Revista Brasileira de Zootecnia

ISSN 1806-9290
www.sbz.org.br

R. Bras. Zootec., v.41, n.2, p.306-313, 2012

Productivity and reproductive performance of grazing beef heifers bred at 18 months of age[1]

Alexandre Nunes Motta de Souza[2], Marta Gomes da Rocha[3], Dalton Roso[3], Luciana Pötter[3], Aline Tatiane Nunes da Rosa[3], Gustavo Freitas Ilha[3], Anna Carolina Cerato Confortin[3]

[1] *Research funded by CNPq.*
[2] *Instituto Federal Farroupilha – Campus São Vicente do Sul/RS.*
[3] *Universidade Federal de Santa Maria.*

ABSTRACT - The experiment was carried out to evaluate the performance and body development of beef heifers reared from 15 to 18 months of age on Pearl millet (*Pennisetum americanum*), Alexandergrass pasture (*Urochloa plantaginea*) or native pasture invaded by Annoni-2 grass (*Eragrostis plana* Nees). The experimental design was completely randomized following a repeated measure arrangement, with three treatments and two replications. The grazing method was continuous with variable stocking rate in order to maintain the sward height at 40 cm. Masses of leaf, stem and dead material, crude protein and neutral detergent fiber were similar between Pearl millet and Alexandergrass. Average daily gain, stocking rate, live weight gain per hectare, body weight, body condition score, weight-to-height ratio and reproductive tract score of the heifers kept on annual summer pastures (Pearl millet or Alexandergrass) were superior, compared with the heifers on Annoni-2 grass pasture.

Key Words: Alexandergrass, *Eragrostis plana*, Pearl millet, pregnancy at 18/20 months

Introduction

The percentage of heifers from 2 to 3 years of age in the cattle herd of Rio Grande do Sul (RS) is 7.6%. It corresponds to around 960 thousand heads which should be inserted into the breeding herd (Anualpec, 2009). The average density of animal units per hectare, in RS, is 0.99 (SEBRAE, SENAR, FARSUL, 2005). As one heifer of this age is equivalent to 0.65 animal units, usually around 626 thousand hectares of pasture are used to keep animals of this category; however, the goal of calves producing is not reached.

The inefficient results described above are the consequence of an inadequate food intake by heifers from weaning to 24 months of age and, which result in mating ages over 28 and 30 months and then low reconception rates as primiparous cows (Gottschall & Lobato, 1996). In this context, the mating of heifers at 18 months of age may be an alternative to improving rates of reconception in primiparous cows, since adequate heifers‘ growth before the mating season are provided. The first calving interval is approximately 540 days and the next primiparous mating is at 36 months of age, without lactation.

From the point of view of ecological and economic management it is desirable to have animals grazing throughout the year. The challenge is to achieve a weight gain during the heifer rearing that allows their mate at 18 months of age. The native pasture, when properly managed, can enable reasonable weight gain with relative low cost (Moojen & Maraschin, 2002). Nevertheless, in Annoni-2 grass invaded areas limited animal performance can happen (Rocha et al., 2004).

The tropical grasses usage has been exploited in order to allow more intensive beef cattle production systems. Among the alternatives, Pearl millet (*Pennisetum americanum*), as well as Alexandergrass (*Urochloa plantaginea*), can be exploited in areas with agriculture integration.

This experiment aimed to evaluate the relationship among structural attributes of pasture, chemical composition of the grass, animal performance and development of reproductive structures of beef heifers when reared from 15 to 18 months in summer annual forage species (Alexandergrass and Pearl millet) and native pasture invaded by Annoni-2 grass.

Material and Methods

The productive performance and body development of beef heifers on Pearl Millet (*Pennisetum americanum*), Alexandergrass (*Urochloa plantaginea*) or native pasture invaded by Annoni-2 grass (*Eragrostis plana* Nees) were evaluated in an experiment carried out at the Universidade

Received July 5, 2010 and accepted July 11, 2011.
Corresponding author: mottadesouza@terra.com.br

Federal de Santa Maria, located in a physiographic region of Rio Grande do Sul, Brazil, called Depressão Central. The climate in the region is a Cfa type according to Koppen classification. The soil of the experimental area is classified as Paleaudalf (EMBRAPA, 2006).

The pasture utilization occurred from January 28th to April 22th, 2006, totaling 84 days. The experimental field occupied an 11-hectare (ha) area segmented in 1.5 ha of Pearl Millet; 1.5 ha of Alexandergrass and 8 ha of native pasture invaded by Annoni-2 grass with two divisions by species, which constituted the experimental units, and a reserve area of 1.5 ha. The Pearl Millet was sown on December 23th, with minimum soil tillage using a mechanical planter. Alexandergrass was established by two disking on December 14th. Paddocks received 330 kg/ha of fertilizer 05-20-20 (N:P:K) and 45 kg of nitrogen/ha in urea form, on January 31st and February 20th.

The forage mass was determined by the direct visual estimation method with double sampling (Gardner, 1986) and the canopy height, considered as the distance from the ground to the height of folding leaves (cm), was measured in the same occasion, in 20 readings/experimental unit. The grazing method was continuous with variable number of animals (Heringer & Carvalho (2002) in order to keep the sward height in 40 cm.

Clip samples to determine dry matter and botanical and morphological composition (leaf blade, stem, dead material) were clipped at ground level and the manual separation of these components was made. Samples were oven-dried to a constant weight (at 65 ^{o}C for 72 hours). The percentage of each component (leaf blade, stem, dead material) was calculated and afterwards the masses of leaf blade, stem and dead material, in kg/ha of dry matter were determined.

Other pasture evaluations were carried out at the beginning and the end of each 21 days period. The leaf/stem ratio was estimated by dividing the leaf mass/stem mass and was expressed in kg of dry leaf/kg of dry stems. The rate of herbage accumulation (kg/ha/day of DM) was estimated by using three exclusion cages located in each paddock. The total production of dry matter per paddock was estimated by the sum of production in each period (daily accumulation rate x days in the period) plus forage mass at the beginning of the grazing period.

The forage losses were determined by the methodology proposed by Hillesheim & Corsi (1990). The forage disappearance (kg of dry matter/ha) was calculated according to the equation: (disappearance of forage = total production of dry matter– forage mass at the end of grazing– forage losses) and when the result was divided by the period number of days resulted in daily forage disappearance. The efficiency of pasture utilization was calculated by the following equation: (daily disappearance of forage/total production of dry matter)*100, expressed as a percentage.

The crude protein, neutral detergent fiber and dry matter values were determined in hand-plucked samples of forage (Euclides et al., 1992). Samples were analyzed according to procedures described by the AOAC (1995) and presented as a percentage.

In five occasions (01/28, 02/17, 03/10, 03/31 and 04/21) in each experimental unit, the vertical structure of the pasture was evaluated in three areas representing the desired sward height. Sampling was carried out using 1 m^2 squares where the herbage was cut considering four strata: 0-15 cm, 15-30 cm, 30-45 cm and above 45 cm from the ground. All forage mass within the same strata was cut and weighted and, in the same experimental unit, samples were taken by strata and separated into stem plus leaf sheath, leaf blade and dead material components. These values were expressed as a percentage and multiplied by the value of the herbage mass of the period. The herbage bulk (kg/ha/cm DM) was calculated by dividing the observed weight (kg dry matter/ha) by 15 cm.

In each experimental unit, four tester Polled Hereford heifers remaining, with an initial age and body weight of 15 months and 278±20.0 kg, respectively, and similar breeding heifers were used on a put-and-take basis throughout the grazing season to maintain the sward at the desired height. All animals were allowed free access to water and mineral salt, and were weighed at the beginning and end of each experimental period after 12 hours fasting.

The stocking rate, kg/ha of live weight, was calculated according to the equation: [mean live weight of testers + (live weight of animals used for adjustments in the stocking rate*number of days at experimental unity)/days of trial period]. The value was divided by 450 kg to determine the stocking rate, expressed as animal units per hectare. The forage allowance was calculated as follows: {[(forage mass/ 21 days) + daily rate of accumulation of DM]/stocking rate}*100. The daily forage disappearance, described previously, was divided by the stocking rate, multiplied by 100 and called agronomic daily forage intake as a percentage of body weight (Jamieson & Hodgson, 1979).

The average daily weight gain (kg/animal/day) of the heifers, in each experimental period, was calculated as the weight difference between two consecutive weight dates and divided by the number of days in the period. In the weighing time the animals were submitted to the subjective evaluation of body condition score (Lowman et al., 1973), considering the body condition score from 1 (very thin) to 5 (very fat). Dividing the average stocking rate by body weight of the tester heifers in each treatment, the average number of animals per hectare was obtained. Multiplying this value by the average daily weight gain of tester heifers the weight gain per unit of area, in kg/hectare of body weight, was estimated.

The physical development of heifers was measured by wither height (BIF, 1996), using a ruler, for subsequent calculation of the weight/height ratio. To assess the reproductive structures development of heifers were considered: pelvic area and reproductive tract score. The pelvic area was determined rectally using a pelvimeter. The height was determined by measuring the linear distance from the approximate midpoint of the top surface of the symphysis pubis to the bottom surface of the midsacrum. Pelvic width was measured as a linear distance between the shafts of the ilea at the right angles to where the height was measured. The pelvic area, in cm^2, was calculated by multiplying the height by the width of the pelvic region. The gain in the pelvic area was calculated as the difference in the pelvic area at 04/22 and 01/28 and divided by the number of days of the experiment. The reproductive tract score was determined at the beginning and end pasture utilization, using a 5-point scale, according Anderson et al. (1991) methodology.

A completely randomized design following a repeated measurement over time was used, with three treatments, two area replication and four testers by area replication. Data were subjected to analyses of variance and F test at 5% of significance. The means were compared using the PROC Mixed and composed symmetry structure of covariance (Statistical Analysis System, version 8.2). Polynomial regression was performed by PROC GLM procedure, considering the period (X = days) variable, correlation test by CORR procedure and multiple regression by STEPWISE procedure (Forward = 0.05). The following mathematical model was used to analyze the parameters studied: $Y_{ijk} = \mu + T_i + R_k(T_i) + P_j + (TP)_{ij} + \varepsilon_{ijk}$; where Y_{ijk} = dependent variables; μ = mean of all observations; T_i = effect of i^{th} forage specie; $R_k(T_i)$ = effect of k^{th} replicate within the i^{th} treatment (error a); P_j = effect of j^{th} period; $(TP)_{ij}$ = effect of i^{th} forage specie × j^{th} period interaction; ε_{ijk} = experimental error 1 (error b).

Because of the similarity (P>0.05) obtained in Pearl millet and Alexandergrass related to the body weight, body condition score, average daily weight gain, stocking rate, weight gain per area, reproductive tract score, weight/height ratio and pelvic area variables these data became part of the treatment called ‘summer annual species’ and were used to test contrasts for comparison to the ‘Annoni-2 grass’. The reproductive tract score was compared by chi-square test. Analyses were performed by the statistical program SAS (Statistical Analysis System, version 8.2).

Results and Discussion

The participation of leaf blades (24.5 vs. 22.7%), stems (42.0 vs. 40.6%) and dead material (10.9 vs. 10.4%) in the forage masses of Pearl millet and Alexandergrass, respectively, were similar. The botanical composition of native vegetation characterizes it as invaded by Annoni-2 grass, with 49% participation of this specie (33.1% of leaf blade; 15.9% of stems; 44.5% of dead material). Even though the leaf blades percentage was on average 9.5 points higher in Annoni-2 grass, in forage as grazed was observed neutral detergent fiber of 69.9% and crude protein of 4.6% (Table 1).

These values characterize Annoni-2 grass as low-quality forage (Clark & Kanneganti, 1998) with observed content of neutral detergent fiber considered limiting for dry matter intake by cattle as well as the crude protein content that is critical for the ruminal microbes’ survival (Van Soest, 1994).

The content of neutral detergent fiber and crude protein in Pearl millet and Alexandergrass (P>0.05) forage as grazed were 53.2 and 18.1% (Table 1), respectively, characterizing these species as a good quality forage (Clark & Kanneganti, 1998).

Table 1 - Mean values of structural and chemical characteristics of pasture and probability of contrast between summer annual grasses and Annoni-2 grass

	Species			
Variables	Annual	Annoni	S[1]	P[2]
Sward height, cm	40.1	46.7	1.95	0.0038
Forage mass, kg/ha of DM	2.876.4	6.333.8	115.30	<0.0001
Leaf blade mass, kg/ha of DM	852.5	2.300.2	90.63	<0.0001
Stem mass, kg/ha of DM	1.486.3	1.065.6	127.54	0.0038
Dead material mass, kg/ha of DM	339.8	2.817.4	158.36	<0.0001
Crude protein, %	18.1	4.6	0.16	<0.0001
Neutral detergent fiber, %	53.2	69.7	0.87	<0.0001
Dry matter, %	17.9	40.4	0.36	<0.0001

[1] Standard error; [2] Probability of contrast.

There was a difference (P<0.01) in the contrast analysis between annual summer species and Annoni-2 grass (Table 1) for sward height, leaf blade, stem and dead material masses and crude protein, neutral detergent fiber and dry matter percentage in forage as grazed. The sward height was greater in natural pasture invaded by Annoni-2 grass, due to the difficulty of heifers in lowering the sward to the previously established level, probably caused by the high strength required for breaking the leaves of Annoni-2 grass (Carlotto et al., 2008).

The chemical composition of the forage as grazed in summer annual grasses and Annoni-2 grass can be partially explained by the sward vertical structure (Table 2). In Annoni-2 grass the leaf blade bulk density was concentrated in the 0-15 and 15-30 cm stratum, making it difficult to be accessed by grazing animals (Montagner et al., 2008). Also, greater dead material bulk density was observed in the same stratum, which increases the difficulty in harvesting leaf blades. In annual summer grasses was observed lower leaf blade and dead material bulk density in the 0-15, 15-30 e 30-45 cm stratum when compared with Annoni-2 grass (Table 2), allowing the heifers to harvest forage with lower levels of neutral detergent fiber and richer in nitrogen (Table 1).

Regression analysis for forage bulk density as a function of days of pasture utilization showed that the leaf blades bulk density of annual summer species and Annoni-2 grass did not fit either to linear or quadratic model in the 0-15, 15-30, 30-45 and above 45 cm stratum. The dead material bulk density increased linearly for the 0-15 cm ($\hat{Y} = 0.55 + 0.612x$; $r^2 = 0.72$; P<0.0001) and the 30-45 cm ($\hat{Y} = 3.44 + 0.045x$; $r^2 = 0.80$; P<0.0001) stratum and was adjusted to a quadratic model for the 15-30 cm stratum ($\hat{Y} = 1.48 + 0.03x + 0.001x^2$; $r^2 = 0.51$; P = 0.0093). In Annoni-2 grass, the dead material bulk density increased linearly in the 0-15 cm ($\hat{Y} = 78.49 + 1.54x$; $r^2 = 0.86$; P = 0.0010) and the 15-30 cm $\hat{Y} = 16.76 + 0.566x$; $r^2 = 0.76$; P = 0.0049) stratum and did not fit to tested models in the 30-45 cm stratum.

The forage allowance was similar (P>0.05) in Pearl millet and Alexandergrass, with a mean value of 13.4 kg of dry matter/100 kg of live weight, and this value is close to the 10-12 kg of dry matter/100 kg of live weight recommended by Sollenberger & Burns (2001) as being the optimal value for summer forages. In Annoni-2 grass the forage allowance was not determined, since it was not possible to calculate the forage accumulation rate, due to the large proportion of dead material in the sward (Table 1).

The total forage production was similar (P>0.05) for Pearl millet and Alexandergrass, with mean value of 15,917 kg of dry matter/hectare. This is a noteworthy production potential of Alexandergrass, considering the fact that is a spontaneous species in crop areas. The forage losses did not differ (P>0.05) between annual summer species, with the mean value of 3,360 kg of dry matter/ hectare during the experimental period, corresponding to 1.9% of live weight/day. These values are close to the values observed by Heringer & Carvalho (2002) in Pearl millet, 1.5% of live weight during January and February and 3% of live weight during March and April.

The efficiency of pasture utilization was 66.9% for Pearl millet and Alexandergrass which fits within the range of efficiency (33-90%) described for tropical forage species (Silva & Nascimento, 2007). The management adopted in the pastures, 40 cm of the sward height, is determinant of its proper utilization and subsequent conversion of forage into animal product.

At 15 months of age, heifers presented live weight and body condition score of 277.8±1.5 kg and 3.2±0.1 points, respectively. This weight corresponds to 59.5% of a mature *weight* of Polled Hereford cows (467 kg), *frame size 3*

Table 2 - Mean values and probability of bulk density morphological components in 0-15 cm, 15-30 cm, 30-45 cm and above 45 cm of sward height (kg of dry matter/ha/cm)

Density	Species		Standard error[1]	P[2]	E × D[3]
	Annual	Annoni			
Leaf blade, 0-15 cm	17.8	66.6	11.34	0.0118	0.0004
Leaf blade, 15-30 cm	16.6	51.7	5.29	0.0035	0.0132
Leaf blade, 30-45 cm	13.5	16.4	2.69	0.2789	0.0029
Leaf blade, above 45 cm	5.7	1.9	1.76	0.0707	0.3257
Stem, 0-15 cm	53.5	40.0	4.39	0.3887	0.1496
Stem, 15-30 cm	27.4	20.7	2.59	0.1138	0.5564
Stem, 30-45 cm	11.7	9.2	2.97	0.5296	0.0782
Stem, above 45 cm	3.3	1.6	1.36	0.2716	0.7101
Dead material, 0-15 cm	27.8	144.0	7.15	0.0002	0.0015
Dead material, 15-30 cm	3.0	40.8	1.23	0.0001	0.0001
Dead material, 30-45 cm	1.5	11.9	1.26	0.0018	0.0001

[1] Standard error; [2] Probability of contrast; [3] Probability of species × days of utilization interaction.

(Fox et al., 1988). To reach 65% of their mature weight, considered as a percentage of reference to the manifestation of puberty (NRC, 1996), further addition of 5.5% (25.8 kg) would be required during the grazing season.

The performance of heifers kept in summer annual pastures, from 15 to 18 months of age, showed positive linear regression of body weight ($\hat{Y} = 278.3 + 0.632x$; $r^2 = 0.90$; P<0.0001) and body condition score ($\hat{Y} = 3.12 + 0.003x$; $r^2 = 0.45$; P = 0.0012) with days of pasture utilization. The weight gain during the rearing of these heifers allowed them to present body weight corresponding to 70.7% of mature weight (26.5 kg more than recommended) at 18 months of age (Table 3) and body condition score above 3 points, value considered by Barcellos (2001) as a minimum score for heifers to manifest puberty.

In Annoni-2 grass, the body weight of heifers fitted to a quadratic regression model ($\hat{Y} = 277.5 + 0.970x - 0.011x^2$; $r^2 = 0.85$; P = 0.0013) and also the body condition score ($\hat{Y} = 3.25 + 0.007x - 0.0001$; $r^2 = 0.77$; P = 0.0055). The body weight of heifers reached its maximum value, 298.9 kg, at 44 days of Annoni-2 grass utilization, corresponding to 64% of mature weight. In that occasion, their body development was close to the target weight recommended for mating. In earlier date, however, on the 35th day of pasture use, heifers had reached their point of maximum body condition score (3.4 points) and then, at their maximum weight, the heifers in Annoni-2 grass were already using their body reserves.

Cattle can use their body reserves as an energy source to maintain the average daily weight gain and to keep their body development (Fox et al., 1992) and the loss of 0.5 points in body condition score in heifers at that stage of development, corresponds to 180 Mcal of net energy.

From the 35th day until the end of pasture utilization, the heifers kept in Annoni-2 grass pasture mobilized body fat corresponding to 3.7 Mcal/day (0.5 points of body condition score). This mobilized energy corresponded approximately to 50% of net energy requirements for Polled Hereford heifers' maintenance in their rearing phase from 15 to 18 months, which is 7.5 Mcal/day (NRC, 1996). At 18 months of age the body weight observed in heifers corresponded to 61.7% of mature weight and body condition score was below 3 points (Table 3). These values are not considered suitable to begin the beef heifers mating.

The combination of greater stocking rate, allowed by its greater daily forage accumulation (P<0.01), and daily weight gain obtained values in summer grasses resulted in greater (P<0.01) weight area gain in relation to native pasture invaded by Annoni-2 grass (Table 3). In summer annual species the weight gain per area was 20 times higher than the gain provided by Annoni-2 grass (Table 3), although when compared to Pearl millet potential of production, the weight gain per area was 449 kg lower than the observed by Montagner et al. (2008).

The animal performance variables have been differently explained through multiple regression analysis for annual summer pastures and Annoni-2 grass (Table 4) and these results may help to establish management goals for heifers rearing in these different pastures.

In the summer annual species, the average daily weight gain was explained in 37% by a positive leaf/stem ratio and by the dry matter content in 15%. The partial regression coefficients showed that the leaf/stem ratio is 40.3% more important than the dry matter content in explaining this variable. The highest proportion of green leaves increases the digestibility and passage rate of forage consumed and, therefore, the diet quality (Minson, 1990) and the highest amount of leaves was observed at the beginning of the pastures utilization ($\hat{Y}_{\text{leaf/stem ratio}} = 1.0 - 0.009X$; $r^2 = 0.76$; P<0.0001).

In Pearl millet, the dry matter content was 18% and probably caused restriction of forage intake (Alberto, 1997), providing lower intake of nutrients. In this way, it would explain the positive effect of dry matter content on the heifers' average daily weight gain (Table 4).

Together, the forage allowance and leaf mass explain 89% of the stocking rate, and forage allowance had 68.4% more influence on the stocking rate than the leaf blade mass. The stocking rate is negatively explained by forage allowance

Table 3 - Probability of contrast between annual summer species and Annoni-2 and mean values of final live weight (kg), body condition score (1-5), daily weight gain (kg/animal/day) of beef heifers, stocking rate (animal unit/ha) and weight gain per area (kg/ha of live weight)

Variables	Species		Standard error	P[2]
	Annual	Annoni-2		
Final live weight[1]	330.0	288.3	5.76	0.0028
Body condition score[1]	3.4	2.9	0.11	0.0152
Daily weight gain	0.616	0.137	0.13	<0.0001
Stocking rate	4.6	1.1	0.30	<0.0001
Weight gain per area	347.6	17.2	9.53	<0.0001

[1] At 18 months (04/22/2007); [2] Contrast probability.

in 52% and it is expected that a greater forage allowance correspond to a lower stocking rate (Mott, 1973). The leaf mass explained 37% of the stocking rate in a positive way (Table 4) and it is certainly related to the photosynthetic role of leaf blades that will determine the positive change in herbage accumulation rate and, hence, in the stocking rate (Quadros & Rodrigues, 2006).

The daily weight gain and weight gain per area for heifers kept in Annoni-2 grass pasture were 85% negatively explained by the stem mass. The stems generally have lower quality than leaves. Brüning (2007) observed in Annoni-2 grass levels of neutral detergent fiber of 79 vs. 76% ($P<0.05$) and crude protein of 5.2 vs. 8.6% ($P<0.05$) for stems and leaf blades, respectively.

The crude protein level explained 10%, in a positive way, the weight daily gain. In the forage as grazed, the crude protein level was less than 7% (Table 1), the critical level at which nitrogen begins to limit intake of feed by heifers (Van Soest, 1994). The importance of the nitrogen supply for heifers kept on Annoni-2 grass can be evidenced by the increase in average daily weight gain of 0.249 to 0.418 kg/day when extra nitrogen, in form of protein salt, was supplied to grazing animals (Brüning, 2007). For beef heifers kept in Annoni-2 grass pasture, the partial regression coefficients indicate that the stem mass was 173.5% more important than crude protein level for weight daily gain variation.

The body development measured by hip height and pelvic area was similar ($P>0.05$) at 18 months (Table 5), even if the heifers kept in summer annual pastures have had a greater average daily weight gain during their rearing (Table 3). This can be explained by the development trajectory of these animals, which in both forage alternatives had presented, in early March, body development near the target considered ideal for mating.

The greatest weight gain of heifers kept in the summer annual pasture has given them, at 18 months of age, a positive difference of 41.7 kg in body weight when compared with heifers kept on Annoni-2 grass. It was reflected in greater weight/height ratio and reproductive tract score (Table 5). For heifers mating, the reference values for weight/height ratio (Fox et al., 1988) and reproductive tract score (Anderson et al., 1991) are 2.6 kg/cm and 3.0 points, respectively, and it was not obtained in heifers reared on Annoni-2 grass.

When Polled Hereford heifers were reared on natural pasture, from 13 to 18 months of age, with average daily weight gain of 0.595 and 0.723 kg/day and reproductive

Table 4 - Multiple regression equations for performance variables of beef heifers and structural and chemical characteristics of pasture

Variable	Variable	Estimate	Partial r^2	Total R^2	P
			Summer annual species		
Daily weight gain	Intercept	0.005	-	-	-
(kg/animal/day)	Leaf/stem ratio	0.33	0.37	-	0.0208
	Dry matter	0.02	0.15	0.52	0.0861
Stocking rate	Intercept	7.46	-	-	-
(animal unit/ha)	Forage on offer	-0.36	0.52	-	0.0015
	Leaf mass	0.002	0.37	0.89	0.0001
			Annoni-2 grass		
Daily weight gain	Intercept	0.322	-	-	-
(kg/animal/day)	Stem mass	-0.001	0.85	-	0.0013
	Crude protein	0.207	0.10	0.95	0.0258
Weight gain/area	Intercept	1.96	-	-	-
(kg/ha live weight)	Stem mass	-0.002	0.85	0.85	0.0011

Table 5 - Hip height, weight/height ratio, pelvic area, reproductive tract score at 15 (01/28) and 18 (04/22) months old

	Species			
Variable	Annual	Annoni-2	Standard error[1]	P[2]
Hip height at 15 months, cm	121.2	117.1	1.61	0.0819
Hip height at 18 months, cm	121.2	118.7	1.21	0.1616
Weight/height ratio at 15 months, kg/cm	2.3	2.4	0.03	0.0841
Weight/height ratio at 18 months, kg/cm	2.7	2.4	0.04	0.0059
Pelvic area at 15 months, cm^2	166.8	181.3	3.35	0.0156
Pelvic area at 18 months, cm^2	200.7	197.8	9.11	0.7802
Pelvic area gain (15 to 18 month)	0.4	0.2	0.04	0.0138
Reproductive tract score at 15 months[3]	1.8	2.1	-	0.2423
Reproductive tract score at 18 months[3]	3.5	1.9	-	0.0491

[1] Residual Standard error; [2] Contrast probability; [3] Chi-square test probability.

tract score of 3.0 and 3.9, respectively, this performance resulted in pregnancy rates of 30 and 50%, respectively (Montanholi et al., 2004).

The weight/height ratio at 18 months of age of heifers grazing summer annual species was higher than the suitable ratio (Fox et al., 1988) for beef heifers' manifestation of puberty. The observed values for heifers in Annoni-2 pasture were below the recommended and similar results were obtained by Pötter et al. (2010), for heifers reared from 14 to 18 months in Annoni-2 grass pasture which showed live weight of 285 kg at 18 months of age.

The reproductive performance of beef heifers is determined by physiological changes that occur along the body development, and it must occur homogeneously (Patterson et al., 1992). The hip height and pelvic area were similar for heifers grazing annual summer species and Annoni-2 grass; however, differences in the reproductive tract score and weight/height ratio were observed (Table 5).

The purpose of mating heifers in the fall, using 65% of mature weight as a goal is questionable, from the data obtained. In the spring, when this target is used for mating heifers at 12-14 months, the pregnancy rate is satisfactory. This is because the heifers' nutritional requirements are met during mating season, when they are exclusively on pastures (Rocha & Lobato, 2002), like native pastures improved by the introduction of perennial legumes such as white clover (*Trifolium repens*) and birdsfoot trefoil (*Lotus corniculatus*). However, from 18 to 20 months old, during the breeding season in May/June, the native pasture species have already ceased their growth since March/April (Soares et al., 2005) and most temperate forages are being established. Thus, there is an interval of variable duration over the years until the beginning of winter forages utilization when it can only be expected that grazing heifers not have weight gain. This weight gain, in the period before mating, is important for beef heifers' high pregnancy rates (Barcellos & Lobato, 1997; Montanholi et al., 2004).

Conclusions

The structure and chemical composition of Pearl millet and Alexandergrass pasture are similar when they are managed at 40 cm sward height. Beef heifers reared from 15 to 18 months in Pearl millet and Alexandergrass have higher productive performance and reproductive structure development at 18 months of age. The rearing of heifers in native pasture invaded by Annoni-2 grass does not provide the adequate development of these variables and it is not recommended when the objective is their mating between 18 and 20 months of age.

Acknowledgements

To the students of "Pastos & Suplementos"' laboratory of Departamento de Zootecnia of Universidade Federal de Santa Maria for their help in carrying out the research project and to Mr. Valter José Pötter from Estância Guatambu, Dom Pedrito/RS, for the loan of experimental animals.

References

ALBERTO, E. Efectos de la calidad de los forrajes y la suplementación en el desempeño de ruminantes en pastoreo. In: JOBIM, C.C.; SANTOS, G.T.; CECATO, U. (Eds.) **Simpósio sobre avaliação de pastagens com animais.** Maringá: Cooper Graf. Artes Gráficas Ltda, 1997. p.53-73.

ANDERSON, K.J.; LEFEVER, D.G.; BRINKS, J.S. et al. The use of reproductive tract scoring in beef heifers. **Agri-Practice**, v.12, p.19-26, 1991.

ANUALPEC. **Anuário da Pecuária Brasileira**. São Paulo: Agra FNP Pesquisas, 2009. 360p.

ASSOCIATION OF OFFICIAL ANALYTICAL CHEMISTS - AOAC. **Official methods of analysis**. 14.ed. Washington, 1995. 1141p.

BARCELLOS, J.O.J.; LOBATO, J.F.P. Desempenho reprodutivo de vacas primíparas Hereford e mestiças Nelore - Hereford com estação de parição e monta no outono-inverno. I Taxa de prenhez. **Revista Brasileira de Zootecnia**, v.26, n.5, p.976-985, 1997.

BARCELLOS, J.O.J. **Puberdade em novilhas Braford**: desenvolvimento corporal e relações endócrinas. 2001. 164f. Tese (Doutorado em Zootecnia) – Universidade Federal do Rio Grande do Sul, Porto Alegre.

BEEF IMPROVEMENT FEDERATION - BIF. **Guidelines for uniform beef improvement programs**. Colby: W&BS, 1996. 161p.

BERETTA, V.; LOBATO, J.F.P. Sistema "um ano" de produção de carne: Avaliação de estratégias de alimentação hibernal de novilhas de reposição. **Revista Brasileira de Zootecnia**, v.27, n.1, p.157-163, 1998.

BRUNING, G. **Efeito da suplementação mineral e protéica no desempenho de novilhas em pastagem nativa invadida por capim-annoni-2.** 2007. 109f. Dissertação (Mestrado em Zootecnia) - Universidade Federal do Rio Grande do Sul, Porto Alegre.

CARLOTTO, S.B.; MEDEIROS, R.B.; PELLEGRINI, C.B. et al. Comportamento ingestivo diurno de vacas primíparas em pastagem nativa dominada por capim-annoni-2 com suplementação proteica e mineral em diversas estações climáticas. **Revista Brasileira de Zootecnia**, v.39, n.3, p.454-461, 2010.

CLARK, D.A.; KANNEGANTI, V.R. Grazing management systems for dairy cattle. In: CHERNEY, J.H.; CHERNEY, D.J.R. (Eds.) **Grass for dairy cattle**. Oxon: CAB International, 1998. p.331.

EMPRESA BRASILEIRA DE PESQUISA AGROPECUÁRIA - EMBRAPA. Centro Nacional e Pesquisa em Solos. **Sistema Brasileiro de Classificação de Solos**. Brasilia: Embrapa-SPI; Rio de Janeiro: Embrapa-Solos, 2006. 306p.

EUCLIDES, V.P.B.; MACEDO, M.C.M.; OLIVEIRA, M.P. Avaliação de diferentes métodos de amostragem sob pastejo. **Revista Brasileira de Zootecnia**, v.21, n.4, p.691-702, 1992.

FOX, D.G.; SNIFFEN, C.J.; O'CONOR, J.D. Adjusting nutrient requirementes of beef cattle for animal and environmental variations. **Journal of Animal Science**, v.66, n.5, p.1475-1453, 1988.

FOX, D.G.; SNIFFEN, C.J.; O'CONOR, J.D. et al. A net carbohydrate and protein system for evaluating cattle diets. **Journal of Animal Science**, v.70, n.11, p.3578-3596, 1992.

GARDNER, A.L. **Técnicas de pesquisa em pastagens e aplicabilidade de resultados em sistemas de produção**. Brasília: IICA, 1986. 197p.

GOTTSCHALL, C.S.; LOBATO, J.F.P. Comportamento reprodutivo de vacas de corte primíparas submetidas a três lotações em campo nativo. **Revista Brasileira de Zootecnia**, v.25, n.1, p.46-57, 1996.

HERINGER, I.; CARVALHO, P.C.F. Ajuste da carga animal em experimentos de pastejo: uma nova proposta. **Ciência Rural**, v.32, n.4, p.675-679, 2002.

HILLESHEIM, A.; CORSI, M. Capim-elefante sob pastejo. II. Fatores que afetam as perdas e utilizacao de materia seca. **Pesquisa Agropecuária Brasileira**, v.25, n.9, p.1233-1246, 1990.

JAMIESON, W.S.; HODGSON, J. The effect of variation in sward characteristics upon the ingestive behavior and herbage intake of calves and lambs under continuous stocking management. **Grass and Forage Science**, v.34, p.273-281, 1979.

LOWMAN, B.G.; SCOTT, N.; SOMERVILLE, S. **Condition scoring beef cattle**. Edinburgh: East of Scotland College of Agriculture, 1973. 8p. (Bulletin, 6).

MINSON, D.L. **Forage in ruminant nutrition.** San Diego: Academic Press, 1990. 483p.

MONTAGNER, D.B.; ROCHA, M.G.; SANTOS, D.T. et al. Manejo da pastagem de milheto para a recria de novilhas de corte. **Ciência Rural,** v.38, n.8, p.2293-2299, 2008.

MONTANHOLI, Y.R.; BARCELLOS, J.O.J.; BORGES, J.B. et al. Ganho de peso na recria e desempenho reprodutivo de novilhas acasaladas com sobreano. **Pesquisa Agropecuária Brasileira**, v.39, n.12, p.1253-1259, 2004.

MOOJEN, E.L.; MARASCHIN, G.E. Potencial produtivo de uma pastagem nativa do Rio Grande do Sul submetida a níveis de oferta de forragem. **Ciência Rural**, v.32, n.1, p.60-65, 2002.

MOTT, G.O. Evaluating forage production. In: HEATH, M.E., METCALFE, D.S., BARNES, R.F. (Eds.) **Forages**. 3.ed. Ames: The Iowa University Press, 1973. p.126-135.

NATIONAL RESEARCH COUNCIL - NRC. **Nutrient requirement of beef cattle**. 7.ed. Washington: National Academy Press, 1996. 242p.

PATTERSON, D.J.; PERRY, R.C.; KIRACOFE, G.H. et al. Management considerations in heifer development and puberty. **Journal of Animal Science**, v.70, n.12, p.4018-4035, 1992.

PÖTTER, L.; ROCHA, M.G.; MACARI, S. et al. Desenvolvimento de bezerras de corte após a desmama sob níveis de concentrado. **Ciência Rural**, v.40, n.10, p.2157-2162, 2010.

QUADROS, D.G. de; RODRIGUES, L.R. de A. Valor nutritivo dos capins Tanzânia e Mombaça adubados com nitrogênio e sob lotação rotacionada. **Acta Scientiarum Animal Sciences**, v.28, n.4, p.385-392, 2006.

ROCHA, M.G.; LOBATO, J.F.P. Sistemas de alimentação pós-desmama de bezerras de corte para acasalamento com 14/15 meses de idade. **Revista Brasileira de Zootecnia**, v.31, n.4, p.1814-1822, 2002.

ROCHA, M.G.; PILAU, A.; SANTOS, D.T. et al. Desenvolvimento de novilhas de corte submetidas a diferentes sistemas alimentares. **Revista Brasileira de Zootecnia**, v.33, n.6, p.2123-2131, 2004 (supl. 2).

SEBRAE, SENAR e FARSUL (Juntos para competir). **Diagnóstico de sistemas de Produção de bovinocultura de corte do Estado do Rio Grande do Sul**. Porto Alegre, 2005. 265p.

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, p.121-138, 2007 (supl. especial).

SOARES, A.B.; CARVALHO, P.C.F.; NABINGER, C. et al. Produção animal e de forragem em pastagem nativa submetida a distintas ofertas de forragem. **Ciência Rural**, v.35, n.5, p.1148-1154, 2005.

SOLLENBERGER, L.E.; BURNS, J.C. Canopy characteristics, ingestive behavior and herbage intake in cultivated tropical grasslands. In: INTERNATIONAL GRASSLAND CONGRESS, 19., 2001, São Pedro. **Proceedings...** São Pedro: São Paulo, 2001. p.24.

VAN SOEST, P.J. **Nutritional ecology of the ruminant**. 2.ed. Ithaca: Cornell, 1994. 476p.