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Pasture height at the beginning of deferment as a determinant of signal grass structure and potential selectivity by cattle

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ABSTRACT. Current experiment identified the height of signal grass {*Urochloa decumbens* (Stapf) R. D. Webster cv. Basilisk [syn. *Brachiaria decumbens* Stapf cv. Basilisk]} at the beginning of deferment that provided an appropriate pasture structure and potential selectivity by cattle on deferred pastures. Four pasture heights at the beginning of deferment (10, 20, 30 and 40 cm) and two forage samples (available on pasture and simulated grazing) were studied. The experimental design was set in completely randomized blocks, with two replications, in a split-plot arrangement. Higher percentage of live leaf blades and lower percentage of live stems and senescent forage were recorded in the forage sample from simulated grazing. The increase in pasture height increased the percentage of senescent forage and reduced the percentage of live leaf blades in forage samples. Pasture height at the beginning of deferment did not affect the potential selectivity index by cattle for the percentage of live leaf blade. The potential selectivity index varied quadratically for the percentage of live stems and increased linearly for the percentage of senescent forage with pasture height. A 10-to-20 cm reduction in pasture height at the beginning of deferment improved the structure of deferred signal grass and optimized selectivity by cattle.

Keywords: *Brachiaria decumbens*, stem, leaf, senescent forage, grazing.

Altura do pasto no início do diferimento como determinante da estrutura do capim-braquiária e da seletividade potencial de bovinos

RESUMO. Objetivou-se identificar a altura do capim-braquiarinha {*Urochloa decumbens* (Stapf) R. D. Webster cv. Basilisk [syn. *Brachiaria decumbens* Stapf cv. Basilisk]} no início do diferimento que possibilite adequada estrutura de pasto e seletividade potencial dos bovinos em pastagens diferidas. Foram estudadas quatro alturas do pasto no início do diferimento (10, 20, 30 e 40 cm) e duas amostras de forragem (disponível na pastagem e de pastejo simulado). O delineamento experimental foi em blocos completos casualizado com duas repetições, em esquema de parcela subdividida. Foi registrada maior porcentagem de lâmina foliar viva e menor de colmo vivo e forragem senescente na amostra de forragem em pastejo simulado. O incremento na altura do pasto aumentou o porcentual de forragem senescente e reduziu a porcentagem de lâmina foliar viva nas amostras de forragem. A altura do pasto no início do diferimento não influenciou o índice de seletividade potencial de bovinos para a porcentagem de lâmina foliar viva. O índice de seletividade potencial variou quadraticamente para a porcentagem de colmo vivo e aumentou linearmente para a porcentagem de forragem senescente com a altura do pasto. A redução da altura do pasto para 10 a 20 cm no início do diferimento melhora a estrutura do capim-braquiária diferido e otimiza a seletividade dos bovinos.

Palavras-chave: *Brachiaria decumbens*, colmo, folha, forragem senescente, pastejo.

Introduction

The deferment of pasture usage is a relatively simple, low-cost management strategy that guarantees a forage stock to be used, under grazing, during the months of forage scarcity. The process contributes towards the minimizing of the adverse effects of production seasonality of tropical-climate pastures on ruminant production (EUCLIDES et al., 2007; SANTOS et al., 2010; SHIO et al., 2011).

However, deferred pastures are often characterized by low nutrition rates due to their high relative participation of stems, senescent forage and reproductive tillers (SANTOS et al., 2009; SOUSA et al., 2012a; VILELA et al., 2013). Consequently, the structure of deferred pasture in general impairs the animal´s selective behavior, intake and performance (SANTOS et al., 2002).

Selective grazing by ruminants on deferred pasture is important since it partially prevents the pasture´s worse morphological composition from dramatically reducing nutrient intake and animal performance. On the other hand, the capacity of an animal to counterbalance the negative effects of the inadequate structure of a deferred pasture through selectivity is limited. In fact, it is more advantageous to seek management strategies that result in a deferred pasture structure that facilitates selection by animals (SANTOS et al., 2011).

With this scenario in view, the average pasture height at the beginning of deferment determines the leaf area index from which the pasture will develop. The latter has relevant effects on the growth rate and on the nature of morphological differentiation of the deferred pasture (SOUSA et al., 2012a). As a consequence, the forage´s nutritional rate, the pasture structure, the grazing efficiency, the ingestive behavior and the animal performance are also modified by variations in the average pasture height at the beginning of deferment.

So that the effects of pasture height at the beginning of deferment on the characteristics of the forage consumed could be known, a simulated grazing technique was adopted, with satisfactory results on selectivity by grazing cattle (EUCLIDES et al., 1992; GOES et al., 2003; MORAES et al., 2005).

Current experiment was conducted to identify the height of signal grass {*Urochloa decumbens* (Stapf) R. D. Webster cv. Basilisk [syn. *Brachiaria decumbens* Stapf cv. Basilisk]} at the beginning of deferment that resulted in a deferred pasture with appropriate structure and optimized potential selectivity by cattle on deferred pastures.

Material and methods

The experiment was conducted at the Forage Sector of the Department of Animal Science of the Universidade Federal de Viçosa, Viçosa Minas Gerais State, Brazil, on a {*Urochloa decumbens* (Stapf) R. D. Webster cv. Basilisk [syn. *Brachiaria decumbens* Stapf cv. Basilisk]} (signal grass) pasture established in 1997. The pasture was divided into eight paddocks with areas ranging between 0.25 and 0.40 ha.

According to the Köppen classification, Viçosa has a Cwa climate type, with well-defined dry (May to October) and rainy (November to April) seasons. The average annual precipitation is 1,340 mm, with average relative air humidity of 80% and average annual temperature of 19°C, oscillating between the mean maximum 22.1°C and mean minimum 15°C. Climate data were recorded at the Meteorological Station of the Department of Agricultural Engineering of Universidade Federal de Viçosa (Table 1).

The soil of the experimental area, classified as a moderately undulated Red-Yellow Latosol of clayey texture, showed the following chemical characteristics within its 0-20 cm layer, in a sampling conducted in November 2009: pH in H_2O: 5.3; P: 3.8 (Mehlich-1) and K: 102 mg dm^{-3}; Ca^{2+}: 1.3; Mg^{2+}: 0.5 and Al^{3+}: 0.3 $cmol_c$ dm^{-3} (KCl 1 mol L^{-1}); organic matter: 3.0 dag kg^{-1}; remaining p : 31.8 mg L^{-1}.

Table 1. Monthly means of minimum, average and maximum daily temperature, total monthly rainfall and total monthly evaporation between March and June 2010.

Month	Average temperature (°C)	Maximum temperature (°C)	Minimum temperature (°C)	Rainfall (mm)	Evaporation (mm)
March	22.8	29.2	19.1	192.5	121.7
April	20.4	27.1	16.3	18.3	103.4
May	18.2	24.9	14.3	45.8	76.0
June	15.3	23.5	9.9	1.2	73.6

Four average pasture heights at the beginning of pasture deferment (10, 20, 30 and 40 cm) and two forage samples (available on pasture and obtained by simulated animal grazing) were evaluated. The experiment was set in completely randomized blocks, with two replications, in a split-plot arrangement. Plots consisted of average pasture heights and sub-plots corresponded to forage samples.

Between January and March 2010, the paddocks were managed under continuous grazing by cattle and at a variable stocking rate to keep pasture heights at approximately 25 cm. The average stocking rate was 2.8 AU ha^{-1} during this period. From the beginning of March 2010, paddocks were managed so that the pastures reached the average heights established for the beginning of deferment. Thus, in four experimental units, the pastures had their heights reduced as follows: in two paddocks, pastures were lowered to 10 cm; in the other two, they were lowered up to the average height of 20 cm. In the other four paddocks, pastures were managed so that their heights would increase so that two of them would have an average height of 30 cm, whereas the other two would reach 40 cm. The deferment period began when they reached the planned pasture heights. Pastures remained deferred from March 19 to June 12, 2010, when the grazing period started. In this period, pastures were managed under continuous grazing and with an initial fixed stocking rate of 3.0 animal unit per hectare (AU ha^{-1}), keeping a minimum of two animals per experimental unit. Crossbred steers with initial average weight of approximately 190 kg were used. Animals received mineral salt *ad libitum* during the grazing period.

On the first day of the grazing period, in three areas representing the average pasture height in each paddock, all the tillers within a 0.16 m^2 rebar frame were cut at soil level, thereby forming a forage sample. Each sample was conditioned in a labeled plastic bag. In the laboratory, the samples were manually separated into live leaf blade, live stem and senescent forage. The yellowish and discolored parts of the stem and the leaf blade were incorporated to the senescent forage section. The components were then weighed and dried in a forced-circulation oven at 65°C for 72 hours. Based on these data, the relative participations (%) of each morphological component in the available forage were estimated.

On the first day of the grazing period, one sample of forage per paddock was also collected from areas representing the average pasture height so that the morphological composition of the forage consumed by the cattle could be simulated, according to methodology by Euclides et al. (1992) and Lima et al. (2012). Sampling was performed by one duly trained person who observed forage consumption of all animals in the experimental area. Each sample was conditioned in a labeled plastic bag and in the laboratory their contents were separated into the morphological components: live leaf blade, live stem and senescent tissue, adopting the same criteria described previously. Each subsample of each morphological component was placed in a forced-ventilation oven at 65°C for 72 hours and weighed to calculate the relative participation of each morphological component in the sample.

The potential selectivity of cattle was measured by dividing each morphological component in the simulated-grazing sample (%) by its respective morphological component in the available forage sample (%), following methodology by Santos et al. (2011).

An analysis of variance and a subsequent regression analysis were performed for each trait to express the effects of plots (pasture heights) within the subplots (forage samples). Their greatest response-surface model, as a function of the means of factors under study, was

$$Y_i = \beta_0 + \beta_1 H_i + \beta_2 H_i^2 + e_i$$

where:

Y_i = response variable;
H_i = independent variable (average pasture height);
$\beta_0, \beta_1, \beta_2$ = parameters to be estimated;
e_i = experimental error.

The model-fitting degree was evaluated by the determination coefficient and by the significance of regression coefficients, tested by the t test, corrected by the residues of the analysis of variance. The qualitative factor levels (forage sample) were compared by F test within each level of the quantitative factors (deferment period). All statistical analyses were performed at 10% significance level.

Results and discussion

The sample obtained by simulation of animal grazing showed a better morphological composition than the forage available on pasture. The live leaf blade content was higher and percentages of live stem and dead forage were lower in the sample from simulated grazing than those of the available forage (Table 2). These results demonstrated that the pasture characteristics did not represent the characteristics of the actual forage consumed by animals. This was due to their selective behavior in grazing. Animals preferred certain parts of the plants and composition of the diet was often morphologically and chemically different from the pasture composition (BRÂNCIO et al., 1997).

Cattle tended to prefer live leaf blades to other pasture morphological components. The above consumption was justified by easy access to animals, lower resistance to shear (NAVE et al., 2010) and better nutritional rates (SANTOS et al., 2008). Moreover, animals avoided consuming dead forage because, due to its location at the basal layer of the pasture (PALHANO et al., 2005), it was more difficult to reach and because of its worse nutritional rate (SANTOS et al., 2008).

Table 2. Percentage of morphological components in forage available on pasture (AP) and in the sample obtained from simulated grazing (SG) with cattle on deferred signal grass at four heights (H).

Sample	Height (cm)				Equation	R^2
	10	20	30	40		
				Live leaf blade (%)		
AP	27.3 b	21.9 b	20.3 b	19.8 b	$\hat{Y} = 28.3110 - 0.2394{*}H$	0.82
SG	74.7 a	70.2 a	55.3 a	56.8 a	$\hat{Y} = 81.4086 - 0.6870{**}H$	0.84
				Live stem (%)		
AP	44.5 a	38.3 a	30.8 a	42.3 a	$\hat{Y} = 31.97$	-
SG	16.6 b	21.2 b	27.9 a	24.0 b	$\hat{Y} = 22.4$	-
				Senescent forage (%)		
AP	28.3 a	39.8 a	48.9 a	37.9 a	$\hat{Y} = 0.983 + 0.320{*}H - 0.565{*}H^2$	0.93
SG	8.7 b	8.7 b	16.8 b	19.2 b	$\hat{Y} = 3.4523 + 0.3954{**}H$	0.88

For each trait, means followed by different letters in the columns are different according to F test ($p < 0.05$); ***Significant according to t test ($p < 0.01$); **Significant according to t test ($p < 0.05$); *Significant according to t test ($p < 0.10$).

When pasture height at the beginning of deferment was taken into account, its effects were deleterious to the morphological composition of the forage available on pasture and in the sample obtained from simulated grazing. The percentage of live stems was the only morphological component not influenced by pasture height (Table 2).

At the beginning of deferment, the higher pastures showed a higher leaf area index (SOUSA et al., 2012a and b) and consequently greater shading within the canopy. In this condition, the senescence of older leaves and leaves located at the basal portion of tillers was stimulated (DA SILVA; NASCIMENTO JÚNIOR, 2007). In addition, in situations of higher competition for light, common in higher pastures, younger and smaller tillers tended to be shaded by the older and longer ones, which resulted in the death of the former. These effects were even more relevant after 85 days of deferment. Consequently, the percentage of live leaf blades was reduced linearly and the dead forage content in the pasture was increased linearly as a ratio of its initial height (Table 2).

Since the pasture structure is a determinant factor of the morphology of the potentially consumed forage by cattle (TRINDADE et al., 2007; SANTOS et al., 2011), in general, the same response patterns caused by the initial heights obtained in the deferred pastures also occurred in the simulated-grazing sample (Table 2).

It is worth remarking that pastures deferred at 10 and 20 cm of average height at the beginning of deferment showed a high percentage of live leaf blades and lower senescent forage content in the simulated-grazing sample. Contrastingly, from 30 cm onwards, the response pattern changed, i.e., the morphological composition of the simulated-grazing sample was impaired (Table 2). Results showed that from 30 cm of initial height, the deferred-pasture structure limited selectivity and, consequently, consumption by cattle.

The potential selectivity index was developed to understand better the effects of pasture height at the beginning of the deferment period. The index was qualified as 'potential' because its values were obtained from samples harvested from simulated grazing and not with fistulated animals. However, it might be assumed that the data obtained with simulated grazing corresponded to those that would be obtained with fistulated animals, as reported by Euclides et al. (1992), Goes et al. (2003) and Moraes et al. (2005). These authors failed to find differences in chemical or morphological traits of forages harvested either via simulated grazing or with fistulated animals.

The potential selectivity index was higher than 1.0 when the morphological component of the pasture preferably selected by the animal (live leaf blade) was considered. On the other hand, the morphological components not preferred by the animal (live stem and senescent forage) had their potential selectivity index lower than 1.0. The more distant the potential selectivity index was from (1.0), the higher was the animal´s selectivity, i.e., there was higher selection and rejection than the preferred and deprecated morphological component, respectively.

Consequently, the larger the difference between the percentages of morphological components between the available forage and the simulated-grazing sample, the higher was the potential selectivity, and indeed, the higher the ability of the animal to choose or reject the morphological component of the pasture.

Owing to the dynamic profile of the pasture structure, with its spatial and temporal variability (SANTOS et al., 2010), and to the marked effect of pasture structure on the animal´s selective behavior, the simultaneous alterations in the morphological compositions of pasture and of forage consumed, albeit with different magnitudes (Table 2), were expected to be the most common way to increase animal selectivity. However, the animal´s ability to relatively maintain the characteristics of its diet with regard to alterations in pasture structure was recognized. The latter may also be characterized as selective. It might also be implied that a situation in which the pasture kept its morphological composition unaltered and in which there were also changes in the morphological composition of the forage consumed was rarer. It might occur oftener and more likely in a short time interval.

The potential selectivity index for live leaf blade was not changed by pasture height at the beginning of deferment, featuring an average rate of 2.90. This fact meant the cattle´s high selectivity for live leaf blades of the deferred signal grass. In fact, the percentage of the morphological component in the potentially consumed diet was 290% higher than in the available pasture.

Live stem´s potential selectivity index by cattle responded quadratically to the initial pasture height, with maximum value 0.91 in pastures deferred at approximately 30 cm (Figure 1). Thus, the increase in pasture height up to 30 cm resulted in a lower selectivity for the stem, i.e., there was an increase in the selectivity index of a morphological component not usually preferred by the animal. It was possible that the higher number of reproductive tillers, commonly observed in high deferred pastures (SANTOS et al., 2009), resulted in increased intake of signal grass inflorescences by cattle due to their location at the apex of tillers during the reproductive stage. Since, within the methodology of current study, the inflorescence organs were considered a live-stem fraction, the increased potential selectivity index of the live stem by cattle in deferred pastures with initial height up to 30 cm made sense. The higher intake of inflorescences by cattle on deferred pastures might also be explained by the fact that the organs of signal grass inflorescences (peduncle, rachis and spikelets) were slender and thereby less resistant to shear by the animal (SANTOS et al., 2011).

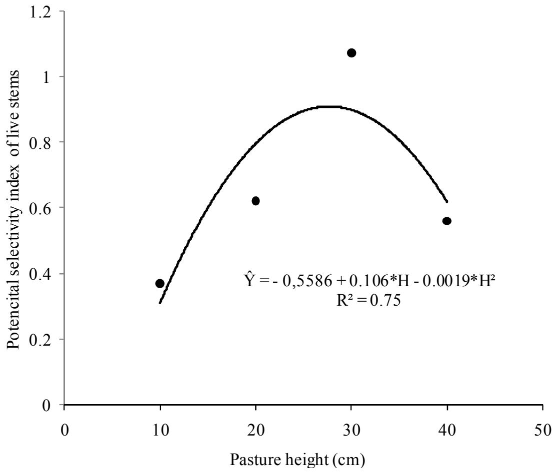

Figure 1. Cattle´s potential selectivity index of live stems on signal grass pastures deferred at four heights (H). *Significant according to t test ($p < 0.01$).

The potential selectivity index of live stem decreased as from 30 cm of initial pasture height upwards (Figure 1). The higher lodging rate in the signal grass deferred at a greater initial height probably reduced the seizure of stems by the cattle.

The potential selectivity index of senescent forage increased linearly as a function of the initial pasture height (Figure 2). An increased potential selectivity index of a morphological component deprecated by the animal, such as senescent forage (TRINDADE et al., 2007; SANTOS et al., 2011), indicated that animals were having difficulty to express their selective behavior. Thus, the higher the signal grass pastures at the beginning of deferment, the lower was the cattle´s selective capacity, which might jeopardize animal intake and performance.

Since deferred pastures had a high senescent forage content (39% on average) and low percentage of live lead blades (22% on average) (Table 2), when the animals tried to ingest the live leaves during grazing, they ended up also ingesting the pasture´s senescent morphological components. This was more common in pastures with higher lodging rates, or rather, pastures deferred at a greater average height. Plant lodging raised the pasture volume density and, consequently, the proximity between the preferred (live leaf blade) and deprecated (stem and senescent tissue) morphological components also increased and hampered the cattle´s selectivity.

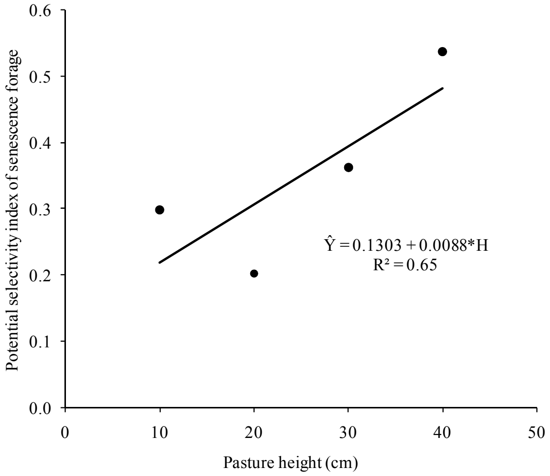

Figure 2. Potential selectivity index of senescent forage by cattle on signal grass pastures deferred at four heights (H). *Significant according to t test ($p < 0.01$).

Variations in the morphological composition of the deferred pastures changed their nutritional value, because each morphological component had specific nutritional characteristics (SANTOS et al., 2008). Although the animal might offset the negative effects of the worse structure of the deferred pasture through its selective behavior, this capacity was limited and did not always guarantee ingestion of forage with adequate characteristics. Results indicated that in pastures deferred at the greatest height (40 cm), cattle had more difficulty to counterbalance the worse morphological composition of the pasture and consumed more of the less preferred morphological components (Table 2). This fact probably entailed the ingestion of forage of a worse nutritional value and led to lower performance in animals. The above was corroborated by a study conducted concomitantly on the same experimental area, where cattle expressed 0.079, 0.139, 0.120 and 0.081 kg animal^{-1} day^{-1} on pastures deferred at 10, 20, 30 and 40 cm, respectively.

Even with different magnitudes, the selectivity for morphological components of deferred pasture by cattle always occurred because the potential selectivity indexes were never equal to (1.0). In fact, in free conditions, animals utilized their selective ability to maximize the quality of their diet, a characteristic developed over thousands of years, in which the animals co-evolved along with forage plants, and which granted a competitive advantage to ruminants within the pasture environment (SANTOS et al., 2011).

Although inherent to ruminants, the selective behavior consumed energy and time, which would in some situations compensate for the benefits. In deferred pastures, for instance, live leaf blades underwent significant changes according to alterations in the pasture structure. In fact, they become sparser and scarcer in deferred canopies with greater heights (Table 2) which might hamper their seizure during the grazing activity and, consequently, a longer time for the formation of the bite. Furthermore, deferred pastures with a high tiller lodging rate might result in a greater ingestion of stem (as previously discussed) and this might lead to higher energy expenditure by animals grazing and chewing forage (ILLIUS et al., 1995).

The above discussion shows that it is important to adopt strategies for the management of the deferred pasture that result in appropriate pasture structures coherent with the preference of the grazing animals. From the morphological standpoint, this structure should be characterized by a higher proportion of live leaves to stem and senescent tissues. In this context, signal grass pastures should be lowered to heights between 10 and 20 cm at the beginning of the deferment period to facilitate the ingestion of live leaves by cattle.

It should be emphasized that in conditions of deferred pastures, this type of adequate pasture structure for ruminant grazing is hampered or limited by two factors: longer rest periods (deferment periods) necessary to obtain a forage stock for the off-season period and climate conditions which restrict pasture growth. The latter reduces or impedes the re-growth of the deferred pasture after grazing and leads towards a high participation of stem and senescent tissues in the deferred pastures.

Conclusion

Reducing the average pasture height to rates between 10 and 20 cm at the beginning of deferment improves the structure of deferred signal grass and selectivity by cattle.

References

BRÂNCIO, P. A.; NASCIMENTO JÚNIOR, D.; MORAES, E. A.; REGAZZI, A. J.; LEITE, G. G. Avaliação de pastagem nativa dos cerrados submetida à queima anual: qualidade da dieta de bovinos. **Revista Brasileira de Zootecnia**, v. 26, n. 3, p. 438-442, 1997.

DA SILVA, S. C.; NASCIMENTO JÚNIOR, D. Avanços na pesquisa com plantas forrageiras tropicais em pastagens: características morfofisiológicas e manejo do pastejo. **Revista Brasileira de Zootecnia**, v. 36, n. 4, p. 121-138, 2007. (Suplemento Especial).

EUCLIDES, V. P. B.; FLORES, R.; MEDEIROS, R. N.; OLIVEIRA, M. P. Diferimento de pastos de braquiária cultivares Basilisk e Marandu, na região do Cerrado. **Pesquisa Agropecuária Brasileira**, v. 42, n. 2, p. 273-280, 2007.

EUCLIDES, V. P. B.; MACEDO, M. C. M.; OLIVEIRA, M. P. Avaliação de diferentes métodos de amostragens (para estimar o valor nutritivo de forragens) sob pastejo. **Revista Brasileira de Zootecnia**, v. 21, n. 4, p. 691-702, 1992.

GOES, R. H. T. B.; MANCIO, A. B.; LANA, R. P.; VALADARES FILHO, S. C.; CECON, P. R.; QUEIROZ, A. C.; COSTA, R. M. Avaliação qualitativa da pastagem de capim tanner-grass (*Brachiaria arrecta*) por três diferentes métodos de amostragem. **Revista Brasileira de Zootecnia**, v. 32, n. 1, p. 64-69, 2003.

ILLIUS, A. W.; GORDON, I. J.; MILNE, J. D.; WRIGHT, W. Costs and benefits of foraging on grasses varying in canopy structure and resistance to defoliation. **Functional Ecology**, v. 9, n. 8, p. 894-903, 1995.

LIMA, H. L.; GOES, R. H. T. B.; CERILO, S. L. N.; OLIVEIRA, E. R.; BRABES, K. C. S.; TEODORO, A. L. Nutritional value of Marandu grass under grazing by three sampling methods. **Acta Scientiarum. Animal Sciences**, v. 34, n. 4, p. 379-384, 2012.

MORAES, E. H. B. K.; PAULINO, M. F.; ZERVOUDAKIS, J. T.; VALADARES FILHO, S. C.; MORAES, K. A. K. Avaliação qualitativa da pastagem diferida de *Brachiaria decumbens* stapf., sob pastejo, no período da seca, por intermédio de três métodos de amostragem. **Revista Brasileira de Zootecnia**, v. 34, n. 1, p. 30-35, 2005.

NAVE, R. L. G.; PEDREIRA, C. G. S.; PEDREIRA, B. C. Nutritive value and physical characteristics of Xaraes palisadegrass as affected by grazing strategy. **South African Journal of Animal Sciences**, v. 40, n. 4, p. 285-293, 2010.

PALHANO, A. L.; CARVALHO, P. C. F.; DITTRICH, J. R.; MORAES, A.; BARRETO, M. Z.; SANTOS, M. C. F. Estrutura da pastagem e padrões de desfolhação em capim-mombaça em diferentes alturas do dossel forrageiro. **Revista Brasileira de Zootecnia**, v. 34, n. 6, p. 1860-1870, 2005.

SANTOS, E. D. G.; PAULINO, M. F.; LANA, R. P.; VALADARES FILHO, S. C.; QUEIROZ, D. S. Influência da suplementação com concentrados nas características de carcaça de bovinos F1 Limousin - Nelore, não-castrados, durante a seca, em pastagens de *Brachiaria decumbens*. **Revista Brasileira de Zootecnia**, v. 31, n. 4, p. 1823-1832, 2002.

SANTOS, M. E. R.; FONSECA, D. M.; EUCLIDES, V. P. B.; RIBEIRO JÚNIOR, J. I.; BALBINO, E. M.; CASARANDE, D. R. Valor nutritivo da forragem e de seus componentes morfológicos em pastagens de *Brachiaria decumbens* diferida. **Boletim da Indústria Animal**, v. 65, n. 4, p. 303-311, 2008.

SANTOS, M. E. R.; FONSECA, D. M.; EUCLIDES, V. P. B.; NASCIMENTO JÚNIOR, D.; QUEIROZ, A. C; RIBEIRO JÚNIOR, J. I. Características estruturais e índice de tombamento de *Brachiaria decumbens* cv. Basilisk em pastagens diferidas. **Revista Brasileira de Zootecnia**, v. 38, n. 4, p. 626-634, 2009.

SANTOS, M. E. R.; FONSECA, D. M.; BALBINO, E. M.; SILVA, S. P.; MONNERAT, J. P. I. S.

Variabilidade espacial e temporal da vegetação em pastos de capim-braquiária diferidos. **Revista Brasileira de Zootecnia**, v. 39, n. 4, p. 727-735, 2010.

SANTOS, M. E. R.; FONSECA, D. M.; MAGALHÃES, M. A.; SILVA, S. P.; CASAGRANDE, D. R.; GOMES, V. M. Estrutura e valor nutritivo do pasto diferido de *Brachiaria decumbens* cv. Basilisk durante o período de pastejo. **Revista Brasileira de Agropecuária Sustentável**, v. 1, n. 1, p. 112-122, 2011.

SHIO, A. R.; VELOSO, C. M.; SILVA, F. F.; ÍTAVO, L. C. V.; MATEUS, R. G.; SILVA, R. R. Ofertas de forragem para novilhas nelore suplementadas no período de seca e transição seca/águas. **Acta Scientiarum. Animal Sciences**, v. 33, n. 1, p. 9-17, 2011.

SOUSA, B. M. L.; VILELA, H. H.; SANTOS, A. L.; SANTOS, M. E. R.; NASCIMENTO JÚNIOR, D.; ASSIS, C. Z.; FARIA, B. D.; ROCHA, G. O. Piata palisadegrass deferred in the fall: effects of initial height and nitrogen in the sward structure. **Revista Brasileira de Zootecnia**, v. 41, n. 5, p. 1134-1139, 2012a.

SOUSA, B. M. L.; VILELA, H. H.; SANTOS, M. E. R.; RODRIGUES, C. S.; SANTOS, A. L.; NASCIMENTO JÚNIOR, D.; ASSIS, C. Z.; ROCHA, G. O. Characterization of tillers in deferred Piata palisade grass with diferent initial heights and nitrogen levels. **Revista Brasileira de Zootecnia**, v. 41, n. 7, p. 1618-1624, 2012b.

TRINDADE, J. K.; SILVA, S. C.; SOUZA JÚNIOR, S. J.; GIACOMINI, A. A; ZEFERINO, C. V.; GUARDA, V. D. A.; CARVALHO, P. C. F. Composição morfológica da forragem consumida por bovinos de corte durante o rebaixamento do capim-marandu submetido a estratégias de pastejo rotativo. **Pesquisa Agropecuária Brasileira**, v. 42, n. 6, p. 883-890, 2007.

VILELA, H. H.; SOUSA, B. M. L.; SANTOS, M. E. R.; SANTOS, A. L.; SILVA, N. A. M.; NASCIMENTO JÚNIOR, D. Characterization of tillers of Piata palisade grass deferred in the fall with varying heights and deferment periods. **Acta Scientiarum. Animal Sciences**, v. 35, n. 1, p. 21-27, 2013.

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