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# Effect of Season and Relocation on Reproductive Competence in Brahman and Hereford Bulls

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## Introduction

Careful selection of a breed or breeds and emphasis upon selection pressure within a breed can increase productivity of a beef cattle herd. Furthermore, productivity within a herd may be effectively increased by utilizing crossbreeding programs. Crossing genetically diverse breeds permits combination of important traits and taking advantage of hybrid vigor. Many crossbreeding programs currently in use involve crosses between *Bos indicus* and *Bos taurus* cattle. One of the more commonly used *Bos indicus* breeds is the American Brahman. Use of the American Brahman in crossbreeding programs throughout the U.S. would increase demand for bulls of this breed.

Brahman cattle and their crosses have been shown to be adapted to the southern regions of the U.S. along the Gulf Coast, while many *Bos taurus* breeds do not perform well in these areas. A growing interest in Brahman cattle will increase demand for Brahman crossbred cattle in areas of the country that do not have environmental conditions to which the Brahman is adapted. It is desirable to know if Brahman cattle can function in areas with colder temperatures and shorter daylengths during the winter. Learning whether Brahman cattle can function in northern areas will be the first step in establishing crossbreeding programs involving Brahman cattle in these areas.

## Procedure

Brahman bulls ( $n = 18$ , 17.6 mo of age) from Texas and Louisiana and Hereford bulls ( $n = 15$ , 14.1 mo of age) from Nebraska and Montana ( $n = 15$ , 15.6 mo of age) were randomly assigned to one of three experimental locations: Texas A&M University Agricultural Research and Extension Center, Overton (TX); MARC, Clay Center, Nebraska (NE), and Montana State University, Bozeman (MT). Each location received six Brahman bulls and five Hereford bulls each from NE and MT. The bulls were relocated during a 4-day period in late May 1984 (5/27-5/30). All bulls were puberal ( $50 \times 10^6$  cells/ejaculate with 10% motility obtained by electroejaculation) at the time of relocation. Bulls were subjected to management practices which were common for each location.

At 28-day intervals after relocation, the following measurements were taken on each bull: body wt, hip height, scrotal circumference (SC), avg testis length (ATL), and paired testes volume (PTV). Paired testes

volume was determined by using the formula  $PTV = ATL \times SC^2 \times .0396$ . Data were collected for approximately 21 mo after relocation.

Within 1 wk of relocation and at 90-day intervals beginning in November 1984, semen was collected from each bull by electroejaculation. Two ejaculates were collected on consecutive days. Within 5 min of collection, the following evaluations were made on each sample: volume, color, gross motility rating, progressive motility rating, and % motility. Other traits measured included % live cells, concentration ( $\times 10^6$  cell/ml), % normal acrosomal ridges, % normal heads, % normal tails, and % proximal droplets. All the motility ratings were done at each location, while the histological evaluations were done at Nebraska by one technician.

For this discussion, semen quality will refer to a combination of sperm motility, viability, morphology, and concentration. Sperm motility was evaluated and given a score on a scale of 1 through 5, with 1 indicating little or no movement and 5 indicating the presence of many rapid swirls with many sperm moving in a forward direction. Sperm viability was determined using a live-dead stain and a score (1, 2, 3, 4, or 5) was given according to the percentage of live cells (0-20, 21-40, 41-60, 61-80, or 81-100%, respectively). Morphology was also scored 1 through 5 with the same scale as viability, except that the percentages refer to morphologically normal cells. Sperm concentration was given a score of 1 through 5 according to the actual concentration of sperm cells in an ejaculate (0-200, 201-400, 401-600, 601-800, and  $> 800 \times 10^6$  cells/ml, respectively). Overall semen quality was determined as the avg of the scores of the four individual traits.

Within 2 wk prior to relocation, 1 wk after relocation, and at 90-day intervals, all bulls were given 200  $\mu$ g of gonadotropin releasing hormone (GnRH) i.m. Blood samples were taken via indwelling jugular catheter (NE, MT) or tail vessel puncture (TX) at 0, 30, 60, 150, and 300 min post-injection. Serum was analyzed for testosterone (T) and luteinizing hormone (LH) by radioimmunoassay. The magnitude of the LH and T peaks, area under the curve, and time to peak were calculated for each bull at each bleeding period. Basal hormone levels were determined from the one sample collected prior to GnRH injection. Mean hormone concentrations were determined on five samples per bull for each bleeding period.

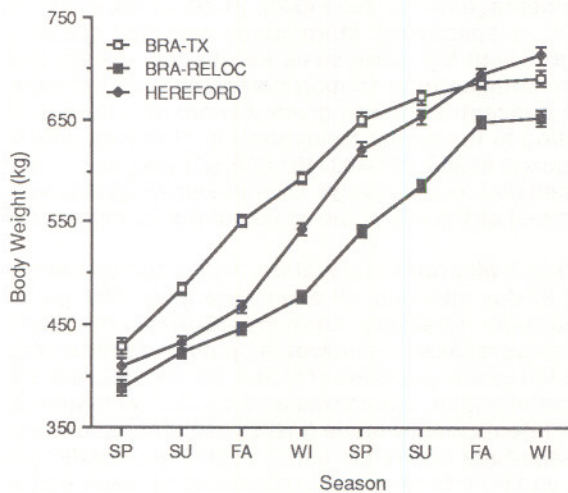
At 6 mo intervals beginning in November 1984, all bulls were subjected to an 8 hr intensive blood sampling. An indwelling jugular catheter was placed in each bull the evening prior to the day of the blood sampling. The following morning, the bulls were either placed in stanchions (MT and NE) or haltered and tied to dividing panels in a holding pen (TX). Blood samples (20 ml) were drawn at 20-min intervals for 8 hr. Serum was analyzed for testosterone (T) and luteinizing hormone (LH) by radioimmunoassay. The number of LH and T peaks, magnitude of the peaks, area under the peaks, duration of the peaks, mean hormone concentration, and basal hormone concentration were calculated for individuals at each bleeding period.

<sup>1</sup>Godfrey is a research affiliate, Reproduction Unit, MARC (formerly a doctoral student, Texas A&M University); Randel is a professor of animal science and Long is resident director, Texas Agricultural Experiment Station, Overton; Lunstra is a research physiologist, Reproduction Unit, MARC; Jenkins is a research animal scientist, Production Systems Unit, MARC; and Berardinelli is a professor of animal science, Montana State University, Bozeman.

<sup>2</sup>Full report of this work by Robert W. Godfrey. 1987. The effect of season and relocation upon reproductive competence in Brahman and Hereford bulls. Ph.D. Thesis, Texas A&M University Library, 196 pp.

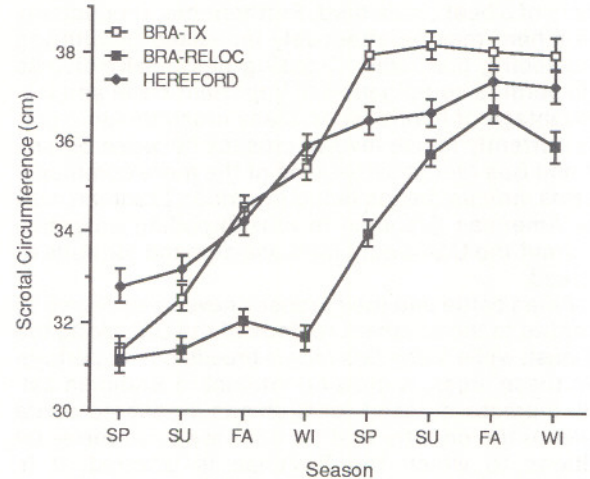
## Results

**Body and testicular growth.** Brahman bulls in Texas gained wt more rapidly during the first 16 mo after relocation than those in Nebraska or Montana; however, Brahman bulls exhibited similar wt at all locations at the end of the study (Fig. 1). The lag time may be due to adaptation to the new environment, although it was not evident in the Hereford bulls which were moved to TX. There was some evidence of heat stress in Herefords in TX, so sunshades were constructed. All bulls at the northern locations were provided with shelter during the cold seasons of the year. At the end of the study, there were only two Brahman bulls remaining in MT; four bulls died due to metabolic acidosis and some disease problems, not the cold environment. Montana Herefords and Nebraska Herefords gained wt at a slower rate in NE than in MT or TX during the first 16 mo of the study, which may be due to the different management practices at the three locations. By the end of the study, however, Hereford bulls at all locations weighed the same (approximately 1,600 lb). Brahman bulls were taller in TX than in NE or MT during the first winter, but not by the second. This indicates that there was normal long bone growth, although it was suppressed during the first winter. On the average, Brahman bulls were taller than Montana and Nebraska Herefords at all locations (56.7 in vs 51.9 in, respectively).

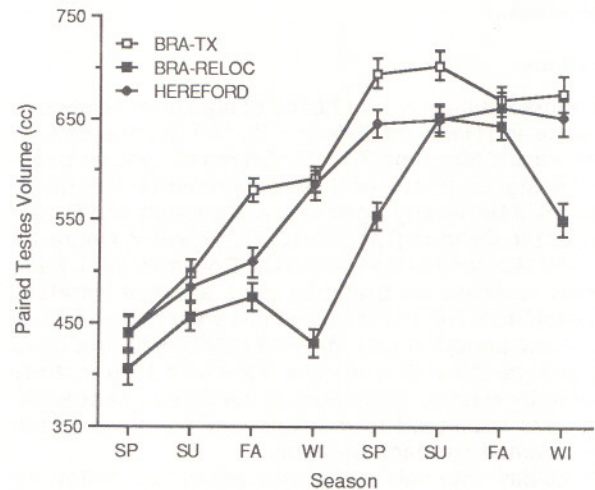


**Figure 1**—Mean body wt of relocated Brahman bulls (BRA-RELOC), control Brahman bulls (BRA-TX), and Hereford bulls (HEREFORD) after relocation.

Brahman bulls in TX exhibited a more rapid increase in scrotal circumference (SC) than in NE or MT (Fig. 2). Relocated Brahman bulls had little increase in SC through the first winter but increased rapidly after that. They still had smaller SC than control Brahman bulls at the end of the study. Testes volume exhibited a similar pattern (Fig. 3). Relocated Brahman bulls had lower testes volume during much of the study period, with decreases during the winter. Testes volume of Hereford bulls was not affected by season or location.

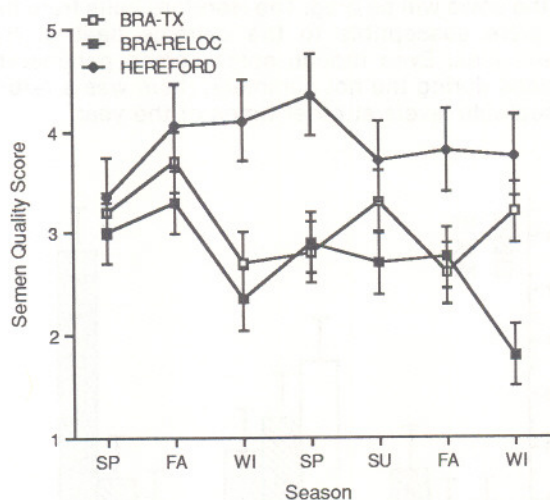


**Figure 2**—Mean scrotal circumference of relocated Brahman bulls, control Brahman bulls, and Hereford bulls after relocation.



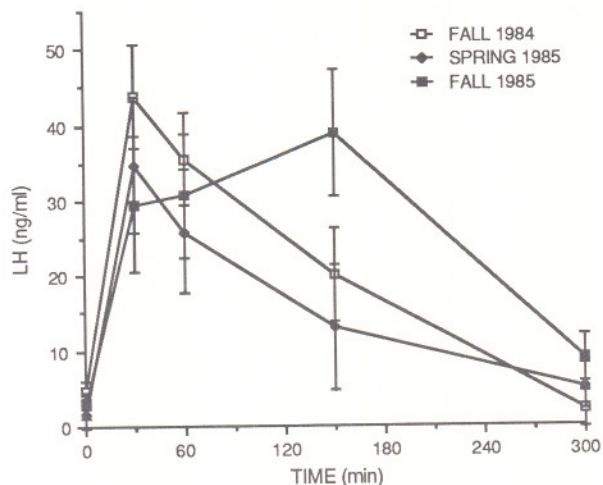
**Figure 3**—Mean paired testes volume of relocated Brahman bulls, control Brahman bulls, and Hereford bulls after relocation.

**Semen quality.** Semen quality score is represented in Figure 4. Hereford bulls had higher average semen quality scores than Brahman bulls throughout much of the study period. Both control and relocated Brahman bulls had decreased semen quality during the first winter, but only relocated bulls decreased during the second winter. All bulls had adequate semen quality during the summer. Hereford bulls did not exhibit any seasonal variation in semen quality.



**Figure 4**—Mean semen quality scores of relocated Brahman bulls, control Brahman bulls, and Hereford bulls after relocation.

**LH and testosterone secretion.** There was no difference in basal serum LH concentrations between the breed types. Time to LH peak was greater for Nebraska Hereford bulls than for Montana Hereford and Brahman bulls. The height of the LH peak was also different between breed types. Brahman bulls had the smallest LH peak height and Nebraska Hereford bulls had the largest. Brahman bulls had the smallest area under the LH curve and Nebraska Hereford bulls had the largest.



**Figure 5**—Mean GnRH-induced LH secretion of relocated Brahman bulls during three seasons.

Montana Hereford bulls had higher basal serum testosterone (T) concentrations than Brahman bulls. Nebraska Hereford bulls had the longest time to T peak. There was no difference between breed type in area under the T curve.

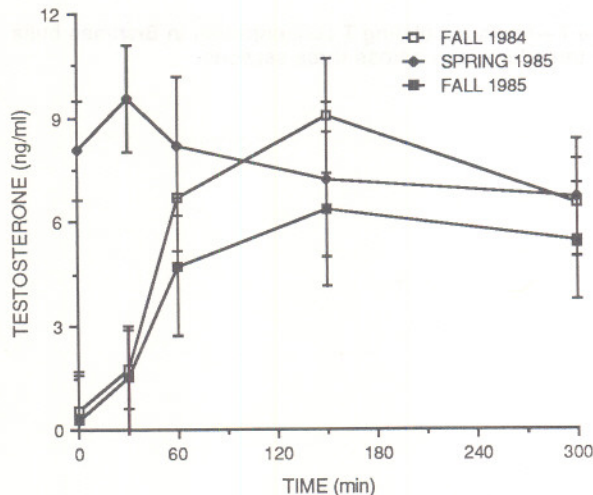
The GnRH-induced LH surge was greater in relocated Brahman bulls in the winter than in the spring (Fig. 5). This may be due to the fact that during the winter the LH is not being released from the pituitary and greater quantities are stored. When challenged with GnRH, the pituitary of the Brahman bulls released this stored LH into the peripheral circulation. During the spring, there was less response to GnRH, indicating that the pituitary may not have as much LH stored at this point. There was very little difference in the endogenous LH secretion in relocated Brahman bulls between the seasons (Table 1).

**Table 1**—Mean circulating LH parameters in relocated Brahman bulls<sup>a</sup>

| Trait                   | Fall 1984 | Spring 1985 | Fall 1985 |
|-------------------------|-----------|-------------|-----------|
| Mean LH (ng/ml)         | 2.1       | 1.9         | 2.6       |
| Basal LH (ng/ml)        | 1.1       | 0.8         | 1.6       |
| No. peaks               | 4.5       | 5.1         | 4.7       |
| Peak Amplitude (ng/ml)  | 3.2       | 2.6         | 2.7       |
| Duration of Peaks (min) | 72.0      | 73.2        | 65.8      |

<sup>a</sup>No effect of season was detected.

The testosterone response of relocated Brahman bulls to the GnRH-induced LH is shown in Figure 6. The response was lower during the winter than the spring. The testosterone concentration prior to GnRH was also influenced by season, with a decrease in winter. There was an increase in endogenous serum T concentration over time, which is most likely due to maturation of the bulls (Table 2).



**Figure 6**—Mean GnRH-induced T secretion of relocated Brahman bulls during three seasons.

**Table 2**—Mean circulating testosterone (T) parameters in relocated Brahman bulls

| Trait                   | Fall 1984         | Spring 1985       | Fall 1985          |
|-------------------------|-------------------|-------------------|--------------------|
| Mean T (ng/ml)          | 1.3 <sup>a</sup>  | 2.7 <sup>b</sup>  | 3.6 <sup>c</sup>   |
| Basal T (ng/ml)         | 0.8 <sup>a</sup>  | 1.2 <sup>ab</sup> | 1.5 <sup>b</sup>   |
| No. peaks               | 1.6 <sup>a</sup>  | 2.3 <sup>b</sup>  | 1.6 <sup>a</sup>   |
| Peak Amplitude (ng/ml)  | 2.4 <sup>a</sup>  | 5.8 <sup>b</sup>  | 6.9 <sup>b</sup>   |
| Duration of Peaks (min) | 61.2 <sup>a</sup> | 93.8 <sup>b</sup> | 135.6 <sup>c</sup> |

<sup>abc</sup>Means within a row with different superscripts are different ( $P < .001$ ).

T concentration seemed to be more seasonally influenced than LH concentration in relocated Brahman bulls (Fig. 7 and 8). Both mean T concentration and amplitude of T peaks were greater in the late spring than in the autumn in Brahman bulls in MT. This trend was not apparent for Brahman bulls in TX or NE.

The data from this study indicate that Brahman bulls have different growth patterns and endocrine profiles than Hereford bulls. Relocation of Brahman bulls to northern environments affected growth and semen quality of Brahman bulls. There was not quite as much influence on the hormonal status of the bulls. There was some influence on serum testosterone, which may have been due to a direct influence on testicular steroidogenic capability, or it may have been due to suppression of testicular growth in the relocated bulls. Relocated Brahman bulls

exhibited a lag time of 6 mo in growth traits compared to control Brahman bulls. To efficiently utilize Brahman bulls in breeding programs in the north, this lag time must be taken into consideration when moving young bulls. The semen traits of relocated Brahman bulls were suppressed during the winter months in the north. The semen quality returned to levels similar to control Brahman bulls during the summer. Since most cattle operations utilize spring calving in the north, the semen quality of Brahman bulls will be at an acceptable level at the time of the year when the cows will be bred. The Hereford bulls from the north were susceptible to the extreme heat of the southern area. Even though some semen parameters decreased during the hot summers, there was a return to acceptable levels at other times of the year.

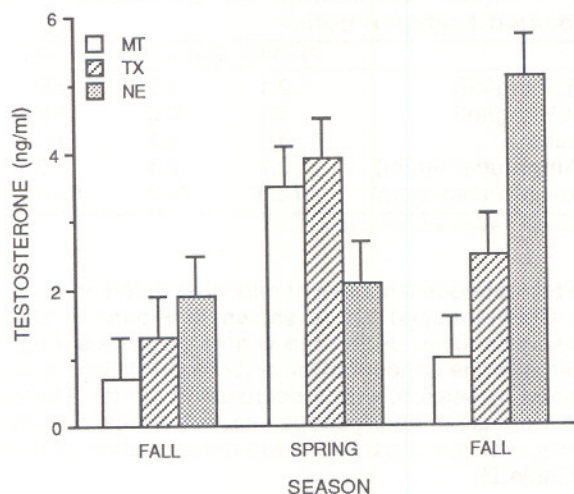


Figure 7—Mean circulating T concentration in Brahman bulls at three locations across three seasons.

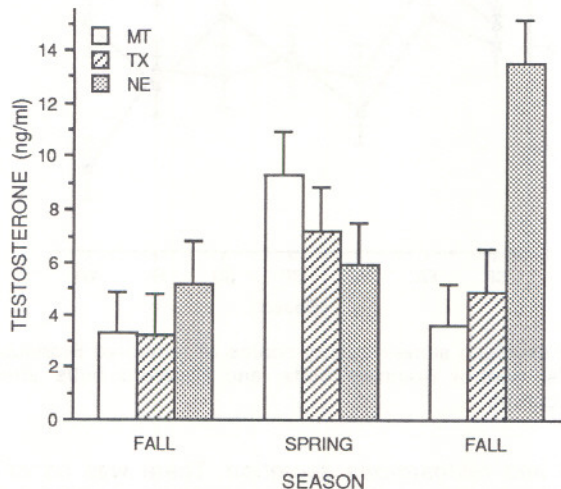


Figure 8—Mean amplitude of endogenous T peaks in Brahman bulls at three locations across three seasons.