Nutritional value of Mombasa grass submitted to different grazing heights and nitrogen fertilization

Valor nutritivo do capim-Mombaça submetido a diferentes alturas de pastejo e adubação nitrogenada

DOI: 10.34188/bjaerv4n1-071

Recebimento dos originais: 20/11/2020
Aceitação para publicação: 20/12/2020

Alzira Gabriela da Silva Pause
Doutor em Zootecnia, Universidade Federal de Goiás
Instituição: Instituto de Estudos em Desenvolvimento Agrário e Regional, UNIFESSPA
Endereço: Folha 31, Quadra 07, Lote Especial, s/n.º - Nova Marabá, Marabá - PA, 68507-590
E-mail: alziragabi@unifesspa.edu.br

Aldi Fernandes de Souza França
Doutor em Agronomia, Universidade de São Paulo
Instituição: Escola de Veterinária e Zootecnia, UFG
Endereço: CAMPUS SAMAMBAIA, CAMPUS II, CEP 74001970 - Goiânia, GO - Brasil
E-mail: aldi@ufg.br

Eliane Sayuri Miyagi Okada
Doutor em Ciência Animal, Universidade Federal de Goiás
Instituição: Escola de Veterinária e Zootecnia, UFG
Endereço: CAMPUS SAMAMBAIA, CAMPUS II, CEP 74001970 - Goiânia, GO - Brasil
E-mail: eliane_miyagi@ufg.br

Jefferson Rodrigues Gandra
Doutor em Ciências, Faculdade de Medicina Veterinária e Zootecnia, Universidade de São Paulo
Instituição: Instituto de Estudos em Desenvolvimento Agrário e Regional, UNIFESSPA
Endereço: Folha 31, Quadra 07, Lote Especial, s/n.º - Nova Marabá, Marabá - PA, 68507-590
E-mail: jeffersongandra@unifesspa.edu.br

Elisangela Dupas
Doutor em Agronomia Universidade Estadual Paulista, UNESP
Instituição: Faculdade de Ciências Agrárias. Universidade Federal da Grande Dourados
Endereço: Rod. Dourados Itahum km 12 Cidade Universitária, Unidade II
E-mail: euclidesoliveira@ufgd.edu.br

Euclides Reuter de Oliveira
Doutor em Zootecnia Universidade Federal de Lavras
Instituição: Faculdade de Ciências Agrárias. Universidade Federal da Grande Dourados
Endereço: Rod. Dourados Itahum km 12 Cidade Universitária, Unidade II
E-mail: euclidesoliveira@ufgd.edu.br

Jorge Luis Ferreira
Doutor em Zootecnia, Universidade Federal de Goiás
Instituição: Universidade Federal do Tocantins, UFT

Endereço: BR-153, Km 112, s/n° | Caixa Postal 132
77804-970 | Araguaína/TO
E-mail: jorgeferreira@uft.edu.br

Orlando Filipe Costa Marques
Mestre em Zootecnia Universidade Estadual de Minas Gerais
Instituição: Faculdade de Ciências Agrárias. Universidade Federal da Grande Dourados
Endereço: Rod. Dourados Itahum km 12 Cidade Universitária, Unidade II
E-mail: orlandozootec@gmail.com

ABSTRACT
We evaluate the effect of sward height (0.20 and 0.40 m) and N-fertilizer doses (0, 100, 300, and 500 kg ha^{-1}) on the nutritive value of Mombaça guinea grass (*Panicum* (syn: *Megathyrsus*) *maximum* (Jacq.)) in the dry and rainy season. The experiment was a complete random block design with a 4 x 2 factorial arrangement, in a split-plot experiment with four repetitions. Dry matter, crude protein, neutral detergent fiber, acid detergent fiber, lignin, and in vitro dry matter digestibility were stated for the whole plant and fractions. Residual heights did not interfere (P>0.05) on production or nutritive value. N doses influenced (P<0.05) of the whole plant, leaf blade and stem nutritive value in both seasons. Higher crude protein contents were obtained with higher N doses and ranged around 10%. The mean whole plant NDF levels were 74.5% (rainy season) and 75.5% (dry season). In vitro dry matter digestibility level increased as N doses increased. The nutritive value of the mombaça grass submitted to cutting heights and nitrogen doses was positively altered. It is recommended the management of the mombaça grass with a forage residue of 0.40 m and application of up to 300 kg.ha^{-1} of nitrogen during the rainy season of the year.

Keywords: Chemical composition. Forage residue. Nitrogen. *Panicum maximum*.

RESUMO
Avaliamos o efeito da altura do pasto (0,20 e 0,40 m) e das doses de N-fertilizante (0, 100, 300 e 500 kg ha-1) no valor nutritivo do capim-da-índia Mombaça (Panicum (syn: Megathyrsus) maximum (Jacq.)) na estação seca e chuvosa. O experimento foi em blocos ao acaso completos com arranjo fatorial 4 x 2, em um experimento de parcela subdividida com quatro repetições. Determinou-se a digestibilidade da matéria seca, proteína bruta, fibra em detergente neutro, fibra em detergente ácido, lignina e matéria seca in vitro para toda a planta e frações. As alturas residuais não interferiram (P> 0,05) na produção ou valor nutritivo. As doses de N influenciaram (P <0,05) no valor nutritivo da planta inteira, lâmina foliar e caule em ambas as estações. Maiores teores de proteína bruta foram obtidos com maiores doses de N e variaram em torno de 10%. Os níveis médios de FDN da planta inteira foram 74,5% (estação chuvosa) e 75,5% (estação seca). O nível de digestibilidade da matéria seca in vitro aumentou com o aumento das doses de N. O valor nutritivo do capim mombaça submetido a alturas de corte e doses de nitrogênio foi alterado positivamente. Recomenda-se o manejo do capim mombaça com resíduo de forragem de 0,40 me aplicação de até 300 kg.ha-1 de nitrogênio durante o período chuvoso do ano.

Palavra-Chave: Composição química. Resíduo de forragem. Azoto. Panicum maximum.

1 INTRODUCTION

The livestock production is based on the use of pastures, due to the low cost for herbivorous animals when compared to other sources of roughage, which makes it possible to efficiently exploit the available area, with increasingly intensive and better production systems (Leal et al., 2017).

The cultivation of grasses of *Megathyrsus* genus has been consolidated in these production systems, with emphasis on the Mombaça guinea grass due to its high productive potential and nutritive value (NV) (Cardoso et al., 2016). However, cultivars of this genus are nutritionally more demanding than *Urochloa* (syn. *Brachiaria*) (Resqín et al., 2020).

Mombaça guinea grass is an upright and cespitose plant, with an average height of 1.60 to 1.65-m, has a high percentage of brittle leaves (80%) with 3-cm wide, with 10 to 40% of production during the drought and provides ground cover between 60 and 80% (Carnevalli et al., 2006). In a study for bromatological characterization of mombaça grass, Silva et al. (2016) determined levels of 8.5% of CP, 65.2% of NDF, and 28.7% of ADF, concentrations considered satisfactory for ruminants feed.

However, for the forage to demonstrate its full productive potential it is necessary to manage it properly. In this sense, N-fertilizer determines the growth rate and interferes in the forage quality produced. However, to avoid losses and increase the efficiency of nitrogen (N) utilization in herbage mass and, consequently, in animal production, it is necessary to know how this nutrient affects the production and quality of forage plants, as well as the appropriate dose to be applied.

Increasing the N concentration in the soil through fertilization is one of the ways to increase productivity in pastures, especially when the forage plant responds to the application of this nutrient (Martuscello et al., 2005). The N-fertilizer application can promote the growth rate and the forage quality, which will provide an increase of herbage accumulation (HA)and protein synthesis with a more uniform annual distribution.

Estimating the NV is of great practical importance, either to allow an appropriate balance of roughage-based diets or to provide subsidies to improve the NV of forages, through genetic selection, more appropriate grazing management or, still, the treatment of forage stubble height (Menke and Steingass, 1988). Studies with forage NV contribute to the identification of possible points that restrict nutrients consumption and, consequently, livestock production (Van Soest, 1994).

There are several factors related to the grazing management, which can influence its NV, such as harvest age fertilization, plant morphological characteristics and the harvest height to which the plant is submitted (Rodrigues et al., 2004). According to Martha Júnior et al. (2004), the use of height as a management index should be used with caution, since the sward structure of *M. maximum* for a given grazing height, is changed throughout the growth cycles.

Another relevant factor is nitrogen fertilization because as sugars are used in the synthesis of amino acids and proteins, the increase in the supply of N to plants reduces the sugar content. Proteins are accumulated in the cell content and have the effect of diluting the components of the cell wall with increased digestibility (Brâncio et al., 2002).

Based on the above, the objective of this study was to evaluate the nutritive value of mombaça grass in two sward heights, submitted to N doses in the dry and rainy season of the year in the Brazilian Midwest.

2 MATERIALS AND METHODS

The experiment were conducted at the Animal Production Department of the School of Veterinary and Zootechnics, Federal University of Goiás (EVZ/UFG), Campus II, Goiânia, GO, Brazil (16º35'S, 49º16'W, 727 m a.m.s.l.).

The meteorological data were monitored, monthly during the conduction of the experiment and measured by the first-class evaporimeter station of the School of Agronomy and Food Engineering (EAEA/UFG). According to Köppen classification (1948), the of the region is Aw type (warm and semi-humid, with well-defined seasons, the dry season, from May to October and the waters, between November and April). During the experimental period, the average annual temperature was 22.1ºC, the average precipitation was 145.7 mm, and the rainy season characterized by low sunshine (194.7 hours per month).

The soil in the experimental area was a Red Latosol Dystrophic (Santos et al., 2018) and for chemical characterization and, later, correction of the chemical attributes of the soil, samples were collected at of 0.20-m depth. Depending on the results of the soil analysis, phosphate and potassium fertilization were carried out, according to the recommendations of Vilela et al. (2000).

Treatments were the split-plot arrangement… distributed in a randomized complete block design with four replicates, totaling 32 experimental units.The treatments consisted of N doses (control, 100, 300 and 500 kg ha^{-1}), with ammonium sulfate as the source, and two residual heights (0.20 and 0.40 m). The nitrogen fertilization was divided according to the time of the year. Thus, 80% of the dose was applied in the rainy season, when cuts were made every 30 days, and 20% in the dry period, with cuts every 60 days. The experiment was conducted from a pre-established pasture of *Panicum maximum* cv. Mombaça in 2003. After a uniform cut, 32 plots of 16 m^2 (4 x 4 m) were allocated, spaced 1 meter apart, with a total area of 512 m^2. Maintenance potassium fertilization was carried out with the application of 15 kg ha^{-1} of K_2O per ton of dry matter removed from the area, following the recommendation of Monteiro (1995).

All cuts were made manually with steel scissors, using the iron square of 1-m on the side, respecting the cutting intensity of the treatments, and excluding the borders. After each evaluation cut, the plot was lowered with the use of a costal brush cutter, observing the pre-established height and then removing the residues.

From the collected material, one subsample of approximately 500 g was taken to determine the partial dry matter. The harvested. After cutting, the material was identified and morphological components were separated (leaf blade, stem+sheath and dead material), weighed and dried in a a stove with forced-air ovencirculation, at 55 °C for 72 hours. The material was Then, it was all weighed again for determination of dry mass and then grinded in a Wiley mill (Model 4, Thomas-Wiley Laboratory Mill, Thomas Scientific, Swedesboro, NJ) to pass a 2-mm stainless steel screen..

The dry matter (DM), crude protein (CP), neutral detergent fiber (NDF), acid detergent fiber (ADF), lignin (Lig) and *in vitro* digestibility (IVD…) were quantified in the foliar blade through near-infrared reflectance spectroscopy (NIRS) (Foss NIRSystems, XDS Rapid Content Analyzer, Denmark).

The experimental design used was a randomized block with split plots, in a 2 x 4 factorial scheme with four replications. The statistical model used was:

$$y_{jik} = \mu + \alpha_i + b_j + e_{ij} + \gamma_k + (\alpha\gamma)_{ik} + e_{ijk},$$

Where: jiky = Observation in the j-th block, of the i-th fertilization dose and k-th residual height μ = Overall average i α = Effect attributed i-th fertilization doses jb = Effect attributed to the j-th block ije = Error associated with the plot (ij) k γ = Effect attributed to the k-th height (αγ) ik = Effect of the interaction between the fertilizer dose and residual height and ijke = Error associated with the subplot (ijk).

For the analysis of variance, the PROC GLM program of the SAS® system (2004) was used, the means were compared by the Tukey test at 5% probability.

3 RESULTS

The residual heights evaluated (0.20 and 0.40 m) did not affect ($P > 0.05$) on the nutritional value of Mombaça grass, therefore, these data were unified. N doses influenced ($P<0.05$) the dry matter content of the whole plant, leaf blade, and stem in both periods (Table 1 and 2).

Table 1. Chemical composition of Mombaça grass submitted to nitrogen doses during the rainy season.

Item (%)	Doses	Harvest 1			2º Cutting			3º Cutting			4º Cutting			5º Cutting		
		WP	LB	S	WP	LB	S	WP	LB	S	WP	LB	S	WP	LB	S
DM	0	25.6 ^{Aa}	24.3^{Ab}	---	27.5 ^{Aa}	29.6^{Aa}	6.4^{Ba}	27.5 ^{Aa}	27.9^{Aa}	---	24.4 ^{Ab}	19.4^{Ac}	---	25.0 ^{Ab}	27.2^{Aa}	---
	100	19.8 ^{Bc}	19.5^{Bb}	---	24.9 ^{Ba}	25.3^{Ba}	---	25.2 ^{Aa}	24.6^{Ba}	---	19.0^{Bc}	18.4^{Ab}	---	21.9 ^{Ab}	21.1^{Bb}	22.5^{Aa}
	300	14.2 ^{Cb}	15.0^{Cc}	10.5^{Ab}	18.6 ^{Ca}	19.6^{Cb}	12.6^{Ab}	19.0 ^{Ba}	21.2^{Ca}	13.4^{Ab}	16.7 ^{Ca}	18.3^{Ab}	12.4^{Ab}	18.0 ^{Ba}	20.5^{Ba}	16.8^{Ba}
	500	13.6 ^{Cb}	13.9^{Cb}	9.5^{Ac}	17.5 ^{Ca}	18.5^{Ca}	12.0^{Ab}	18.0 ^{Ba}	20.5^{Ca}	13.3^{Aa}	16.0 ^{Ca}	19.3^{Aa}	11.0^{Ab}	16.4 ^{Ba}	18.1^{Ca}	15.3^{Ba}
CP	0	7.9 ^{Bb}	8.5^{Ca}	---	9.7 ^{Aa}	8.8^{Ba}	3.4^{Ba}	9.1 ^{Aa}	8.1^{Aa}	---	9.6 ^{Ba}	7.4^{Ab}	---	7.9 ^{Ab}	8.04^{Ba}	---
	100	7.9 ^{Bb}	9.9^{Ba}	---	9.7 ^{Aa}	9.0^{Ba}	---	8.6 ^{Aa}	8.2^{Ab}	---	9.6 ^{Ba}	8.1^{Ab}	---	7.9 ^{Ab}	8.31^{Bb}	7.5^{Aa}
	300	10.0 ^{Aa}	10.7^{Ba}	6.4^{Ab}	9.7 ^{Aa}	8.7^{Bb}	7.7^{Aa}	8.5 ^{Aa}	7.7^{Ac}	8.60^{Aa}	9.7 ^{Ba}	8.3^{Ab}	9.0^{Aa}	7.7 ^{Ab}	8.68^{Bb}	7.5^{Aa}
	500	9.9 ^{Ab}	12.2^{Aa}	5.9^{Ab}	9.6 ^{Ab}	9.9^{Ab}	7.3^{Ab}	9.1 ^{Ab}	7.6^{Ad}	7.95^{Aa}	11.3 ^{Aa}	8.5^{Ac}	9.6^{Aa}	8.0 ^{Ac}	9.61^{Ab}	6.6^{Ab}
NDF	0	73.9 ^{Aa}	74.0^{Ab}	---	71.2 ^{Ab}	73.4^{Ab}	38.3^{Ba}	72.1 ^{Aa}	76.0 ^{Aa}	---	72.6 ^{Aa}	75.0 ^{Aa}	---	72.8 ^{Aa}	73.7^{Ab}	---
	100	73.5 ^{Aa}	70.8^{Bb}	---	71.9 ^{Aa}	73.5^{Aa}	---	72.9 ^{Aa}	75.0^{Aa}	---	70.9 ^{Ab}	74.5^{Aa}	---	73.2 ^{Aa}	73.6^{Aa}	75.5^{Aa}
	300	70.6 ^{Bb}	70.3^{Bc}	79.0^{Aa}	73.0 ^{Aa}	73.1^{Ab}	75.2^{Aa}	73.6 ^{Aa}	75.1^{Aa}	72.7^{Aa}	70.9 ^{Ab}	74.1^{Aa}	73.8^{Aa}	74.3 ^{Aa}	73.4^{Aa}	73.7^{Aa}
	500	72.7 ^{Ab}	68.5^{Cc}	79.0^{Aa}	72.7 ^{Ab}	71.4^{Bb}	76.0^{Aa}	72.5 ^{Ab}	76.6^{Aa}	75.6^{Aa}	70.9 ^{Ab}	74.0^{Ab}	72.4^{Aa}	74.5 ^{Aa}	73.2^{Ab}	75.6^{Aa}
ADF	0	43.4 ^{Ab}	44.6^{Aa}	---	41.9 ^{Ab}	43.3^{Ab}	23.9^{Ba}	42.3 ^{Ab}	44.1^{Ba}	---	42.1 ^{Ab}	45.5^{Aa}	---	45.4 ^{Aa}	43.4^{Ab}	---
	100	43.6 ^{Aa}	42.0 ^{Bc}	---	42.3 ^{Ab}	42.5^{Ab}	---	43.0 ^{Ab}	43.8^{Bb}	---	42.9 ^{Ab}	45.6^{Aa}	---	45.3 ^{Aa}	43.6^{Ab}	47.6^{Aa}
	300	40.7 ^{Bc}	40.3^{Ca}	48.8^{Aa}	42.5 ^{Ab}	43.2^{Aa}	46.1^{Aa}	43.7 ^{Ab}	44.2^{Ba}	44.1^{Aa}	41.0 ^{Bc}	44.5^{Aa}	44.1^{Aa}	46.1 ^{Aa}	42.7^{Ab}	46.9^{Aa}
	500	41.3 ^{Bb}	37.7^{Dc}	49.3^{Aa}	41.7 ^{Ab}	42.1^{Ab}	47.3^{Aa}	42.9^{Ab}	45.8^{Aa}	46.8^{Aa}	39.6 ^{Bc}	44.6^{Aa}	43.5^{Aa}	46.9 ^{Aa}	42.0^{Ab}	48.0^{Aa}
LIG	0	8.6 ^{Aa}	9.4^{Aa}	---	7.8 ^{Aa}	8.3^{Ab}	4.1^{Ba}	7.8 ^{Aa}	9.1^{Aa}	---	8.1 ^{Aa}	8.9^{Ab}	---	8.5 ^{Aa}	8.6^{Ab}	---
	100	8.5 ^{Aa}	7.4^{Bb}	---	7.7 ^{Aa}	7.8^{Ab}	---	7.9 ^{Aa}	8.8^{Aa}	---	7.6 ^{Ab}	8.7^{Aa}	---	8.8 ^{Aa}	8.4^{Aa}	8.2^{Aa}
	300	7.0^{Bb}	7.3^{Bb}	10.8^{Aa}	7.9^{Aa}	7.6^{Ab}	7.9^{Ab}	8.2^{Aa}	8.5^{Aa}	7.5^{Ab}	7.3^{Ab}	8.3^{Aa}	7.0^{Ab}	8.5 ^{Aa}	8.1^{Aa}	6.8^{Ab}
	500	8.1^{Aa}	6.9^{Bc}	10.8^{Aa}	7.8^{Ab}	7.3^{Ab}	8.3^{Ab}	7.5^{Ab}	9.1^{Aa}	8.9^{Ab}	6.8 ^{Bb}	8.6^{Aa}	6.4^{Ac}	9.2^{Aa}	7.7^{Ab}	7.2^{Ac}
IVDDM	0	51.4^{Bb}	52.2^{Ba}	---	58.1^{Aa}	53.8^{Aa}	31.1^{Ba}	57.5^{Aa}	49.8^{Ab}	---	55.3^{Ba}	53.7^{Aa}	---	50.0^{Ab}	53.9^{Ba}	---
	100	52.4^{Ba}	58.7^{Aa}	---	56.3^{Aa}	54.0^{Ab}	---	54.0 ^{Aa}	48.5^{Ac}	---	56.6^{Aa}	55.0^{Aa}	---	50.9 ^{Ab}	54.8^{Ab}	61.2^{Aa}
	300	59.1^{Aa}	54.5^{Ba}	52.4^{Aa}	56.1^{Aa}	55.6^{Aa}	66.0^{Aa}	54.7 ^{Aa}	50.3^{Ab}	63.4^{Aa}	59.1^{Aa}	55.1^{Aa}	61.2^{Aa}	52.1 ^{Ab}	56.4^{Aa}	61.7^{Aa}
	500	56.6^{Aa}	60.8^{Aa}	52.7 ^{Aa}	59.8 ^{Aa}	56.8^{Ab}	62.3^{Aa}	58.6 ^{Aa}	48.6^{Ac}	61.6^{Aa}	60.4^{Aa}	55.0^{Ab}	62.9^{Aa}	48.4 ^{Ab}	58.8^{Aa}	63.0^{Aa}

For the same variable, distinct uppercase letters in the columns differ from each other and distinctive lowercase letters in the same columns differ from each other, both by the Tukey test ($P<0.05$). Variation coefficients: DM (WP 5.93; LB 7.06; C 23.29). CP (WP 7.62; LB 5.25; C 23.15). NDF (WP 1.75; LB 1.36; C 23.29). ADF (WP 2.38; LB 1.91; C 23.61). LIG (PI 7.96; LB 7.28; C 24.73) e IVDDM (WP 4.94; LB 4.14; C 23.77).Dry matter (MS). Crude protein (CP). Neutral detergent fiber (NDF). Acid detergent fiber (ADF). Lignin (LIG). *In vitro* digestibility of dry matter (IVDDM). The whole plant (WP). Leaf-blade (FB). Stem (S).

There was no significant difference (P>0.05) between the doses and the months evaluated when applying 300 and 500 kg ha^{-1} of N, for the whole plant samples in both periods and, for leaf blade in the dry season (Table 2).

Table 2. Chemical composition of Mombasa grass subjected to nitrogen doses during the dry period.

Item (%)	Doses	1º Cutting			2 º Cutting			3º Cutting		
		WP	LB	S	WP	LB	S	WP	LB	S
DM	0	---	---	---	---	---	---	20.9^{A}	23.5^{Aa}	8.6^{Aa}
	100	---	---	---	---	---	---	20.8^{A}	22.0^{Aa}	6.9^{Aa}
	300	29.2^{Aa}	26.2^{Aa}	17.1^{Aa}	---	---	---	16.5 ^{Bb}	16.9^{Bb}	13.2^{Aa}
	500	29.4^{Aa}	25.8^{Aa}	12.0^{Ba}	29.8 ^{Aa}	26.9^{Aa}	---	15.6^{Bb}	15.7^{Bb}	12.4^{Aa}
CP	0	---	---	---	---	---	---	8.8 ^{Aa}	7.5^{Ba}	2.7^{Aa}
	100	---	---	---	---	---	---	7.7^{Ba}	7.5^{Ba}	3.0^{Aa}
	300	8.1^{Aa}	8.6^{Aa}	7.6^{Aa}	---	---	---	8.2^{Aa}	8.0^{Aa}	5.4^{Aa}
	500	8.0^{Ab}	8.9^{Aa}	8.3^{Aa}	6.1^{Ac}	8.2^{Aa}	---	8.8^{Aa}	8.8^{Aa}	5.2^{Ab}
NDF	0	---	---	---	---	---	---	74.0^{Aa}	74.3^{Aa}	73.4^{Ab}
	100	---	---	---	---	---	---	74.0^{Aa}	75.0^{Aa}	40.2^{Ba}
	300	75.5^{Aa}	74.2^{Aa}	78.3^{Aa}	---	---	---	73.3^{Ab}	75.3^{Aa}	80.6^{Aa}
	500	74.3^{Aa}	73.4^{Ab}	76.9^{Aa}	74.9 ^{Aa}	75.6^{Aa}	---	71.6^{Bb}	73.4^{Ab}	81.0^{Aa}
ADF	0	---	---	---	---	---	---	43.1^{Aa}	44.0^{Aa}	23.2^{Ba}
	100	---	---	---	---	---	---	44.5^{Aa}	44.2^{Aa}	23.4^{Ba}
	300	43.1^{Aa}	42.42^{Aa}	45.49^{Aa}	---	---	---	43.9^{Aa}	43.8^{Aa}	47.5^{Aa}
	500	43.0^{Ab}	42.1^{Ab}	42.4^{Aa}	47.6^{Aa}	44.2^{Aa}	---	42.0^{Bb}	41.9^{Bb}	48.4^{Aa}
LIG	0	---	---	---	---	---	---	7.9^{Aa}	8.6^{Aa}	4.4^{Ba}
	100	---	---	---	---	---	---	7.9^{Aa}	8.6^{Aa}	4.6^{Ba}
	300	8.4^{Aa}	8.5^{Aa}	9.5^{Aa}	---	---	---	8.0^{Aa}	8.4^{Aa}	9.6^{Aa}
	500	7.9^{Ab}	8.3^{Ab}	8.6^{Aa}	8.8^{Aa}	9.5^{Aa}	---	7.4^{Ab}	8.2^{Ab}	9.7^{Aa}
IVDDM	0	---	---	---	---	---	---	57.0^{Aa}	51.2^{Ba}	30.5^{Ba}
	100	---	---	---	---	---	---	54.2^{Ba}	53.5^{Aa}	30.5^{Ba}
	300	54.0^{Ab}	54.0^{Aa}	60.1^{Aa}	---	---	---	57.1 ^{Aa}	55.0^{Aa}	59.9^{Aa}
	500	55.0^{Ab}	56.1^{Aa}	62.0^{Aa}	49.5^{Ac}	50.1^{Ab}	---	57.3^{Aa}	56.6^{Aa}	59.1^{Aa}

For the same variable, distinct uppercase letters in the columns differ from each other and distinctive lowercase letters in the same columns differ from each other, both by the Tukey test (P<0.05). Variation coefficients: DM (WP 9.41; LB 9.37; S 56.89). CP (WP 8.91; LB 16.52; S 47.14). NDF (WP 2.22 LB 2.58; S 50.45). ADF (WP 3.86; LB 4.25; S 50.79). LIG (WP 9.18; LB 10.33; S 49.14) IVDDM (WP 4.23; FB 7.21 S 52.0).Dry matter (MS). Crude protein (CP). Neutral detergent fiber (NDF). Acid detergent fiber (ADF). Lignin (LIG). *In vitro* digestibility of dry matter (IVDDM). The whole plant (WP). Leaf-blade (FB). Stem (S).

Regarding the DM content of the stalk, there was no statistical difference (P>0.05) between the doses of 300 and 500 kg ha^{-1} in the rainy and dry period, except in the first cut of the dry period. There was a linear response of the CP content of mombaça grass to fertilization, an increase (P<0.05) was observed in both periods evaluated.

There was no significant difference (P>0.05) for the NDF content between doses of 0 and 100 kg ha^{-1} N, for LB and C; between 300 and 500 kg ha^{-1} of N for the whole plant, LB and S. Regarding the NDF content of the whole plant, it was observed that there was no difference (P>0.05) between the tested doses, except for 300 kg ha^{-1} of N, in the first cut of the rainy season and for the dose of 500 kg ha^{-1} of N, on the occasion of the third cut of the dry season. However, between the cuts, there was a significant difference (P<0.05) in all doses.

The NDF contents of the leaf blade did not differ (P>0.05) between the doses of 100 and 300 kg ha^{-1} of N, in the rainy season and as well as between the different doses evaluated in the dry season, however, it differed between the cuts. For stems, there was no significance (P>0.05) between doses and cuts in the rainy season, except in the control treatment of the second cut.

The ADF values determined for the whole plant during the rainy season did not differ (P>0.05) between the doses of 0 and 100 kg ha^{-1} of N and between 300 and 500 kg ha-^{1} of N, and it was not observed in the dry period a significant difference between doses. However, there were differences (P<0.05) between all cuts in both evaluated periods, except in the dose equivalent to the application of 300 kg.ha^{-1} of N, in the dry period.

The increase in applied N doses was a decisive factor in reducing the leaf blade in the ADF levels in the rainy season, with a significant difference (P <0.05) between all doses and cuts. For stems, no differences were observed (P<0.05), between doses and cuts, except for the control treatment, on the occasion of the second cut in the rainy season. In the dry period, there was a difference (P<0.05) for the leaf blade only at the dose of 500 kg ha^{-1} of N, in the third cut of the dry period. Regarding the ADF content of the stems, no significant differences were observed between doses and cuts of 0 and 100 kg ha^{-1} and between 300 and 500 kg ha^{-1} of N.

The levels of Lig in the whole plant determined in the rainy season were not significant (P>0.05) between doses of 0 and 100 kg ha^{-1} of N, in contrast to what occurred between the cuts. Inverse behavior was observed (P<0.05) between doses and cuts equivalent to the treatments of 300 and 500 kg ha^{-1} of N. Higher levels were found with the application of the lowest doses of N. No significant difference was observed (P>0.05) between doses and cuts for WP in the dry period, except between dose cuts with the application of 500 kg ha^{-1} of N, which presented the highest value (8.8%), in the second cut of the dry period.

For LB, there were no differences (P>0.05) in Lig contents between doses in both periods evaluated, except for the control treatment in the rainy season. Between the cuts, there was a significant difference (P<0.05) in the levels of Lig in all cuts, except for the dose of 300 kg ha^{-1}. The levels of Lig determined in the stems were not significant (P>0.05) between doses, except for the control treatment and between cuts (P<0.05) in the rainy season. In the dry season, the levels did not differ between doses of 0 and 100 kg ha^{-1} of N and between 300 and 500 kg ha^{-1} of N. Among the cuts within the evaluated treatments, there were also no significant differences.

The in vitro digestibility of the dry matter of the whole Mombaça grass plant did not differ (P>0.05), both in the rainy season and in the dry season. Regarding the cuts, there was significance (P<0.05) among all doses.

Observing the values of IVDDM of leaf blade (LB) and stems of Mombaça grass, it was found that the increase in N doses promoted an improvement in the IVDDM levels of the evaluated fractions, in both periods. In the rainy season, there was a significant difference ($P<0.05$) between all cuts and at doses of 0 and 300 kg ha^{-1} of N, about the others for LB. The stem fraction differed only in the control, with no variations between cuts.

In the dry period, IVDDM of the LB differed ($P>0.05$) between doses in the control between the cuts only with the application of the dose of 500 kg ha^{-1} of N; the stem fraction did not differ between the 0 and 100 doses and between 300 and 500 kg ha^{-1} of N, as well as there was no significance between the cuts.

4 DISCUSSION

The small variation in residual heights can be attributed to the low variation in the structural composition of the plant, obtained during the cuttings since Mombaça grass has a habit of growing cespitoso, leaf blades, and long stems, which composed the samples collected in both heights (Table 1 and 2). It is important to note that nitrogen fertilization can alter the structural composition of plants (Soares Filho et al., 2015), where the application of this nutrient favors the emergence of new tillers, the number of live leaves and the length of leaf blades, and consequently increasing the nutritional value of the plant.

According to Carvalho et al. (2017), evaluating the production and quality of Mombaça grass under different residual heights (30 and 50 cm), noticed that a residual height of 50 cm promotes greater accumulation of forage with an average of 100.07 kg of DM ha^{-1} day^{-1}.Therefore, cutting heights and/or post-grazing residue must be evaluated and defined for each forage species, since the pasture height goals have the potential to develop grazing management strategies for both continuous and rotational stocking.

For DM concentration, it was observed that, as the N doses increased, there was a reduction of up to 37% in the DM levels between 0 and 500 kg ha^{-1} of N, for whole plant and blade in the rainy and dry period (table 2), the increase in nitrogen availability along with environmental factors favorable to plant development, alters morphogenic and morphological characteristics such as increased tiller appearance, leaf size and stem (Martuscello et al., 2006), these when managed properly has a higher water content in its composition.

As for the increase in protein values with nitrogen doses, this behavior can be attributed to the effect of this nutrient on plant tissue, since it is part of the composition of the amino acids that form proteins, consequently favoring the concentration of crude protein, however, not all CP can be used by ruminants. In work conducted with Massai grass also of the *Panicum* genus, Marques et al.

(2016) reported a linear increase in the average CP content due to the increase in N, whose average value in the first cut for the control was 10.23 and 15.80% for the treatment with the application of 120 kg ha^{-1} of N. In a study carried out with a large tropical grass of the *Pennisetum* genus, Martuscello et al. (2016) also found that nitrogen fertilization promoted a linear and positive effect on the levels of crude protein (CP) of leaf blades and stems.

In the rainy season, the highest levels of CP in the whole plant (11.3%), leaf blade (12.2%), and stem (9.6%) occurred at a dose of 500 kg ha^{-1} of N (Table 1). The high levels of CP in the plant fractions at the highest doses of N indicated that good amounts of N were concentrated in the tissues of the plants, possibly in inorganic form.

During the dry period, a reduction in the CP content of the whole plant and leaf blade was observed in comparison to the rainy period, with the lowest value being observed when there was no nitrogen fertilization. This behavior of reduction in the levels of CP in the dry period occurs due to the decrease of the development of the plants at this time of the year combined with the physiological maturation of the tissues, however, the values found are above 7%, which would be a minimum value for the ruminant animals to be able to maintain microbial activity in the rumen environment for degradation of the fibrous components of the diet (Lazzarini et al., 2009), which shows that the presence of the fertilizer provided an improvement in the composition of the produced forage.

The NDF values found are related to the plant structure, mainly with the leaf/stem ratio. The accelerated growth of the plant due to the application of N can cause an increase in the concentrations of structural carbohydrates such as cellulose and hemicellulose, increasing the contents of NDF. According to Van Soest (1965), it is necessary to observe the rapid growth of grasses, as NDF contents above 66% compromise the forage consumption since the association between NDF and consumption is explained by a linear regression equation negative and usually has been interpreted as a rumen filling effect.

The NDF values in the LB decreased in the rainy season, with a higher value observed in doses of 500 kg ha^{-1} of N (76.6%). Such values are in agreement with those cited by Mochel Filho et al. (2016) evaluating the productivity and chemical composition of *Panicum maximum* cv. Mombaça under irrigation and nitrogen fertilization, where an average of NDF value of 70.10% was observed in the leaf blade. The highest levels of both the whole plant and its components were observed during the dry period, with a maximum content of 75.5; 75.6 and 81.0%, for the whole plant, leaf blade, and stem, respectively.

As for the ADF values in the whole plant, the highest value was observed in the dose of 500 kg ha^{-1} of N with an average value of 46.9%. Lower values were reported by Fernandes et al. (2014)

who conducted an experiment to evaluate the productive and qualitative potential of *Panicum maximum* genotypes and determined average of ADF levels of 37.1 and 36.9% in the first and second year of evaluation, respectively. According to Van Soest, (1994) the concentration of the FDA correlates in a negative linear way with the digestibility of forage DM, so that with the increase of this fraction, the IVDDM decreases. Thus, this negative linear association naturally depends on several factors, among which are the species, climate, soil, and the adopted management, originating from geographical variations between the different microclimates of cultivation of forages.

Due to the direct effect of nitrogen application on the development of plants, the determination of the cell wall of forage plants becomes of great importance, since they are related to the fact that the consumption of DM of tropical grasses of type C4, which have high cell wall content by cattle is relatively high, including the species of P. maximum, possibly because these animals can better accommodate fibrous forages in their large rumens (Barros et al., 2011).

The contents of Lig in the whole plant had higher values with the application of the lowest doses of N, between doses and cuts equivalent to the treatments of 300 and 500 kg ha^{-1} of N. Lignin, a non-carbohydrate polymer is composed of phenolic monomers which are responsible for decreasing the digestibility of nutrients in forage plants (Van Soest, 1963;), is an important component in determining the extent of biological degradation in ruminants (Van Soest and Robertson, 1980), in tropical forage plants their accumulation is more accentuated and with the rapid development of plants with the supply of nitrogen can cause the use of these by animals is compromised.

The *in vitro* digestibility of dry matter of the whole plant was similar between the seasons with an average close to 60%, which can be considered satisfactory in the case of tropical grasses, although the IVDDM of the Mombaça grass can reach values higher than those found in this experiment. The IVDDM values determined in this work are lower than those described in the literature by Clipes et al. (2005) in an experiment conducted in a pasture area with rotated and irrigated grass-mombaça, with manual grazing simulation, which found IVDDM values of 63.56%.

The reductions in the IVDDM values in the dry period are probably related to the high levels of fibers and lower concentrations of CP determined in the plant at this time of year. According to Dias et al (2007), the advance of the physiological stage of plants causes an increase in the levels of NDF, ADF, and reduction of protein concentration, decreasing the IVDDM. In this context, Pereira et al. (2011), evaluated Mombaça grass and concluded that, regardless of nitrogen fertilization and crop density, Mombaça grass plants stall their development during the winter, the dry season of the year. Thus, it is expected that in this period the nutritional value of the plant maintained in field conditions will also be compromised.

5 CONCLUSIONS

The nutritional value of Mombaça grass submitted to cutting heights and doses of N was positively altered. Management of mombaça grass with 0.40 m forage residue and application of up to 300 kg ha^{-1} of N is recommended throughout the rainy season of the year.

REFERENCES

Barros, L.V; Paulino, M.F., Valadares Filho, S.D.C., Detmann, E., Silva, F.G., Valente, E.E.L., Lopes, S.A & Martins, L.S. (2011). Replacement of soybean meal by cottonseed meal 38% in multiple supplements for grazing beef heifers. *Revista Brasileira de Zootecnia*, 40 (4), 852-859. DOI: https://doi.org/10.1590/S1516-35982011000400020

Brâncio, P. A., do Nascimento, D., Euclides, V. B., da Fonseca, D. M., de Almeida, R. G., Macedo, M. M., & Barbosa, R. A. (2003). Evaluation of three varieties of Panicum maximum Jacq. under grazing: diet composition, dry matter intake and animal weight gain. *Revista brasileira de zootecnia-brazilian journal of animal science*, *32*(5), 1037-1044.

Cardoso, S., Volpe, E., & Macedo, M. C. M. (2016). Effect of nitrogen and lime on Massai grass subjected to intensive cutting. *Pesquisa Agropecuária Tropical*, *46*(1), 19-27. DOI: https://doi.org/10.1590/1983-40632016v4638132.

Carnevalli, R. A., Da Silva, S. C., Bueno, A. D. O., Uebele, M. C., Bueno, F. O., Hodgson, J., ... & Morais, J. P. G. (2006). Herbage production and grazing losses in Panicum maximum cv. Mombaça under four grazing managements. *Tropical grasslands*, *40*(3), 165.

Carvalho, A. L. S., Martuscello, J. A., Almeida, O. G. D., Braz, T. G. D. S., Cunha, D. D. N. F. V., & Jank, L. (2017). Production and quality of Mombaça grass forage under different residual heights. *Acta Scientiarum. Animal Sciences*, *39*(2), 143-148. DOI: https://doi.org/10.4025/actascianimsci.v39i2.34599.

Clipes, R. C., Coelho da Silva, J. F., Detmann, E., Vasquez, H. M., Scolforo, L., & Lombardi, C. T. (2005). Avaliação de métodos de amostragem em pastagens de capim-elefante (Pennisetum purpureum, Schum) e capim-mombaça (Panicum maximum, Jacq) sob pastejo rotacionado. *Arquivo Brasileiro de Medicina Veterinária e Zootecnia*, 57(1), 120-127. DOI: https://doi.org/10.1590/S0102-09352005000100016

Dias, F. J., Jobim, C. C., Cecato, U., Branco, A. F., & Santello, G. A. (2007). Composição química do capim-Mombaça (Panicum maximum Jacq. cv. Mombaça) adubado com diferentes fontes de fósforo sob pastejo. *Acta Scientiarum. Animal Sciences*, *29*(1), 9-16.

Fernandes, F. D., Ramos, A. K. B., Jank, L., Carvalho, M. A., Martha Jr, G. B., & Braga, G. J. (2014). Forage yield and nutritive value of Panicum maximum genotypes in the Brazilian savannah. *Scientia Agricola*, 71(1), 23-29. DOI: https://doi.org/10.1590/S0103-90162014000100003

Koppen, W 1948, '*Climatologia: un estudio de los climas de la Tierra*'. Fundo de Cultura Economica. México, 478 p.

Lazzarini, I., Detmann, E., Sampaio, C. B., Paulino, M. F., Valadares Filho, S. C., Souza, M. A., & Oliveira, F. A. (2009). Dinâmicas de trânsito e degradação da fibra em detergente neutro em bovinos alimentados com forragem tropical de baixa qualidade e compostos nitrogenados. *Arquivo Brasileiro de Medicina Veterinária e Zootecnia*, 61(3), 635-647. DOI: http://dx.doi.org/10.1590/S0102-09352009000300017

Leal, D. M., França, A. D. S., Oliveira, L. G., Correa, D. S., Arnhold, E., Ferreira, R. N., ... & Brunes, L. C. (2017). Fracionamento de carboidratos e proteínas da Brachiaria híbrida 'Mulato II'sob adubação nitrogenada e regime de cortes. *Archivos de zootecnia*, *66*(254), 181-188. DOI: https://doi.org/10.21071/az.v66i254.2320

Marques, M. F., Romualdo, L. M., Martinez, J. F., Lima, C. G. D., Lunardi, L. J., Luz, P. H. D. C., & Herling, V. R. (2016). Momento de aplicação do nitrogênio e algumas variáveis estruturais e bromatológicas do capim-massai. *Arquivo Brasileiro de Medicina Veterinária e Zootecnia*, *68*(3), 776-784. DOI: https://doi.org/10.1590/1678-4162-8500

Júnior, M., Bueno, G., Corsi, M., Barioni, L. G., & Vilela, L. (2004). Intensidade de desfolha e produção de forragem do capim-tanzânia irrigado na primavera e no verão. *Pesquisa Agropecuária Brasileira*, 39(9), 927-936. DOI: http://dx.doi.org/10.1590/S0100-204X2004000900013

Martuscello, J. A., Fonseca, D. M. D., Nascimento Júnior, D. D., Santos, P. M., Ribeiro Junior, J. I., Cunha, D. D. N. F. V., & Moreira, L. D. M. (2005). Características morfogênicas e estruturais do capim-xaraés submetido à adubação nitrogenada e desfolhação. *Revista Brasileira de Zootecnia*, *34*(5), 1475-1482. https://doi.org/10.1590/S1516-35982005000500007

Martuscello, J. A., Fonseca, D. M. D., Nascimento Júnior, D. D., Santos, P. M., Cunha, D. D. N. F. V., & Moreira, L. D. M. (2006). Características morfogênicas e estruturais de capim-massai submetido a adubação nitrogenada e desfolhação. *Revista brasileira de Zootecnia*, *35*(3), 665-671. https://doi.org/10.1590/S1516-35982006000300006

Menke, K. H. (1988). Estimation of the energetic feed value obtained from chemical analysis and in vitro gas production using rumen fluid. *Animal research and development*, *28*, 7-55.

Mochel Filho, W. D. J., Carneiro, M. S. D. S., Andrade, A. C., Pereira, E. S., Andrade, A. P. D., Cândido, M. J., ... & Costa, N. D. L. (2016). Produtividade e composição bromatológica de Panicum maximum cv. Mombaça sob irrigação e adubação azotada. *Revista de Ciências Agrárias*, *39*(1), 81-88. DOI: http://dx.doi.org/10.19084/RCA14154

Monteiro, FA 1995, 'Nutrição mineral e adubação', Proceedings of the Simpósio Sobre Manejo Da Pastagem, Fundação Estudos Agrários Luiz de Queiroz, Universidade de São Paulo, Piracicaba, pp.219-244.

Pereira, V. V., Fonseca, D. M. D., Martuscello, J. A., Braz, T. G. D. S., Santos, M. V., & Cecon, P. R. (2011). Características morfogênicas e estruturais de capim-mombaça em três densidades de cultivo adubado com nitrogênio. *Revista Brasileira de Zootecnia*, *40*(12), 2681-2689. https://doi.org/10.1590/S1516-35982011001200010

Resquín, M. F. A., Britez, G.V. D., Areco, N. V. A., Luján, L.M.A., Villamayor, M. E. M., Carson, J.I.L., Aguero, M.A.F., Torres, M. R.C. 2020 Response of (Brachiaria Brizantha cv. Piatã) to the application of mycorrhizae and phosphates. Brazilian Journal of Animal Eviromental Reshearch, 4(3), 2887-2896. https://doi.org/ 10.34188/bjaerv3n4-010

Rodrigues, A. L. P., Sampaio, I. B. M., Carneiro, J. C., Tomich, T. R., & Martins, R. G. R. (2004). Degradabilidade in situ da matéria seca de forrageiras tropicais obtidas em diferentes épocas de corte. *Arquivo Brasileiro de Medicina Veterinária e Zootecnia*, *56*(5), 658-664. DOI: https://doi.org/10.1590/S0102-09352004000500014

Santos, H. G., Jacomine, P. K. T., Dos Anjos, L. H. C., De Oliveira, V. A., Lumbreras, J. F., Coelho, M. R., ... & Cunha, T. J. F. (2018). *Sistema brasileiro de classificação de solos*. Brasília, DF: Embrapa, 2018.

SAS INSTITUTE INC 2004, 'SAS user's guide: SAS/STAT®', release 9.1. Cary, North Carolina, 824p.

Silva, J. D. L., Ribeiro, K. G., Herculano, B. N., Pereira, O. G., Pereira, R. C., & Soares, L. F. P. (2016). Massa de forragem e características estruturais e bromatológicas de cultivares de Brachiaria e Panicum. *Ciência Animal Brasileira*, *17*(3), 342-348. DOI: http://dx.doi.org/10.1590/1089-6891v17i332914

Soares Filho, C. V., Cecato, U., Ribeiro, O. L., Roma, C. F. D. C., & Beloni, T. (2015). Morphogenesis in pastures with Tanzania grass fertilized with nitrogen doses under a grazing system. *Acta Scientiarum. Animal Sciences*, 37(3), 235-241. DOI: http://dx.doi.org/10.4025/actascianimsci.v37i3.27101

Soest, P. V. (1963). Use of detergents in the analysis of fibrous feeds. II. A rapid method for the determination of fiber and lignin. *Journal of the Association of Official Agricultural Chemists*, *46*(5), 829-835. DOI: https://doi.org/10.1093/jaoac/46.5.829

Van Soest, P. J. (1965). Symposium on factors influencing the voluntary intake of herbage by ruminants: voluntary intake in relation to chemical composition and digestibility. *Journal of Animal Science*, *24*(3), 834-843. DOI: https://doi.org/10.2527/jas1965.243834x

Van Soest, P., & Robertson, J. (1979). Systems of analysis for evaluating fibrous feeds. In *Standardization of analytical methodology for feeds: proceedings*... IDRC, Ottawa, ON, CA.

Van Soest, P. J. (2018). *Nutritional ecology of the ruminant*. Cornell university press.

Vilela, L., Soares, W. V., Sousa, D. D., & Macedo, M. C. M. (1998). *Calagem e adubação para pastagens na região do cerrado*. Planaltina: Embrapa Cerrados.

Martuscello, J. A., Majerowicz, N., Da Cunha, D. N. F. V., De Amorim, P. L., & Braz, T. G. S. (2016). Características produtivas e fisiológicas de capim-elefante submetido à adubação nitrogenada. *Archivos de zootecnia*, *65*(252), 565-570. DOI: https://doi.org/10.21071/az.v65i252.1927