




## Performance and feed intake of beef heifers on rotational grazing of natural grassland receiving protein and energy supplement in cool season

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**ABSTRACT:** *The aim of this study was to evaluate the performance and feed intake of grazing beef heifers on two grazing intervals determined by thermal sum related to leaf elongation duration during cool season on natural grasslands. A complete randomized block design experiment with two treatments and three replications was conducted from May to September 2011 in the central part of the state of Rio Grande do Sul, Brazil. The treatments were two thermal sums calculated at 375 and 750 degrees-days (DD) to determine the intervals between grazing periods in a rotational grazing system. Thirty six beef heifers with average age of 18 months old and (initial body weight = 220±14kg) were used, all heifers received ground corn supplement at a rate of 5g kg<sup>-1</sup> of body weight per day, at 2p.m., throughout the experiment and had free access to mineral and protein supplementation (450g kg<sup>-1</sup> of CP). Similar average daily gain (ADG), beef production gain (BPG) and feed intake (FI), were obtained in both treatments. Leaf elongation duration is an alternative grazing management tool for improved animal production and to increase animal stocking rate.*

**Key words:** animal production, beef heifers rearing, grazing system.

### Desempenho de bezerras de corte em pastoreio rotativo em pastagem natural recebendo suplemento proteico-energético

**RESUMO:** *Objetivou-se avaliar o desempenho e consumo de matéria seca de bezerras manejadas em pastoreio rotativo, com intervalos de pastoreio definidos por duas somas térmicas relacionadas à duração de alongação foliar de dois grupos funcionais de gramíneas durante a estação fria em pastagem natural. O delineamento experimental foi o de blocos completamente casualizados, com dois tratamentos e três repetições de área na região central do Rio Grande do Sul, Brasil. Os tratamentos foram duas somas térmicas: 375 e 750 graus-dias (GD), que determinaram os intervalos entre os pastoreios. Foram utilizadas trinta e seis bezerras de corte com idade média de 18 meses e peso corporal médio de 220±14kg. Durante todo o experimento, as bezerras receberam como suplemento grão de milho moído a uma taxa de 0,5% do peso corporal por dia, às 14:00 horas e tiveram livre acesso à suplementação proteinada (45% PB). Não houve diferença para o ganho médio diário, ganho de peso por área e consumo de matéria seca entre os tratamentos. A soma térmica como intervalo de descanso entre os pastoreios mostrou-se uma alternativa de manejo para aumentar a taxa de lotação.*

**Palavras-chave:** pastagem natural, graus-dia, suplemento, produção animal.

## INTRODUCTION

South America natural grasslands include all Uruguay, northeast Argentina, south Brazil and part of the Paraguay. In Brazil, these natural grasslands are located in the southern region and encompasses two biomes. According to the national classification (IBGE, 2004), the grasslands situated in the northeast region of Rio Grande do Sul, Santa Catarina and Paraná states belong to Mata Atlântica

biome and the grasslands situated in the southern part of Rio Grande do Sul state are called Pampa biome.

Pampa biome represents 2.07% (176.496Km<sup>2</sup>) of Brazilian territory (IBGE, 2004) and, currently, still remain 23% (41.054,61Km<sup>2</sup>) of its natural vegetation, mainly grasslands, without anthropic modification (HASENACK et al., 2010). It is important to define appropriate management strategies for specific grazing systems (HODGSON & DA SILVA, 2000); however, grasslands with high

species biodiversity, as observed in the Pampa biome, renders grazing management difficult and becomes almost impossible to prioritize only one aspect (e.g. animal, plant and soil) making necessary a holistic system approach.

To facilitate natural grassland management evaluation for optimal animal production and conservation, CRUZ et al. (2010) simplified the grass species diversity clustering functional groups with similar specific leaf area and leaf dry matter content. Similarly, QUADROS et al. (2011) suggested as a grazing management tool the using these functional groups of the main native grasses based in its ecophysiological traits, these traits are linked to thermal sum necessary to turn on physiological process.

The use of thermal sum in degree-days (DD) is defined as the sum across days of the average between maximum and minimum temperature within a day (OMETTO, 1981), it may be in near real-time as a grazing management tool (i.e. calculating DD according to ambient temperature on a day per day basis) would allow accounting for the effects of actual environmental conditions and specific characteristics of plant functional groups. The thermal sum could be a tool to measure on farm and has the potential to improve grazing management as it determines permanence time and length of grazing intervals for each specific grazing system QUADROS et al. (2011).

The present study aimed to evaluate heifer's performance and feed intake throughout the cool season using two different grazing intervals based in the thermal sum of the main native forage species on natural grassland.

## MATERIALS AND METHODS

The experiment was conducted from May to September (2011) in a natural grassland, located at Depressão Central region, in Rio Grande do Sul state, Brazil. The area is situated in the coordinates (29°43'29.97"S, 53°45'36.91"W), 95 m above sea level and subtropical humid climate (Cfa) according to Köppen classification. In the area there are two soil types: Typic Albaqualf on lowland areas and Rhodic Paleudalf on top and slope areas. During the trial, the mean of the minimum and maximum temperatures were, respectively, 10.6°C and 20.4°C and the mean precipitation was 102mm per month. Experimental procedures were conducted in accordance with the Ethics Committee on Animal Use of Universidade Federal de Santa Maria.

Treatments consisted of two different thermal sums, 375 and 750 degree-day (DD), related

to leaf elongation duration of contrasting grasses functional groups. The 375 DD is the interval necessary for the elongation of 2.5 leaves of *Axonopus affinis* and *Paspalum notatum*, which are prostrate C<sub>4</sub> grasses of the functional groups A and B (QUADROS et al., 2006), with an average phyllochron of 150 DD (EGGERS et al., 2004; MACHADO et al., 2013). The 750 DD represent the time for elongation of 2.2 leaves for tufted grasses from functional groups C and D, as *Aristida laevis* and *Saccharum angustifolius*, with phyllochron of 333 DD (MACHADO et al., 2013; CONFORTIN et al., 2010).

The occupation time of each paddock (grazing cell) was a function of rest time (between the grazing periods) according to the following formula:

$$\text{Occupation (degree-days)} = \frac{\text{Resting period (DD)}}{\text{Nro. paddocks} - 1}$$

Where DD is the treatment (375 or 750 DD), 1 is the paddock in use, and *Nro. paddocks* are either 6 or 8 for the 375 and 750 DD treatments, respectively. For 375 DD, it ranges from 4 to 7 occupation days, with mean of 5.1 and for 750 DD, it ranges from 6 to 11 occupation days, with mean of 7.9 days. During the trial, in 375 DD treatment held 4 cycles (26.2 days each cycle) in the pasture. In 750 DD, 1.8 cycles (60 days by cycle).

Both treatments were managed with constant stocking rate and variable herbage allowance subjected to rotational grazing. A paddock (0.5 ha) was selected in each replicate (representative paddock) for all the pasture measurements.

The trial lasted for 113 consecutive days and was divided into four periods: May, 26<sup>th</sup> to June 24<sup>th</sup> (period 1); June, 24<sup>th</sup> to July 22<sup>th</sup> (period 2); July 22<sup>th</sup> to August 20<sup>th</sup> (period 3) and August 20<sup>th</sup> to September 16<sup>th</sup> (period 4).

A complete randomized block design was employed, with two treatments and three replicates. The experimental area had 21ha divided into six replicates (experimental units) randomly assigned to the 2 treatments with 3 replicates each. In treatment 375 DD, each replicate was subdivided in six cells (paddocks) whereas in the 750 DD treatment the replicates were divided in eight cells (paddocks) for animal rotation. In total, 42 grazing cells (paddocks) with 0.5ha each were used and all were provided with fresh water ponds.

Thirty six beef heifers of approximately 18 months of age with an average initial body weight of 220±14kg, were distributed as six animal into replicate. All heifers received daily supplementation at 2:00p.m. at

a rate of  $50\text{g kg}^{-1}\text{ d}^{-1}$  of body weight mean of each replicate of ground corn. They also had protein supplement ( $450\text{g kg}^{-1}$  of crude protein from urea) allowed for ad libitum consumption. Sanitary management was made when necessary with pour-on (Fluazuron or Fipronil) sprinkling shower (Amitraz), and vaccination as required (endoparasite, *clostridium* sp.)

Herbage mass (HM;  $\text{kg ha}^{-1}$  of dry matter (DM)) was measured using a direct comparison to standards calibrated with double-sampling technique (HAYDOCK; SHAW, 1975), where six samples ( $0.5\times 0.5\text{m}$ ) were cut at the ground level and 20 visual estimations were done in the representative paddock for each replicate.

Removed biomass from cut samples was divided into 2 subsamples and weighed, one subsample was used to determine DM content, dried in a forced air oven at  $55^{\circ}\text{C}$  for at least 72 hours and another subsample was used to separate morphological components (green leaf lamina, pseudo stem and dead material). Herbage allowance ( $\text{kg DM } 100\text{kg}^{-1}$  of body weight) was calculated using the mean of leaf lamina contribution in the HM in each period of the rotational, divided by the number of occupation days and divided by the instantaneous stocking rate, multiplied by 100. Mean leaf lamina contribution were calculated using the percentage of green leaf lamina material, from available morphological components of the representative paddock.

Instantaneous stocking rate (ISR) was calculated as the sum of all animals' body weight in an experimental group divided by the paddock area in use. Mean stocking rate (MSR;  $\text{kg ha}^{-1}$  of body weight) was calculated as ISR divided by replicate (all paddocks per block) area. Beef production gain per area (BPA;  $\text{kg BW ha}^{-1}$ ) was calculated as number of animals per area multiplied by average daily gain (ADG) and number of days per period. The animals were weighed each 28 consecutive days, after a total fasting period of at least 12 hours, mean ADG calculated. The ADG was the difference of body weight between 2 consecutive weighs divided by the number of days between measurements.

*In situ* organic matter degradability (ISOMD) of the ground corn and hand-plucked samples of herbage, similar to that selected by the animals were determined according to Orskov and Mc Donald (1979) and hand-plucked was collected according to EUCLIDES et al. (1992). Samples were collected when the animals were on the second day of occupation in both treatments. The hand plucking samples were also analyzed for total DM in an oven at  $105^{\circ}\text{C}$  for 24 hours, total nitrogen (N;  $\text{N}\times 6.25 = \text{crude protein}$ ; AOAC, 1990) and neutral and acid detergent fiber without amylase (VAN SOEST, 1967).

Herbage intake estimates was taken on two occasions (July 9<sup>th</sup> and September 12<sup>th</sup>, 2011; second and last periods above described), representing autumn and winter seasons, respectively. Two animals per replicate were evaluated, using  $\text{Cr}_2\text{O}_3$  as an external marker for determination of faecal excretion. Animals received  $5\text{g of Cr}_2\text{O}_3\text{ d}^{-1}$ . The marker supply, the adaptation period and faeces collection followed the methodology described by (KOZLOSKI et al., 2006). On the same occasion to reduce animal management in the faeces collection days, they received a polyethylene external marker, with different colors for each animal to identify faeces on grassland. The polyethylene external marker was made with plastic A4 sheets of 0.3mm thickness, using a manual machine binder (Excentrix) with 4mm diameter. The  $\text{Cr}_2\text{O}_3$  supply started when animals were moved to representative paddocks considering fecal collection period. For collections, daily "sweeps" on paddocks were performed and if the polyethylene marker was present, samples were collected for each animal replicate. The standard curve was prepared with  $100\text{mg of Cr}_2\text{O}_3$ . Fecal production (FP) was estimated as follows:  $\text{FP} = \text{supplied Cr}_2\text{O}_3 (\text{g d}^{-1}) / \text{feces Cr}_2\text{O}_3 (\text{g kg}^{-1}\text{ DM})$ . Then, the intake estimation was calculated as follows:  $\text{Intake} (\text{g day}^{-1}) = \text{FP} (\text{g d}^{-1}) / (1 - \text{degradability})$ .

Results were analyzed with ANOVA and F-test at 0.05 significance level and 0.10 was considered as tendency. Differences between means were determined using the Tukey test for multiple comparisons, using the PROC MIXED model procedure, including the fixed effects of treatments, periods and the interaction treatment  $\times$  period using, whereas animal group was a random effect from SAS (Statistical Analysis System, version 9.3). Period was considered a repeated measure and best covariance structure chosen according to smallest Bayesian Information Criteria.

## RESULTS

An interaction between the effects of treatments and period ( $P < 0.05$ ) was observed for average daily gain (ADG). Heifers in 375 DD treatment presented an increase along the evaluation periods. Conversely, heifers' ADG in 750 DD presented a fluctuation along the periods (Table 1), showing the lowest ADG in period 2 and highest in period 3. In addition, both management strategies resulted in similar ADG just in periods 4 ( $P < 0.01$ ). In contrast, heifers in 750 DD showed 64% higher ADG ( $P < 0.05$ ) compared to heifers in 375 DD during period 3 (Table 1).

Mean stocking rate (MSR) differed ( $P < 0.05$ ) between treatments and periods (Table 2). MSR was

Table 1 - Treatments × periods interactions of the average daily gain of heifers (kg animal<sup>-1</sup> d<sup>-1</sup>) grazing a natural grassland subjected to two thermal sums determining the rest intervals (375 and 750 degree-days).

Treatments (DD)	-----Periods-----				SEM	-----P - Value-----		
	1	2	3	4		Treat	Per	Treat × Per
375	0.058 <sup>A</sup>	0.323 <sup>A</sup>	0.358 <sup>B</sup>	0.413 <sup>A</sup>	0.0438	0.674	0.0001	0.0048
750	0.157 <sup>A</sup>	0.087 <sup>B</sup>	0.554 <sup>A</sup>	0.332 <sup>A</sup>				

25% higher in 375 DD compared to 750 DD; however, this difference could be partly attributed to the fact that the treatment 750 DD has a larger area (33% higher) per repetition.

Total beef production gain per area (BPA) was similar between treatments ( $P < 0.01$ ). Instantaneous stocking rate (ISR) was similar between treatments, been different just for periods ( $P < 0.05$ ), showing an increase along the trial (Table 2).

There is difference between periods ( $P < 0.05$ ) for feed intake (FI), decreasing from the first to the second period (Table 2). The intake of ground corn (GCI) increased 8% between period 1 and 4 ( $P < 0.05$ ), it was due to animal gain along the periods. The protein supplementation intake (PSI) was similar among periods. Estimations of nutritional value (Table 2) did not present a significant treatment × period interaction ( $P > 0.05$ ). Crude protein (CP)

concentration was similar among treatments ( $P > 0.05$ ) and it was 35% greater in period 3 compared to periods 1, 2 and 4 ( $P < 0.05$ ). *In situ* organic matter degradability (ISOMD) had a similar trend to CP with increasing values over the period 3 being 14.5% greater than period 1 and 2 ( $P < 0.05$  and  $P < 0.01$ ). Neutral detergent fiber (NDF) was similar among treatments and increased sharply from period 1 to 2 ( $P > 0.01$ ). Acid detergent fiber (ADF) was not affected by treatments or periods ( $P > 0.05$ ; Table 2). Ground corn supplement had 86.7g kg<sup>-1</sup> of CP, 935.7g kg<sup>-1</sup> of ISOMD and 198.7g kg<sup>-1</sup> of NDF.

Sward morphological components was mostly similar amongst treatments and periods ( $P > 0.05$ ). Green leaf mass was 1108kg ha<sup>-1</sup> of DM, stem mass was 105kg ha<sup>-1</sup> of DM and dead material mass was 2388kg ha<sup>-1</sup> of DM ( $P > 0.4$ ). No interactions between treatments and periods or differences between

Table 2 - Variables of animal production, feed intake and forage value of hand-plucked samples of heifers grazing a natural grassland subjected to two thermal sums determining the rest intervals (375 and 750 degree-days).

Items	---Treats (DD)---		SEM	-----Periods-----				SEM	----P- Value----	
	375	750		1	2	3	4		T	P
Initial BW <sup>1</sup>	221	219.1	3.31	220.0 <sup>D</sup>	223.0 <sup>C</sup>	228.6 <sup>B</sup>	241.8 <sup>A</sup>	1.99	0.856	0.000
Final BW <sup>1</sup>	252.6	251.3	2.83	223.0 <sup>D</sup>	228.7 <sup>C</sup>	241.8 <sup>B</sup>	251.9 <sup>A</sup>	2.08	0.867	0.000
MSR <sup>2</sup>	931.2	695.9	9.03	775.5 <sup>D</sup>	790.9 <sup>C</sup>	823.8 <sup>B</sup>	864 <sup>A</sup>	6.60	0.002	0.000
BP <sup>2</sup>	147.7	144.8	1.66	14 <sup>D</sup>	20.78 <sup>C</sup>	62.33 <sup>A</sup>	49.10 <sup>B</sup>	1.90	0.889	0.000
ISR <sup>2</sup>	2793	2783	33.2	2658 <sup>D</sup>	2710 <sup>C</sup>	2823 <sup>B</sup>	2962 <sup>A</sup>	24.99	0.852	0.000
FI <sup>3</sup>	23.8	26.7	0.120	-	26.7 <sup>A</sup>	-	22.8 <sup>B</sup>	0.087	0.229	0.008
GCI <sup>4</sup>	1.11	1.13	0.014	1.10 <sup>B</sup>	1.11 <sup>B</sup>	1.14 <sup>B</sup>	1.19 <sup>A</sup>	0.010	0.669	0.002
PSI <sup>4</sup>	0.232	0.283	0.030	0.253	0.218	0.295	0.264	0.042	0.321	0.679
CP <sup>5</sup>	97.0	91.0	0.53	82.0 <sup>B</sup>	87.0 <sup>B</sup>	-	115.0 <sup>A</sup>	0.97	0.442	0.011
OMISD <sup>5</sup>	587.0	568.0	1.38	538.0 <sup>B</sup>	564.0 <sup>B</sup>	-	631.0 <sup>A</sup>	2.66	0.371	0.008
NDF <sup>5</sup>	689.0	607.0	4.59	485.0 <sup>B</sup>	724.0 <sup>A</sup>	-	736.0 <sup>A</sup>	6.26	0.238	0.016
ADF <sup>5</sup>	326.0	329.0	3.03	281.0	359.0	-	339.0	3.21	0.984	0.343

BW – Body weight; MSR – Mean stock rate; BP – Beef production; ISR – Instantaneous stock rate; FI – Feed intake (forage plus supplements); GCI – Ground corn intake; PSI – Protein supplement intake; CP – Crude protein; OMISD – Organic matter *in situ* degradability; NDF – Neutral detergent fiber; ADF – Acid detergent fiber. <sup>1</sup>Kg; <sup>2</sup>kg BW ha<sup>-1</sup>; <sup>3</sup>g kg<sup>-1</sup> d<sup>-1</sup> of body weight; <sup>4</sup>kg animal<sup>-1</sup> day<sup>-1</sup>; <sup>5</sup>g kg<sup>-1</sup> of dry matter. Means followed by different letters in the row differ by Tukey's test ( $P < 0.05$ )



periods were observed. Only stem mass had difference amongst periods ( $P < 0.05$ ) with higher values in periods 1 and 3 (134 and 142 kg DM ha<sup>-1</sup>, respectively) compared to periods 2 and 4 (89 and 57 kg DM ha<sup>-1</sup>, respectively), but it represents less than 4% of total above ground biomass all over the trial.

Dead material did not differ among treatments or periods ( $P > 0.05$ ), and represents a mean of 65% of DM. Other plant species mass (than *Poaceae*) tended to be greater in 375 DD compared to 750 DD ( $P < 0.10$ ) but also represents less than 4% of overall biomass, which not presented significant differences amongst periods (overall average of 117 kg DM ha<sup>-1</sup>). Herbage allowance was similar amongst treatments and periods ( $P > 0.10$ ) with a mean of 100g DM kg<sup>-1</sup> body weight.

## DISCUSSION

Limitations to young cattle performance along cool season in natural grasslands were due to low forage quality that is a consequence of lower temperatures and frosts that inhibit C4 grasses growth. These species contributed to the major part of available herbage mass (65 to 80%) according to QUADROS et al. (2011), but in this trial, it represents more than 93%, considering dead material as not available. GARAGORRY et al. (2008) recorded crude protein and in situ organic matter degradability in natural grassland of respectively, 6.2 and 29.8% during cool season.

Sward structural components (leaf mass, stem mass and dead material mass) did not differ among the treatments in the present study. Dead material was near 65% of total HM, which could be to lower temperatures, while BARBIERI et al. (2015) found 44% of dead material on HM during warm season. The high percentage of dead material recorded may be attributed to sample procedures in both trials, as tussocks were also sampled, unlike PINTO et al. (2007), that sampled just among tussocks. Herbage mass reported by these authors is almost 2.5 times less than those obtained in this trial. Therefore, the higher percentage of dead material recorded could be also attributed to include tussocks in sampling.

QUINTANS et al. (1994) recorded body weight loss of 0.253 kg animal<sup>-1</sup> d<sup>-1</sup> in natural grassland with heifers of same age, without supplementation and has obtained average daily gain of 0.161 kg animal<sup>-1</sup> d<sup>-1</sup>, with a rate of 100g kg<sup>-1</sup> of body weight of whole rice. The present study found positive ADG values which could be attributed to the nutritional attributes of hand-plucked herbage samples, similar

to that selected by heifers, to the non-limiting herbage availability and to supplementation provided in the present study, besides that the dry material percentage was of 65% of the HM, 13% less than that recorded by QUINTANS et al. (1994).

VAN SOEST (1994) suggested CP concentrations below 7% of DM limit growth of rumen microorganisms changing feed digestibility and intake. The CP values from the hand-plucked samples recorded in this trial are above such CP-limiting values, which could indicate that the observed ADG are not only due to the supplements. The CP values of the present study were also higher than those reported by OSPINA & MEDEIROS (2003) in similar grassland and similar to those of BARBIERI et al. (2015) during spring/summer at the same experimental site. As expected, ADG was greater in periods 3 and 4 compared to periods 1 and 2, in agreement with higher CP and digestibility values.

GONÇALVES et al. (2007) reported greater ADG, 0.550 kg animal<sup>-1</sup> d<sup>-1</sup> compared to the present study when supplementing heifers with whole rice bran at 50g kg<sup>-1</sup> of body weight in a natural grassland. However, heifers in those studies were supplemented from February to June whereas the critical period for animal production in Pampa biome grasslands ranges from June to late August.

FONTOURA JÚNIOR et al. (2007), CRANCIO et al. (2006) and SOARES et al. (2005) reported body weight loss in heifers and steers during the cool season with herbage allowances of 80 and 140g DM kg<sup>-1</sup> of body weight under continuous grazing. The herbage allowance (from leaves) in this trial was in average of 100g DM kg<sup>-1</sup> body weight in both treatments, it value is 3 to 4 times the intake potential, considered non-limiting to feed intake of the animals (SOLLENBERGER et al., 2005).

Nevertheless, calves and heifers also lost weight in the same experimental area and treatments with just protein supplementation (450g kg<sup>-1</sup> CP from urea) during the cool season (QUADROS et al., 2011). According to SOARES et al. (2005); MOOJEN & MARASCHIN (2002); NABINGER et al. (2000) the Pampa natural pastures allows body weight gains above 0.5 kg animal<sup>-1</sup> d<sup>-1</sup> during the warm season without hydric deficit. In the cool season, most heifers rearing production systems based on natural grasslands presents weight loss as the 20% of body weight loss reported by QUINTANS et al. (1994). In this; however, recorded mean value of 0.285 kg animal<sup>-1</sup> d<sup>-1</sup> represented 57% of the gain in the favorable season above mentioned. This daily growth rate could allow mating heifers at 24 months

old (60% of mature body weight; NRC, 1996) which is one of the primary goals in cow-calf operations of southern Brazil.

Production per area in the present study was higher than the 45kg ha<sup>-1</sup> reported by SOARES et al. (2005) and five times the mean beef production per area (BPA) during the cool season in Rio Grande do Sul (NABINGER et al., 2000). The higher BPA of the present study could be attributed to the best nutritional value of herbage and to supplementation that allowed higher stocking rate.

Mean stocking rate was two-fold higher in the present study compared to values reported by FONTOURA JÚNIOR et al. (2007); NEVES et al. (2009); SOARES et al. (2005), and similar to cool season annual pastures (POTTER et al., 2010). Similar stocking rate were achieved by QUADROS et al. (2011) and BARBIERI et al. (2015) using the same experimental protocol. Therefore, stocking rate of the present study could be regarded as high and could be attributed to high leaf mass, herbage mass and leaf allowance. Natural grasslands supporting higher stocking rates, while achieving ADG appropriate for mating heifers at 24 months of age, produces gain per area to make livestock production economically competitive with other agricultural land uses (QUADROS et al., 2011).

Pre-grazing herbage mass was similar among the treatments, unlike data from QUADROS et al. (2011) and BARBIERI et al. (2015). These authors reported significant differences in the pre-grazing herbage mass amongst treatments using a similar protocol (same thermal accumulation rest intervals) to the present study. The lack of difference amongst treatments in the present study could be due to a forage deferring period of 45 days before the experimental period. Herbage mass from this trial was higher than the HM reported by MARASCHIN (1998), MOOJEN & MARASCHIN (2002) in trials with fixed herbage allowances during the spring and summer pasture growing season. SOARES et al. (2005); (PINTO et al., 2008) and (MEZZALIRA et al., 2012) reported HM values 2.2 times lower compared to the present study when evaluating natural grasslands with similar grasses functional groups composition and combining variable herbage allowance across seasons (80 to 120g kg<sup>-1</sup> of BW), considering this combination the best for beef production.

The same herbage allowance among treatments could explain the similar ADG, that according to NABINGER et al. (2009) the optimal animal performance (individual and per area) was found with herbage allowance between 115 to 135g kg<sup>-1</sup> of

body weight. The herbage allowance recorded was a consequence of the grazing methodology, rotational grazing system. In this system, grazing intervals of grazing followed by removal of animals to allow similar recover periods for all tillers in the pasture. This plant regrowth strategy are often used and could have profound effects on quantity and quality of pasture regrowth and what is available to the grazing animal (HUMPHREYS, 1991; LEMAIRE et al., 2009). VIRGONA et al. (2000) reported higher herbage mass and frequency of desirable species on rotational grazing system, similar during dry and cool season; therefore, this grazing system increases available forage quality.

## CONCLUSION

Using grasses' morphogenic traits based strategies to determine the rest intervals in a rotational grazing system allows higher stocking rate when combined with low supplementation rate during the cool season. These strategies could accomplish heifers' growth rate to reach a target body weight for mating at 24 months, improving beef cattle production in natural grasslands.

## BIOETHICS AND BIOSSECURITY COMMITTEE APPROVAL

All procedures in this study were performed in accordance to Registration Protocol approved by the Comitê de Ética em Uso de Animais na Universidade Federal de Santa Maria.

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