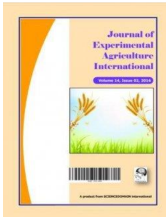

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Agronomic and Bromatological Traits of *Brachiaria brizantha* cv. Piatã as Affected by Nitrogen Rates and Cutting Heights

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Authors' contributions

This work was carried out in collaboration among all authors. Authors ACDA and DOSL designed the study, performed the statistical analysis, wrote the protocol and wrote the first draft of the manuscript. Authors DAF and SP managed the analyses of the study. Authors RCR, JGA, LSC and WMP managed the literature searches. All authors read and approved the final manuscript.

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ABSTRACT

This study aimed to evaluate the bromatological traits of *Brachiaria brizantha* cv. Piatã submitted to different cutting heights and nitrogen (N) rates. A randomized complete block design with sixteen treatments and four replications was used. The treatments arranged in 4x4 factorial arrangement, comprised four cutting heights (8, 16, 24 and 32 cm) and nitrogen rates (0, 100, 200, 300 kg N ha^{-1}). N rates were applied after a standardization cutting. Agronomic traits comprised number of tillers, dry mass, leaf blade pseudocolus ratio and amount of senescent material. Bromatological

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traits of morphological components leaf blade and pseudostem comprised crude protein (CP), neutral detergent fiber (NDF), acid detergent fiber (ADF) and mineral matter (MM). In the first and second cuttings, maximum yields were obtained at 16 and 32 cm cutting heights combined with N rates of 180.5 and 230.5 kg ha^{-1}, respectively. No interaction was observed between N rates and cutting heights. It was concluded that 16 and 24 cm cutting heights combined with N rates of 200 and 300 kg ha^{-1} improved agronomic and bromatological traits of Brachiaria with a better efficiency in pasture system.

Keywords: Fertilizer application; pasture management; tropical forage; tillering stage; ratooning ability.

1. INTRODUCTION

Cattle production in Brazil comprises natural and cultivated pastures as the main source of animal feed, due to the large extension of available areas with a great adaptability of plants currently cultivated. Optimum grazing practices in livestock production will promote a better animal feed and therefore a good quality meat production at a reduced cost [1].

In addition to that, a significant part of ruminant production in Brazil is conducted in systems which pasture is the main source of animal feed. However, due to the climatic conditions, tropical forages present a marked seasonality of production, with forage of good nutritive value and availability in the rainy season, and forage losses in quantity and quality during the dry season. In this perspective, it is fundamental to implement management practices that allow the optimization of the forage use for increasing animal production [2,3,4].

Studies indicate that from 50% to 70% of pastures present some degree of degradation, mostly due to inadequate management and lack of cultural treatments such as soil fertilization [5]. The low soil fertility associated with the absence or inefficiency of fertilizer applications, especially N-fertilization, accelerates the process of pasture degradation, which today is a major concern in Brazilian livestock farming [6-7].

Nitrogen (N) is the most influencing nutrient in terms of gains in forage production. Its application is of crucial importance to maintain the productivity and sustainability of pasture. Nitrogen is required in larger quantities in maintenance fertilizers, and its cycle in the ecosystem is of paramount importance to avoid pasture degradation [8-10]. In addition, it acts in the process of meristem activation and is closely related to the number of dormant buds at plant tillering stage [11]. It is also the main constituent of proteins participating actively in the synthesis of organic compounds forming plant structure. Therefore, it is responsible either for structural characteristics (leaf size, tiller density and leaves per tiller), as for morphogenic characteristics (leaf growth rate and foliar senescence) of the plant [12]. It is even able to alter the proportion of these morphological components, with the leaves being richer in proteins and more easily digestible [13].

Several factors interact with each other in a grazing cattle system. The understanding of the functioning of these factors and, therefore, of the causal relations that govern their behavior passes through the knowledge of its components and of its degree of organization [14].

The principle of any bovine production system is to achieve a balance between food demand and supply (energy and digestible/metabolizable nutrients). Theoretically, a high quality fodder should be able to provide the necessary nutrients for meeting the requirements of grazing animals. Dry matter (DM) intake is the most important factor in nutrition, since it establishes the amount of nutrients available for health and animal production [15].

The idealization and formulation of pasture management strategies based on pasture goals, particularly plant height, become a real alternative and a basic premise for improving and increasing the efficiency and the output of animal production systems in tropical pastures [16].

Leaf proportion as well as the leaf/culm ratio regarding forage production were used in reference to pasture management, since they influence the digestive behavior and the grazing performance of ruminants. The highest leaf/culm ratio can be used as an index of forage nutritive value, as well as the height of the pasture and the dry matter availability, which facilitates forage intake by the animal and consequently its behavior during grazing [17,18].

The aim of this study was to recommend combinations of cutting heights and nitrogen rates that promote the increase of agronomic and bromatological characteristics of *B. brizantha* cv. Piatã.

2. MATERIALS AND METHODS

2.1 Location of the Study Area

The experiment was carried out in a greenhouse of the Faculty of Agronomy and Animal Science at the Federal University of Mato Grosso (UFMT), in the following geographic coordinates: 15°36'31 "S, 56°03'49" W. Forage crop material used was *B. brizantha* cultivar Piatã.

2.2 Data Collection

The soil used in the experiment was collected over a depth of 0-20 cm on the Experimental Farm of the Federal University of Mato Grosso (UFMT), MT State (Brazil). The preceding crop was maize for silage production. After collection, the soil was dried, sifted, homogenized and placed in plastic pots with capacity for 8 kg, using a 6.5 kg soil sample in each pot. The soil was classified as Yellow Latosol [19]. The temperature was continuously monitored during the course of experiment (minimum of 25°C, maximum of 41°C).

Sowing was performed on November 1, 2007, with 30 seeds per pot. Seedling emergence occurred seven days after sowing, and periodic thinning interventions were performed until six plants remained in each container. With regard to crop water requirements, the vessels were kept at field capacity, being monitored three times a day.

At the last thinning, 40 days after sowing, four nitrogen rates were applied. At that moment, a standardization clipping was also performed at the pre-determined height, measured with a ruler from ground level.

Treatments were arranged in a 4x4 factorial design, consisting of four nitrogen doses (N) and four cutting heights. Nitrogen rates equivalent to 0, 100, 200 and 300 kg ha^{-1} (0, 0.72, 1.44 and 2.16 g pot^{-1}) were applied, using urea as fertilizer. Always prior to the N application, clippings were made at the previously defined heights of 8, 16, 24 and 32 cm. The first application was performed after the standardization clipping. After 30 days, the first clipping and the second application of the nitrogen fertilization were performed to the new growth cycle. The experimental design was completely randomized, with 16 treatments and 4 replications.

Two cuttings were performed, with the forage being separated into shoot comprising leaf blade, culm and sheath (pseudostem), and senescent material. Subsequently, the material was dried until constant weight in a forced-air ventilation oven at 60°C for 72 hours. After pre-drying, samples were weighed and processed in a Willey mill with a 2 mm mesh sieve. The milled plant material was then packed into plastic bags for further chemical analyses.

The following agronomic characteristics were evaluated: Number of tillers, dry mass (g pot^{-1}), leaf-blade/pseudostem ratio, and senescent material production (g pot^{-1}). It is worth mentioning that the tillering evaluation was performed prior to each clipping by counting the number of tillers per pot.

The determination of dry matter content in the leaf blade, pseudostem and senescent material components of the samples was performed according to the authors cited in the reference [20], as described below. From each treatment, three samples of leaf, pseudostem and senescent material were subjected to pre-drying in a forced air circulation oven at temperatures ranging from 55 to 60°C for 24 hours. Afterward the samples were subjected to grinding by a shopping mill equipped with a 1 mm mesh sieve. Subsequently, three 3-gram replicates of each milled material were weighed and placed in a forced ventilation oven at 105°C for 16 hours. At the end of these procedures, the dry matter content (DM) was determined by difference in weight [20].

Crude protein (CP), neutral detergent fiber (NDF), acid detergent fiber (ADF) and mineral matter (MM) contents were determined according to the methodology of authors cited in the reference [20], as described below.

Crude protein content was determined through digestion, distillation and titration of the samples. The process started by weighing three 0.5 g replicates of leaf, pseudostem and senescent material samples for each treatment, previously grinded in mills with 1 mm mesh sieves.

Samples were placed in test tubes for analysis with 2 g of the digest mixture (10:1 sodium and copper sulfate) and 10 mL of pure sulfuric acid. Then, using a laminar flow cabinet, the test tubes were placed in a block digester and heated at 350°C until bleaching of solution. At the bleaching point, the solution was further heated during 30 minutes [20].

Test tubes were then withdrawn from the block digester and placed inside a laminar flow cabinet for cooling. Afterward, 40 mL of distilled water were added to the digested solution in the test tube and homogenized. The sample from the test tube was transferred to a distillation assembly (Kjeldahl) and 20 mL of sodium hydroxide were added. In parallel, 50 mL of distilled water, 50 mL of boric acid and a mixed indicator (bromocresol green-methyl red) were added to the to an Erlenmeyer flask and coupled to the distillation assembly to receive ammonia from the distillation process. An Erlenmeyer flask was then withdrawn with the distilled sample and the titration was performed with 0.1 N hydrochloric acid until change in color of the mixed indicator (from green to pink). It is noteworthy that two "blank" tests consisting of two test tubes without samples were subjected to all the above-mentioned processes (digestion, distillation and titration) to certify that results obtained are precisely from samples subjected to treatments [20].

For NDF determination, 1.0 g of leaf in three replicates, pseudostem, and senescent material samples were weighed for each treatment, previously crushed with 1 mm mesh sieves. Samples were placed in beakers with 100 mL of neutral detergent and then heated for 60 minutes. Afterward, filtration was performed in a previously weighed filter crucible, through vacuum suction. The material was washed with hot water into the filter crucible and then with 30 mL of acetone, being subsequently packed into a muffle furnace at 105°C for 8 hours. The neutral detergent fiber (NDF) content was determined by difference in weight. ADF was determined similarly as NDF, at the difference that the detergent used was acid. Nitrogen concentration was calculated as follows:

[(A - B) x N x 14 x 100] / mass of the sample; considering A = volume of the hydrochloric acid solution used in the titration (mL); B = volume of the hydrochloric acid solution used in the "blank" titration (mL); N = normality of the hydrochloric acid [20].

Mineral matter was determined by weighing 2.0 g of leaf three times, pseudostem and senescent material samples for each treatment, previously crushed with 1 mm mesh sieves. Samples were prepared in crucibles and taken to oven muffle at 600°C for 4 hours. Mineral matter (MM) content was determined by difference in weight [20].

2.3 Data Analysis Procedure

The data were subjected to analysis of variance and regression analysis with a significance level of 5%, using the SANEST software [21].

3. RESULTS AND DISCUSSION

3.1 Agronomic Traits of *B. brizantha* cv. Piatã

At first clipping, the highest number of tillers (21 tillers pot^{-1}) was observed at the 24 cm height, with N rate of 207.75 kg ha^{-1} (Table 1). Considering that nitrogen stimulates grass tillering [22], the authors cited in the reference [23] also obtained a positive response from the total number of tillers due to increase in nitrogen supply.

Similar results on response to nitrogen fertilizer were reported [24], where maximum tillering of *B. decumbens* and *B. brizantha* cv. Marandu occurred, respectively, with 183 and 178 mg dm^{-3}. The maximum number of tillers in the *B. brizantha* cv. Marandu was obtained at a nitrogen rate of 188 mg dm^{-3} [25]. This increase was due to nitrogen influence on forage structural characteristics [26].

At first clipping, a maximum yield (8.08 g pot^{-1}) was observed at the 16 cm height with an intermediate N rate of 180.50 kg ha^{-1} (Table 1). At second clipping, the maximum yield (12.62 g pot^{-1}) was obtained at the 32 cm height with the N dose of 230.50 kg ha^{-1}.

The authors cited in the reference [27], working with the *B. brizantha* cv. Xaraés, verified an increase in the total dry mass production of the shoot part due to the increase in the leaf production under increasing N doses. This might have occurred because nitrogen is the nutrient that provides most of the yield in the dry matter production of forage grasses, for being an important component of proteins and influencing metabolic processes [10,28]. In addition, it promotes increments in the production of green dry matter by increasing the regrowth vigor due to the increase of the cellular constituents of the plant by the assimilation and association of nitrogen into the carbon chains [29].

For the leaf blade/pseudostem ratio, the effect of the N doses occurred only in the first clipping (Table 1), and a dose of 84 kg ha^{-1} N provided increase of the leaf blade/pseudostem ratio. In the second clipping, the highest leaf blade/pseudostem ratio (17, 26) was verified at the height of 32 cm and at the dose of 232.92 kg ha^{-1} of N (Table 1).

The authors mentioned in the reference [27], when performing correction of nitrogen and potassium doses, verified that in the highest N doses the leaf blade/pseudostem ratio decreased in the *B. brizantha* cv. Xaraés, due to the higher plant growth and to the elongation process of the stems. However, in studies with *Panicum maximum* cv. BRS Quênia, regardless of nitrogen fertilization, a high leaf blade/pseudostem ratio was maintained, pointing to differences in the response profile to the fertilization of grasses belonging to other genera [23].

In the first clipping, there was no effect of the cutting heights or nitrogen rates on the production of senescent material, with this being associated to the fact that the plant is still in its first growth cycle, presenting a large proportion of young tissue in its botanical composition. In the second clipping, at the height of 32 cm, the highest production of senescent material (1.26 g pot^{-1}) was observed at the dose of 146.25 kg ha^{-1} of N (Table 1).

Comparing these results with findings reported by authors cited in the reference [30] with *B. brizantha* cv. Marandu, the leaf senescence rate was also higher in pastures maintained with higher cutting heights. Growing nitrogen rates can increase the senescence rate [31], as mentioned in reference [23] could conclude that the production of dead material was increasing linearly to fertilization, increasing from 3.46 g pot^{-1} to 8.50 g pot^{-1}, at doses of 0 and 200 mg dm^{-3}, respectively.

One measure that can prevent forage loss through senescence is the adjustment of grazing management, that is, when an increase in N doses occurs (fertilization), it is also necessary to increase the intensity of clipping or defoliation. This statement can be proven by the verification that the highest nitrogen dose (300 kg ha^{-1} of N) provided reduction in the senescent material production at the cutting heights of 24 and 32 cm, a benefit also reported by the authors cited in reference [32] in studies with the *P. maximum* Jacq. cv. Tanzânia-1, being associated with the light intercepted by the leaf surface.

3.2 Bromatological Attributes of *B. brizantha* cv. Piatã

There was no interaction between the N doses and the cutting heights whereas there was effect of the nitrogen doses on the CP content in the leaf blades in the first clipping. There was an increase of 0.0139% and 0.008% in the CP content per kg of N applied in the *B. brizantha* cv. Piatã (Table 2), in the first and second clippings, respectively. At 300 kg ha^{-1} of N, the highest CP content (9.06%) was observed in the first clipping in comparison to the second one (7.43%), possibly due to the fact that in the first clipping the tissues were tender and younger, since the plants were in the first growth cycle (Table 2).

In the first clipping, there was interaction between N doses and cutting heights for the crude protein content in the pseudostem, according to Table 2. At the cutting height of 8 cm, the point of maximum CP content (6.67%) was reached at a dose of 217.50 kg ha^{-1} of N, compared to 6.18% at 16 cm height combined with the dose of 243.33 kg ha^{-1} of N (Table 2). At 24 cm height, a 0.0108% increase in CP content was observed per kg of N applied.

These findings may be explained due to the fact that nitrogen fertilization can increase both the dry matter yield and the crude protein content of the forage [33]. The authors cited in the reference [34], studying the grazing of lactating cows in pastures of *P. maximum* cv. Mombaça, observed high CP contents in the plants from the pasture management associated with nitrogen fertilization and irrigation.

These high contents are desirable, since, in spite of the availability of potentially digestible fiber in pastures, protein is the nutrient that most limits animal performance during the dry period [35]. According to the authors mentioned in the reference [36], for the cellulolytic ruminal bacteria to be well developed, the CP content should be higher than 7%.

In the second clipping, there was an increase of 1.74% in the CP content of the pseudostem with the maximum nitrogen dose compared to the absence of nitrogen (Table 2). The authors mentioned in the reference [37], working with the *B. brizantha* cv. Marandu under four nitrogen (0, 100, 200 and 300 kg ha^{-1} year^{-1}) and three phosphorus doses (0, 50 and 100 kg ha^{-1} year^{-1}), also found that the CP levels in the culm increased along with the nitrogen rates, corroborating with the results obtained in the present study. In addition, the authors mentioned in the reference [38], working with N and P levels in the *B. brizantha* cv. Marandu found that the highest CP levels in the culms were verified with the application of the maximum level of nitrogen.

In the first and second clippings, there was no interaction between the N levels and the cutting heights for the neutral detergent fiber (NDF) in the leaf blades (Table 2). These results contrast with those reported by the authors cited in the reference [39], stating that the NDF levels in the leaf blade of *Pennisetum purpureum* Shum in the rainy period increased as a function of the applied N doses, with values between 75.39 and 77.49% for the doses of 100 and 400 kg ha^{-1} of N, respectively.

In addition to that, the authors cited in the reference [40] reported that the NDF levels were influenced by the nitrogen rates in the first, eighth, ninth and tenth clippings, adjusting to an increasing linear function. This fact was also observed by the authors mentioned in the reference [3], when studying growing nitrogen doses in *P. maximum* cultivars Tanzania-1 and Mombaça. It is worth noting that it is not only fertilization that regulates the fiber level of the roughage, but also genetic aspects, intrinsic to the species/cultivar and environmental factors.

Table 1. Agronomic traits of *B. brizantha* cv. Piatã submitted to N rates and cutting heights

Cutting height	N dose (kg ha^{-1})				Adjusted equation	R^2
(cm)	0	100	200	300		
Tiller number (nº pot^{-1})						
8	15.425	17.255	17.025	14.825	$y = 15.425 + 0.028x – 0.0001x^2$	0.99
16	12.675	18.025	18.975	15.525	$y = 12.675 + 0.0755x – 0.0002x^2$	0.99
24	11.938	18.248	20.558	18.868	$y = 11.938 + 0.0831x – 0.0002x^2$	0.99
32	13.75	17.87	17.99	14.11	$y = 13.75 + 0.0612x – 0.0002x^2$	0.99
DM production (g pot^{-1})						
1st Clipping						
8	3.1775	5.1975	5.2175	3.2375	$y = 3.1775 + 0.0302x - 0.0001x^2$	0.98
16	4.8231	7.4331	8.0431	6.6531	$y = 4.8231 + 0.0361x - 0.0001x^2$	0.99
24	2.8398	5.9398	7.4398	7.3398	$y = 2.8398 + 0.039x - 0.00008x^2$	0.94
32	2.1361	4.9461	6.1561	5.7661	$y = 2.1361 + 0.0361x - 0.00008x^2$	0.99
2nd Clipping						
8	2.1769	4.6069	5.0369	3.4669	$y = 2.1769 + 0.0343x - 0.0001x^2$	0.80
16	2.5561	8.0261	9.4961	6.9661	$y = 2.5561 + 0.0747x - 0.0002x^2$	0.99
24	2.3408	8.8908	11.4408	9.9908	$y = 2.3408 + 0.0855x - 0.0002x^2$	0.92
32	1.9971	9.2171	12.4371	11.6571	$y = 1.9971 + 0.0922x - 0.0002x^2$	0.98
Leaf blade/pseudostem ratio						
1st Clipping	2.0971	2.2271	3.5471	6.8671	$y = 2.9071 – 0.0168x + 0.0001x^2$	0.99
2nd Clipping						
8	1.5574	3.2174	3.4774	2.3374	$y = 1.5574 + 0.0236x - 0.00007x^2$	0.75
16	2.0105	5.8205	7.2905	6.4205	$y = 2.0105 + 0.0498x - 0.000117x^2$	0.99
24	2.0569	6.8769	9.0969	8.7169	$y = 2.0569 + 0.0612x - 0.00013x^2$	0.93
32	1.7544	7.4324	10.0064	9.4764	$y = 1.7544 + 0.0723x - 0.0001552x^2$	0.98
Senescent material production (g pot^{-1})						
1st Clipping						
24	2.0569	6.8769	9.0969	8.7169	$y = 2.0569 + 0.0612x - 0.00013x^2$	0.93
32	1.7544	7.4324	10.0064	9.4764	$y = 1.7544 + 0.0723x - 0.0001552x^2$	0.98
2nd Clipping						
24	0.3426	0.6726	0.6026	0.1326	$y = 0.3426 + 0.0053x - 0.00002x^2$	0.58
32	0.4093	1.1793	1.1493	0.3193	$y = 0.4093 + 0.0117x - 0.00004x^2$	0.92

Table 2. Bromatological traits of *B. brizantha* cv. piatã submitted to N rates and cutting heights

Cutting height (cm)	N Dose (kg ha^{-1})				Adjusted equation	R^2
	0	100	200	300		
Leaf blade CP content (%)						
1st Clipping	4.8898	3.4998	2.1098	0.7198	y = 4.8898 - 0.0139x	0.99
2nd Clipping	5.0301	5.8301	6.6301	7,4301	y = 5.0301 + 0.008x	0.98
Pseudostem CP content (%)						
1st Clipping						
8	2.8886	5.5686	6.6486	6.1286	y = 2.8886 + 0.0348x – 0.00008x^2	0.94
16	2.6329	4.9529	6.0729	5.9929	y = 2.6329 + 0.0292x – 0.00006x^2	0.97
24	2.766	3.8445	4.923	6.0015	y = 2.766 + 0.010785x	0.92
32	6.3839	4.8829	4.5399	5.3549	y = 6.3839 - 0.0208x + 0.0000579x^2	0.95
2nd Clipping	3.7563	4.3363	4.9163	5.4963	y = 3.7563 + 0.0058x	0.81
Leaf blade NDF (%)						
1st Clipping	80.964	73.064	69.434	69.804	y = 80.694 - 0.0963x + 0.0002x^2	0.99
2nd Clipping	78.712	72.412	70.112	71.812	y = 78.712 - 0.083x + 0.0002x^2	0.94
Pseudostem NDF (%)						
1st Clipping						
8	87.673	84.073	80.473	76.873	y = 87.673 - 0.036x	0.93
16	86.6791	81.7511	79.5071	78.9471	y = 86.6791 - 0.0627x + 0.0001342x^2	0.98
24	85.133	82.823	80.513	78.203	y = 85.133 - 0.0231x	0.99
32	85.001	83.011	81.021	79.031	y = 85.001 - 0.0199x	0.95
2nd Clipping	80.402	85.342	84.282	77.222	y = 80.402 + 0.0794x - 0.0003x^2	0.94
Leaf blade ADF (%)						
1st Clipping	40.489	38.289	36.089	33.889	y = 40.489 - 0.022x	0.99
2nd Clipping	40.096	37.686	35.276	32.866	y = 40.096 - 0.0241x	0.82
Pseudostem ADF (%)						
1st Clipping	53.103	47.433	45.763	48.093	y = 53.103 - 0.0767x + 0.0002x^2	0.97
2nd Clipping	47.354	52.784	52.214	45.664	y = 47.354 - 0.0843x – 0.0003x^2	0.99
Leaf blade MM (%)						
1st Clipping	8.7174	11.1774	23.6374	46.0974	y = 8.7174 - 0.0254x + 0.0005x^2	0.99
2nd Clipping	7.8509	5.7309	5.2109	6.2909	y = 7.8509 - 0.0292x + 0.00008x^2	0.99
Pseudostem MM (%)						
1st Clipping						
8	8.2659	7.6559	8.6459	11.2359	y = 8.2659 - 0.0141x + 0.00008x^2	0.99
16	8.692	7.792	8.692	11.392	y = 8.6920 - 0.018x + 0.00009x^2	0.99
2nd Clipping	7.8067	5.3267	4.4467	5.1667	y = 7.8067 - 0.0328x + 0.00008x^2	0.99

It is important to consider the effect of N on the nutritive value of the forage. The authors cited in the reference [41] observed that the increase of N could cause compensatory decrease in components such as the cell wall, and change the NDF content of the forage. In addition, the authors mentioned in the reference [42], analyzing the NDF levels in the *B. brizantha* cv. Marandu under sources and doses of nitrogen also found a reduction in the NDF content with the increase of the nitrogen doses applied to the soil.

In the first clipping, there was a reduction of 0.036%, 0.0231% and 0.0199% in the NDF content in the pseudostem kg^{-1} of N applied, at the heights of 8, 24 and 32 cm, respectively (Table 2). At the height of 16 cm, a minimum content of 76.87% was verified at the N dose of 233.60 kg $ha^{-1}$of N. In the second clipping (Table 2), the maximum NDF of 85.63% was obtained in the pseudostem at the N dose of 132.33 kg ha^{-1}, damaging consumption and animal performance, since the NDF acts as determinant factor of the ruminal repletion process [43].

In the first and second clippings, there was a reduction of 0.022% and 0.0241% in the content of acid detergent fiber (ADF) kg^{-1} of N applied in the *B. brizantha* cv. Piatã, respectively (Table 2). Forages with ADF of 40% or more do not present a satisfactory nutritional value for use as animal feed, presenting lower consumption and digestibility [40]. The authors cited in the reference [42] verified an ADF content of 34.06%, close to that observed for the *B. brizantha* cultivar Piatã in the analyzed clippings.

Conversely, the authors cited in the reference [39], in an experiment with elephant grass subjected to nitrogen fertilization (0, 100, 200, 300 and 400 kg ha^{-1} of N) observed that the ADF levels in the leaf blades increased linearly (Table 2). According to the authors, this occurred due to changes in the structural components of the plant as a consequence of variation in the maturity stages, accelerated by fertilization and favorable climatic factors. With regard to the ADF content in the pseudostem, in the first clipping, the minimum percentage (45.75%) was verified at the dose of 191.75 kg ha^{-1} of N. In the second clipping, the maximum percentage (53.28%) was observed at the dose of 140.50 kg ha^{-1} of N (Table 2).

However, there are authors [40] who correlate the nutritional value and digestibility more with the plant physiology than with the applied nutrient doses and sources. The highest ADF levels in the whole plant in comparison to leaf blades may be attributed to the culm portion [39]. It is therefore important that the culm fraction present a good nutritive value in order to depreciate roughage quality as little as possible.

The minimum mineral matter (MM) content in the leaf blades (5.49%) was verified at the dose of 254 kg ha^{-1} of N in the first clipping. In the second clipping, the minimum content (5.19%) was obtained at the N dose of 182.50 kg ha^{-1} (Table 2). These results indicate that the increase of the nitrogen levels provided a dilution effect of the MM percentages, possibly due to the increase of the dry matter production of the forage, also considering that plants in nutritional imbalance (excess or nitrogen restriction) are more affected by this phenomenon [44].

The authors cited in the reference [45], studying *Brachiaria* sp. and fertilization, observed ash contents of 11.9 and 10.4% for the *B. brizantha* cv. Marandu and *B. decumbens* under P application, values close to those verified for the *B. brizantha* cv. Piatã in this experiment, of 8.72% and 7.85% for the first and second clippings, respectively.

In the first clipping, minimum MM contents of 7.64% (88.12 kg ha^{-1} of N) and 7.79% (100 kg ha^{-1} of N) were observed in the dry mass of the *B. brizantha* cv. Piatã for the heights of 8 and 16 cm, respectively. In the second clipping, there was no interaction between the N doses and the cutting heights, with effect of the nitrogen doses on the MM contents in the *B. brizantha* cv. Piatã being observed. The minimum ash content was 4.44% at the dose of 205 kg ha^{-1} of N (Table 2).

Similar to the leaf blade fraction, the levels of MM in the pseudostem decreased with the increase of the nitrogen fertilization, corroborating with the results found by the authors mentioned in the references [44,45], who suggested the occurrence of dilution of the MM contents with the increase in DM production, due to increases in nitrogen fertilization.

4. CONCLUSION

The study showed that 16 and 24 cm of cutting heights combined with a nitrogen rate ranging from 200 to 300 kg ha^{-1} promote an increase in agronomic and bromatological traits of *B. brizantha* cv. Piatã, as a management strategy to increase the efficiency of tropical forage systems.

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

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