

4 **Agronomic and bromatological traits of**
5 ***Brachiaria brizantha* cv. Piatã as affected by**
6 **nitrogen rates and cutting heights**
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13 **ABSTRACT**
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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 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.

15
16 **Keywords:** *fertilizer application, pasture management, tropical forage, tillering stage,*
17 *ratooning ability.*
18

19 **1. INTRODUCTION**
20

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

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

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

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

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

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

55 The idealization and formulation of pasture management strategies based on pasture goals,
56 particularly plant height, become a real alternative and a basic premise for improving and
57 increasing the efficiency and the output of animal production systems in tropical pastures
58 [16].

59 Leaf proportion as well as the leaf/culm ratio regarding forage production were used in
60 reference to pasture management, since they influence the digestive behavior and the
61 grazing performance of ruminants. The highest leaf/culm ratio can be used as an index of
62 forage nutritive value, as well as the height of the pasture and the dry matter availability,
63 which facilitates forage intake by the animal and consequently its behavior during grazing
64 [17; 18].

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

68 2. MATERIAL AND METHODS

69 2.1 Location of the study area 70

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

75 **2.2 Data collection**

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

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

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

89 Treatments were arranged in a 4x4 factorial design, consisting of four nitrogen doses (N)
90 and four cutting heights. Nitrogen rates equivalent to 0, 100, 200 and 300 kg ha⁻¹ (0, 0.72,
91 1.44 and 2.16 g pot⁻¹) were applied, using urea as fertilizer. Always prior to the N application,
92 **clippings** were made at the previously defined heights of 8, 16, 24 and 32 cm. The first
93 application was performed after the standardization **clipping**. After 30 days, the first **clipping**
94 and the second application of the nitrogen fertilization were performed to the new growth
95 cycle. The experimental design was completely randomized, with 16 treatments and 4
96 replications.

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

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

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

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

118 Crude protein content was determined through digestion, distillation and titration of the
119 samples. The process started by weighing three 0.5 g replicates of leaf, pseudostem and
120 senescent material samples for each treatment, previously grinded in mills with 1 mm mesh
121 sieves. Samples were placed in test tubes for analysis with 2 g of the digest mixture (10:1
122 sodium and copper sulfate) and 10 mL of pure sulfuric acid. Then, using a laminar flow
123 cabinet, the test tubes were placed in a block digester and heated at 350 ° C until bleaching
124 of solution. At the bleaching point, the solution was further heated during 30 minutes [20].

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

137 For NDF determination, 1.0 g of leaf in three replicates, pseudostem, and senescent material
138 samples were weighed for each treatment, previously crushed with 1 mm mesh sieves.
139 Samples were placed in beakers with 100 mL of neutral detergent and then heated for 60
140 minutes. Afterward, filtration was performed in a previously weighed filter crucible, through
141 vacuum suction. The material was washed with hot water into the filter crucible and then with
142 30 mL of acetone, being subsequently packed into a muffle furnace at 105 ° C for 8 hours.
143 The neutral detergent fiber (NDF) content was determined by difference in weight. ADF was
144 determined similarly as NDF, at the difference that the detergent used was acid. Nitrogen
145 concentration was calculated as follows:

146 $[(A - B) \times N \times 14 \times 100] / \text{mass of the sample}$; considering A = volume of the hydrochloric
147 acid solution used in the titration (mL); B = volume of the hydrochloric acid solution used in
148 the "blank" titration (mL); N = normality of the hydrochloric acid [20].

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

153 **2.3 Data analysis procedure**

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

156 **3. RESULTS AND DISCUSSION**

157

158 **3.1 Agronomic traits of *B. brizantha* cv. Piatã**

159

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

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

169 At first clipping, a maximum yield (8.08 g pot^{-1}) was observed at the 16 cm height with an
170 intermediate N rate of $180.50 \text{ kg ha}^{-1}$ (Table 1). At second clipping, the maximum yield
171 (12.62 g pot^{-1}) was obtained at the 32 cm height with the N dose of $230.50 \text{ kg ha}^{-1}$.

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

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

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

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

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

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

209 **Table 1. Agronomic traits of *B. brizantha* cv. Piatã submitted to N rates and cutting**
 210 **heights**
 211

Cutting height (cm)	N Dose (kg ha ⁻¹)				Adjusted Equation	R ²
	0	100	200	300		
Tiller number (n° 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						
1 st 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

		2 nd 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	

212

213 3.2 Bromatological attributes of *B. brizantha* cv. Piatã

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

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

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

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

235 In the second clipping, there was an increase of 1.74% in the CP content of the pseudostem
 236 with the maximum nitrogen dose compared to the absence of nitrogen (Table 2). The
 237 authors mentioned in the reference [37], working with the *B. brizantha* cv. Marandu under
 238 four nitrogen (0, 100, 200 and 300 kg ha⁻¹ year⁻¹) and three phosphorus doses (0, 50 and
 239 100 kg ha⁻¹ year⁻¹), also found that the CP levels in the culm increased along with the
 240 nitrogen rates, corroborating with the results obtained in the present study. In addition, the
 241 authors mentioned in the reference [38], working with N and P levels in the *B. brizantha* cv.
 242 Marandu found that the highest CP levels in the culms were verified with the application of
 243 the maximum level of nitrogen.

244 In the first and second clippings, there was no interaction between the N levels and the
 245 cutting heights for the neutral detergent fiber (NDF) in the leaf blades (Table 2). These
 246 results contrast with those reported by the authors cited in the reference [39], stating that the
 247 NDF levels in the leaf blade of *Pennisetum purpureum* Shum in the rainy period increased
 248 as a function of the applied N doses, with values between 75.39 and 77.49% for the doses of
 249 100 and 400 kg ha⁻¹ of N, respectively.

250 In addition to that, the authors cited in the reference [40] reported that the NDF levels were
 251 influenced by the nitrogen rates in the first, eighth, ninth and tenth clippings, adjusting to an
 252 increasing linear function. This fact was also observed by the authors mentioned in the

253 reference [3], when studying growing nitrogen doses in *P. maximum* cultivars Tanzania-1
254 and Mombaça. It is worth noting that it is not only fertilization that regulates the fiber level of
255 the roughage, but also genetic aspects, intrinsic to the species/cultivar and environmental
256 factors.

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

263 In the first clipping, there was a reduction of 0.036%, 0.0231% and 0.0199% in the NDF
264 content in the pseudostem kg^{-1} of N applied, at the heights of 8, 24 and 32 cm, respectively
265 (Table 2). At the height of 16 cm, a minimum content of 76.87% was verified at the N dose of
266 233.60 kg ha^{-1} of N. In the second clipping (Table 2), the maximum NDF of 85.63% was
267 obtained in the pseudostem at the N dose of 132.33 kg ha^{-1} , damaging consumption and
268 animal performance, since the NDF acts as determinant factor of the ruminal repletion
269 process [43].

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

276 Conversely, the authors cited in the reference [39], in an experiment with elephant grass
277 subjected to nitrogen fertilization (0, 100, 200, 300 and 400 kg ha^{-1} of N) observed that the
278 ADF levels in the leaf blades increased linearly (Table 2). According to the authors, this
279 occurred due to changes in the structural components of the plant as a consequence of
280 variation in the maturity stages, accelerated by fertilization and favorable climatic factors.
281 With regard to the ADF content in the pseudostem, in the first clipping, the minimum
282 percentage (45.75%) was verified at the dose of 191.75 kg ha^{-1} of N. In the second clipping,
283 the maximum percentage (53.28%) was observed at the dose of 140.50 kg ha^{-1} of N (Table
284 2).

285 However, there are authors [40] who correlate the nutritional value and digestibility more with
286 the plant physiology than with the applied nutrient doses and sources. The highest ADF
287 levels in the whole plant in comparison to leaf blades may be attributed to the culm portion
288 [39]. It is therefore important that the culm fraction present a good nutritive value in order to
289 depreciate roughage quality as little as possible.

290 The minimum mineral matter (MM) content in the leaf blades (5.49%) was verified at the
291 dose of 254 kg ha^{-1} of N in the first clipping. In the second clipping, the minimum content
292 (5.19%) was obtained at the N dose of 182.50 kg ha^{-1} (Table 2). These results indicate that
293 the increase of the nitrogen levels provided a dilution effect of the MM percentages, possibly
294 due to the increase of the dry matter production of the forage, also considering that plants in
295 nutritional imbalance (excess or nitrogen restriction) are more affected by this phenomenon
296 [44].

297 The authors cited in the reference [45], studying *Brachiaria* sp. and fertilization, observed
298 ash contents of 11.9 and 10.4% for the *B. brizantha* cv. Marandu and *B. decumbens* under

299 P application, values close to those verified for the *B. brizantha* cv. Piatã in this experiment,
 300 of 8.72% and 7.85% for the first and second clippings, respectively.

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

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

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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 (%)						
1 st Clipping	4.8898	3.4998	2.1098	0.7198	$y = 4.8898 - 0.0139x$	0.99
2 nd Clipping	5.0301	5.8301	6.6301	7.4301	$y = 5.0301 + 0.008x$	0.98
Pseudostem CP content (%)						
1 st 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
2 nd Clipping	3.7563	4.3363	4.9163	5.4963	$y = 3.7563 + 0.0058x$	0.81
Leaf blade NDF (%)						
1 st Clipping	80.964	73.064	69.434	69.804	$y = 80.694 - 0.0963x + 0.0002x^2$	0.99
2 nd Clipping	78.712	72.412	70.112	71.812	$y = 78.712 - 0.083x + 0.0002x^2$	0.94
Pseudostem NDF (%)						
1 st 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
2 nd Clipping	80.402	85.342	84.282	77.222	$y = 80.402 + 0.0794x - 0.0003x^2$	0.94

Leaf blade ADF (%)						
1 st Clipping	40.489	38.289	36.089	33.889	$y = 40.489 - 0.022x$	0.99
2 nd Clipping	40.096	37.686	35.276	32.866	$y = 40.096 - 0.0241x$	0.82
Pseudostem ADF (%)						
1 st Clipping	53.103	47.433	45.763	48.093	$y = 53.103 - 0.0767x + 0.0002x^2$	0.97
2 nd Clipping	47.354	52.784	52.214	45.664	$y = 47.354 - 0.0843x - 0.0003x^2$	0.99
Leaf blade MM (%)						
1 st Clipping	8.7174	11.1774	23.6374	46.0974	$y = 8.7174 - 0.0254x + 0.0005x^2$	0.99
2 nd Clipping	7.8509	5.7309	5.2109	6.2909	$y = 7.8509 - 0.0292x + 0.00008x^2$	0.99
Pseudostem MM (%)						
				1 st 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
2 nd Clipping	7.8067	5.3267	4.4467	5.1667	$y = 7.8067 - 0.0328x + 0.00008x^2$	0.99

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4. CONCLUSION

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COMPETING INTERESTS

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