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Influence of timing and rate of gain on puberty and reproductive performance of beef heifers

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Abstract

Seventy-seven crossbred heifers (573 lb initial body weight) were developed in drylot and limit-fed a corn, sorghum silage diet predicted to produce gains of either 1 lb/day for the entire developmental period (EVENGAIN) or .25 lb/day for the first two-thirds of the period followed by 2 lb/day during the last third (LATEGAIN). Treatments began on November 15, 1993 and continued until April 25, 1994, the onset of the breeding season. Actual daily gains averaged 1.31 lb/day for EVENGAIN heifers, whereas LATEGAIN heifers averaged .55 lb/day for the first two-thirds of the feeding period and 2.5 lb daily for the last third. Age and weigh t at puberty were not affected by feeding treatment, and body condition score, estimated fat thickness, frame score, and pelvic area were similar regardless of growth regimen. At the conclusion of the feeding period, estrus was synchronized using two injections of prostaglandin F , and heifers 2" were inseminated artificially during a 45-day breeding season. Open heifers were mated naturally for an additional 1 5 days. First-service and overall pregnancy rates were similar between treatments. In summary, rate and time of gain did not affect puberty or breeding performance. However, LATEGAIN heifers were more efficient and developed on 12% less feed than the EVENGAIN heifers. These data suggest that replacement heifers can be developed more efficiently if most of the body weight gain required to enter the breeding season occurs late in development.

Keywords

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INFLUENCE OF TIMING AND RATE OF GAIN ON PUBERTY AND REPRODUCTIVE PERFORMANCE OF BEEF HEIFERS

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Summary

Seventy-seven crossbred heifers (573 lb initial body weight) were developed in drylot and limit-fed a corn, sorghum silage diet predicted to produce gains of either 1 lb/day for the entire developmental period (EVENGAIN) or .25 lb/day for the first two-thirds of the period followed by 2 lb/day during the last third (LATEGAIN). Treatments began on November 15, 1993 and continued until April 25, 1994, the onset of the breeding season. Actual daily gains averaged 1.31 lb/day for EVENGAIN heifers, whereas LATEGAIN heifers averaged .55 lb/day for the first two-thirds of the feeding period and 2.5 lb daily for the last third. Age and weight at puberty were not affected by feeding treatment, and body condition score, estimated fat thickness, frame score, and pelvic area were similar regardless of growth regimen. At the conclusion of the feeding period, estrus was synchronized using two injections of prostaglandin $F_{2\alpha}$, and heifers were inseminated artificially during a 45-day breeding season. Open heifers were mated naturally for an additional 15 days. First-service and overall pregnancy rates were similar between treatments. In summary, rate and time of gain did not affect puberty or breeding performance. However, LATEGAIN heifers were more efficient and developed on 12% less feed than the EVENGAIN heifers. These data suggest that replacement heifers can be developed more efficiently if most of the body weight gain required to enter the breeding season occurs late in development.

(Key Words: Beef Heifers, Puberty, Heifer Development.)

Introduction

Yearling beef heifers conceiving early in their first breeding season will have increased lifetime production and efficiency. It is critical that these heifers attain enough weight to initiate their first estrous cycle before the onset of the breeding season. Current management practices target heifers to reach 60 to 65% of their estimated mature body weight by the start of the breeding season. However, little is known regarding the importance of the timing of this weight gain.

Our primary objective was to evaluate when this weight should be acquired; specifically, whether uniform weight gain over the development period is necessary or whether restriction followed by rapid gain could provide cost efficient gain without compromising reproductive performance.

Experimental Procedures

Seventy-seven, spring-born, Angus × Hereford heifers (573 lb initial weight) were blocked by weight and assigned randomly within weight blocks to two treatments. Heifers were fed to gain 1 lb/day for the entire 159-day period of development (EVENGAIN) or to gain .25 lb/day for the first two-thirds of the development period followed by 2 lb/day for the last third (LATEGAIN). Heifers were housed in drylot with eight head per pen and five pens per treatment. Of 80 heifers that began the experiment, three were removed for health reasons or reproductive tract abnormalities. The feeding period began on November 15, 1993 and continued until April 25, 1994, the onset of the breeding season. LATEGAIN heifers were switched to the higher rate of gain on March 7, 1994. Diets were formulated according to NRC

(1984) recommendations. Based on previous research with restricted gain on a similar diet, dry matter intake was adjusted to compensate for increased efficiency at the predicted rate of gain. The diet (as fed) was 62% corn, 20% sorghum silage, 9% prairie hay, 7% of a vitamin-mineral supplement (which supplied Rumensin® at 150 mg/head/day), and 2% molasses. Soybean meal was topdressed to meet protein requirements for desired weight gains. Body weights were measured every 14 days.

Beginning on January 24, 1994, blood samples were collected every Monday, Wednesday, and Friday. Serum was harvested and frozen at -20°C until analyzed for progesterone. Four consecutive samples with progesterone greater than 1 ng/ml indicated first ovulation and luteal function. The day of puberty was estimated by subtracting two days from the first day when progesterone was greater than 1 ng/ml, followed by an estrous cycle of normal duration.

Body weight and body condition score (1=extremely thin, 9 =extremely fat) were determined at day 0 (initial), day 112 (feed switch), and day 159 (onset of breeding season), when ribeye fat thickness, pelvic area, and frame score were estimated. Estrus was synchronized using two injections of Lutalyse®, given 14 days apart. Heifers were inseminated artificially at estrus according to the AM-PM rule for the first 45 days of the breeding season. Heifers then were exposed to bulls for 15 days to complete the 60-day breeding season. First-service pregnancy rates were determined by transrectal ultrasonography at approximately 30 days postbreeding.

Results and Discussion

The results for EVENGAIN and LATEGAIN treatments are summarized in Table 1. Age and weight at puberty were similar between treatments, and treatment had no effect on body condition score, ribeye fat thickness, frame score, or pelvic area. In addition, we found no differences in first-service or overall pregnancy rates in heifers.

Although dry matter intake was adjusted to compensate for increased efficiency at restricted rates of gain, both treatments exceeded NRC predicted daily gains. The higher than predicted gain tended to increase over time, suggesting that limit-fed animals became more efficient as they matured. LATEGAIN heifers were developed to the same end weight as the EVENGAIN heifers on approximately 12% less feed, resulting in a substantial decrease in feed expense.

Our data suggest that rate and time of gain did not affect the onset of puberty or breeding performance. Therefore, the primary objective of replacement heifer development should be to reach a target weight prior to the onset of the breeding season that facilitates reproductive performance, in a cost-efficient manner. Delaying the majority of the necessary weight gain until the last third of development should require less feed, because a smaller heifer can be maintained more economically for a longer period of time.

Table 1. Performance and Reproductive Characteristics of Heifers Developed at Different Rates and Times of Gain

	Dietary Treatments[a]		
Item	EVENGAIN	LATEGAIN	SE
No. of heifers	39	38	
Initial weight, lb	573.5	572.9	21.94
Pre-breeding weight, lb	781.9	752.4	20.27
Daily gain, lb/head	1.31	.55; 2.5[b]	
Age at puberty, day	388.0	384.4	10.25
Weight at puberty, lb	726.4	694.0	17.33
Body condition score[c,d]	5.65	5.60	.054
Ribeye fat thickness[d], cm	.485	.476	.029
Pelvic area[d], cm^2	195.7	192.5	5.56
Frame score[d]	4.53	4.41	.118
First service conception, %	55.3	55.5	
Overall pregnancy rate, %	87.2	86.8	

[a]EVENGAIN heifers were fed to gain 1 lb/day (November 15, 1993 to April 25, 1994) and LATEGAIN heifers were fed to gain .25 lb/day from November 15, 1993 until March 7, 1994, when predicted rate of gain was increased to 2 lb/day until April 25, 1994.

[b]Daily gain for LATEGAIN heifers represents the gains during the first two-thirds and last third of the breeding period, respectively.

[c]BCS: 1 = extremely thin, 9 = extremely fat.

[d]Determined at the onset of the breeding season, April 25, 1995.