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Research Article

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

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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 done 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 6m^2. The treatments were; T_1 (50kg/ha), T_2 (100kg/ha), T_3 (150kg/ha) and T_4 (0kg/ha). The fertilizer was applied at week eight and 10 after planting. The growth parameters were found to vary, with the 150kg/ha at various measuring weeks exhibiting the highest mean plant height of 181.20, 187.80 and 198.40cm (9, 11 and 13 WAP respectively). The leaf length followed the trend of the plant height across the treatments and in all harvesting stage. The control produced Mulato II with the shortest leaves and T_3 produced grasses with the longest leaves. The Leaf number increased with increase in the rate of urea fertilizer. At 9 WAP, 6.80, 6.75, 6.95 and 6.40 number of leaves for T_1 to T_4 respectively were recorded. Overall, there were no significant differences ($p<0.05$) between the T_1 and T_2 for number of leaves. 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, T_3 (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 150kg/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

1. 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 [20]. 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 in Nigeria, mostly during the dry season [8]. Pasture production capacity is intrinsically related to

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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 [3].

Brachiaria hybrid has promising potential tropical forage of African origin with desirable attributes of agricultural and environmental significance to fill gap [4]. Bracharia 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 [7]. Brachiaria as a forage grass has been used in crop pasture intergraded systems where the grass seed is over sown on maize crop planted earlier favoring the production of high-quality forage in the off season [10]. 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 [19]. 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 [4]. Urea fertilizer is a commonly used nitrogen fertilizer in tropical forage grass production systems. A study by [17] 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 in order 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.

2. Material and Methods

2.1. 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 13°-19°, 37N and longitude 12° - 16°, 42E at an altitude 185.9m above sea level it lies within the Northern Guinea Savannah zone of Nigeria, and the soil is sandy loam; it has a tropical type of climate with distinct dry and wet seasons with an annual rainfall of 956mm. It has an average minimum temperature of 20.8°C and a maximum of 33.9°C [1].

2.2. Experimental Material

The plant material used in the study is *Brichairia* 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.

2.3. 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; T_1 (50kg/ha), T_2 (100kg/ha), T_3 (150kg/ha) and T_4 (0kg/ha) of the urea fertilizer. Treatment four (T_4) 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 6m^2 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.

2.4. 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 3m x 2m 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 5cm deep, 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.

2.5. 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, $1m^2$ of each replicate was harvested. After harvest, the samples were weighed fresh using a spring balance.

2.6. Data Analysis

Data collected on morphological parameters was analyze using a one-way analysis of variance (ANOVA) using Statistical Analysis System (SAS 9.0) software [15]. The mean separation was done using the Least Significant Difference (LSD) of the same package at a significance level of 0.05.

3. Results and Discussion

3.1. Plant Height

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

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 150kg/ha treatment consistently resulting in the tallest plants across various weeks which are; 181.20, 187.80 and 198.40cm at 9 WAP, 11 WAP and 13 WAP respectively. The 0kg/ha treatment consistently produced the shortest plants (128.15, 142.00 and 153.50cm at week 9, 11 and 13 WAP respectively). This is consistent with the findings of an investigation conducted by Santos et al. [17] 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. [11] who noted that as the level of inorganic fertilizer increased (0 to 150 to 300 kg/ha) the mean plant height of Brachiaria increased steadily (6.74 to 7.86 to 10.13cm respectively at 60 days of harvesting age). Hunegnaw et al. [6] also reported an increase in plant height of Mullato II from 55cm (no fertilizer) to 82cm (150kg/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 the establishment where the experiment was conducted [2].

3.2. 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 0kg/ha treatment consistently shows the lowest mean leaf length among the treatments, while the 150kg/ha treatment consistently shows the highest mean leaf length 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. [13] conducted a study examining the effects of nitrogen fertilizer on leaf elongation and biomass accumulation rates in Brachiaria species, including Mulato II grass. Their findings showed that increased nitrogen levels considerably enhanced the leaf. The different treatment methods suggest that fertilizer application, particularly at 150 kg/ha and 100 kg/ha, increase mean leaf length compared to the control treatment (0 kg/ha). [16] examined the influence of nitrogen fertilization on the leaf morphology and growth of Brachiaria grass. The results showed 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.

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

3.3. 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. [14] 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 [12] 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.

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}	6.95a	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

3.4. Forage Yield

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

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 influence the yield of fresh Mulato II grass. Specifically, higher fertilizer rates, such as T_3 (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. [9], 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 [18], 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. [5], 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 [17] and [14]. They have highlighted the significant impact of fertilizer application rates on forage yield in various grass species.

4. 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 has shown to be better in all the measured parameters than without fertilizer. Therefore, application of 150kg/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.

Abbreviations

SEM	Standard Error of the Mean
HS	Harvesting Stage
WAP	Weeks After Planting

Conflicts of Interest

The authors declare no conflicts of interest.

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