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Article

Interference of Noxious Shrubs on Grazing Behavior by Bovines

Interferência de Arbustos Nocivos no Pastejo por Bovinos

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ABSTRACT - The grazing behavior practice by bovines can be positive or negatively influenced by the pasture structure where the animal is inserted. Several factors determine the pasture structure and the presence of weeds is considered one of the most important. This study aimed to assess the effect of species with and without stiff structures over the grazing behavior of bovines in pasture areas. The experimental design was a split block design with four replications, in which treatments were arranged in a 4 x 3 factorial design: four weed species (*Zanthoxylum rhoifolium*, *Cnidoscolus urens*, *Dasyphyllum brasiliensis*, and *Luehea divaricata*) associated with three proximity strips of weeds: 0-50, 50-100, and 100-150 cm in relation to the main stem of the studied weed. Forage intake by animals was measured by determining the real forage offers at 0, 3, 6, 9, and 15 days after the beginning of animal grazing (DAP). The presence of noxious shrubs influenced bovine grazing behavior. The influence on the intake is most evident in the presence of plants that promote animal discomfort. The species *Z. rhoifolium*, *C. urens*, and *D. brasiliensis* were the weeds with the greatest influence on feed access among the species that have stiff structures. The negative influence on grazing behavior is higher in the proximity strip closest to the plant, i.e. 0-50 cm from the main stem of the weed.

Keywords: thorny shrub, nettle, pastures utilization, animal access, weed.

*RESUMO - O hábito de pastejo praticado pelos bovinos pode ser positiva ou negativamente influenciado pela estrutura da pastagem onde esse animal está inserido. Vários são os fatores que determinam a estrutura da pastagem, e a presença de plantas daninhas pode ser considerada um dos principais. O presente trabalho teve por objetivo avaliar o efeito de espécies com e sem estruturas contundentes sobre o comportamento de pastejo de bovinos em áreas de pastagens. O experimento foi conduzido em faixa no delineamento de blocos completos casualizados com quatro repetições, onde os tratamentos foram dispostos em faixas 4 x 3: quatro espécies de plantas daninhas (**Zanthoxylum rhoifolium, Cnidoscolus urens, Dasyphyllum brasiliensis** e **Luehea divaricata**) associados a três faixas de proximidade das plantas daninhas: 0-50, 50-100 e 100-150 cm de distância em relação ao caule principal da planta daninha estudada. O consumo de forragem pelos animais foi mensurado determinando-se a oferta real de forragem aos 0, 3, 6, 9 e 15 dias após o início de pastejo animal (DAP). A presença de arbustos nocivos influencia o comportamento de pastejo de bovinos. A influência no consumo é mais evidente quando existem plantas que promovem desconforto animal. **Z. rhoifolium, C. urens** e **D. brasiliensis** e foram as daninhas de maior influência negativa sobre o acesso ao alimento entre as espécies que possuem unidades contundentes. A influência negativa no pastejo é maior na faixa mais próxima à planta, ou seja, 0-50 cm de distância do caule principal da daninha.*

Palavras-chave: arbusto espinhoso, urtiga, utilização da pastagem, acesso animal, planta daninha.

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INTRODUCTION

The pasture ecosystem is very dynamic, with mechanisms and processes involved in the production, harvesting, and transformation of forage into animal product acting in an integrated and compensatory way. This hinders to reach positive net results from isolated actions in any compartment of the productive system (Santos et al., 2011; Carvalho et al., 2016). In order to achieve satisfactory productive indices and enable shorter cycle livestock with economic efficiency, it is necessary that the animal feed process does not become an obstacle to their achievement (Gléria et al., 2017).

In most tropical pasture production systems, the forage harvesting task rests with the animals themselves, which have specific strategies to obtain their nutritional demands (Teixeira et al., 2010). It has been experimentally demonstrated that animals have a certain wisdom in the choice of food so that the vital balance of nutrients is ensured (Shariatmadari and Forbes, 1993; Cooper et al., 1995; O'Reagain and Schwartz, 1995).

Thus, the animal must search for and choose its food within the pasture, which can present different types of structure regarding the quality and abundance variable in time and space. The association between all factors determines the pasture structure, which cannot be considered only as a description of its characteristics, but rather consider it as a management attribute since the structural characteristics are at the interface of the plant with the animal (Carvalho et al., 2007a; Teixeira et al., 2010). In other words, just as the structure of pasture affects the amount of consumed dry mass, the animal also has a marked influence on the pasture structure.

The distribution of animals in the pasture can be influenced by some factors of pasture structure, namely relief (Ganskopp and Vavra, 1987), location of the water source (Hart et al., 1993), botanical composition and forage quality (Bailey et al., 1996), factors that favor thermal regulation such as shade and wind (Senft et al., 1985), cattle management (Skovlin, 1957), and location of supplements (Bailey et al., 2001). The presence of unwanted plants may also affect the pattern of use of certain grazing sites. Some studies show that animals avoid areas with large quantities of plants having stiff structures such as thorns or stinging trichomes (Williams, 1954; Cook, 1966; Senft et al., 1985; Owens et al., 1991; Santos et al., 2011; Carvalho et al., 2016). More recent studies conducted by Santos et al. (2011) and Carvalho et al. (2016) reported that *Solanum sisymbriifolium* causes spatial variability of *Urochloa decumbens* cv. Basilisk in a continuous stocking with bovine.

Thus, the aim of this study was to assess the effect of weed species with and without stiff structures on the intake habit of bovine in the pasture of *Urochloa brizantha* cv. Marandu.

MATERIAL AND METHODS

The experimental phase was performed in a pasture of *Urochloa brizantha* (Hochst. Ex A. Rich.) Stapf cv. Marandu located at the geographical coordinates of 15º29'57" S and 52º33'31" W, with climate type Aw according to Köppen classification.

The entire experimental area was previously mowed with a rotary cutter aiming at eliminating forage residues from the previous grazing and stimulating the production of new aerial biomass by the forage and weed community.

The experimental area was isolated for the presence of animals immediately after the mowing operation and the access to cattle was allowed only 40 days after mowing when the forage grass and voluntary plants had emitted a new aerial part. The same grazing system routinely used by the farm was adopted, i.e. a continuous grazing for 15 days by Nellore barrows with an average age of 3.0 years, at an intensity equivalent to 2.4 animal units per hectare (AU ha^{-1}), and considering 1.0 AU as 450 kg live weight.

The experiment was conducted in a 4 x 3 factorial scheme, represented by four weed species (with and without a stiff structure) associated with three proximity strips of weeds: 0-50, 50-100, and 100-150 cm in relation to the main stem of the studied weed, in a randomized complete block design with four replications, whose blocking criterion was the weed species. In addition, we adopted the experiment in strips due to operational reasons aiming at arranging the factor distance from the stem respectively at each level. Treatment casualization in the plots was performed according to the recommendation of Barbosa and Maldonado Jr. (2015).

The weed species were *Dasyphyllum brasiliensis* (Spreng.) Cabrera, with an average height of 1.55 m, average dry mass of 493.9 g m^{-2}, and 251 thorns m^{-1} of stem with an average size of 1.97 cm; *Cnidoscolus urens* (L.) Arthur, with an average height of 1.73 m, average dry mass of 371.0 g m^{-2}, and stinging trichomes in the leaf blade and petiole; *Zanthoxylum rhoifolium* Lam., with an average height of 1.75 m, average dry mass of 280.1 g m^{-2}, and 460 thorns m^{-1} of stem with an average size of 0.84 cm; and *Luehea divaricata* Mart., with an average height of 1.77 m, average dry mass of 383.1 g m^{-2}, and no stiff structure that would cause discomfort to animals, being considered as the control.

The forage plants were assessed at 15 days after the beginning of animal grazing (DAP), at which time the samples were collected by cutting the forage 10 cm above the soil in an area delimited by a 1.0 x 1.0 m metallic square randomly chosen in the experimental unit.

The collected samples were immediately taken to the laboratory and fractionated into green leaf, green stem, and dead material. The eventually present inflorescences were considered as the green stem. The samples were then packed in paper bags and maintained in a forced air ventilation oven at 65 °C for three days, at which time the weight of each forage fraction was measured in a scale with an accuracy of 0.01 g.

From the data of the weight of each fraction, we determined the amount of green leaf dry mass (GLDM), green stem dry mass (GSDM), dead material dry mass (DMDM), and the total dry mass (TDM), all of them expressed in grams per square meter (g m^{-2}). The leaf weight to stem weight ratio (L:S) was calculated as the following equation:

$$L:S = \frac{GLDM}{GSDM}$$

where L:S is the relationship between leaf and stem, GLDM is the green leaf dry mass (g), and GSDM is the green stem dry mass (g).

The evolution of height and real forage offer (RFO) for each species and distance was assessed during the period of animal grazing. Readings and collection of samples were carried out at each sub-grazing period, namely 0, 3, 6, 9, 12, and 15 DAP. The relative RFO was calculated by the quotient of the arithmetic mean of the initial and final forage mass of each grazing sub-period and the number of days of that sub-period plus the corresponding accumulation rate. The availability was divided by the average animal load of the sub-period (in kg ha^{-1} of animal live weight) and the obtained value was multiplied by 100 to express the offer in relation to the live weight (Mezzalira et al., 2011):

$$RFO = \frac{\frac{\frac{MFi + FMf}{2}}{n + AR}}{AL} * 100$$

where RFO is the real forage offer (kg DM 100 kg-1 LW), FMi is the initial forage mass (kg ha^{-1} DM), FMf is the final forage mass of the sub-period (kg ha^{Š1} DM), n is the number of days in the period, AR is the daily forage accumulation rate (kg ha^{-1} DM), and AL is the animal load (kg ha^{-1} LW). The rate of daily forage accumulation was determined by the grazing exclusion cage technique, as proposed by Klingman et al. (1943), a methodology that was adapted to eliminate possible competition effects of weeds on forage.

The results of dry mass from fractions and total produced by the forage and the leaf to stem ratio obtained in this experiment were submitted to analysis of variance by the F test and the means were compared by the Tukey's test ($p \leq 0.05$) using the statistical software AgroEstat (Barbosa and Maldonado Jr., 2015). Height evolution was submitted to regression analysis ($p \leq 0.05$) and the real forage offer was adjusted according to the Boltzmann's sigmoidal model, as proposed by Kuva et al. (2001).

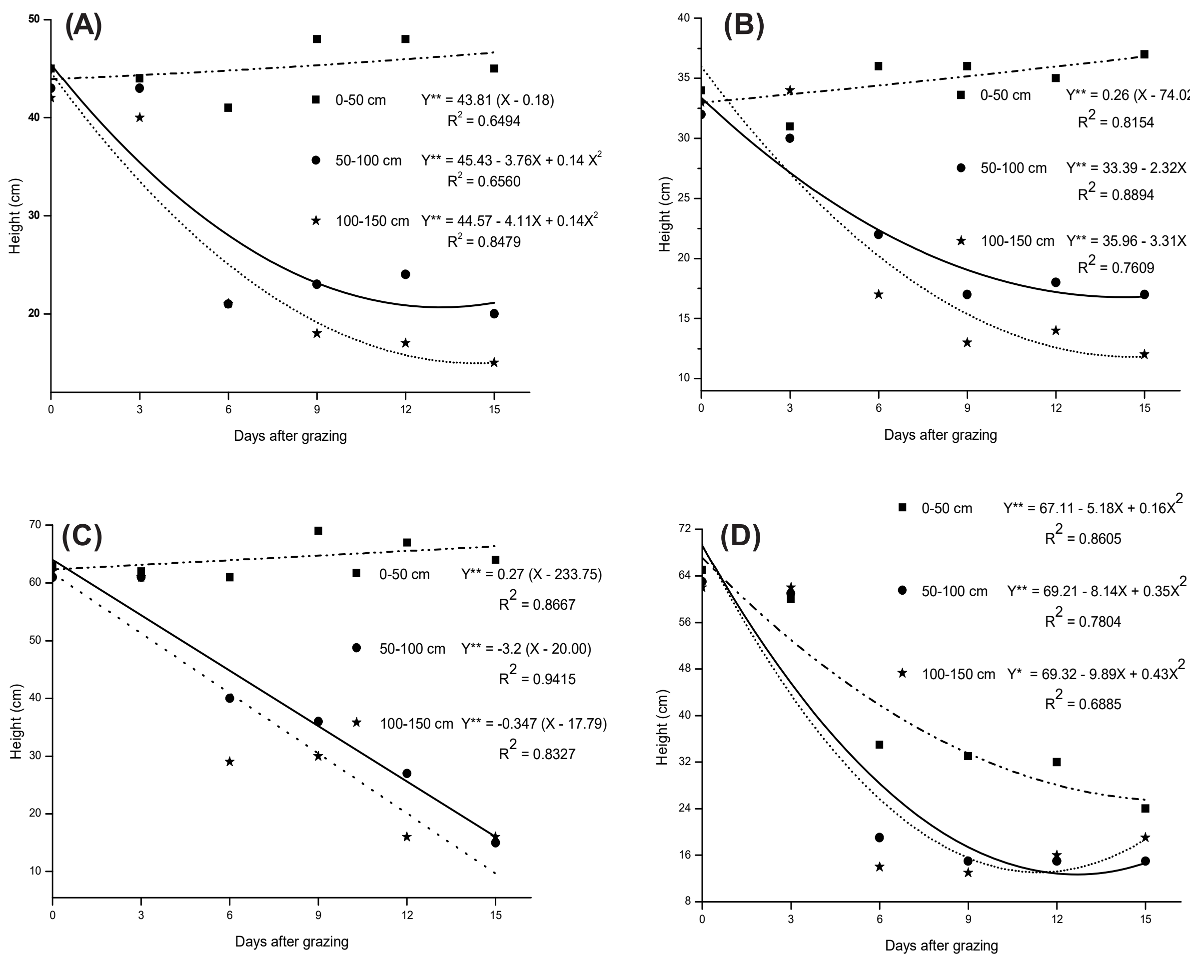
RESULTS AND DISCUSSION

The evolution of the canopy height of forages during the 15 day period of grazing reveals the bovine behavior in the presence or absence of stiff structures in spontaneous plant species (Figure 1). The animals avoided areas located in the strip between 0 and 50 cm from species that presented discomfort to the animal, regardless of the size and quantity of thorns in the stem or stinging structure (Figure 1A, B, and C). Thus, the absence of animal grazing allowed linear increases in the average plant height after 15 days from the beginning of animal grazing in the distance strip closest to the stem.

The reduction in height in the forage species was noticed at the beginning of animal grazing in the strip of 0-50 cm from the species that does not have any structure that causes animal discomfort (LUEDI, *Luehea divaricata*) (Figure 1D), demonstrating that the animals were present and grazed the forage in this area.

The average forage height decreased considerably over the animal grazing period in the strips of 50-100 and 100-150 cm, regardless of the spontaneous species. The reductions were exponential for the species ZANRO (*Zanthoxylum rhoifolium*), DASBR (*Dasyphyllum brasiliensis*), and LUEDI and linear for the species IATUR (*Cnidoscolus urens*) (Figure 1A, B, C, and D).

In addition, these reductions in height were proportional to an increase in distance to the stem of the undesired plant since the average forage heights obtained during the animal grazing presented the order 0-50 > 50-100 > 100-150 cm (Figure 1). However, a similarity was observed in the average forage height before the beginning of animal grazing (0 DAP).



** Significant at 1% probability; * significant at 5% probability.

Figure 1 - Evolution of the average height of pasture as a function of the proximity to the weeds (A) ZANRO (*Zanthoxylum rhoifolium*), (B) DASBR (*Dasyphyllum brasiliensis*), (C) IATUR (*Cnidoscolus urens*), and (D) LUEDI (*Luehea divaricata*).

Rajcan and Swanton (2001) observed that the competition between forage and weed by water, nutrients, space, and light causes changes in the structural characteristics of the pasture because the forage modifies its growth pattern and hence its morphology in response to the differentiated microclimate that is established near the weed.

The highest forage heights obtained in the strip of 0-50 cm from the stem occur because the spontaneous species are competing for light with the Marandu grass. One of the responses of the forage plant in a shaded environment is the elongation of its internodes, which results in a higher plant height. This pattern of response is in line with that observed by Gobbi et al. (2009), who verified an increase in plant height of *U. decumbens* cv. Basilisk when the shading level increased from 0 to 70%, indicating an adaptive morphological response (phenotypic plasticity) of this species. Santos et al. (2011) reported that the presence of the weed *Solanum sisymbriifolium* conditioned an increase in tiller height of *U. decumbens* cv. Basilisk, especially in the strip located within a radius of 0.50 cm from the stem.

The lowest height of the Marandu grass in the strips farther from weeds is due to a higher intensity of defoliation related to animal grazing. Thus, probably, many tillers had their apical meristems eliminated due to animal grazing and, consequently, tiller development was interrupted. In fact, the elimination of the pseudo-stem apex can determine tiller death (Cecato et al., 2008), preventing the forage canopy to reach a higher height.

The analysis of variance showed a significance for the sources of variation weed species and distance in relation to weed stem and for the interaction between both factors, indicating that the variables GLDM, GSDM, DMDM, TDM, and L:S were differently affected. In addition, no effect was observed for the source of variation weed species only on the variable L:S (Table 1).

Table 1 - Summary of the analysis of variance for green leaf dry mass (GLDM), green stem dry mass (GSDM), dead material dry mass (DMDM), total dry mass (TDM), and leaf to stem ratio (L:S)

Source of variation	F values				
	GLDM(1)	GSDM(2)	DMDM(3)	TDM(4)	L:S(5)
Species (S)	250.00**	117.60**	94.77**	356.64**	0.95NS
Distance (D)	505.09**	444.35**	44.12**	404.57**	8.42*
S x D	57.29**	34.80**	22.29**	38.13**	3.18*
CV Residual S (%)	5.68	9.65	7.19	3.99	12.32
CV Residual D (%)	5.42	7.03	7.02	4.84	6.47
CV Residual S x D (%)	6.78	11.21	7.52	6.04	13.42

NS Not significant. ** Significant at 1% probability. * Significant at 5% probability.

The dry mass of the various fractions of *U. brizantha* assessed at 15 DAP can also be used to understand animal grazing behavior. The green leaf (GLDM), green stem (GSDM), and total (TDM) dry masses obtained in the strip of 0-50 cm from the LUEDI stem were statistically lower when compared to the other species. Considering only the species with stiff structures, GLDM, GSDM, and TDM obtained in the strip between 0 and 50 cm from the IATUR species were significantly higher when compared to those obtained in the same strip from the ZANRO and DASBR species (Table 2).

The variables GLDM and TDM were also statistically lower in the strip between 50 and 100 cm from the LUEDI stem when compared to the species ZANRO, DASBR, and IATUR. The fractions obtained in the same proximity strip of IATUR were also statistically higher when compared to those of ZANRO and DASBR (Table 2).

The amount of dead material dry mass (DMDM) was statistically higher in the strips of 0-50 cm and 50-100 cm from the stem of ZANRO. However, a higher amount of DMDM in the strip of 100-150 cm was obtained for the IATUR species (Table 2).

Similar to that observed in relation to plant height evolution and analyzing GLDM, GSDM, DMDM, and TDM only as a function of weed, we observed that the respective amounts of dry mass decreased as the distance from plant stem of ZANRO, DASBR, and IATUR increased. In

Table 2 **-** Pasture dry mass obtained at 15 DAP as a function of distance and weed species

Species[5]	GLDM[1] (g m^{-2})			GSDM[2] (g m^{-2})			DMDM[3] (g m^{-2})			TDM[4] (g m^{-2})		
	0-50	50-100	100-150	0-50	50-100	100-150	0-50	50-100	100-150	0-50	50-100	100-150
IATUR	265.7 aA	142.3 aB	122.2 aC	256.7 aA	114.9 aB	102.8 aB	184.0 bA	146.9 bB	202.5 aA	706.5 aA	404.2 aB	427.5 aB
DASBR	179.8 bA	117.7 bB	82.4 bC	148.7 bA	84.4 bB	76.7 bB	147.3 cA	134.1 bAB	125.2 cB	475.8 cA	336.2 bB	284.4 cC
ZANRO	160.3 cA	108.9 bB	96.2 bB	161.1 bA	92.5 bB	75.2 bB	263.9 aA	181.7 aB	160.6 bC	585.3 bA	383.1 aB	332.0 bC
LUEDI	93.0 dA	101.1 cA	93.4 bA	71.1 cA	88.4 bA	73.7 bA	141.2 cA	128.1 bA	137.7 cA	305.4 dA	315.3 bA	304.8 bcA

Means followed by the same lowercase letter in the column and uppercase letter in the row do not differ statistically from each other by the Tukey's test at 5% probability. [1] GLDM – green leaf dry mass; [2] GSDM – green stem dry mass; [3] DMDM – dead material dry mass; [4] TDM – total dry mass; [5] Species: ZANRO (*Zanthoxylum rhoifolium*), IATUR (*Cnidoscolus urens*), DASBR (*Dasyphyllum brasiliensis*), and LUEDI (*Luehea divaricata*).

addition, the dry mass of the various fractions obtained within the different strips from the stem of the LUEDI species was significantly similar after the 15 day grazing period (Table 2). These results are in accordance with Mezzalira et al. (2011), who observed that the herd behavior in a pasture can cause unevenness in grazing, which has many negative implications, such as the reduction in forage plant stand and soil coverage in certain areas, with a consequent increase in the risk of erosion and weed infestation, poor fecal distribution in pasture and impairment of nutrient cycling, and a reduced productivity in the system.

In fact, Hein and Miller (1992), working on native grasses infested with weeds containing thorns, found that for every 10% increase in weed infestation led to an 8.7% reduction in the use of the pasture forage. Thus, some tillers of *U. brizantha* close to the weeds have probably developed up to the reproductive stage, a situation in which stem elongation is common (Cecato et al., 2008), which results in a higher plant height and lower density of morphological components, as observed in our study.

Deleterious effects on the forage structure due to weed presence were also observed by several authors (Williams, 1954; Cook, 1966; Senft et al., 1985; Owens et al., 1991). Santos et al. (2011) observed that the volumetric density of green leaf and total dry mass produced by *Urochloa decumbens* cv. Basilisk was statistically lower in plants located within a radius of 0.50 cm from the weed *Solanum sisymbriifolium* when compared to plants located at longer distances.

Another important parameter used in the study of forage grass morphogenesis is the leaf to stem ratio, in which the highest values were obtained near the species LUEDI and ZANRO (1.31 and 1.21, respectively) in the strip of 0-50 cm from the stem. In addition, the leaf to stem ratio observed in this proximity strip of LUEDI was statistically higher when compared to the ratios obtained in the same strip from the stems of IATUR and DASBR (Table 3). However, the leaf to stem ratio also tended to increase in the strips farther from the stems of IATUR, DASBR, and ZANRO, while the values of this ratio remained statistically similar in the three strips from the stem of LUEDI (Table 3).

All the parameters mentioned above are susceptible to a direct interference by weeds since the forage and the other four species are dividing the same space in the environment. This common survival can favor the establishment of the biological relationship between individuals called competition in which each plant species will exert some degree of interference on the

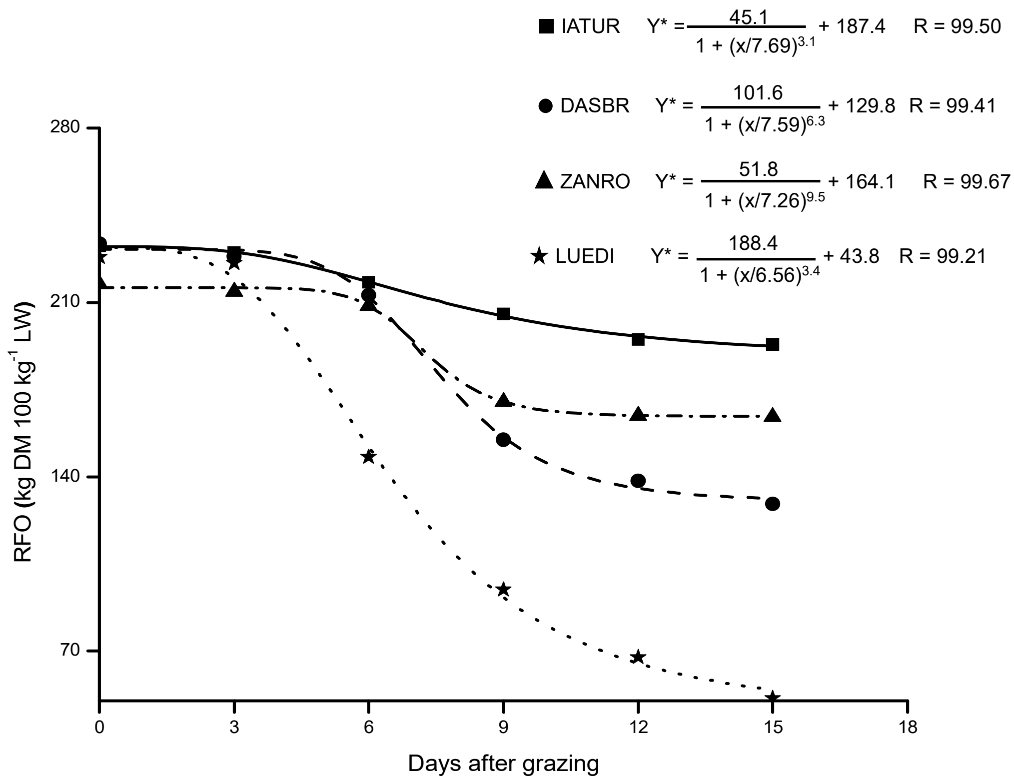
Table 3 **-** Leaf dry mass to stalk dry mass ratio (leaf:stem) obtained at 15 DAP as a function of distance and weed species

Species[1]	Leaf:stem		
	0-50	50-100	100-150
IATUR	0.99 bB	1.18 bAB	1.29 aA
DASBR	1.04 bB	1.27 bA	1.22 aAB
ZANRO	1.21 abAB	1.39 aA	1.07 aB
LUEDI	1.31 aA	1.14 bA	1.26 aA

Means followed by the same lowercase letter in the column and uppercase letter in the row do not differ statistically from each other by the Tukey's test at 5% probability. [1] Species: ZANRO (*Zanthoxylum rhoifolium*), IATUR (*Cnidoscolus urens*), DASBR (*Dasyphyllum brasiliensis*), and LUEDI (*Luehea divaricata*).

neighboring species. This interference will influence the horizontal growth and the biomass accumulation capacity of the individuals. Furthermore, each of the spontaneous species has different adaptation levels to the local environmental conditions and will probably provide different degrees of interference in the behavior of the exotic species *U. brizantha*.

The real pasture offer is an important parameter that relates the availability of forage dry mass proportional to each of spontaneous species and resulting from the animal grazing activity. Thus, we can isolate the differences of possible competitive pressures exerted by the spontaneous species during the experimental period. The RFO were pratically the same in the assessment performed immediately before the beginning of animal grazing (0 DAP), indicating that the weeds did not compete with the forage grass during the period of conducting the experiment (Figures 2, 3, and 4).



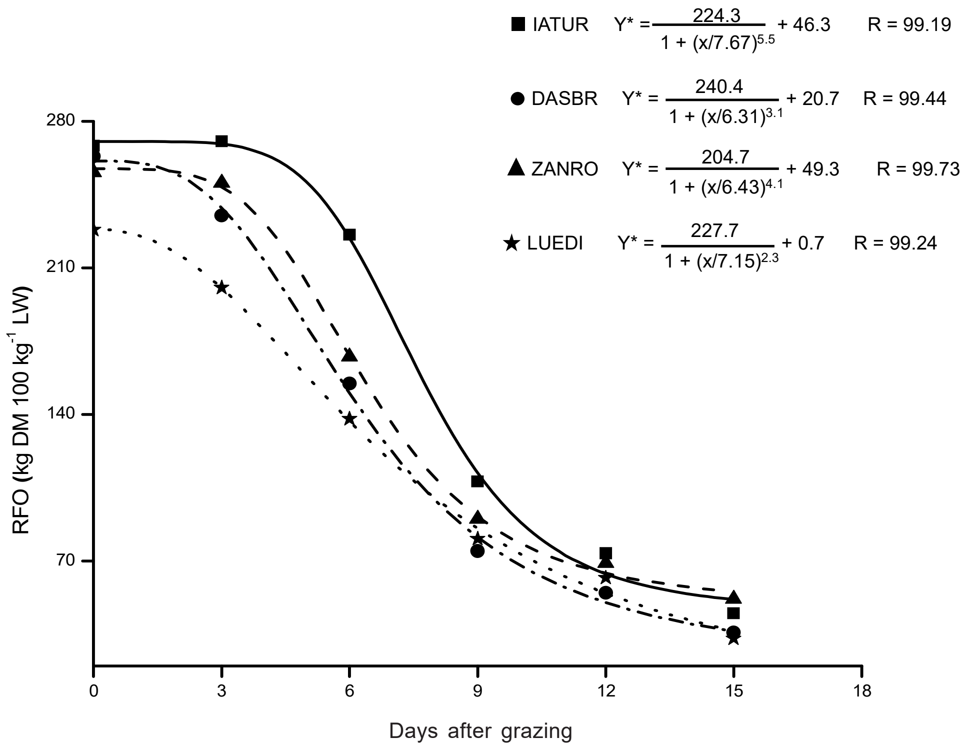
* Significant at 5% probability. ZANRO (*Zanthoxylum rhoifolium*), DASBR (*Dasyphyllum brasiliensis*), IATUR (*Cnidoscolus urens*), and LUEDI (Luehea divaricata).

Figure 2 **-** Evolution of the real forage offer (RFO) obtained in the strip of 0-50 cm from the stem of the spontaneous plant species throughout the animal grazing period.

The variable RFO remained practically unchanged in the strip of 0 50 cm from the stem of the species IATUT, DASBR, and ZANRO up to 6 DAP. Expressive reductions in RFO in the same distance strip from the stem of LUEDI occurred at the beginning of the grazing period (3 DAP), while the reductions were more evident only from 6 DAP in this distance strip for the species DASBR and ZANRO and only from 9 DAP for the species IATUR (Figure 2).

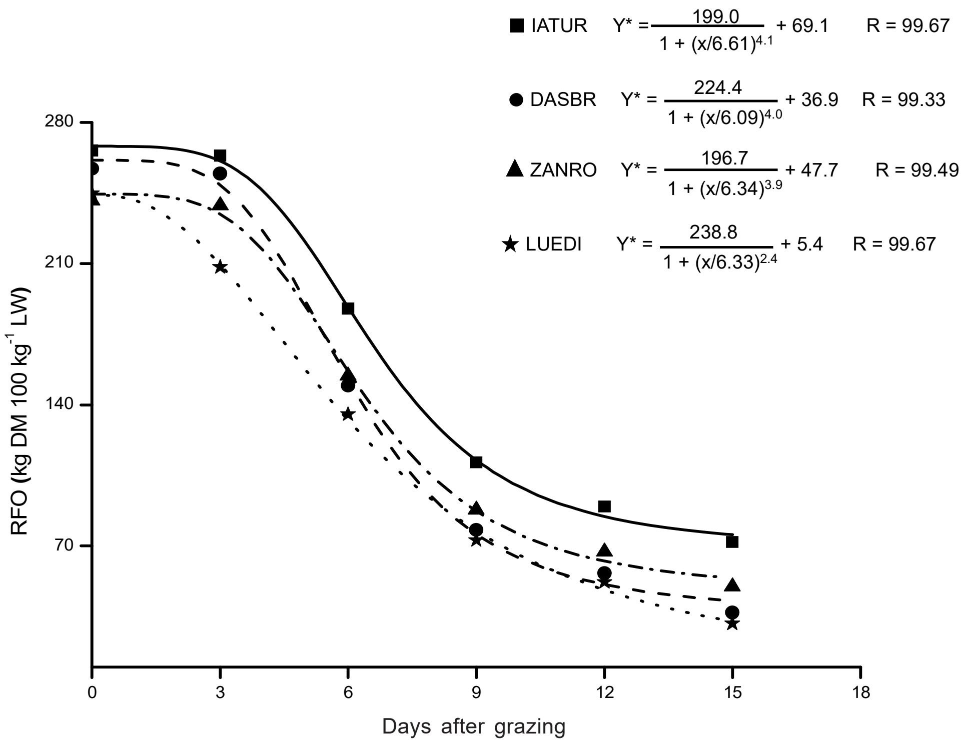
Curiously, the RFO obtained in the same distance strip from the species that have structures that cause animal discomfort did not reduce from 9 DAP and remained constant until the end of the grazing period, indicating that the animals avoided the species IATUR, DASBR, and ZANRO in this strip (Figure 2).

The evolution of the RFO relative to the species observed in the other two distance strips from the stem presented alterations regarding the closest distance strip, and an increase in the distance gave higher reductions in RFO values. The availability of RFO obtained in the strip of 50-100 cm from the stem of the species DASBR and ZANRO decreased considerably from 3 DAP



* Significant at 5% probability. ZANRO (*Zanthoxylum rhoifolium*), DASBR (*Dasyphyllum brasiliensis*), IATUR (*Cnidoscolus urens*), and LUEDI (*Luehea divaricata*).

Figure 3 - Evolution of the real forage offer (RFO) obtained in the strip of 50-100 cm from the stem of the spontaneous plant species throughout the animal grazing period.



* Significant at 5% probability. ZANRO (*Zanthoxylum rhoifolium*), DASBR (*Dasyphyllum brasiliensis*), IATUR (*Cnidoscolus urens*), and LUEDI (*Luehea divaricata*).

Figure 4 - Evolution of the real forage offer (RFO) obtained in the strip of 100-150 cm from the stem of the spontaneous plant species throughout the animal grazing period.

and was relatively similar to the reduction obtained in the same distance strip from the stem of the species LUEDI (Figure 3). The RFO relative to the species IATUR also decreased in this distance strip, but the reduction was relatively higher only from 6 DAP (Figure 3). This probably occurred because the species IATUR have stinging bristles, which bovine identifies as a higher discomfort at the time of approach to obtain the food since the animals develop an ingestive memory based on mechanisms by which they search, select, defoliate, and ingest forage in the pasture (Carvalho et al., 2013).

The evolution of RFO values relative to the species in the strip of 100-150 cm from the stem was considerable and similar from 3 DAP, regardless of the spontaneous species (Figure 4).

In addition, although the RFO relative to the species is practically the same at the beginning of animal grazing, the relative values of RFO from 3 DAP obtained near IATUR were always higher when compared to the others species regardless of the studied strip (Figures 2, 3, and 4).

Although forage offer describes the amount of feed made available to the animal, it does not give any information about the way the forage is presented to it. This form of spatial distribution of plant shoot, which is called pasture structure, considerably affects the intake and selection of diets of grazing animals (Carvalho et al., 2007b).

According to Mezzalira et al. (2011), animals transmit signals on the pasture structure, through ingestive behavior, regarding the abundance and quality of its pastoral environment. The reduction in food availability obtained in this experiment practically forced the animals to get closer to the plants with stiff structures at 15 DAP, especially in the distance of 50-100 cm. However, even with offer reductions, bovine showed an ability to choose the food according to the pasture structure since the areas between 0 and 50 cm from the stem of the species IATUR were not practically grazed by the animals.

The influence on the animal intake is evident in the presence of plants containing structures that promote animal discomfort, as in the case of *Zanthoxylum rhoifolium*, *Cnidoscolus urens*, and *Dasyphyllum brasiliensis*. *Cnidoscolus urens* was the species that had the highest negative influence on food access among the species that have stiff structures. The negative influence on food access is higher in the strip closest to the plant, i.e. 0-50 cm away from the main stem.

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