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Defoliation patterns on a mixture pasture of forage sorghum and Alexandergrass

Padrões de desfolha em pastagem consorciada de sorgo forrageiro e capim Papuã

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Highlights

Heifer's defoliation patterns are altered when kept on mixed pastures.
Detailing a mixed pasture allows a broader view of plant-animal interactions.
Heifers preferred forage sorghum due to its easy accessibility.
Alexandergrass increased the period of pasture use.

Abstract

Detailing the morphogenic characteristics of tropical species that form mixed pastures allows a broader view of plant-animal interactions. The objective of this study was to evaluate the intensity and frequency of defoliation in a mixed pasture of forage sorghum (*Sorghum bicolor* (L.) Moench.) and Alexandergrass (*Urochloa plantaginea* (Link) Hitch.) grazed by beef heifers and maintained under continuous stocking. The experimental design was completely randomized with two treatments, five evaluation periods, and nine replicates (paddocks). The tillers in each treatment were identified and marked in the same experimental unit (paddock), considering the existence of the pasture mixture. The treatments included forage species, forage sorghum, and Alexandergrass along the pasture cycle. The defoliation intensity of the leaf blades was higher in forage sorghum than in Alexandergrass during the second and fourth evaluation periods. The defoliation frequency of general leaf blades (number of defoliations blade^{-1} day^{-1}) was higher for forage sorghum (0.13) than for Alexandergrass (0.11; *P*=0.0001). Total leaf blade mass (kg dry matter ha^{-1}) was higher and lower during the first and fifth evaluation periods, respectively. Alexandergrass

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maintained leaf blade mass during the last evaluation period, while forage sorghum started the pre-flowering phenological stage. There was a preference for forage sorghum, but Alexandergrass ensured greater longevity of the system, and mixed pastures of these species are recommended.
Key words: Defoliation frequency. Defoliation intensity. *Sorghum bicolor* (L.) Moench. Tropical forages. *Urochloa plantaginea* (Link) Hitch.

Resumo

Detalhar as características morfogênicas de espécies tropicais que formam uma pastagem consorciada permite uma visão mais ampla da interação planta-animal. Nesse sentido, este estudo foi realizado com o objetivo de avaliar a intensidade e a frequência de desfolha em pastagem consorciada de sorgo forrageiro (*Sorghum bicolor* (L.) Moench.) e capim Papuã (*Urochloa plantaginea* (Link) Hitch.) pastejada por novilhas de corte, mantidas em lotação contínua. O delineamento experimental foi inteiramente casualizado, com dois tratamentos, cinco períodos de avaliação e nove repetições (piquetes). Os perfilhos de cada tratamento foram identificados e marcados em uma mesma unidade experimental (piquete), considerando a existência do consórcio forrageiro. Os tratamentos foram as espécies forrageiras, sorgo forrageiro e capim Papuã, ao longo do ciclo da pastagem. A intensidade de desfolha das lâminas foliares foi maior no sorgo forrageiro comparado ao capim Papuã no segundo e quarto períodos de avaliação. A frequência de desfolha das lâminas foliares gerais (número de desfolhações lâmina^{-1} dia^{-1}) foi maior para o sorgo forrageiro (0,13) em comparação ao capim Papuã (0,11). A massa total de lâminas foliares (kg de matéria seca ha^{-1}) foi maior e menor no primeiro e quinto períodos de avaliação, respectivamente. O capim Papuã manteve a massa de lâminas foliares nos últimos períodos de avaliação, enquanto o sorgo forrageiro estava iniciando o estádio fenológico de pré-florescimento. Houve preferência pelo sorgo forrageiro, porém o capim Papuã garantiu maior longevidade ao sistema, sendo recomendado o uso de pastagens consorciadas dessas espécies.
Palavras-chave: Forrageiras tropicais. Frequência de desfolha. Intensidade de desfolha. *Sorghum bicolor* (L.) Moench. *Urochloa plantaginea* (linked) Hitch.

Introduction

Forage sorghum (*Sorghum bicolor* (L.) Moench.), and Alexandergrass (*Urochloa plantaginea* (Link) Hitch.) are species that have broad adaptations to tropical and subtropical climates and are used as pastures (Bergoli et al., 2019; Severo et al., 2019). The cultivation of different forage species is considered a promising practice (Duchini et al., 2018), as it makes a higher quantity of forage available and favors conditions of selectivity for animals. In this context, the adoption of mixed pastures is becoming more popular in forage production because of the benefits of increased productivity and animal performance (Maciel et al., 2022).

A mixed pasture formed by species with different pasture structures and growth patterns prolongs the period of pasture use (Soares et al., 2020) and favors animal selectivity, as long as there are no restrictions on pasture consumption. Owing to these characteristics, studies on the processes that affect species use and their interactions with the adopted management and the environment are of paramount importance. Therefore, defoliation patterns in mixed pastures of tropical species require further exploration. The intensity and frequency of defoliation are processes that determine the plant-animal interface. Defoliation affects morphogenetic variables, depending on the intensity (amount of material removed) and frequency (number of times the plant is defoliated) (Gastal & Lemaire, 2015). In other words, the objective of controlling defoliation originates from the desire to determine the extent to which animals graze (intensity) and control the recovery of plants from defoliation (frequency) (Portugal et al., 2022). Understanding these defoliation patterns allows the development of strategies to determine the time required for the recovery of each species after grazing.

Previous studies have evaluated the defoliation patterns in single crops (Eloy et al., 2014; Hundertmarck et al., 2017; Salvador et al., 2023). However, there have been no evaluations of tropical forage species mixtures with detailed levels per forage species. In the present study, forage species had distinct plant heights associated with a high participation of stems in their morphological composition, which is common in tropical species and may affect different defoliation patterns. In this context, it was hypothesized that the defoliation patterns of beef heifers are altered when kept in mixed pastures with tropical grasses throughout the pasture cycle. Therefore, the objective of the present study was to evaluate the intensity and frequency of defoliation in a pasture mixture composed of forage sorghum and Alexandergrass grazed on by beef heifers under conditions of continuous stocking.

Material and Methods

The animals used in this study were treated according to the rules of the Ethics Committee for the Use of Animals of the Federal University of Santa Maria (permit number: 9986160619).

Site description

The experiment was carried out from November 2020 to April 2021, in an experimental area of the Federal University of Santa Maria (UFSM) located in the Central Depression physiographic region (29° 43'44"S; 53° 42' 38" W; altitude 93 m) Santa Maria, Rio Grande do Sul, Brazil. According to the Köppen climate classification, the climate of the region is Humid Subtropical (Cfa) (Moreno, 1961). The soil was classified as Ultisol (Santos et al., 2018). Chemical analysis of the soil, before planting, revealed levels of pH-H_2O: 5.1; P: 21.9 mg dm^{-3}; K: 120 mg dm^{-3}; organic matter: 2.6%; Al: 0.4 $Cmol_c$ dm^{-3}; Base Saturation: 53.5%, and Al Saturation: 5.1%. Climatological data for the duration of the experiment were obtained from the UFSM Meteorological Station. Meteorological data from the experimental period (December to April 2021) showed that the observed temperature was similar to the historical average and precipitation values were below expectations for the experimental period, except in January (Figure 1).

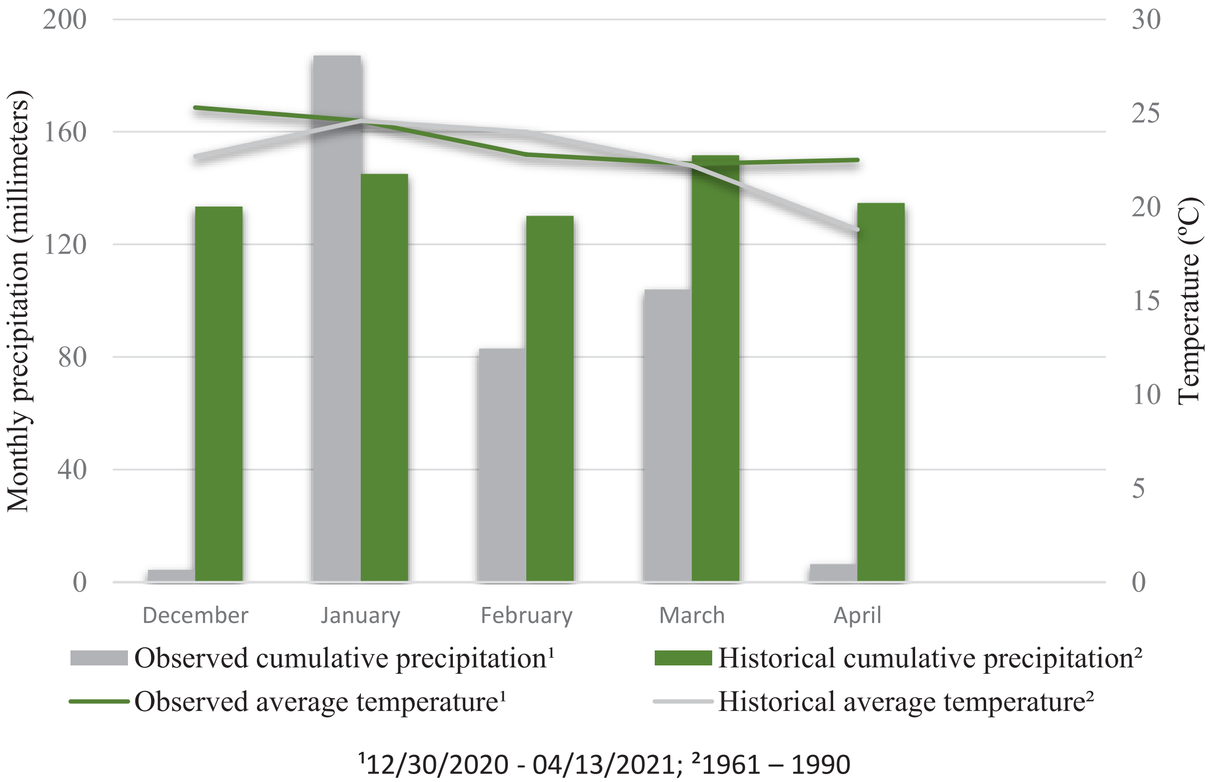

Figure 1. Average temperature and accumulated rainfall during the experimental period along with historical averages. Santa Maria/RS, Brazil. Source: UFSM Meteorological Station.

Experimental design and treatments

The experimental area was 7.2 ha, divided into nine experimental units (0.8 ha each). The experimental design was completely randomized with two treatments, totaling nine replicates. Each replicate was represented by the average number of tillers marked within the experimental unit. The treatments included forage sorghum and Alexandergrass during the pasture cycle. The evaluation periods were named according to the following dates and phenological stages: 'Period 1' (Dec./30/2020, to Jan./19/2021; forage sorghum and Alexandergrass in vegetative stage); 'Period 2' (Jan./20/2021, to Feb./9/2021; forage sorghum and Alexandergrass in vegetative stage); 'Period 3' (Feb./10/2021, to Mar./2/2021; forage sorghum in pre-flowering stage and Alexandergrass in vegetative stage); 'Period 4' (Mar./03/2021, to Mar./24/2021; forage sorghum in pre-flowering stage, the full bloom and Alexandergrass in pre-flowering stage) and 'Period 5' (Mar./25/2021, to Apr./13/2021; forage sorghum in full bloom and Alexandergrass in pre-flowering stage – full bloom), totaling 105 days of grazing. The description of the phenological stages and, consequently, the number of periods (1 5) follow the number of grazing periods (average of 21 days). The intensity and frequency of defoliation assessment did not last until 'Period 5' because forage sorghum already contained more than 50% of the plants in the complete flowering stage. Thus, these variables were assessed in Periods 1 to 4 (n=72). Five evaluation periods were considered for leaf blade mass of the pasture mixture (n=90).

Conduction of study

The forage sorghum (*Sorghum bicolor* L. Moench) variety B1F500 (crossing *Sorghum bicolor* x *Sorghum sudanensis*) was established by the end of November 2020 via no-tillage with a seeding density of 20 kg ha^{-1}. The Alexandergrass (*Urochloa plantaginea* (Link) Hitch.) were established in the seed-bank area. Was used 217.5 kg ha^{-1} of fertilizer formulation 13-24-12 at the base and two top-dressing fertilizers of 150 kg ha^{-1} of N formulation 27-00-00. The experimental protocol was based on maintaining the allowance of leaf blades between 600 and 1.000 kg ha^{-1} of dry matter (Montagner et al., 2008), considering that under these conditions, it is possible to quantify the forage readily available for grazing. Tester animals were Braford heifers, with initial age and body weight (BW) of 15 months and 288.1 ± 24.8 kg, respectively. The employed grazing method had a continuous stocking rate with variable use of "put-and-take" animals to maintain the intended leaf blade mass (Mott & Lucas, 1952). Three test animals were used per paddock. The regulatory animals used to maintain leaf blade mass were kept in a contiguous area of 1.5 ha hectares. The mean stocking rates per grazing period were, Period 1:2734.8 kg ha^{-1} BW; Period 2:2168.4 kg ha^{-1} BW; Period 3:1731.4 kg ha^{-1} BW; Period 4:1687.5 kg ha^{-1} BW; Period 5:1842.1 kg ha^{-1} BW.

Traits measured

Leaf blade mass (LM; kg ha^{-1} of DM) was determined using the components of manual separation: leaf (leaf blade), stem (leaf sheath + stem), inflorescence, dead material, and other species that were collected from the visual standard comparison using a double sampling technique (Wilm et al., 1944) at the beginning of each experimental period. From this, the mean percentage contribution of each forage species of the mixture was obtained for each grazing period: Period 1: 75.4% forage sorghum, 11.3% Alexandergrass and 13.3% composed of other species and senescent material; Period 2: 63.5% forage sorghum, 26.8% Alexandergrass and 9.7% composed of other species and senescent material; Period 3: 34.7% forage sorghum, 41.4% Alexandergrass and 23.9% composed of other species and senescent material; Period 4: 27.6% forage sorghum, 56.4% Alexandergrass and 16.0% composed of other species and senescent material; Period 5: 10.9% forage sorghum, 57.1% Alexandergrass and 32.0% composed of other species and senescent material. To determine structural variables and, subsequently, calculate the intensity and frequency of defoliation, it was the "marked tillers" technique (Carrère et al., 1997). Four representative pasture points were demarcated in each paddock using stakes, and tillers were marked and identified using colored plastic threads. At the first three stakes, three tillers of each forage species were marked, whereas at the fourth stake, four tillers of each forage species were marked, totaling 234 tillers. Tillers were monitored at intervals of four days on average, and measurements of canopy height (from ground level to the curvature of leaf blades;

centimeters [cm]) and pseudo-stem height (from ground level to the base of the ligule of the last expanded leaf; cm) were taken. The difference between the height of the pasture canopy and that of the pseudo-stem was used to calculate the leaf blade depth (LD; cm) or the depth of the grazable layer (Roman et al., 2007). Furthermore, expanded, expanding, senescent, and total leaves were also measured in terms of their condition (i.e., senescent or not, intact, or defoliated). Leaves with at least 50% senesced leaf blades were considered senesced.

The defoliated leaf blades were identified to determine the intensity and frequency of defoliation. The defoliation intensity (ID; % leaf blades removed) was estimated as follows: ID = [(initial length × final length)/initial length]x100. The defoliation frequency (DF; number of defoliations blade^{-1} day^{-1}) was calculated from the defoliation measurements of the marked tillers. When it was verified that the leaf had been grazed, its apex was marked using a spelling corrector ("liquid paper") for future identification of new defoliation events. Defoliation frequency was estimated as follows: FD = number of touches on grazing days/(number of touches possible on grazing days × evaluation duration). The time interval or return rate (in days) between two successive defoliations was determined using the following formula: time interval = 1/FD. For the defoliation intensity and frequency values, the average of all the grazed leaves and the developmental phase of each leaf (elongation, expansion, and senescence) were considered.

Statistical analyses

A selection test of the covariance structures was performed using Bayesian Information Criterion (BIC) to determine the model that best represented the data. The general mathematical model referring to the analysis of variance was represented by: Yijk= μ + Ti + ek:I + Pj + (T*Pij) + kijk, where: μ = mean of all observations; Ti= is the fixed effects of treatments; ek:I = is the random effect of the paddock nested in the treatments (error a); Pj= is the fixed effect of evaluation periods; T*Pij= interaction treatments*evaluation periods; kijk= residual experimental error (error b). To compare treatments, variables that showed normality of the residues were submitted to analysis of variance by Mixed procedure, of the software SAS®. The averages when differences were found were compared using the lsmeans procedure. The interaction of forage species × evaluation period was split when significant at 5% probability.

Results and Discussion

There was interaction among forage species x evaluation periods for leaf blade mass (LM; Table 1) and defoliation intensity of general leaf blades (DIG; Table 2). Forage sorghum had a higher LM than Alexandergrass in the first period. From the third period onward, Alexandergrass showed a higher LM than forage sorghum. Looking only at forage sorghum, the highest LM was observed in the first evaluation period, lower LM in the third, fourth, and fifth periods, and intermediate LM in the second evaluation period. Alexandergrass presented the highest LM in the fourth period and the lowest in the first period. Intermediate values were observed during the second and fifth periods. In the third period, the values did not differ between the intermediate and highest values. The sum of the LM of the species presented the highest and lowest values in the first and fifth evaluation periods, and intermediate LM values were found in the second and fourth evaluation periods. During the third period, the LM of the species did not differ between the intermediate and lowest values. LM management may be more appropriate for quantifying forage that is readily available for grazing (Montagner et al., 2008). The results obtained were in line with those recommended by Montagner et al. (2008) for pearl millet (600 and 1,000 kg ha^{-1} DM), except during the fifth evaluation period. Furthermore, extending the period of use of forage resources provided by Alexandergrass alleviated the scarcity of forage in the autumn void.

Table 1
Structural characteristics of a mixture pasture throughout the evaluation periods

Evaluation period	Forage Sorghum	Alexandergrass		P1	P2	P3
	Leaf blade mass (LM)[4]		Total**			
Period 01	1427.41 Aa	302.22 Cb	1729.63 A	0.0001	0.0001	0.0020
Period 02	592.16 Ba	505.35 Ba	1097.51 B			
Period 03	131.55 Cb	730.74 ABa	862.29 BC			
Period 04	127.40 Cb	923.28 Aa	1050.68 B			
Period 05	28.15 Cb	535.25 Ba	563.40 C			
Mean	461.33	599.36	-			
SEM*	97.84	97.84	-			
	Leaf blade depth (LD)[5]		Mean			
Period 01	40.34	14.96	27.65 A	0.0001	0.0001	0.1889
Period 02	14.24	10.12	12.18 B			
Period 03	16.08	10.64	13.36 B			
Period 04	17.03	9.49	13.26 B			
Mean	21.92 a	11.30 b	-			
SEM*	0.60	0.31	-			

[1]Probability between forage species; Values followed by lowercase letters in the rows indicate differences (P<0.05); [2]Probability between evaluation periods; Values followed by uppercase letters in the columns indicate difference (P<0.05); [3]Probability of interaction between forage species × evaluation periods; [4]Kg of dry matter ha^{-1}; [5]Centimeters; * standard error; ** analysis performed by the sum of leaf blade mass of forage sorghum and Alexandergrass.

Compared with Alexandergrass, forage sorghum exhibited the highest DIG in the second and fourth periods. For forage sorghum, the highest and lowest DIG occurred in the second and first periods, respectively, and intermediate DIG occurred in the third and fourth periods. For Alexandergrasses, similar DIGs were observed across the assessment periods. The values for DIG were close to the range of 40 to 60%, as recommended by Gastal and Lemaire (2015). The DIG values for forage sorghum were higher than those described by Gastal and Lemaire (2015) in the second evaluation period. For Alexandergrass, the values remained within the recommended range throughout the experimental period. Although the DIG of forage sorghum exceeded the recommended range, there was probably no dietary restriction for the animals because increases in DIG were associated with adjustments in forage consumption by herbivores (Gonçalves et al., 2009). It is worth mentioning that from the second evaluation period onward, there was a 58.5% reduction in the LM of forage sorghum compared to that in the first period, justifying the increase in DIG for this forage species. From the third period onward, the LM for forage sorghum remained constant, favoring greater removal of leaf blades to the detriment of other parts of the plant. Regarding DIG, the literature states that the proportion of leaf length removed at each defoliation stage is relatively constant (Gastal & Lemaire, 2015). This behavior has been observed in studies evaluating summer forage species in monocultures (Eloy et al., 2014; Salvador et al., 2014; Ongaratto et al., 2021; Monfardini et al., 2022; Salvador et al., 2023). In the present study, it was observed that cattle had different defoliation patterns depending on the forage species.

There was no forage species x evaluation period interaction for the variables leaf blade depth (LD; Table 1), defoliation intensity of elongated leaf blades (DIEL; Table 2), defoliation intensity of expanded leaf blades (DIEXL), defoliation intensity of senesced leaf blades (DISL), defoliation frequency of general leaf blades (DFG; Table 2), defoliation frequency of elongated leaf blades (DFEL), defoliation frequency of expanded leaf blades (DFEXL; Table 2) and defoliation frequency of senesced leaf blades (DFSL).

Table 2
Intensity and frequency of a mixture pasture throughout the evaluation periods

Evaluation period	Forage Sorghum	Alexandergrass	Total**	P1	P2	P3
	Defoliation intensity of general leaf blades (DIG)[4]					
Period 01	53.82 Ca	58.48 Aa	56.15	0.0044	0.0158	0.0214
Period 02	69.23 Aa	58.88 Ab	64.05			
Period 03	60.92 Ba	54.52 Aa	57.72			
Period 04	61.72 Ba	51.00 Ab	56.36			
Mean	61.42	55.72	-			
SEM*	1.18	1.53	-			
	Defoliation intensity of elongated leaf blades (DIEL)[4]		Mean			
Period 01	49.93	59.69	54.81 B	0.5303	0.0133	0.0577
Period 02	70.54	60.15	65.35 A			
Period 03	63.50	63.84	63.68 A			
Period 04	59.15	52.53	55.84 B			
Mean	60.78	59.05	-			
SEM*	1.93	1.93	-			
	Defoliation frequency of general leaf blades (DFG)[4]		Mean			
Period 01	0.11	0.11	0.11 BC	0.0001	0.0131	0.1882
Period 02	0.15	0.11	0.13 A			
Period 03	0.15	0.11	0.13 AB			
Period 04	0.12	0.09	0.11 C			
Mean	0.13 a	0.11 b	-			
SEM*	0.01	0.01	-			
	Defoliation frequency of expanded leaf blades (DFEXL)[4]		Mean			
Period 01	0.07	0.08	0.08 B	0.3594	0.0057	0.2575
Period 02	0.09	0.09	0.09 A			
Period 03	0.11	0.09	0.10 A			
Period 04	0.08	0.07	0.08 B			
Mean	0.09	0.08	-			
SEM*	0.01	0.01	-			

[1]Probability between forage species; Values followed by lowercase letters in the row indicate differences ($P<0.05$); [2]Probability between evaluation periods; Values followed by uppercase letters in the column indicate differences ($P<0.05$); [3]Probability of interaction between forage species × evaluation periods; [4]% of removed length; [5]Number of defoliation $blade^{-1}$ day^{-1}; *Standard error.

LD differed between species and evaluation periods (Table 1). Forage sorghum had the highest LD compared to Alexandergrass. The highest LD value was observed in the first period and the lowest value was observed in the remaining periods. The higher LD observed for forage sorghum throughout the experimental period demonstrates a greater preference for animals to consume the species. Animals that have access to higher LD will likely have the opportunity to select parts of the leaf blades with better nutritional value and lower resistance to seizures than those kept in pastures with lower LD (Roman et al., 2007). The value observed in a previous study on forage sorghum was higher than that reported for pearl millet (Monfardini et al., 2022). For Alexandergrass, the LD was similar to that reported by Severo et al. (2019). In this context, despite the lower LD observed for Alexandergrass, there were probably no forage restrictions for animal consumption. However, it is worth considering that even though LD is higher for forage sorghum, the animal finds fewer leaves available in this forage species than in Alexandergrass, which has a lower structure and a longer vegetative cycle. In this context, there was probably a reduction in the bite mass of the animals when consuming forage sorghum because low forage density and the dispersion of blades in the upper strata force the animals to collect fewer leaves in each bite or even individual leaves (Gonçalves et al., 2009).

For DIEL, there was no difference between species, but there was a difference between the periods (Table 2). The largest DIEL was observed in the second and third periods, and the smallest in the first and fourth evaluation periods. Although there were variations in DIEL over the periods, it was observed that the animals maintained a higher DIEL in the upper extract of the tillers, regardless of the forage species. When bovines explore the upper portion of the tillers, sufficient leaf blades remain in the plant for post-grazing recovery via photosynthesis. For DIEXL, there was a difference between species (*P*=0.0016), but no difference between the evaluation periods (*P*=0.3411). A higher DIEXL was observed in forage sorghum (68.21%) than in Alexandergrass (59.42%). Although the production cycle of forage sorghum advances, with greater fiber accumulation and motivating cattle to reject this species in preference to Alexandergrass, which remains in the vegetative stage, with lower fiber content and producing forage with better nutritional quality, the results obtained can probably be related to the distinct growth habits of the species. More upright plants are more vulnerable to animal action through defoliation than prostrate plants (Marriott & Carrère, 1998). In a pasture mixture of *Urochloa brizantha* and *Arachis pintoi,* there was a higher consumption of grass at the expense of legumes because of the plant's architecture, which provided a higher bite depth and volume (Rego et al., 2006). For DISL, there was no significant difference between species (*P*=0.7942) or between evaluation periods (*P*=0.1885). The species presented an average value of 55.45% ± 11.27. The probability of defoliation of individual leaf blades by animals is higher for elongating and expanded leaf blades (Lemaire & Agnusdei, 2000), as they are located in the upper stratum of the canopy (Hodgson, 1990), which corroborates the results of the present study. As senescent leaf blades are situated in the lower stratum of the forage canopy, the DISL for this type of leaf is lower.

The DFG differed between species and evaluation periods (Table 2). A higher average DFG value was observed in forage sorghum. The highest and lowest DFG values are observed during the second and fourth periods, respectively. DFG in the first and third evaluation periods did not differ between the highest and lowest values. The highest DFG content was observed in forage sorghum. The return rate of animals to the leaf blades of forage sorghum and Alexandergrass corresponded to average intervals of 11.0 and 13.9 days, respectively. These results are superior to those observed in tropical forage species (Eloy et al., 2014; Salvador et al., 2014; Hundertmarck et al., 2017; Monfardini et al., 2022). Although the quality of each forage species could influence this context, the differences found may again be associated with the architecture of forage sorghum, as the animal operates as a harvest mechanism. The most recurrent limiting factor in animal production based on the grazing process is not the chemical attributes of the forage (digestion), but rather its capture (ingestion) (Charnov, 1976; Smith et al., 2021). Each day, 7.9% and 6.1% of the leaf blades of forage sorghum and Alexandergrass were removed, respectively.

DFEL differed between species (P=0.0001) but did not differ between the evaluation periods (*P*=0.4884). A higher average DFEL value was observed for forage sorghum (0.09) than that for Alexandergrass (0.07). For DFEXL, there was no difference between species, but there was a difference between the periods (Table 2). The highest DFEXL values were distributed in the second and third periods, and the lowest in the first and fourth evaluation periods. No significant differences were observed between species (*P*=0.1275) and evaluation periods (*P*=0.1466) for DFSL, with mean values of 0.06 ± 0.01. The frequency of defoliation by leaf type (DFEL, DFEXL, and DFSL), when evaluated in days (rate of return to the same tiller), demonstrated that in sorghum forage and Alexandergrass, there were higher (14.5 days) and lower (17.5 d) rates of animals returning to the elongating leaf blades, respectively. With respect to the return of animals to expanded and senescent leaf blades, similar values were observed between species, with average return rates to the same tiller of 16 and 19.3 days, respectively. These leaves, when grazed at the same frequency, indicate that the type of leaf blade harvested occurred casually, mediated by ready accessibility (Machado et al., 2011).

Conclusions

Beef heifers show altered defoliation patterns depending on the forage sorghum and Alexandergrass pasture cycles. Mixed pastures are recommended because of the complementarity between them. The contribution of Alexandergrass to forage sorghum pasture guarantees pasture production until autumn, thereby prolonging the vegetative phenological cycle. The preference for forage sorghum arises from the architecture of the plant and position at which the leaf blades are inserted into the canopy.

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