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Research Article

Productivity of Brs Zuri Grass Subjected to Nitrogen Fertilization

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Abstract

Nitrogen (N) is the main nutrient for maintaining the productivity of forage grasses. The objective of this work was to evaluate the effect of different doses of N on BRS Zuri grass. The experiment was conducted in the area of the University Unit of Palmeiras de Goiás, located in Palmeiras de Goiás - GO. In a factorial scheme, randomized block design (DBC), containing 5 treatments and 4 replications, totaling 20 plots of 2x3m, 6m^2. The doses of N used in the treatments were: Treatment (T1) control. Treatment (T2) 200 kg of N ha^{-1}. Treatment (T3) 400 kg of N ha^{-1}. Treatment (T4) 600 kg of N ha^{-1} and Treatment (T5) 800 kg of N ha^{-1}. Fertilization was carried out at the time of planting and only one cut was performed during the rainy season, after 90 days of planting and plant height (AP), fresh mass production (PMF), dry mass production (PMS), capacity forage support (CSF) and nitrogen utilization efficiency (EUN) as a function of applied nitrogen rates. Only the variable nitrogen utilization efficiency (EUN) showed a statistical difference. Nitrogen efficiency is inversely proportional to the nitrogen doses applied and the maximum efficiency was obtained at the dose of 200 kg of N ha^{-1}. Intermediate doses used in this test should be tested to evaluate the behavior of the BRS Zuri forage..

Keywords: *Megathyrsus Maximum*; Nitrogen; Forage Production

Introduction

Forages are the primary source of food, essential and fundamental for the production of cattle herds, due to their low cost and practicality in production, becoming a more economical and viable means. Thus, most of the time, the low productivity of animals is related to the lack of nutrients in a large part of Brazilian pastures. The use of technologies has become essential as it intensifies and improves management in forage production systems, considering that about 50% of animal production costs are related to feeding. Therefore, it is noted that pastures will become productive and of quality as long as they are managed correctly [1-3].

Our country has approximately 160 million hectares of pasture areas, representing 18.94% of the total Brazilian area. In 2020, the cerrado biome had 52 million "ha^{-1}", representing 32.37%; in 2021, this value decreased to approximately 49.8 million hectares, a difference of 4.42%. The state of Goiás has about 13 million hectares of cultivated pasture areas, being the sixth largest in Brazil. The states of Minas Gerais, with around 20 million ha^{-1}, and Mato Grosso, with just over 19 million hectares of area, lead the ranking with the largest pasture area [4]. In 2020, Brazil presented a gross domestic product (GDP) of 7.4 trillion, representing a 4.1% decrease compared to the previous year. On the other hand, livestock showed a GDP that increased from 8.4% to 10%, highlighting the importance of livestock in the national economy. Also, during the same period, Brazil had a herd of approximately 187.55 million heads [5].

A genus that stands out in Brazil is Megathyrsus maximum, as it can group high-production forages of notable quality and can be adapted to various regions. Several materials have been developed through research involving the Megathyrsus genus, materials with greater adaptation capacity to new soils and climates [6]. The forage BRS Zuri was developed in a joint effort by Embrapa Gado de Corte and other Embrapa units. Its commercial release date was 2014. This hybrid is the result of a selection derived from M. maximum collected in Tanzania, East Africa [7]. Furthermore, BRS Zuri grass is a plant that has tussock growth, concerning its size, it has an erect stature with tall plants, the leaves are dark green, being long and wide, and the leaves are arched. This variety was selected based on some resistance parameters, including pasture spittlebug and leaf spot, besides having the ability to tolerate wet soils and also having great potential for development in well-drained soils [8]. Therefore, this type of forage is not recommended for low fertility soils but for soils of medium and high fertility.

One of the most demanded nutrients by forage plants is Nitrogen, once absorbed by mass flow in the form of NH_4^+ ions (ammonium) or NO_3^- ions (nitrate). When absorbed, they assimilate into leaves to form amino acids, which are then synthesized into proteins, thus promoting the leaf growth of plants [9].

The most used nitrogen source in agriculture is urea. Since it has high solubility, simple manufacturing, and low cost, the concentration of N varies from 44 to 46%. In contrast, its major disadvantage is ammonia (NH_3) volatilization, which can lead to significant nitrogen losses when applied directly to the soil, as it undergoes rapid hydrolysis in the presence of the urease enzyme. The factor that makes nitrogen important in grasses is the acceleration of new leaf development, increased plant height, increased root volume, and promotion of better regeneration after cutting, resulting in higher production yields [8].

The amount of nitrogen present in the soil is a limiting factor for plant productivity; in cases of low availability, a significant decrease in animal weight gain is observed [10]. Proper nitrogen management in agriculture is essential to avoid cost/benefit losses in the environment; this also applies to the nutrition of animals and plants, as well as preventing contamination of water sources, ensuring human health maintenance [11,12].

Methodology

The experiment was conducted in the area of the Palmeiras de Goiás University Unit, located in Palmeiras de Goiás - GO, at an altitude of 626 meters and at the geographical coordinates; latitude 16° 49′ 26″S and longitude 49° 55′ 20″W. According to Köppen-Geiger, the climate in the western region of Goiás is defined as hot and humid, with the average temperature ranging between 25-26°C and average annual precipitation of 1400-1600 mm. The predominant soil in the region is dark red latosol, well-drained according to Embrapa Cerrado. Soil samples from 0-20 cm were collected and taken to the laboratory for analysis of the chemical and physical characteristics of the experimental area soil (Table 1).

Soil correction was done using only dolomitic limestone composed of 30% calcium and 18% magnesium, with a PRNT of 100%. A total of 650 kg was applied to the total area of 2500 m², following

Physical components						
OM	OC	Sand	Silt	Clay	Textural Classification	
“g kg^{-1}”					medium texture	
39,73	23,1	560	110	330		
Macronutrients						
P	K	S	Ca	Mg	Na	
mg.dm^{-3}			cmol.dm^{-3}			
1,19	47,7	6,47	2,71	1,14	0,02	
Micronutrients					Acidity	
Zn	B	Cu	Fe	Mn	Al	H+Al
mg. dm^{-3}					cmol.dm^{-3}	
0,96	0,24	1,94	28,19	31,3	0,13	5,5

Table 1: Physical Components, Macronutrient, and Micronutrient Contents of the Experimental Area at UEG - Palmeiras de Goiás University Unit, Palmeiras de Goiás - GO. 2022.

EMBRAPA's recommendation [13]. Soil preparation was done conventionally and occurred in two distinct periods; the first was carried out in August 2022 using a tractor to till the soil, followed by the application of limestone and its incorporation.

In the second management, which took place in January 2023, 200 g of herbicide (isopropylamine salt glyphosate - 48%) was used in 8 liters of water to eliminate weeds from the area. The application was done manually using a backpack sprayer bar, and after 11 days, tilling was performed to incorporate organic matter into the soil. Planting, addition of urea to the soil, and its incorporation were carried out one day after soil tilling. The experiment was conducted during the rainy season, from January to May 2023.

The experiment was conducted in a randomized complete block design with five doses of N and four replications, totaling 20 plots of 2 x 3, each with an area of 6 m^2. The nitrogen doses used in the treatments were: 0 kg N ha^{-1}, 200 kg N ha^{-1}, 400 kg N ha^{-1}, 600 kg N ha^{-1}, and 800 kg N ha^{-1}. The urea used contains 44% N, and fertilization was applied at planting.

The seed used has a cultural value (CV) of 40%, with a recommendation of 15 kg ha^{-1} + 30% broadcast. Thus, 220 g of seed was distributed in the area. Treatment evaluation took place 90 days after planting, and sampling was carried out using a wooden square measuring 1 m^2 and cut at a height of 30 cm from the soil surface. The following aspects were evaluated: Fresh biomass production (FBP): Samples were cut with scissors and weighed using a semi-analytical balance with a hood.

- **Dry biomass production (DBP):** After weighing the fresh biomass, samples were standardized to 100 grams and dried in an oven at a temperature of 60 to 65°C for 72 hours, with forced air ventilation until constant weight was achieved. Then, they were weighed again using a semi-analytical balance with a hood.
- **Nitrogen utilization efficiency (NUE):** Was determined using the method described by [14], where:
- **Nitrogen utilization efficiency (NUE):** Total dry matter production (kg DM ha^{-1}) of each nitrogen treatment - treatment without nitrogen fertilization / total nitrogen dose applied in each treatment.

Forage carrying capacity (FCC) was determined according to the Embrapa technical manual, 1998.

Results and Discussion

The doses of N used at the beginning of sowing did not statistically influence plant height (PH), fresh biomass production (FBP), dry biomass production (DBP), and forage carrying capacity (FCC). Only the evaluation of nitrogen utilization efficiency (NUE) showed a statistical difference.

Figure 1 shows the fresh matter (FM) production of BRS Zuri grass at different N doses. No effect of nitrogen fertilization on fresh biomass production was observed at the tested doses. Mathematically, the dose of 200 kg ha^{-1} showed higher FBP during the 90-day experiment, reaching a production of 15,843.00 kg ha^{-1}, a 35.34% increase compared to the dose of 400 kg N ha^{-1}, which obtained 11,706.10 kg ha^{-1}. The FBP of the 0 kg N ha^{-1} dose and the 800 kg N ha^{-1} dose showed similar behavior, respectively presenting 7,388.00 kg ha^{-1} and 7,930.10 kg ha^{-1}. André., *et al.* [15]. observed a linear trend in the fresh biomass production of BRS Zuri when cultivating forage with lower doses than those tested in this study (0, 25, 50, 75, and 100 kg ha^{-1} per cycle). Bittar [16], studying Megathyrsus Zuri grass in the central Goiano region, concluded that nitrogen supply increased leaf growth at doses of 200 and 300 kg N ha^{-1}. Primieri [17], studying African star grass subjected to different nitrogen topdressing doses, observed that nitrogen responded to the dose of 332 kg N ha^{-1} and decreased at the dose of 415 kg N ha^{-1}.

By Figure 2, it can be observed the participation of nitrogen in dry mass production (PMS), causing positive effects at the dose of 200 kg N ha^{-1}, presenting an accumulation of dry mass of 5,837.00 kg ha^{-1}. After that, there is a decrease in production at the studied doses. The dose of 400 kg ha^{-1} showed 5,650.0 kg ha^{-1}, a 3.20% higher than the dose of 600 kg ha^{-1}, representing 4,149.00 kg ha^{-1}. Sousa., *et al.* [18]. studying the effect of nitrogen fertilization on irrigated Mombaça Grass in the Tocantins region and Abreu., *et al.* [1]. studying BRS Zuri subjected to nitrogen fertilization in the Minas Gerais region observed that 800 kg of N ha^{-1} showed desirable agronomic performance in dry mass production. Unlike what was observed in this trial, where dry matter was not influenced by nitrogen fertilization.

Another point to be discussed is the nutrient application method to the soil. According to Taiz and Zeiger [19], as the water potential of the solution changes depending on the concentration, water enters or leaves the cell by osmosis. Thus, in this experiment, the high concentration of urea incorporated into the soil resulted in a reduction in plant population in the treatment that received the dose of 800 kg of N ha^{-1}. One hypothesis for this behavior is that the high single-dose may have dehydrated the seed and damaged its structures, compromising its development, and consequently resulting in a decrease in plant population and leaf production. Sousa [20] asserts that nitrogen fertilizer application should be done in a split manner, as it reduces the risk of unfavorable responses in production.

Picazevicz., *et al*. [21] observed, while studying the effect of *Panicum maximum* cv. BRS Zuri growth in response to rhizobacteria and nitrogen, also found no difference in dry matter accumulation with the use of nitrogen fertilization in the forage. However, there was an increase in the dry mass of the aerial part of BRS Zuri with seed treatment with the rhizobacteria *Azospirillum brasilense.*

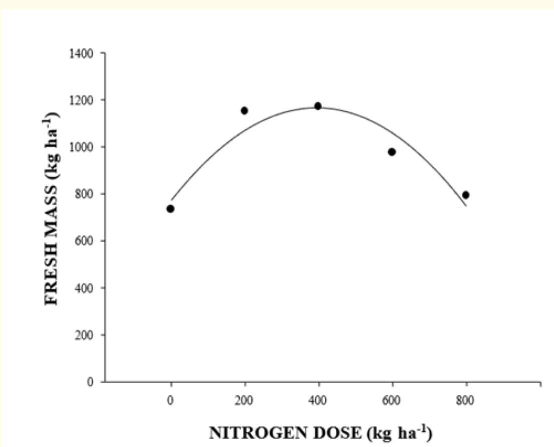

Figure 1: Fresh mass production of BRS Zuri subjected to nitrogen fertilization

In figure 3, the doses of 200 and 400 kg of N ha^{-1} showed similar height values (AL), being relatively 1.38 and 1.36 meters, with a difference of 1.47%. The dose of 200 kg of N ha^{-1} presented the highest height among the treatments. The difference between the percentage of the control and the dose of 800 kg of N ha^{-1} was

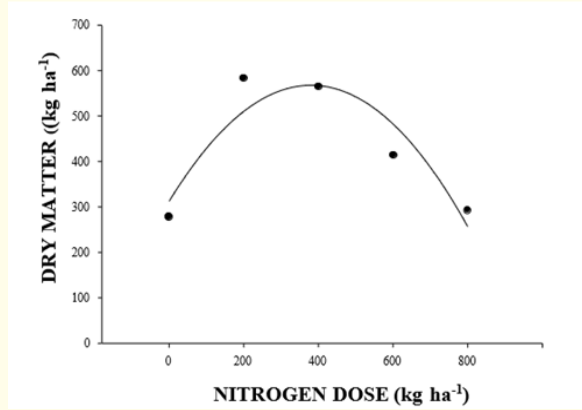

Figure 2: Dry matter production of BRS Zuri grass subjected to different doses of nitrogen fertilization in Palmeiras de Goiás - GO. UEG, 2023.

2.52%, with values of 1.19 and 1.22 meters, respectively. The dose of 600 kg of N ha^{-1} reached a height of 1.28 meters. Gonçalves, Peron, and Costa [22] also did not find significant differences in plant height when studying alternative nitrogen sources for intensifying Zuri grass production, as observed in this experiment. However, Rocha [8], studying the forage Megathyrsus Zuri in the Mato Grosso region, found that plant height was influenced by nitrogen doses, which differs from what was observed in this trial.

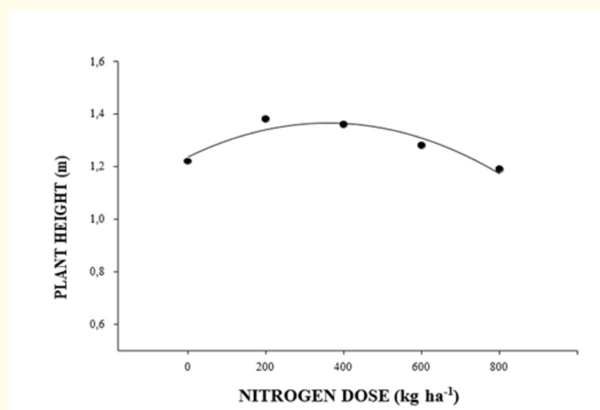

Figure 3: Plant height of BRS Zuri grass subjected to different doses of nitrogen fertilization in Palmeiras de Goiás - GO. UEG, 2023.

Efficiency in nitrogen use decreased as the N dose increased (Figure 4). The dose of 200 kg of N ha^{-1} resulted in 61.04% for each kg of N applied, representing 117.69% more efficiency compared to the dose of 400 kg of N ha^{-1}, which showed 28.65%. At doses of 600 and 800 kg of N ha^{-1}, the efficiency was 9.04% and 0.75%, respectively. Gonçalves., *et al*. [22], studying the Urochloa mosambicensis grass in the Minas Gerais region, also found a decrease in nitrogen efficiency similar to that observed in this trial. Artuscello., *et al*. [23], researching production, morphogenesis, and fertilizer efficiency in BRS Quênia grass in the Minas Gerais region, observed efficiency values ranging from 52.60% to 21.19% for doses of 100, 200, and 400 mg/dm^3 of N, admitting a decrease in efficiency for each applied dose, similar to what was observed in this experiment.

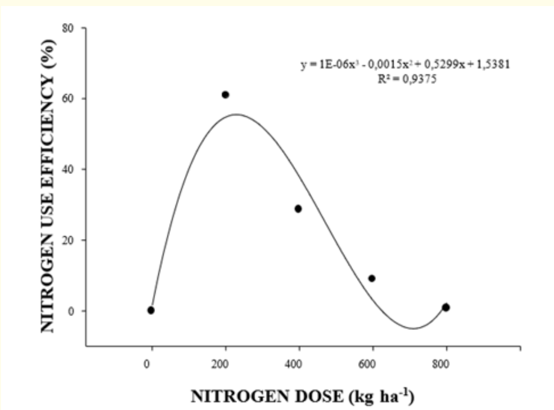

Figure 4: Nitrogen Use Efficiency of BRS Zuri Grass Subjected to Different Nitrogen Fertilization Rates in Palmeiras de Goiás - GO. UEG, 2023.

The low efficiency may be related to nitrogen dynamics in the soil since it is a highly mobile element in the soil, thus leaching and losses of nitrate (NO_3) to deeper soil layers can occur, as well as losses by volatilization of nitrogen in the form of ammonia (NH_3), resulting in low nitrogen efficiency and environmental pollution causing nitrous oxide (N_2O) emissions due to high doses [24].

In the doses studied, no statistical difference was observed for any dose under these conditions, the animal unit capacity was not influenced. The dose of 200 kg of N ha^{-1} achieved an animal unit capacity of 8.64 AU ha^{-1}, and the control presented 4.08 AU ha^{-1}.

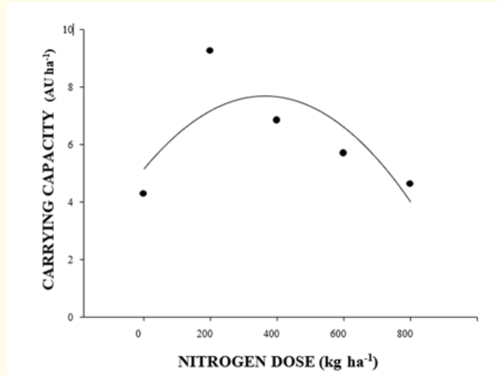

Figure 5: NCarrying Capacity (UA) of BRS Zuri grass subjected to different doses of nitrogen fertilization in Palmeiras de Goiás - GO. UEG, 2023.

The doses of 400 kg ha^{-1} and 800 kg ha^{-1} reached 6.65 and 4.87 AU ha^{-1}, respectively.

For the optimal management of pastures, it is necessary to understand the forage's capacity to sustain animals over a specific period, as well as considering the forage cultivation conditions. Sousa Junior [25], analyzing the economic viability of nitrogen fertilization in Mombaça grass in the Anápolis region - GO, found that the animal unit (AU) per hectare increased with nitrogen fertilization, contrary to what was observed in this research. AU per hectare is directly related to green mass production, so the greater the availability of forage, the higher the rate of animals per hectare.

Conclusion

The efficiency of nitrogen is inversely proportional to the doses of nitrogen applied; thus, the higher the dose, the lower the nitrogen efficiency. The dose of 200 kg of N per hectare stood out among the doses, exhibiting an efficiency of 61.04% when using urea as a fertilizer. The dose of 200 kg of N per hectare yielded the best results among all doses and analyses studied. Intermediate doses, different from those used in this trial, should be tested to assess the behavior of BRS Zuri forage.

Bibliography

1. Abreu MJID., *et al*. "Morphogenesis, structural characteristics, and forage accumulation of Megathyrsus maximus BRS Zuri subjected to nitrogen fertilization". *Boletim de Indústria Animal* (2020).
2. Gonçalves MB., *et al*. "Forage production and nitrogen use efficiency in Corrente grass". *Caderno de Ciências Agrárias* (2022).
3. Fernandes JC. "Sources and doses of nitrogen in the fertilization of Mombaça grass in low-altitude cerrado" (2011).
4. Atlas das Pastagens. "Pasture Atlas" (2020).
5. ABIEC. "Profile of Livestock in Brazil" (2021).
6. Lucena MD. "Agronomic and structural characteristics of Brachiaria spp subjected to nitrogen doses and sources in cerrado soil" (2011).
7. EMBRAPA. "Technological Solutions Panicum maximum BRS Zuri" (2014).
8. Rocha FD. "Production and nutrition of Panicum maximum BRS Zuri subjected to types of urea" (2015).
9. Dechen AR and Nachtigall GR. "Elements required for plant nutrition". (2007).
10. Rocha GP., *et al*. "Nitrogen fertilization in grasses of the Cynodon genus". *Brazilian Animal Science* (2002).
11. Costa, KAP., *et al*. "Nitrogen fertilization for Brachiaria grasses in Cerrado soils". (2006).
12. Costa M.C. G. "Agronomic efficiency of nitrogen sources in sugarcane cultivation under non-burning harvest system" (2001).
13. EMBRAPA. "Soil correction and fertilization". (2004).
14. Castagnara DD., *et al*. "Forage production, structural characteristics, and nitrogen utilization efficiency in tropical forages under nitrogen fertilization". *Semina: Agricultural Sciences* (2011).
15. André TB., *et al*. "Root masses and net accumulation of BRS Zuri grass, under nitrogen and subsurface irrigation". Symposium on Agricultural and Environmental Sciences, Federal University of Uberlândia (2020).
16. Bittar DY and Souza BAA. "Effect of nitrogen on structural characteristics and biomass production in panicum grasses". *Ipê Agronomic Journal* (2021).
17. Primieri C and Cechella F. "Productivity of African star grass subjected to different nitrogen topdressing doses". *Brazilian Journal of Animal Science* (2002).
18. Sousa GF., *et al*. "Nitrogen doses under Mombaça grass cultivation". 7th JICE - Jornada de Iniciação Científica e Extensão (2016).
19. Taiz L and Zeiger E. "Plant Physiology and Development". (2017).
20. Sousa DMG., *et al*. "Efficient use of lime and fertilizer in pastures". (2007).
21. Picazevicz AAC., *et al*. "Growth of Panicum maximum cv. BRS Zuri in response to rhizobacteria and nitrogen". *Brazilian Journal of Sustainable Agriculture* (2020).
22. Gonçalves JM., *et al*. "Alternative nitrogen sources for increasing Zuri grass production". *Journal of Agro-Veterinary Sciences* (2022).
23. Artuscello J., *et al*. "Forage production, morphogenesis, and agronomic efficiency of fertilizer on BRS Quênia grass under nitrogen doses". (2018).
24. Liu S., *et al*. "Ammonia and greenhouse gas emissions from a subtropical wheat field under different nitrogen fertilization strategies". *Journal of Environmental Sciences* 57 (2017): 196-210.
25. Sousa Junior ODD. "Economic Viability of Nitrogen Fertilization in Mombaça Grass (*Panicum maximum*) (2018).