

DOES AMOUNT OF CUT VEGETAL RESIDUE ON THE CANOPY INFLUENCE GROWTH AND THE STRUCTURAL CHARACTERISTICS OF MARANDU PALISADEGRASS?

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Abstract

The pasture mowing in late winter removes the old forage, improving the pasture structure in spring and summer. However, the residue after mowing can affect tillering, thus limiting forage production and the structural characteristics of pasture. We hypothesized that the high amount of cut vegetal residues on the plants in late winter causes a decrease in forage production and modifies the structural characteristics of the forage canopy during the spring and summer. The treatments were four cut vegetal residues (0; 2,000; 4,000 and 8,000 t ha⁻¹ of natural material) deposited on *Urochloa brizantha* cv. Marandu canopy in late winter. After that, the forage production and structure characteristics were evaluated during the spring and summer for two years. The complete randomized block design, with four replications, was used. The defoliation management was characterized by the adoption of pre- and post-cut heights of 25 and 15 cm, respectively. For both years, there was no effect of cut vegetal residue on all the characteristics evaluated. No variable was affected by the interaction cut vegetal residue amount × year of evaluation. The dead leaf blade percentage was greater in year 2 (6.9%) than in year 1 (3.5%). The average values of variables were live leaf blade percentage = 84.2%; live stem percentage = 8.7%; dead stem percentage = 1.9%; number of vegetative tiller = 653 tiller/m²; number of reproductive tiller = 5 tiller m⁻². The forage production rate presented an average value of 46 kg/ha/day of dry matter. The cut vegetal residue amount of up to 8,000 t/ha of natural material on the plants in late winter does not affect the forage production or modifies the structural characteristics of marandu palisadegrass during the subsequent spring and summer.

Keywords: *Brachiaria brizantha* syn. *Urochloa brizantha*. Forage Production. Morphological Composition. Number of Tiller. *Urochloa brizantha*.

1. Introduction

In Brazil, *Brachiaria brizantha* syn. *Urochloa brizantha* (Hochst ex A Rich) Stapf. Cv. Marandu (marandu palisadegrass) is one of the most used grasses by ranchers for pasture formation. When using the deferment of pastures, it is common that marandu palisadegrass to have high forage mass, with high stems and dead material percentages in late winter (Silva et al. 2016), which may have negative effects on tillering (Santana et al. 2014).

In order to avoid problems of tall grasses in late winter, mowing the sward can be used to rapidly remove older plants, which would stimulate the renewal of its population from the spring on and, consequently, it would provide the formation of a structure more available to animal apprehension and intake, improving the animal performance. In this context, Sousa et al. (2018), in a work with *B. brizantha* cv. Marandu, found that tall pasture (31.3 cm) and mowed to 8 cm at the late winter had a higher live leaf blade percentage and a lower stem dead percentage in the subsequent spring, compared to no-mowed tall pasture (31.4 cm). Thus, the sheep performance in spring, when all pastures were managed in continuous stocking, was 33% higher in the tall/mowed pasture than in the tall pasture in late winter.

A large amount of cut vegetal residue on the lowered pasture can reduce the incidence of light at the bottom of the canopy and, therefore, inhibiting tillering (Matthew et al. 2000; Sbrissia et al. 2010), consequently reducing the forage production. The high carbon: nitrogen ratio of tropical forage grasses may also limit the mineralization of the plant residue, causing immobilization of nitrogen by the microorganisms in the soil. As a consequence, this nutrient may be unavailable to forage plants (Carneiro et al. 2008), which would also reduce tillering. In this sense, Santana et al. (2014) founded that deferred pastures of *Brachiaria decumbens* cv. Basilisk with lower heights (10 and 20 cm) at the beginning of the deferment period showed a greater renewal of tillers in the spring, in comparison to the tall, deferred pastures (30 and 40 cm). The authors argued that this response pattern was a consequence of the lower forage mass at late winter in the deferred pastures with 10 and 20 cm, in contrast to those deferred with 30 and 40 cm.

Because of the large number of Brazilian farmers using mowing as a management strategy, which results in a large amount of cut vegetal residue on plant base, this study was developed to verify if the forage production and the structural characteristics of the marandu palisadegrass during spring and summer are modified in response to the deposition of cut vegetal residues after canopy cutting in late winter. We hypothesized that the high amount of cut vegetal residues on the plants in late winter causes a decrease in forage production and modifies the structural characteristics of the forage canopy during the spring and summer.

2. Material and Methods

The experiment was conducted from October to March and in two consecutive years (2014/2015 and 2015/2016) on pasture with *Brachiaria brizantha* syn. *Urochloa brizantha* (Hochst ex A Rich) Stapf. cv. Marandu (marandu palisadegrass), in which 16 experimental plots (experimental units) of 9 m² each were demarcated. The experimental area was located at the Experimental Capim-Branco Farm, at Federal University of Uberlândia, Uberlândia, MG, Brazil. The approximate geographical coordinates of the site are 18° 30' south latitude and 47° 50' west longitude of Greenwich, and its altitude is 776 m. The climate of Uberlândia, according to the Köppen classification, is Aw type, tropical savannah (Alvares et al. 2013), with well-defined dry (April to September) and rainy (October to March) seasons. Information on the climatic conditions during the experimental period was monitored at a meteorological station located 200 m away from the experimental area (Figure 1).

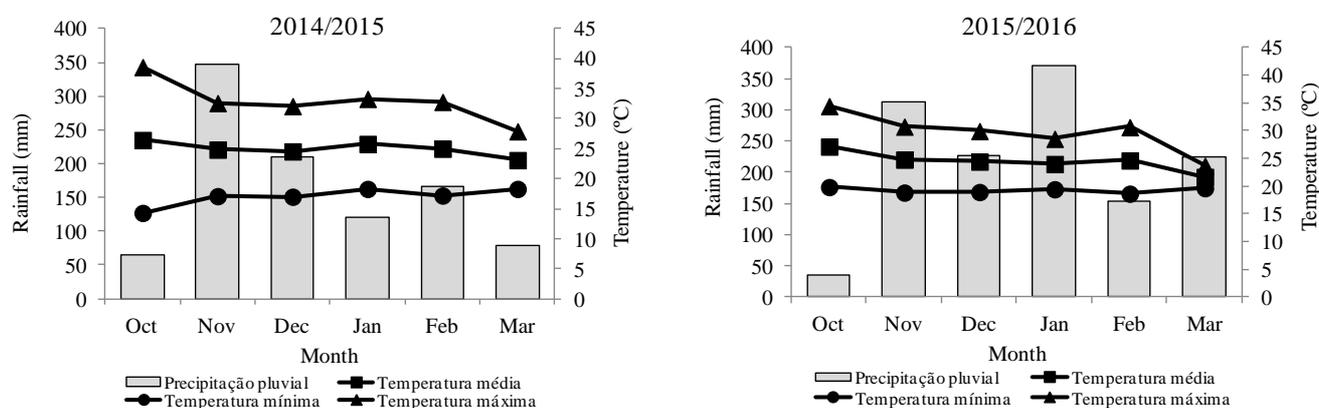


Figure 1. Monthly rainfall and average of maximum, minimum and mean air temperatures on the experimental site from October to March of the two experimental years.

In October of 2014, soil samples were collected from the experimental area to analyze the fertility level. The results were: pH in H₂O: 6.0; P: 5.2 (Mehlich⁻¹) and K: 156 mg dm⁻³; Ca²⁺: 5.4; Mg²⁺: 2.0 and Al³⁺: 0.0 cmol_c dm⁻³ (KCl 1 mol/L). Based on these results, liming and potassium fertilization was not necessary. Phosphate and nitrogen fertilization were performed after cutting the plants in October, applying 50 kg ha⁻¹ of N and P₂O₅. In December, an extra 50 kg ha⁻¹ of N dose was applied. Urea and simple superphosphate were used as fertilizer sources. Fertilization was carried out with a single application in the late afternoon and coverage, according to the recommendations of Cantarutti et al. (1999) for a medium-level technological system.

The experiment was conducted in a randomized complete block design with four replicates. The effects of deposition of cut vegetal residues (0; 2,000; 4,000 and 8,000 kg.ha⁻¹ of natural material) at late winter on forage production and structural characteristics of marandu palisadegrass during the following spring and summer were evaluated.

In early October, forage canopies were 37 and 43 cm in height in the first and second year of the study, respectively. In addition, forage mass (6,233 and 7,073 kg ha⁻¹ of DM in the first and second year, respectively) consisted of the high stem (43.7% and 47% in the first and second year, respectively) and dead material (51.8% and 49.3% in the first and second year, respectively) percentages. Thus, to eliminate this old forage, all the plants were cut at 15 cm height. Subsequently, all cut plants were removed from above and between the canopies of the remaining plants. Then, the amounts of cut vegetal residue in each experimental unit, according to the treatments, were distributed evenly on the lowered plants. The cut vegetal residue consisted of the forage from above the 15 cm cut, with 81% DM and 78% DM in the first and second experimental years, respectively.

As of October, and according to recommendations of Trindade et al. (2007), canopies were cut when the plants reached an average height of 25 cm, leaving a post-cut residue of 15 cm. This procedure occurred until March of each year. Three cuts were performed in the first year and four cuts in the second experimental year.

All evaluations were performed before the cuts. The canopy height was measured with a graduated ruler, in 10 points of each plot, observing the distance from the soil surface to the highest living leaf in the canopy as the criterion.

The forage production rate was estimated with a cut above 15 cm, using a quadrat of 0.5 m side per plot. Each sample was separated into the live leaf blade, dead leaf blade, and live stem and dead stem. These components were weighed, dried in a forced draught oven at 65°C to constant weight, and reweighed. With these data, the forage mass was calculated, as well as their morphological composition. The volumetric densities of the total forage mass and its morphological components were obtained by dividing the forage masses by the height of the cut stratum in the canopies.

The number of vegetative and reproductive tillers was quantified using a 0.25 × 0.5 m rectangle, which was fixed to the soil, to count the tillers contained therein. Tiller was considered vegetative when it did not have the inflorescence nor the flag leaf, and reproductive when it was present.

Data were subjected to analysis of variance at $p < 0.05$ using the MIXED procedure (mixed models) of SAS, version 9.2 (SAS Institute, Cary, NC, USA). The assumption of homogeneity of variances and normality was tested for each ANOVA. The models included the treatment (T), year (Y), and the treatment × year (T*Y) interaction as described below:

$$Y_{ij} = m + T_i + Y_j + (T * Y) + e_{ijk}$$

3. Results

A summary of the statistical analysis, with the factor's significance (p value) for each variable response, is presented in Table 1. For all the variables analyzed, the same response pattern was observed in the two years of the research: the amount of cut vegetal residue on the plants did not influence the forage production and the structural characteristics of marandu palisadegrass. Additionally, no variable response was affected by the interaction treatment (amount of vegetal residue on the plants) × year of evaluation (Table 1).

Table 1. Summary of the statistical analysis, with the factor's significance (p value) for each variable response.

Variable response	Factor		
	Treatment	Year	Treatment x Year
Forage production rate	0.9006	0.1053	0.8768
Morphological composition in the produced forage (%)			
Live leaf blade	0.9682	0.1870	0.8071
Dead leaf blade	0.6509	0.0071*	0.0539
Live stem	0.5556	0.2000	0.4689
Dead stem	0.2615	0.0807	0.6583
Volumetric density (kg cm ⁻¹ ha ⁻¹)			
Total forage	0.6200	0.0051*	0.7477
Live leaf blade	0.6668	0.0001*	0.8990
Dead leaf blade	0.6811	0.0010*	0.3638
Live stem	0.9413	0.2034	0.9924
Dead stem	0.4906	0.1878	0.8693
Tiller m ⁻²			
Vegetative	0.9630	0.0504	0.4938
Reproductive	0.2562	0.0699	0.6200

*Statistical difference (p < 0.05).

The year of evaluation had an effect on the dead leaf blade percentage and on the volumetric densities of total forage, live leaf blade, and dead leaf blade (Table 1). The values of dead leaf blade percentage (6.9 and 3.5%), volumetric densities of total forage (163 and 142 kg/ha.cm), live leaf blade (133 and 123 kg/ha.cm) and dead leaf blade (15 and 6 kg/ha.cm) were greater in year 2 (2015/2016) than year 1 (2014/2015).

The average values of response variables were forage production rate = 46 kg.ha⁻¹.day⁻¹ of dry matter; live leaf blade percentage = 84.2%; live stem percentage = 8.7%; dead stem percentage = 1.9%; volumetric density of live stem = 12 kg/cm.ha; volumetric density of dead stem = 3 kg/cm.ha; number of vegetative tiller = 653 tiller/m²; and number of reproductive tiller = 5 tiller.m⁻².

4. Discussion

The mean heights of pre-cut marandu-grass remained similar in the two experimental years (24.8 cm in the first year and 25.7 cm in the second year) since all plants were managed with the same criterion: lowered from 25 to 15 cm. This cut management was based on Trindade et al. (2007), who verified that the management characterized by the pre-grazing height corresponding to the interception of 95% of the light (25 cm) and the post-grazing height of 15 cm resulted in greater intake by cattle of live leaf blade than stems or dead material. Additionally, Giacomini et al. (2009) worked in the same experimental area as Trindade et al. (2007) and concluded that this pasture management resulted in the most favorable crop growth rate, relative growth rate, and net assimilation rate, particularly during the transition period between winter and spring.

In the two experimental years, the structural characteristics of forage canopies were similar, regardless of the amount of cut vegetal residue on the plants. Again, this occurred due to the same management adopted in the pre- and post-cut conditions. The management of defoliation based on canopy height has been shown to be efficient in controlling and maintaining the structural characteristics of several tropical forage types of grass within the same time of year, being one of the main advantages and reasons for the recommendation of this grazing management criterion. In part, this occurs because, when the canopy height is controlled, its stage of development is controlled concomitantly, a process that is responsible for the generation of the plant structure (Araújo et al. 2015; Silveira et al. 2016; Pedreira et al. 2017).

Thus, the forage produced was composed of a high percentage of live leaf blades (84.2%) in relation to the other plant morphological components (8.7 % of the live stem and 71% dead material). With the canopy cutting at 25 cm height, there is greater leaf growth, but low stem lengthening, and reduced leaf senescence, due to the fact that there is less light competition inside the canopy (Giacomini et al. 2009).

The adequate canopy structure during spring and summer was possible due to the elimination of the old forage with the mowing in the late winter. When mowing is not carried out, it is probable that the old forage from winter would remain mixed with the new forage, from regrowth from spring. As a result, the structure of forage canopies is damaged. In this sense, Souza et al. (2015) evaluated in early summer the marandu palisadegrass structure after its mowing in the late winter, compared to pasture submitted only to grazing with sheep in continuous stocking (without mowing). These authors verified that mowing marandu palisadegrass in late winter maintained the pasture with a younger vegetative tiller population in the early summer. The presence of vegetative and young tillers can increase the forage production of the pasture because this category of tiller has greater tissue flow (Paiva et al. 2011). In addition, young tillers have better morphology (Santos et al. 2019) and nutritional value (Santos et al. 2006) than older tillers.

Due to the low pre-cut height adopted (25 cm), the flowering of the plants became controlled, which had a low appearance of reproductive tillers. With this management, the plants were prevented from reaching greater heights and, consequently, greater development stages. When the inflorescence began to develop at the apex of the tillers, it was cut. So, the flowering did not manifest itself intensely. The reduced flowering can also be attributed to the flowering season of the marandu palisadegrass, which occurs in late summer, in February and March (Valle et al. 2010), when the evaluations were already finished.

In both experimental years, the forage production rate was also not influenced by the amounts of cut vegetal residue. This indicates that the cut vegetal residue on the plants does not reduce the population density of tillers and forage production. A possible explanation for this result may be related to the reserve compounds accumulated in the plant. In low-growing conditions, such as in winter, the energy demand for the expansion and formation of new plant tissues is reduced, allowing photo-assimilates to be stored in reserve structures (da Silva et al. 2014). In this context, it is possible that marandu palisadegrass stocked the reserve compounds during winter and those used after lowering to 15 cm for the development of new tillers. This process may have been stimulated by the elimination of the apical meristem of the tiller after cutting. Therefore, the apical dominance of the tiller was eliminated and, consequently, many buds that previously had their activity inhibited have developed into tillers (Taiz and Zeiger 2013).

Even without impair the number of tillers and forage production, the mowing of the forage canopy results in an increase in the cost of production, because it depends on machinery, fuel, and labor. Thus, as far as possible, it is important to manage the pastures so that, in late winter, they are low and do not need to be mowed to stimulate their regrowth and improve their structure from spring. Indeed, Santana et al. (2014), studying *B. decumbens* cv. Basilisk found that deferred and lower pasture in late winter had a greater appearance tiller rate in the spring when compared to higher pastures in late winter.

The differences between the values of dead leaf blade percentage and volumetric densities of total forage, live leaf blade and dead leaf blade between the years of evaluation may have been due to differences in the climatic conditions of these years. From October 2015 to March 2016, the rainfall was 34% higher than the rainfall of the same period of the previous year. The minimum air temperature also was 13,2% greater in the first year than the second year (Figure 1).

We hypothesized that the high amount of cut vegetal residues on the plants in late winter causes a decrease in forage production and modifies the structural characteristics of the marandu palisadegrass during the spring and summer. However, based on our results, we reject this hypothesis.

5. Conclusions

The amount of cut vegetal residue up to 8000 kg.ha⁻¹ of natural matter on the plants in late winter does not affect the forage production neither modifies the structural characteristics of *Brachiaria brizantha* syn. *Urochloa brizantha* cv. Marandu during the following spring and summer.

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