Effect of Hay Quality and Breed on the Onset of Puberty and Subsequent Reproductive Performance in Beef Heifers

R.C. Perry, L.R. Corah, R.C. Cochran, and J.R. Brethour[1]

Summary

The effect of hay quality on the onset of puberty and subsequent reproductive performance was evaluated in 51 3/4 Hereford x 1/4 Angus (HA) heifers and 47 3/4 Hereford x 1/4 Brahman (HB) heifers. Two qualities of alfalfa hay were fed ad libitum, along with an average of 3.1 lbs/hd/day of ground sorghum grain.

HB heifers were heavier and carrying more backfat and body condition ($P<.05$) at the start of the experiment and they maintained their weight advantage through out the experiment. A higher ($P<.05$) percent of the HB heifers reached puberty by 14 and 15 months of age and became pregnant during a 45 day artificial insemination breeding period. HA heifers reached puberty at a lighter ($P<.05$) average weight.

Heifers fed high quality alfalfa hay were heavier ($P<.05$) by the start of the breeding season and were carrying more ($P<.05$) backfat and body condition. A higher percent ($P=.08$) of the heifers receiving higher quality hay reached puberty by 16 months of age and a higher ($P=.10$) percent became pregnant during the breeding period.

Heifers inseminated at their pubertal estrus had lower ($P=.04$) first service conception rates than heifers inseminated at their second or later estruses (52% vs. 88%).

Introduction

In most areas of the United States, economics dictate that producers must calve their replacement heifers first at 2 years of age. In order for heifers to calve that early, they must reach puberty by 15 months of age.

Because of increased use of larger breeds of beef cattle in crossbreeding systems and because these breeds are later maturing, age at puberty is becoming more important to today's beef cattle producer.

Our objective was to determine the influence of hay quality on growth, onset of puberty, and subsequent reproductive performance in heifers of two breed types.

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[1]Fort Hays Branch Experiment Station.

Experimental Procedures

Animals and Management. Fifty-one 3/4 Hereford X 1/4 Angus (HA) and 47 3/4 Hereford X 1/4 Brahman (HB) were allotted by breed, age, weight, and body condition to four groups within each breed type. Of the 98 heifers, all except 1 HA and 5 HB were sired by one sire. Two randomly selected groups from each breed type received high quality alfalfa hay (HQ) and the other two groups from each breed type received low quality alfalfa hay (LQ). Hay was fed ad libitum, and the heifers had access to trace minerals and salt. All heifers received an average of 3.1 lbs of ground sorghum grain /hd/day. The average nutritional characteristics of the two hays are presented in Table 2.1.

Upon delivery of hay, a core sample was taken from one out of every ten small square bales. Two core samples were taken from each large round bale. Samples from bales within a load were combined prior to analyses.

Heifers were weighed, scored for body condition, ultrasonically scanned for backfat, and measured for hip height at the beginning of the trial and prior to the start of the breeding period. Heifers were scored for body condition by two independent researchers on a scale from 1 to 9 (1 = emaciated, 9 = obese). Heifers were weighed at 28-day intervals, and a final weight was taken at the end of the trial.

Heifers were maintained in four adjacent drylot pen, with one group from each breed type in each lot. Groups were randomly assigned to lots at the start of the trial and rotated among lots every 28 days.

Puberty and Artificial Insemination. Observations for estrus were made twice daily from day 1 to 134 and three times daily from day 135 to the end of the trial. Vasectomized bulls equipped with chest harnesses filled with colored grease were used to aid in detection of estrus. Bulls were rotated biweekly among groups before day 135 and weekly after day 135.

Heifers had to meet the following criteria to be determined pubertal: (1) seen in standing estrus or marked by a bull; (2) a palpable corpus luteum present and (3) blood serum progesterone exceeding 1 ng/ml. Between day 6 to 12 after the occurrence of a visible estrus or mark, heifers were weighed and rectally palpated, and one 7-ml blood sample was taken. Those heifers showing their first visible estrus after the start of the artificial insemination (AI) period (day 135) were not palpated at this time and, thus, they only had to meet two of the three aforementioned criteria to be determined pubertal.

Heifers were artificially inseminated for 49 days beginning on day 135. Heifers were inseminated approximately 12 h after last seen in standing estrus. All inseminations were performed by one technician using semen from one sire. Conception and pregnancy rates were determined by fetal aging via rectal palpation.

Statistical Analysis. Differences in weights, gains, condition scores, backfat measurements, and weight at puberty were analyzed using general linear models. Differences in percent reaching puberty by certain ages, pregnancy rate, and first

service conception rate were analyzed using an appropriate analysis for categorical percentage data.

Results and Discussion

Mean weights, condition scores, backfat measurements, and average daily gains (ADG) are shown in Table 2.2, along with average weight at puberty for the four treatment groups.

At the start of the experiment, HB heifers were heavier, taller, and had greater backfat, and received higher body condition scores ($P<.05$).

When prebreeding measurements were taken on May 1, HB heifers were still heavier and taller ($P<.05$); however, there were no breed differences in body condition or backfat. Hay quality influenced performance, with heifers fed HQ hay heavier and fleshier based on backfat and body condition scores ($P<.05$).

In evaluating the differences in prebreeding ADG, a breed x hay interaction ($P<.05$) was found. HA heifers gained more weight on both hay qualities, however, HB heifers showed more difference in performance between the two hay qualities than HA heifers.

Final weights were taken on June 15. HB heifers and those heifers receiving HQ were heavier at this time ($P<.05$). A hay x breed interaction influenced ($P<.05$) 180 day ADG, with the HB heifers showing higher ADG than the HA heifers on HQ and HA heifers exhibiting higher ADG than the HB heifers on LQ. HA heifers reached puberty at a lighter ($P<.05$) average weight than the HB heifers.

The actual cumulative percent of heifers that reached puberty by 13, 14, 15 and 16 months of age and the percent of the total heifers treated that became pregnant during the 45 day AI breeding period are shown in Table 2.3.

A higher ($P<.05$) percent of the HB heifers were pubertal by 14 and 15 months of age than HA heifers, and a higher ($P=.10$) percent of the HB heifers became pregnant during the 45-day AI breeding period. These differences were mainly due to the HB heifers being heavier at the start of the experiment.

Hay quality influenced reproductive performance, with a higher ($P=.08$) percent of the HQ heifers reaching puberty by 16 months of age and a higher ($P=.10$) percent becoming pregnant during the AI breeding period.

Neither hay quality nor breed influenced first service conception rate (Table 2.4). However, those heifers that reached puberty during the breeding season and, therefore, were inseminated at their first (pubertal) estrus had lower ($P=.04$) first service conception rates than those heifers that reached puberty prior to the breeding season and, therefore, were inseminated at their second or later estrus. This emphasizes the importance of proper heifer development with higher quality forages, so that heifers reach puberty prior to the breeding season and, therefore, are not bred on their first estrus.

Table 2.1. Nutrient Composition of High and Low Quality Alfalfa Hay.

Hay Quality	Dry matter %	Crude protein %	Acid detergent fiber %	Neutral detergent fiber %	Calcium %	Phosphorus %
Low	91.3	18.3	36.7	53.5	1.31	.25
High	92.4	19.5	33.0	44.2	1.43	.27

Table 2.2. Summary of Initial Weights, Hip Heights, Condition Scores, Backfat Measurements, Average Daily Gains, and Weight at Puberty.

Hay Quality	Low		High	
Breed	HA	HB	HA	HB
No. heifers	26	23	25	22
Initial Weight (lbs)[a]	435	500	436	498
Initial hip height (inches)[a]	41.5	43.7	41.5	43.6
Initial body condition[a]	5.0	5.3	4.9	5.3
Initial backfat (cm)[a]	.20	.24	.23	.25
Prebreeding weight (lbs)[ab]	661	696	678	732
Prebreeding body condition[b]	5.2	5.3	5.5	5.7
Prebreeding backfat (cm)[b]	.38	.39	.50	.50
Prebreeding hip height (inches)[a]	45.4	47.3	45.3	47.5
Prebreeding ADG (lbs/day)[1c]	1.68	1.45	1.80	1.73
Final Weight (lbs)[ab]	724	769	734	803
180 day ADG (lbs/day)[2c]	1.61	1.50	1.66	1.70
Weight at puberty[a]	717	760	741	788

[1]Prebreeding ADG = ADG from the start of the experiment to the first day of AI
[2]breeding period (135 days)
[2]180 day ADG = ADG during the entire experiment.
[a]Significant breed effect (P<.05)
[b]Significant hay effect (P<.05)
[c]Significnat hay x breed interaction (P<.05)

Table 2.3. Cumulative Percent of Heifers Reaching Puberty by 13, 14, 15, and 16 Months of Age and Pregnancy rate[1]

Hay Quality	Breed	Age in Months				Pregnancy rate, %
		13	14	15	16	
		----------%----------				
LQ	HA	4	12[a]	35[a]	50[a]	35[cd]
LQ	HB	4	30	57	61	48
HQ	HA	8	12	40	68	48
HQ	HB	14	41	68	77	68

[1]Pregnancy rate = No. of heifers that became pregnant during a 45 day AI breeding period/total No. of heifers treated

[a]Significant breed effect (P<.05)

[b]Significant hay effect (P=.08)

[c]Significant breed effect (P=.10)

[d]Significant hay effect (P=.10)

Table 2.4. Differences in Conception Rate between Heifers Bred on Their First vs. Later Estrus[1]

Estrus	Conception rate, %
First	88[a]
Later	52[b]

[1]Later estrus = heifers inseminated for the first time on their second, third or fourth estrus.

[ab]Numbers with different superscripts differ (P=.04).