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Natural and improved pastures on growth and reproductive performance of Hereford heifers

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ABSTRACT - This study evaluated yearling growth and reproductive performance of Hereford heifers at 24-26 months of age grazing on natural pastures at two stocking rates during winter and spring, associated or not to improved natural pastures. Heifers were classified according to three weight groups (Light, Medium and Heavy) and randomly distributed into four feeding management practices: 0.6 AU (1 animal unit = 450-kg body weight) – heifers on natural pastures at a stocking rate of 0.6 AU/ha; 0.8 AU – heifers on natural pastures at a stocking rate of 0.8 AU/ha; 0.6 AUI – heifers on natural pastures at a stocking rate of 0.6 AU/ha and on improved natural pastures between Sept 1st and Nov 1st; 0.8 AUI – heifers on natural pasture at a stocking rate of 0.8 AU/ha and on improved natural pastures between Sept 1st and Nov 1st. The stocking rate of 0.8 AU resulted in significant weight loss during winter months (-0.138 and -0.356 kg for 0.6 and 0.8 AU, respectively). Heifers grazing during the spring on improved natural pastures presented higher weight gain before the breeding season and higher body weight and body condition score in the beginning and end of the breeding season in relation to those grazing only on natural pastures. Heifers kept at 0.6 AU/ha obtained 69.7% pregnancy rate, which was significantly higher than the 54.2% of those managed at 0.8 UA/ha. Heifers grazing on improved natural pastures during the spring achieved 83.8% pregnancy rate, whereas those maintained on natural pastures achieved only 40.2%. Light and medium heifers lost less weight during the winter as compared with the heavy ones, but weight differences between groups remained until the end of the breeding season. Heavy heifers have higher pregnancy rates. Heifers submitted to lower stocking rate and those grazing on improved natural pastures conceive earlier.

Key Words: body condition, live weight, pregnancy, stocking rate, weight gain

Introduction

Reducing age at first breeding is one of the main goals of productive beef cattle production systems. Breeding heifers and slaughtering steers at two years of age, Pötter et al. (1998) obtained 28% outcome rate.

However, first breeding at two days of age is not achieved in all farms in the state of Rio Grande do Sul and in Brazil. The wide range of soil types and the lack of good management practices of forage resources and of the use of improved pastures (Pereira Neto et al., 1999), as well as the lack of good health practices hinder the achievement of that goal.

Among the low-cost practices to improve this scenario, alternative practices can be employed, such as adjusting natural pasture allowance (Neves et al., 2009) and using winter-spring pasture, allocating pasture production and offer according to the requirements of growing and pre-breeding heifers (Lobato, 2003). Identifying the need to make such decisions during the macro-processes identified in production systems (Rosado Júnior & Lobato, 2009) rather posteriorly is critical for the establishment of high productivity in beef cattle production (Beretta et al., 2002; Rosado Júnior & Lobato, 2010).

Farmers need to understand the association between the cattle frame of their herds and stocking rates and management practices of natural and improved pastures to increase the efficiency of their production systems.

This study aimed at evaluating the effects of two stocking rates of yearling Hereford heifers maintained on natural pastures during winter and spring until first breeding at 24-26 months of age, the responses of one third of these heifers grazing on improved natural pastures in September and October, and the effects of body weight (Light, Medium, and Heavy) on reproductive performance.

Material and Methods

The experiment was carried out at Xiriscal Farm, located at 30° 44' 676'' South, 54° 47' 941'' West and at 183 m of altitude, in the municipality of Dom Pedrito, RS, Brazil, district of Campo Seco, in the geographic region called

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Campanha, during the period of June 1st, 2008 to February 28, 2009.

Two hundred forty-two Hereford heifers, with 20 months of age, on average, at the beginning of the experiment were randomly distributed in the following pasture management practices:

0.6 AU – 81 heifers grazing on natural pastures with 1295 kg of DM initial allowance, stocking rate of 0.6 AU/ha = 270 kg/ha (Animal Unit (AU) = 450-kg body weight) between June 1st and Nov 1st, 2008;

0.8 AU – 81 heifers grazing on natural pastures with 833 kg of DM initial allowance, stocking rate of 0.8 AU/ha = 360 kg/ha between June 1st and Nov 1st, 2008;

0.6 AUI – 40 heifers grazing on natural pastures with 1295 kg of DM initial allowance, stocking rate of 0.6 AU/ha = 270 kg/ha between June 1st and Aug 31, and then grazing on improved natural pastures between Sept 1st and Nov 1st, 2008; and

0.8 AUI – 40 heifers grazing on natural pastures with 833 kg of DM initial allowance, stocking rate of 0.8 AU/ha = 360 kg/ha between June 1st and Aug 31, and then grazing on improved natural pastures between Sept 1st and Nov 1st, 2008.

Animal performance on natural pastures was evaluated between June 1st and Aug 31, 2008, in two 160-ha paddocks where summer-cycle species (*Andropogon lateralis*, *Desmodium incanum*, *Paspalum dilatatum*, *Paspalum notatum* and *Trifolium polimorphum*) predominated. Both paddocks presented similar water distribution, woods, topography, salt bunkers, and were separated by conventional wire fences. Heifers grazed on these paddocks between June 1st and Aug 31, 2008. On Aug 31, 40 heifers from each paddock were randomly chosen and placed in paddocks with natural pastures improved by the introduction of ryegrass (*Lolium multiflorum* Lam), white clover (*Trifolium repens*) and birdsfoot trifoil (*Lotus corniculatus* cv. *São Gabriel*) until Nov 1st, 2008. Heifers grazed until Nov 1st, 2008 as a single group at a stocking rate of 0.7 AU/ha (315 kg/ha). Heifers remaining on natural pastures grazed after Nov 1st, 2008 as a single group at a stocking rate of 0.7 AU/ha, which was obtained by the inclusion of other heifers of the farm.

During the first 45 days of the breeding season, started on Nov 15, 2008, heifers in estrus were submitted to artificial insemination. On the next 21 days, until Jan 20, 2009, natural breeding was used with bulls that were previously approved in libido tests and andrological examination, at a ratio of 1 bull:50 heifers. Pregnancy diagnosis by ultrasound was performed 30 days after the end of the breeding season.

Forage allowance estimates were regularly estimated when heifers were weighed, through the comparative method of Haydock & Shaw (1975). Pasture samples were collected, identified according to collection day, weighed and analyzed for crude protein (CP) and neutral detergent fiber (NDF) using the methods described by the AOAC (1984) in the Laboratório de Nutrição Animal da Escola de Agronomia, UFRGS (Table 1).

Heifers were weighed after 12 hours of solid and liquid fasting at average intervals of 28 days. Body weight changes were determined as weight differences between weighings, divided by the number of days between weighings. At the time of weight measurements, body condition scores were attributed (BCS; Lowman et al., 1973), according to a 1-5 scale, where 1 = very thin and 5 = very fat.

Heifers were classified according to weight groups as: Light (average weight: 241 kg; range: 215-250 kg), Medium (average weight: 259 kg; range: 251-269 kg) and Heavy (average weight: 286 kg; range: 270-309 kg).

The parameter conception date of 2008 was estimated considering the calving date in 2009 minus 285 days, which corresponds to the average pregnancy duration in Hereford cows (Sawyer et al., 1991).

Data were analyzed according to a completely randomized experimental design, with the effect of pasture (natural pasture or improved natural pasture) nested within previous stocking rate (high or low stocking rates), determining the four forage management systems described above.

The analysis of the three weight groups did not show any interactions with the other effects (P>0.05), and therefore, the interactions were removed from the model.

Table 1 - Forage mass and crude protein and neutral detergent fiber percentages of the pastures grazed during the experimental period

Management system	Period	Forage mass (kg/ha DM)		Crude protein (%)	Neutral detergent fiber (%)
		Mean	Range		
0.6 AU	June-August	1183	1123-1295	6.77	68.55
	September-November	1340	1240-1434	5.80	71.65
0.8 AU	June-August	801	760-833	5.70	65.86
	September-November	899	893-910	5.30	70.92
Improved natural pasture	September-November	2244	2145-2312	11.99	49.90
0.7 AU	November-January	2449	2295-2692	6.50	74.47

Data were submitted to analysis of variance, and means were compared by the t-test at 5% significance levels, using SAS statistical package (Statistical Analyses System, version 6). The following model was applied: $Y_{ij} = \mu + SR_i + PAST_j + PAST(SR)_{ij} + WEIGHT\ GROUP_l +$ eijl; i = 1.2; j = 1.2, l = 1.2.3, where Y_{ijl} = IW (initial weight), FW (final weight), IBCS (initial body condition score), FBCS (final body condition score), DAV (daily average weight variation) of the k-th heifer, belonging to the i-th stocking rate (SR), to the j-th Pasture (PAST) and to the l-th weight group (WEIGHT GROUP); μ = general mean; SR_i = effect of the i-th stocking rate; $PAST_j$ = effect of pasture j; WEIGHT $GROUP_l$ = effect of weight group j; eijl = effect of the random error associated to each Y_{ijl} observation.

Continuous parameters with normal distribution were analyzed considering an unequal number of replicates. The effect of feeding management on pregnancy rate was analyzed by the Chi-Square test at 5% probability level (Steel & Torrie, 1989).

Results and Discussion

Heifers submitted to stocking rates of 0.6 and 0.8 AU/ha, with average forage allowances between June and August of 1183 and 801 kg DM/ha, respectively, suffered significant weight loss, which considerably affected their body weight as measured on Sept 1st, 2008 (Tables 1 and 2). In the beginning of the experiments, heifers managed at 0.6 AU/ha had an allowance of 4.07 kg of DM/100-kg body weight (BW), whereas the stocking rate of 0.8 AU/ha provided an allowance of only 2.52-kg DM/100-kg BW. On Aug 1st, 2008, forage allowances were 4.55 and 2.80-kg DM/100-kg BW, which were virtually the same as 60 days before due to weight loss: on Sept 1st, heifers accumulated BW losses of -12.7 and -32.7 kg, grazing at stocking rates of 0.6 and 0.8 AU/ha, respectively. On average, during this period, heifers grazing at 0.6 AU/ha were supplied 4.32-kg DM/100-kg BW, whereas those grazing at 0.8AU/ha received 2.62kg DM/100 kg BW. These allowances were low, particularly for the season, and, associated to the forage quality (Table 1), they determined the observed BW losses. High stocking rates resulted in low forage allowance and pasture height (Neves et al., 2009).

When submitting heifers of the same age to 4% forage allowance – higher than those used in the present experiment – during the entire year, Neves et al. (2009) found considerable daily weight gain and body condition score losses. This information is important for the animal class under study, as high weight loss in heifers may result in failure at first breeding (Lobato, 2003), and therefore, compromise a relevant step of the calf production macro-process (Rosado Júnior & Lobato, 2009).

Forage allowances lower than 8-kg DM/100-kg BW maintain average pasture height below 6.0 cm, which is the minimum height promoting efficient grazing by cattle (Neves et al., 2009). With 8% DM, pastures are capable of maintaining their regrowth and structure, thereby providing adequate allowance, height and quality (Maraschin, 2001).

The biggest losses occurred during the worst winter period, between Jul 1st and Aug 1st, with -0.5 and -0.7 kg/day at stocking rates of 0.6 and 0.8 AU/ha, respectively. During this period, weather and plant structure, associated to soil and relief characteristics (Neves et al., 2009), as well as pasture allowance and quality, may have caused considerable losses.

Although the paddocks had been previously closed for 40 days, DM accumulation was insufficient to prevent BW losses during that period. Scholl et al. (1976) closed paddocks for 60 days, and obtained a pasture allowance of more than 30-kg DM/100 kg, which resulted in 4.5-kg BW gain during the winter, with higher gains during the first 28 days.

Body weight loss when cattle are grazing natural pastures during periods of low pasture allowance and quality is normal, mainly due to low allowance (Pilau & Lobato, 2006; Vaz & Lobato, 2010a). Menegaz et al. (2008) obtained 0.189-kg/day weight gain during the period of June 11 to July 08, but with an initial allowance of 2520-kg DM/ha. During the period from June 11 to Sept 10, average weight gain was 0.261 kg/day, but with an average allowance of 1817 kg DM/ha. Under the conditions of the study of Menegaz et al. (2008), monthly DM/ha allowances of 2520, 2062, 1470 and 1216 kg DM/ha were obtained.

During the period from Aug 1st to Sept 1st, 2008, increasing sunlight and temperature increased natural pasture quality, promoting weight gains, according to

Table 2 - Average body weight (kg) of heifers grazing natural pastures at stocking rates of 0.6 or 0.8 AU/ha between June 1st and September 1st

	Stocking rate	
Weighing days	0.6 AU	0.8 AU
June 1st, 2008	262.8±1.38a	261.8±1.39a
Jul 1st, 2008	249.8±1.47a	246.3±1.45a
Aug 1st, 2008	234.8±1.31a	224.1±1.29b
Sept 1st, 2008	250.1±1.50a	229.1±1.49b
Total body weight variation	-12.7±1.00a	-32.7±1.01b
Average daily weight variation	-0.138±0.011a	-0.356±0.011b

a,b – Means in the same row followed by different letters are different by t-test (P<0.05).

stocking rate, of 0.533 kg and 0.170-kg/day with 0.6 and 0.8 AU/ha, respectively. Menegaz et al. (2008), between Aug 10/08 and Sept 10, determined weight gains of 0.435 kg/day with 0.6 AU/ha and 9.36-kg DM/100 kg BW allowance.

The results found in the literature relative to animal performance in natural pastures during autumn and winter are very contradictory, as influenced by climate (rainfall and temperature) and diversity of the flora of the studied region (Menegaz et al., 2008; Neves et al., 2009). Menegaz et al. (2008) obtained in natural pastures average weight gains of 0.261 kg, but at a lower stocking rate (0.6 AU/ha and 1345-kg DM/ha), which supplied higher pasture allowance as that obtained in the present study. Animal performance depends on pasture allowance, which is adjusted by stocking rate (Moojen & Maraschin, 2002; Neves et al., 2009).

On September 1st, 2008, 82 heifers grazing at 0.6 and 0.8 AU/ha were maintained in the same paddocks, whereas 80 were transferred to improved natural pastures (I) at stocking rates of 0.6 UAI and 0.8 UAI (Table 3).

Regardless of the stocking rate applied until Nov 15th, 2008, the heifers at improved natural pastures gained significantly more weight than those maintained on natural pastures (0.869 vs. 0.421 kg/day for heifers at 0.6 AU and 0.747 vs. 0.454 kg/day for heifers at 0.8AU; P<0.05).

The higher weight gain obtained by heifers, regardless of the previous feeding management, is explained by the improvement in the quality of natural pastures in the spring and by the higher quality of the improved natural pastures (Table 1). The higher efficiency and higher weight gain observed are due to the higher consumption of metabolizable energy, which was higher than maintenance requirements, allowing the animal to direct the ingested nutrients to tissue accretion, increasing its efficiency to gain weight (Poppi & McLennan, 1995). Pilau & Lobato (2006) also observed weight recovery in cattle from different herds after a period of feed restriction when grazing natural pastures during the winter, and attributed this recovery to the interaction between pasture quality, compensatory gain, and genetic potential.

Heifers grazing on improved natural pastures between Sept 1st and Nov 15, 2008 gained s106.4 and 64.5% more weight was compared with those grazing on natural pastures at 0.6-AU and 0.8-AU stocking rates. This suggests that there was compensatory gain during this period, with heifers submitted to more stringent feed restriction in the previous period obtaining higher weight gain when the available feed was sufficient to demonstrate this compensation. After feed restriction, animals are able to recover their body weight and gain weight under adequate feed allowance (Di Marco, 1998). According to Ryan (1990), ruminants maintained under feed restriction tend to compensate their average daily gain when restriction ends, and the intensity of gain weight is influenced by feed quality, feed restriction period, and animal age.

Regardles of the stocking rates used in heifer management, compensatory gain was observed in the subsequent periods, as previously observed by Simeone & Lobato, (1998) and Restle et al. (1999), albeit not significant (Almeida & Lobato, 2004).

The better performance demonstrated by the higher weight gain before the breeding season is critical for the reproductive performance of heifers, as the higher nutrient supply triggers the secretion and release of reproductive hormones (Schillo, 1992). With higher protein supply, and particularly higher energy supply, to heifers, LH pulses are more intense and occur at shorter intervals (Kinder et al., 1994). Neves et al. (2009), working with excessive stocking rates, observed lower cycling and lower reproductive tract scores.

Average body weights in the beginning and end of the breeding season were higher (P<0.05) for heifers grazing on improved natural pastures until Nov 15, 2008 as compared with those grazing exclusively on natural pastures (Table 4).

The average body weights of 261, 314, 264 and 306 kg obtained at the beginning of the breeding season for 0.6 AU, 0.6 AUI, 0.8 AU and 0.8 AUI, respectively, represent 52, 63, 53 and 61% of the mature weight of the studied herd, whose cows sold for slaughter at a body condition score of 4.5 - 5.0 presented 500-kg average weight. Therefore, the percentage of mature weight of 24-25-month-old heifers obtained with the use of improved natural pastures in the present study

Table 3 - Average weight and weight variation according to stocking rate of heifers grazing on natural pastures or improved natural pastures during the period of Sept 1st to Nov 15, 2008

	0.6 AU		0.8 AU	
Weight measurement	Natural pasture	Improved pasture	Natural pasture	Improved pasture
Sept 1st, 2008, kg	229±1.3b	248±2.1a	230±1.3b	250±2.2a
Nov 15, 2008, kg	261±2.2b	314±3.1a	264±2.2b	306±3.1a
Weight gain, kg	32±1.4b	66±2.0a	34±1.4b	56±2.0a
Average daily gain, kg	0.421±0.018b	0.869±0.026a	0.454±0.018b	0.747±0.017a

a,b – Means in the same row followed by different letters are different, within stocking rate, by t-test (P<0.05).

is slightly higher than the required weights mentioned in the literature, except for Freetly (1999), who considers that heifers are well developed when reaching 70% of their mature weight at two years of age. According to the NRC (1996), *Bos taurus* heifers must weigh at least 60% of their mature weight to be able to reach puberty and to conceive. Rovira (1996) mentions that 280 to 300-kg BW in British breeds and their crosses are sufficient to achieve at least 85% pregnancy during the first six weeks of the breeding season.

During the breeding season, all heifers were maintained as a single group on natural pastures at a stocking rate of 315-kg BW/ha (0.70 AU/ha). During this period, their daily weight gain was lower than that obtained by the heifers grazing on improved natural pastures between Sept 1st and Nov 15, 2008. The ruminal flora adjustment required when changing for poorer nutritional regimes, according to Van Soest (1994), determines lower weight gain or even weight loss when the new feeding regime starts. Cattle changed to low quality feeding conditions immediately after a period when their performance was close to their optimal potential present weigh gain reduction (Allden & Morley, 1981).

Rocha et al. (2004), evaluating the development of beef heifers grazing on lopsided oats and ryegrass, with or without energy supplementation, also found low weight gain and weight loss when heifers were subsequently placed on natural pasture in the beginning of spring. According to Ferrell (1982) and Van Soest (1994), the adaptation of the ruminal microbial flora is one of the possible causes of the worse performance of cattle removed from improved pastures and submitted to new feeding management as they require some time to adjust to the new diet.

The FDN and crude protein values determined in the natural pasture used during the breeding season (Table 1) determined the low weight gain of the heifers during this period. According to Van Soest (1994), high FDN levels limit forage intake, as they are associated to rumination, passage rate, and feed intake.

The heifer average weight gains obtained in the present study are higher than those observed by Rocha et al. (2004), who, when evaluating heifers exposed to breeding at 13-15 months of age after grazing on cultivated winter/spring pastures, observed weigh losses of -0.185 kg/heifer/day on natural pastures. In order to prevent losses and gradual adjustment to the new forage matrix, Pilau & Lobato (2009) worked with heifers at 13-15 months of age to be bred before leaving cultivated pastures and at the beginning of grazing on natural pastures, supplemented or not with corn grain, and, for the period, obtained weight gains of 0.800 vs. 0.658 kg/day (P<0.05), respectively. The weight gains determined in the present study are lower than the 0.384 kg/day reported by Vaz & Lobato (2010b), who worked with heifers bred at 13-15 months of age that were submitted to early weaning at 77 days or at the conventional age of 147 days.

Literature reports very variable body weight performances during the breeding season due to the conditions under which the studies were carried out. However, several authors agree that, regardless of weight gain during the breeding season, body weight in the beginning of the breeding season is critical for obtaining adequate reproductive response that is required in intensive beef cattle production systems (Rovira, 1996; Rocha & Lobato, 2002; Pilau & Lobato, 2008; Vaz & Lobato 2010b).

The analysis of variance of body condition score showed differences between feeding management practices (P<0.05), with heifers previously grazing on improved natural pastures obtaining higher scores. Body condition score is a good indicator of subcutaneous fat deposition, which determines the early manifestation of estrus, even before the breeding season and as well as reproductive performance itself (Lemenager et al., 1980).

Average body condition scores at the beginning and end of the breeding season of 3.2 and 3.1 (P>0.05) obtained

Table 4 - Development and reproductive performance of heifers according to stocking rates on natural pastures and improved natural pastures before the breeding season

	0.6 AU		0.8 AU	
Body weight and body condition score	Natural pasture	Improved natural pasture	Natural pasture	Improved natural pasture
Weight beginning of the breeding season, kg	261±2.2b	314±3.1a	264±2.2b	306±3.1a
Weight end of the breeding season, kg	294±2.0b	320±3.0a	278±2.0b	316±3.0a
Average daily gain, kg	0.211±0.024a	0.105±0.035b	0.237±0.025a	0.162±0.036a
Body condition score beginning of the breeding season	2.8±0.03b	3.2±0.04a	2.5±0.03b	3.1±0.05a
Body condition score end of the breeding season	2.8±0.03b	3.3±0.05a	2.6±0.03b	3.2±0.05a
Pregnancy, %	51.9B	87.5A	28.4B	80.0A
Beginning breeding season conception interval, days	33.1a	28.3a	42.6b	34.5a

a,b – Means in the same row followed by different letters are different, within stocking rate, by the t-test (P<0.05).
A,B – Means in the same row followed by different letters are different, within pasture allowance, by the Chi-Square test (P<0.05).

with treatments of 0.6 AUI and 0.8 AUI were higher than the body condition scores of 2.8 and 2.55 of heifers managed at stocking rates of 0.6 AU and 0.8 AU on natural pastures, respectively. Literature shows that body condition scores higher than 3.0 are sufficient for obtaining good reproductive results in two-year-old heifers (Menegaz et al., 2008). In the present study, the body condition scores of heifers grazing on natural pastures were limiting for good reproductive results. Low weight and body condition development of heifers negatively affect herd reproductive performance as they delay age at conception, resulting in lower productivity in calving-to-finishing systems (Pötter et al., 2000; Beretta et al., 2001; Vieira et al., 2006).

In spite of the previous feeding management practice, body condition score did not evolve during the breeding season due to the low weight gain during this period. Increasing body condition reflects the sufficient energy to supply animal requirements, influencing weight gain and accelerating fat deposition. There is a strong relationship between body weight and body condition score in heifers due to the significant need for muscle tissue accretion, as they are still growing (Pilau & Lobato, 2006; Vaz & Lobato 2010a).

Regardless of stocking rate until Sept 1st, heifers that grazed on improved natural pastures presented significantly higher pregnancy rates (Table 4), as a result of achieving the minimum body weights and body condition scores previously discussed in this paper. These results are consistent with other studies that, in spite of the breed and heifer age at pregnancy (24-26 or 14-15 months), also stress the need for achieving adequate minimum body weight and body condition score to obtain significant pregnancy rates (Semmelmann et al., 2001; Rocha & Lobato, 2002; Pilau & Lobato, 2006; Menegaz et al., 2008; Vaz & Lobato, 2010b).

Heifer pregnancy rate was influenced by the initial stocking rates to which heifers were submitted. Those grazing at 0.6 AU presented 69.7% pregnancy rate, whereas those at 0.8 AU presented 54.2%. These results demonstrate the importance of stocking rate and resulting pasture allowance, even when grazing only natural pastures, on body weight and body condition score in the beginning and end of the breeding season, and consequent heifer reproductive performance, as previously reported by Menegaz et al. (2008) and Vaz & Lobato (2010b).

Heifers grazing 60 days before the breeding season on improved natural pastures conceived, on average, 31.3 days earlier ($P<0.05$); however, their conception time was not different from those grazing on natural pastures at low stocking rate (33.3 days), which presented the highest body weight and body condition score between heifers grazing on natural pastures. Menegaz et al. (2008) observed the same trend in heifers with higher weight gain and body condition score in the beginning of the breeding season, obtaining average conception rates of 30.6, 36.5 and 39.4 days for heifers previously grazing on improved natural pastures, natural pastures and natural pastures with supplementation, respectively.

The better forage allowance and quality determined the difference in the number of days required to conceive between heifers submitted to different forage systems before the breeding season. Byerley et al. (1987) emphasize that estrus fertility increases up to the third estrus. Early conception in the breeding season has positive influence on the reproductive performance of first-calf cows, as they allow a higher number of days between calving and the end of the second breeding season (Osoro, 1986).

There were differences in weight loss during autumn and winter, and, after Sept 1st, heifers grazing on natural pastures devloped slower and those grazing on improved natural pastures hd better response (Figure 1).

As there was no interaction between stocking rate and pasture type (natural or natural associated with the use of improved natural pastures) on heifer initial weight, this effect is discussed separately.

When heifers were classified in the beginning of the study in three weight groups (Light, Medium and Heavy, with 241, 259 and 286 kg average body weight, respectively), it was observed that, during the period of autumn-winter, heavier heifers lost more of it. Light, Medium and Heavy heifers lost 0.192, 0.242 and 0.307 kg/day ($P<0.05$), respectively (Table 5) until Sept 1st, 2008. The weight

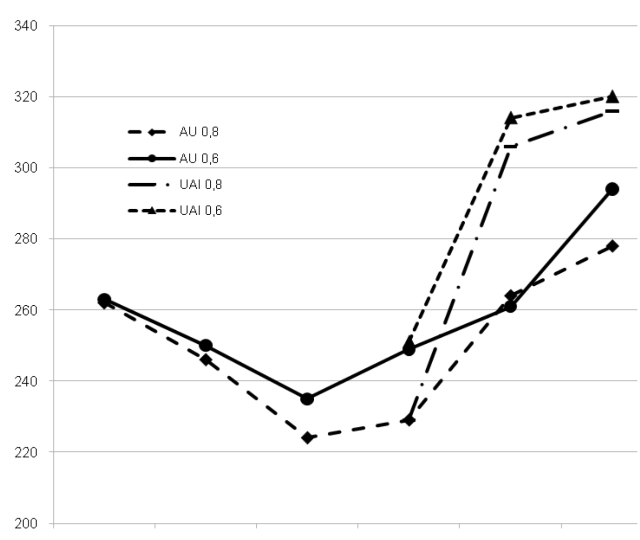

Figure 1 - Body weight evolution of heifers between June 1st and the end of the breeding season according to feeding management practice.

differences measured in the beginning of the study were maintained until Sept 1st, but with increasing weight losses (P<0.05) as heifer body weight increased (-0.192; -0.242 and -0.307 kg/day; Table 5). The higher weight loss in the heavier heifers during periods of nutritional deficiencies is due to their higher requirements and higher feed intake (Di Marco, 1998), which require animals to use their body reserved to supply maintenance requirements.

Menegaz et al. (2008), also studying the effect of feeding management practices on the reproduction of two-year-old heifers classified in three weight groups, also observed the same trend towards maintenance of the initial weight groups. Those authors worked with lower initial body weights, but observed, instead of weight loss, average daily gains of 0.600, 0.612 and 0.634 kg/day (P>0.05) in Light, Medium and Heavy heifers, respectively, during the same season.

The weight groups remained different in the beginning and end of the breeding season (P<0.05), indicating that, regardless of initial body weight, heifers presented similar weight gain during the breeding season.

The results show that the forage systems used in the present study maintained the body weight differences from the beginning of the study until the end of the breeding season between weight groups. However, body condition score differences were obtained both in the beginning and the end of the breeding season. Heavy heifers presented significantly higher body condition score, which allows us to assume that that group has better genetic potential for weight gain and precocity. Nevertheless, heifers with larger mature size and heavier mature weight tend to deposit fat later, particularly when feed is limiting in quantity and quality (Di Marco, 1998). Pereira Neto & Lobato (1998) and Menegaz et al. (2008) found better body condition score in lighter animals.

There was no difference in average conception date between weight groups, with Light, Medium and Heavy heifers conceiving on days 31.3, 33.3 and 32.4, respectively. Menegaz et al. (2008) observed that heavy heifers presented lower breeding-conception interval (29.86 days) (P<0.05) as compared with medium and light heifers (36.80 and 39.83 days, respectively), which were not different.

The pregnancy rate of heavy heifers (71.5%) was higher (P<0.05) than those of the medium (61.2%) and light (54.9%) heifers, which were not different. Heavy heifer pregnancy rate was 16.6% higher in heavy heifers relative to the light heifers. These results, according to literature, show the beneficial effects of the association of body weight to a higher percentage of mature weight and the resulting conception rate of heifers: the heavier or the higher the development of the heifers, the higher their conception rate. At the beginning of the breeding season, light, medium and heavy heifers presented 55%, 58% and 62% of the 500-kg mature weight of the herd, and at the end of that season, 57%, 60% and 64%, respectively. Therefore, only the heavy heifers had more than 60% of the mature weight in the beginning and the end of the breeding season, as recommended by the NRC (1996) for the beginning of breeding. The influence of the higher body weight in the beginning and end of the breeding season was also observed in heifers bred at 24-26 months of age (Pereira Neto & Lobato, 1998; Menegaz et al., 2008) and at 14-15 months of age (Rocha & Lobato, 2002; Vaz & Lobato, 2010b).

In intensive beef cattle production systems, where there are no forage limitations, most heifers are heavy, with high pregnancy rates. However, if this continues throughout the years, heifer frame and weight may increase due to selection of larger animals, which may result in late sexual maturity and higher maintenance requirements of the breeding herd caused by the larger mature size (Jenkins

Table 5 - Average development and reproductive performance parameters of beef heifers with different body weights

	Weight groups		
	Light	Medium	Heavy
Weight on June 1st, 2008, kg	241±1.8c	259±1.5b	286±1.9a
Weight on Sept 1st, 2008, kg	223±1.9c	237±1.6b	258±2.0a
Daily weight variation between June 1st and Sept 1st, 2008, kg	-0.192±0.014a	-0.242±0.012b	-0.307±0.014c
Weight on Nov 15, 2008, kg	277±2.4c	288±2.0b	309±2.3a
Daily weight variation between June Sept 1st and Nov 15th, 2008, kg	0.708±0.020	0.665±0.016	0.673±0.020
Weight (end of breeding season), kg	285±2.3c	300±1.9b	321±2.2a
Average daily gain (breeding season), kg	0.134±0.028b	0.207±0.023a	0.195±0.026ab
Body condition score (start of breeding season)	2.74±0.04c	2.87±0.03b	3.10±0.03a
Body condition score (end of breeding season)	2.81±0.04c	2.96±0.03b	3.17±0.04a
Beginning of breeding season – conception interval, days	31.3±4.3	33.3±3.0	32.4±4.5
Pregnancy, %	54.9B	61.2AB	71.5A

a,b,c – Means in the same row followed by different letters are different by the t-test (P<0.05).
A,B – Means in the same row followed by different letters are different by the Chi-Square test (P<0.05).

& Willians, 1994; Cundiff et al., 1998), affecting fist-calf cow reproduction, as observed by Olson (1994) and recently by Lobato et al. (2010) and Tanure et al. (2011).

Although all heifers were born in the same season of 90 days in 2006, weight groups may have been confused with age in days, as the precise date of birth of the heifers was no available. Therefore, heavier heifers could have been the older ones. This is important in intensive production systems (Pötter et al., 1998; Beretta et al., 2002), since the pregnant heifers are usually the heaviest, the eldest, and present the highest body condition scores and weight gains from birth until the end of the breeding season (Rocha & Lobato, 2002; Vieira et al., 2006; Vaz & Lobato, 2010b). In calving-to-finish systems, heifers that conceive earlier in their first breeding season are usually the first-calf cows with the highest pregnancy rates (Vieira et al., 2006; Vaz et al., 2010).

Conclusions

Natural pastures need to be closed for longer and grazed at lower stocking rates to supply forage allowances that prevent heifer weight loss during the fall and winter. Grazing on improved natural pastures results in adequate body weight and body conditions that promote good reproductive indexes and earlier conception. Heavier heifers present higher pregnancy rates. In essentially grazing systems, particularly in calving-to-finish systems, where all animal classes have to go through steps along the seasons to achieve successful reproduction, the continuous follow-up of animal development is critical. Supplying adequate feeding and development to the different herd classes is essential for the achievement of high productive and economic outcomes, which determine the income of farmers.

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