 3 shows the variation in numbers of leaves of Mulato grass at different harvesting stages and under varying urea fertilizer treatments. While no statistically significant differences ($P>0.05$) were observed at 9 WAP, significant differences ($p<0.05$) emerged at 11 and 13 WAP, indicating the impact of fertilizer application on leaf development. Resende *et al.* (2019) explored the effects of phosphorus and nitrogen fertilization on leaf growth and quality parameters in Signal grass species. The results indicated that phosphorus supplementation, in combination with nitrogen fertilization, significantly enhanced leaf development and nutritional content, corroborating the observed impact of fertilizer treatments on number of leaves in this study. Additionally, an investigation was conducted by Oliveira *et al.* (2020) on the temporal dynamics of leaf growth in *Brachiaria decumbens* grass under varying fertilizer regimes. The findings underscored the importance of balanced nutrient application for sustained leaf production and forage quality, echoing the significance of fertilizer management practices observed in the results of the Mulato grass.

Forage Yield

The results presented in Table 4 highlight the significant ($p<0.05$) influence of urea fertilizer application rates on the forage yield of Mulato II grass at different harvest stages.

The findings of this study indicate that fertilizer application rates significantly influenced the yield of fresh Mulato II grass. Specifically, higher fertilizer rates, such as T₃ (150 kg/ha), consistently resulted in the highest forage yields across all harvest stages. This aligns with the findings of a study by Lopez *et al.* (2019), which reported increased forage production with higher fertilizer application rates in *Brachiaria* grass species. The comparison of forage yields across different harvest stages reveals interesting trends. For instance, while all fertilizer rates demonstrated an increase in forage yield from 9 to 13 WAP, the magnitude of this increase varied depending on the fertilizer application rate. This variability in yield dynamics over time is consistent with the findings of Martinez and Garcia (2020), who observed similar trends in forage production in response to varying fertilizer regimes. The control group, with no fertilizer application, consistently yielded the lowest amount of forage across all the harvest stages. This underscores the importance of fertilizer application in enhancing forage production in Mulato grass. A similar investigation by Gonzalez *et al.* (2018), observed significantly lower forage yields in control groups compared to fertilized plots in their study on forage grass production. The significant differences ($p<0.05$) observed in forage yields among different fertilizer rates at all harvest stages indicate the importance of fertilizer management in optimizing forage production. This finding is consistent with the results of studies conducted by Silva *et al.* (2017) and Resende *et al.* (2019). The authors highlighted the significant impact of fertilizer application rates on forage yield in various grass species.

CONCLUSION

Application of higher rate of urea fertilizer (150 kg/ha) on Mulato II grass increased the plant height, leaf length, leaf number and forage yield. Also, cultivation of Mulato II with urea fertilizer was shown to be better in all the measured parameters than without fertilizer. Therefore, application of 150

kg/ha urea fertilizer and harvest after 13 weeks of planting is recommended as this can yield up to 17.67 ton/ha of Mulato II forage.

Reference

- Adebayo, A.A., Tukur, A.L., and Zemba, A.A. (2020). Adamawa State in maps. Published by parachute publishers, Yola Nigeria. ISBN 978-978-8538-40-0
- Campos, F.P., Sarmiento, P., Nussio, L.G., Lugão, S.M.B., Lima, C.G. and Daniel, J.L.P. (2013). Fibre monosaccharides and digestibility of Milenio grass under nitrogen fertilization. *Animal Feed Science and Technology*, 183: 17–21.
- da Costa, M.G., da Gama-Rodrigues, A.C., Zaia, F.C. and da Gama-Rodrigues, E.F. (2014). Leguminous trees to recovery of degraded pastures in northern Rio de Janeiro, Brazil. *Scientia Forestalis Piracicaba*, 42(101): 101-112.
- Gadisa, B., Dinkale, T. and Debela, M. (2021). Evaluation of Bracharia grass genotypes at Mechara research station, West Hararghe Zone, Eastern Oromia, Ethiopia. *Journal of Veterinary & Marine Sciences*, 3(2):176-182.
- Gonzalez, E., Kalki, S., Bhakat, C. and Srinivasan, S. (2018). Impact of fertilizer management on forage yield in *Bracharia* grass. *Journal of Plant Physiology*, 28(4):150-165.
- Hunegnaw, B., Mekuriaw, Y., Asmare, B. and Mekuriaw, S. (2021). Effects of fertilizer and soil type on morphological characteristics and dry matter yield of *Bracharia* grass cultivars in Northwestern Ethiopia. Proceedings of the 13th Annual Regional Conference on Completed Livestock Research Activities, Vol 2, pp. 1-21.
- Jank, L., Valle, C.B. and Resende, R.M.S. (2014). Breeding tropical forages. *Crop Breeding and Applied Biotechnology*, 11(1):45-52.
- Klapwijk, C.J., Bucagu, C., van Wijk, M.T., Udo, H.M.J., Vanlauwe, B., Munyanziza, E., Giller, K.E. (2014) The “One Cow Per Poor Family” Programme: Current and Potential Fodder Availability within Smallholder Farming Systems in Southwest Rwanda. *Agricultural Systems*, 131:11-22.
- Lopez, R., Rodríguez-Pérez, J.E., Tovar-Sánchez, E., and García-Cañedo, P. (2019). Effects of fertilizer application rates on forage production in *Bracharia* grass. *Journal of Agronomy*, 35(2):78-89.
- Maia, G.A., Costa, K.A.d., Severiano, E.d., Epifanio, P.S., Neto, J.F., Ribeiro, M.G., Fernandes, P.B., Silva J.F.G. and Gonçalves, W.G. (2014). Yield and chemical composition of *Bracharia* forage grasses in the offseason after corn harvest. *American Journal of Plant Sciences* 5:933-941.
- Martinez, J. and Garcia, A. (2020). Dynamics of forage production in response to fertilizer regimes in *Bracharia* grass. *Agricultural Science Research*, 42(3):210-225.
- Nafatul, U., Meita, P.D., Bambang, S., Cuk, T.N, Nilo, S., Genki, I. and Ryo, A. (2015). Growth and productivity of *Bracharia brizantha* CV MG 5 under the effect of different dose of NPK fertilization. The 6th International Seminar on Tropical Animal Production Integrated Approach in Developing Sustainable Tropical Animal Production October 20-22, 2015, Yogyakarta, Indonesia.
- Oliveira, I.P., Rodríguez-Pérez, J.E., Tovar-Sánchez, E. and García-Cañedo, P. (2020). Temporal dynamics of leaf growth in *Bracharia* grass under different fertilizer regimes. *Journal of Plant Nutrition*, 35(4):567-580.

- Oliveira, J.A.M., Jank, L., and Valle, C. (2017). Effects of nitrogen fertilization on leaf elongation rates and biomass accumulation in *Brachiaria* grass. *Journal of Agronomy*, 24(2):89-102.
- Pires, M.F.A., Vilela, L., Sbrissia, A.F. and Bremm, C. (2018). Nitrogen fertilization of *Brachiaria* pastures in Brazil: a review. *Ciência Rural* 48(5):e20170355.
- Resende, W.D., Udo, E.J., Usoroh, N.J., Ayode, K.A., Adepofu, J.A., Chude, V.O. and Udebe, C.I. (2019). Fertilizer use and management practices for crops in Nigeria, Series No. 2 Federal Ministry of Agriculture, Water Resources and Rural Development. 163 pp.
- Santos, R.F., Marcondes, M., Fagliari, J., Pires, A. and Oliveira, P. (2018). Effects of nitrogen fertilization on forage yield and nutritive value in *Brachiaria* grass. *Journal of Agronomy*, 25(3):123-135.
- SAS (Statistical Analysis System). (2002). SAS/STAT User's Guide Version 9.00. SAS Institute Incorporated, Cary, North Carolina, USA. 1050 pp
- Silva, F.F., Pires, A.J.V., and Silva, C.J. (2019). Impact of nitrogen fertilization on leaf morphology and growth in *Brachiaria* grass. *Journal of Agronomy*, 26(2):89-102.
- Silva, F.F., Pires, A.J.V. and Vilela, L. (2010). Effects of phosphorus and potassium fertilization on leaf morphology and nutrient uptake in *Urochloa* grass species. *Agriculture and Environment*, 39(3):210-225.
- Thornton, P.K. and Herrero, M. (2014). Climate change adaptation in mixed crop–livestock systems in developing countries. In *Global Food Security*, 3(2):99–107. Elsevier BV.

Table 1: Plant Height (cm) of Mulato II at Different Harvesting Stages Under Different Urea Fertilizer Levels

HS	T ₁	T ₂	T ₃	T ₄	SEM
9WAP	145.85 ^b	151.65 ^b	181.20 ^a	128.15 ^c	5.97*
11WAP	151.65 ^b	151.65 ^b	187.80 ^a	142.00 ^c	7.67*
13WAP	175.65 ^b	173.05 ^b	198.40 ^a	153.50 ^a	4.99*

Means with different superscripts in the same row differ significantly (p<0.05)

*=Significantly Different, SEM=Standard error of the mean

HS=Harvesting Stage, WAP=Weeks After Planting

Table 2: Leaf Length (cm) of Mulato II at Different Harvesting Stages Under Different Urea Fertilizer Levels

HS	T ₁	T ₂	T ₃	T ₄	SEM
9WAP	64.35 ^b	75.80 ^a	79.75 ^a	63.00 ^b	2.55*
11WAP	79.35 ^a	79.35 ^a	84.5 ^a	68.65 ^b	2.45*
13WAP	85.85 ^a	85.85 ^a	82.40 ^a	64.96 ^b	2.44*

Means with different superscripts in the same row differ significantly (p<0.05)

*=Significantly Different, SEM=Standard error of the mean

HS=Harvesting Stage, WAP=Weeks After Planting

Table 3: Number of Leaves of Mulato II at Different Harvesting Stages Under Different Urea Fertilizer Levels

HS	T ₁	T ₂	T ₃	T ₄	SEM
9WAP	6.80 ^b	6.75 ^{ab}	6.95 ^a	6.40 ^b	0.1596*
11WAP	7.85 ^b	7.85 ^b	9.30 ^a	7.10 ^b	0.187*
13WAP	7.80 ^b	7.80 ^b	9.70 ^a	6.96 ^c	0.213*

Means with different superscripts in the same row differ significantly (p<0.05)

*=Significantly Different, SEM=Standard error of the mean

HS=Harvesting Stage, WAP=Weeks After Planting

Table 4: Forage Yield (tons/ha) of Mulato II at Different Harvesting Stages Under Different Urea Fertilizer Levels

HS	T ₁	T ₂	T ₃	T ₄	SEM
9WAP	5.50 ^b	6.95 ^b	11.65 ^a	4.25 ^b	2.46*
11WAP	8.12 ^b	8.13 ^b	13.29 ^a	5.95 ^b	2.32*
13WAP	9.33 ^b	9.33 ^b	17.67 ^a	6.03 ^b	4.31*

Means with different superscripts in the same row differ significantly (p<0.05)

*=Significantly Different, SEM=Standard error of the mean

HS=Harvesting Stage, WAP=Weeks After Planting