PUBLICATIONS
1988

FORAGE AND LIVESTOCK RESEARCH - 1988

RESEARCH CENTER TECHNICAL REPORT 88-1

Texas A&M University Agricultural Research & Extension Center
at Overton

Texas Agricultural Experiment Station
Texas Agricultural Extension Service

Overton, Texas

April 21, 1988

SEASONAL INFLUENCES ON REPRODUCTIVE TRAITS IN BRAHMAN AND HEREFORD BULLS

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SUMMARY

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.

The data from this study indicate that Brahman bulls have different growth patterns and endocrine profiles compared to Hereford bulls. Relocation of Brahman bulls to northern environments affected growth and semen quality of Brahman bulls. There was not quite as much of an 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 northern parts of the U.S., 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 northern U.S. 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.

INTRODUCTION

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.

PROCEDURES

Brahman bulls from Texas and Louisiana (n=18, 17.6 mo of age) and Hereford bulls from Nebraska (n=15, 14.1 mo of age) 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), Roman L. Hruska USDA Meat Animal Research Center, 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 (50×10^6 cells/ejaculate with 10% motility obtained by electroejaculation) at the time of relocation. Bulls were subjected to management practices which were common for each locations.

At 28 day intervals after relocation, the following measurements were taken on each bull: body weight, hip height, scrotal circumference (SC), average testis length (ATL), and paired testes volume. Paired testes volume (PTV) 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 percent motility. Other traits measured included percent live cells, concentration ($X\ 10^6$ cell/ml), percent normal acrosomal ridges, percent normal heads, percent normal tails, and percent proximal droplets. All of the motility ratings were done in 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 x 10^6 cells/ml, respectively). Overall, semen quality was determined as the average of the scores of the four individual traits.

Within 2 wk prior to relocation, and 1 wk after relocation and at 90-day intervals beginning in November 1984, all bulls were given 200 µg of gonadotropin releasing hormone i.m. (GnRH). 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 by calculating the average for the five samples collected for each bull at 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, the magnitude of the peaks, area under the peaks, duration of the peaks, mean hormone concentration and basal hormone concentration were calculated for each bull at each bleeding period.

RESULTS

Body and testicular growth. Brahman bulls in Texas gained weight more rapidly during the first 16 mo after location than in Nebraska or Montana, however Brahman bulls exhibited similar weights at all locations at the end of the study (Figure 1). The lag time may be due to adaptation to the new environment, although it was not evident in the Hereford bulls moved to Texas. There was some evidence of heat stress in Herefords in Texas; therefore, 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 Montana. The four bulls that died did so due to metabolic acidosis and some disease problems, not the cold environment. Montana Herefords and Nebraska Herefords gained weight at a slower rate in Nebraska than in Montana or Texas 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, all Hereford bulls at all locations weighed the same (approximately 1600 lb). Brahman bulls were taller in Texas than in Nebraska or Montana during the first winter, but not by the second winter. This indicates that there was normal long bone and muscle 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).

Brahman bulls in Texas exhibited a more rapid increase in scrotal circumference (SC) than in Nebraska or Montana (Figure 2). Relocated Brahman bulls had little increase in SC through the first winter but increased rapidly after this. They still had smaller SC than control Brahman bulls at the end of the study. Testes volume exhibited a similar pattern (Figure 3). Relocated Brahman bulls had lower testes volume during much of the study period, with decreases during the winter. Hereford bulls were not affected by season or location with respect to testes volume.

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 over the study.

LH and testosterone secretion. There was no difference in basal serum LH concentration between the breedtypes. 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 breedtypes. 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.

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

The GnRH induced LH surge was greater in relocated Brahman bulls in the winter than in the spring (Figure 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).

The testosterone reponse 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).

Testosterone concentration seemed to be more seasonally influenced than LH concentration in relocated Brahman bulls (Figures 7 and 8). Both mean testosterone concentration and amplitude of testosterone peaks were greater in the late spring than in the autumn in Brahman bulls in Montana. This trend was not apparent for Brahman bulls in Texas or Nebraska.

ACKNOWLEDGEMENTS

This research was partially funded by a grant from the American Brahman Breeders Association. Brahman bulls were donated by several Brahman Breeders in Texas and Louisiana.

Table 1. Mean circulating LH parameters in relocated Brahman bulls[a]

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
Number of 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

[a]No effect of season was detected.

Table 2. Means circulating testosterone (T) parameters in relocated Brahman bulls

Trait	Fall 1984	Spring 1985	Fall 1985
Mean T (ng/ml)	1.3[a]	2.7[b]	3.6[c]
Basal T (ng/ml)	0.8[a]	1.2[a,b]	1.5[b]
Number of peaks	1.6[a]	2.3[b]	1.6[a]
Peak Amplitude (ng/ml)	2.4[a]	5.8[b]	6.9[b]
Duration of Peaks (min)	61.2[a]	93.8[b]	135.6[c]

[a,b,c]Means within a row with different superscripts are different ($P<.001$).

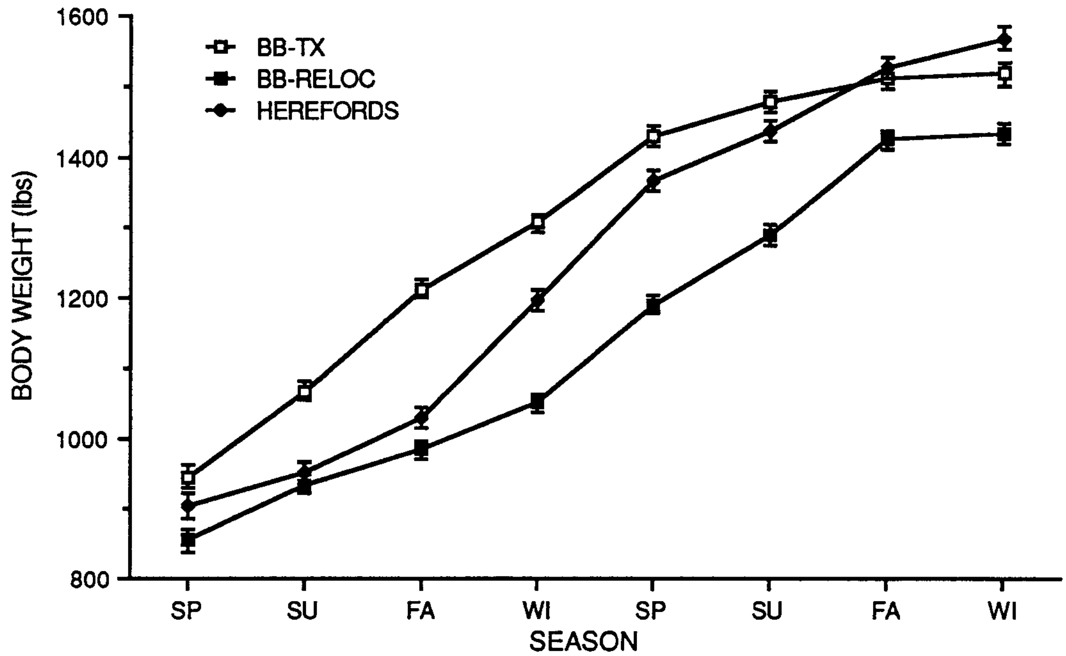

Figure 1. Body weight of relocated Brahman bulls (BB-RELOC), control Brahman bulls (BB-TX), and Hereford bulls (HEREFORDS) after relocation

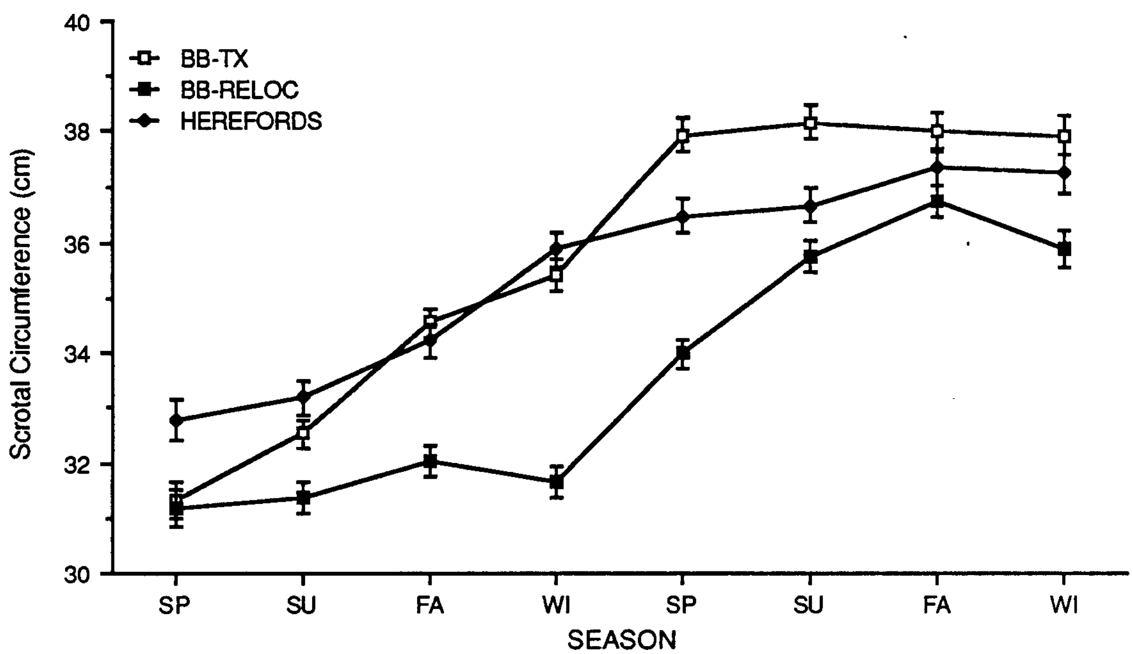

Figure 2. Scrotal circumference of relocated Brahman bulls (BB-RELOC), control Brahman bulls (BB-TX), and Hereford bulls (HEREFORDS) after relocation

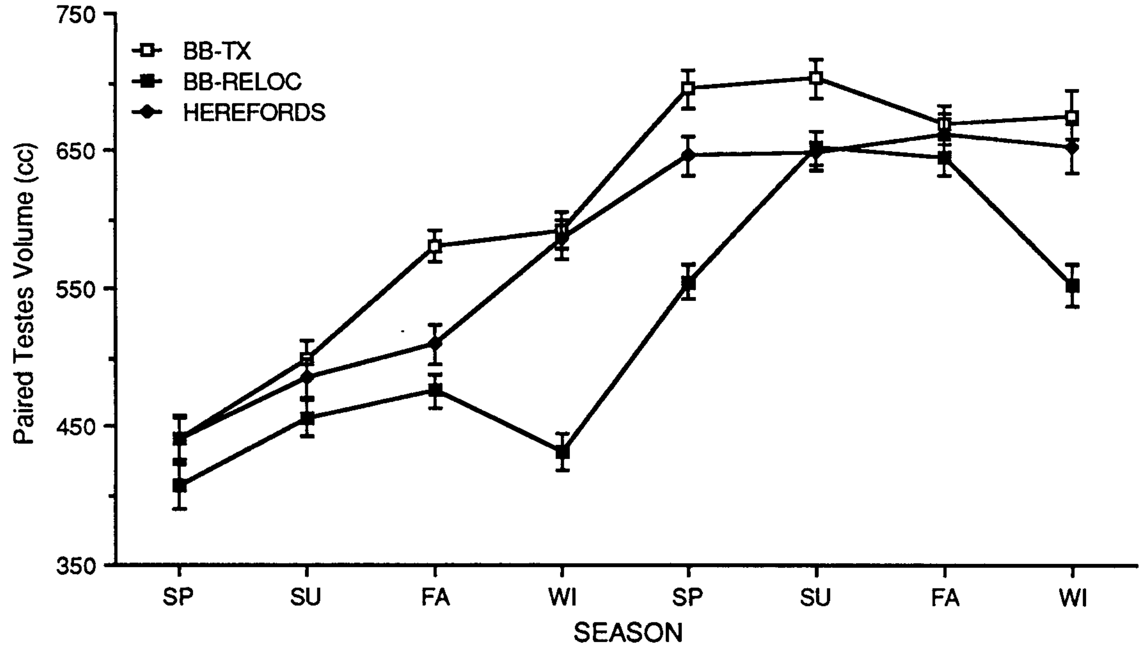

Figure 3. Paired testes volume of relocated Brahman bulls (BB-RELOC), control Brahman bulls (BB-TX), and Hereford bulls (HEREFORDS) after relocation

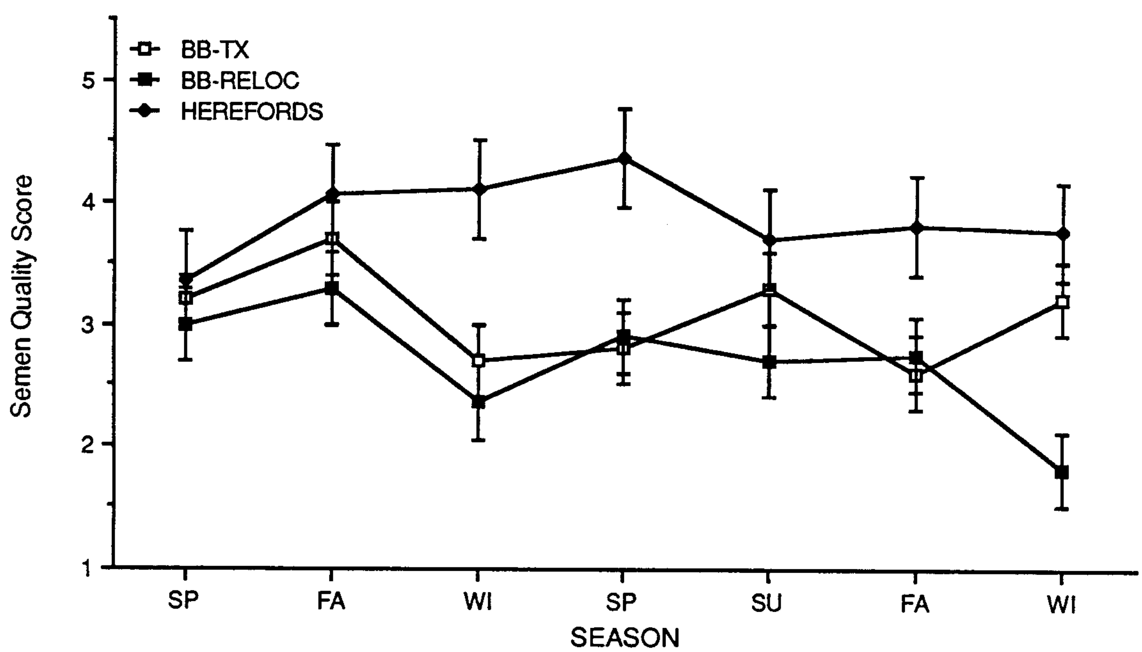

Figure 4. Semen quality score of relocated Brahman bulls (BB-RELOC), control Brahman bulls (BB-TX), and Hereford bulls (HEREFORDS) after relocation

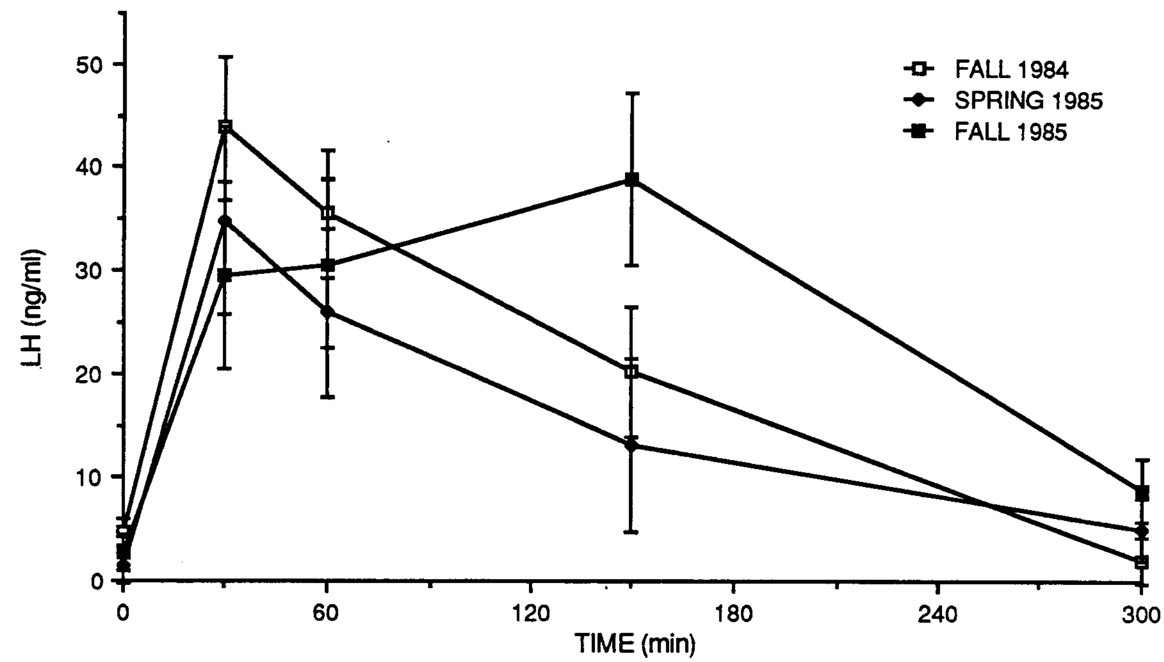

Figure 5. GnRH induced LH secretion in relocated Brahman bulls during three seasons

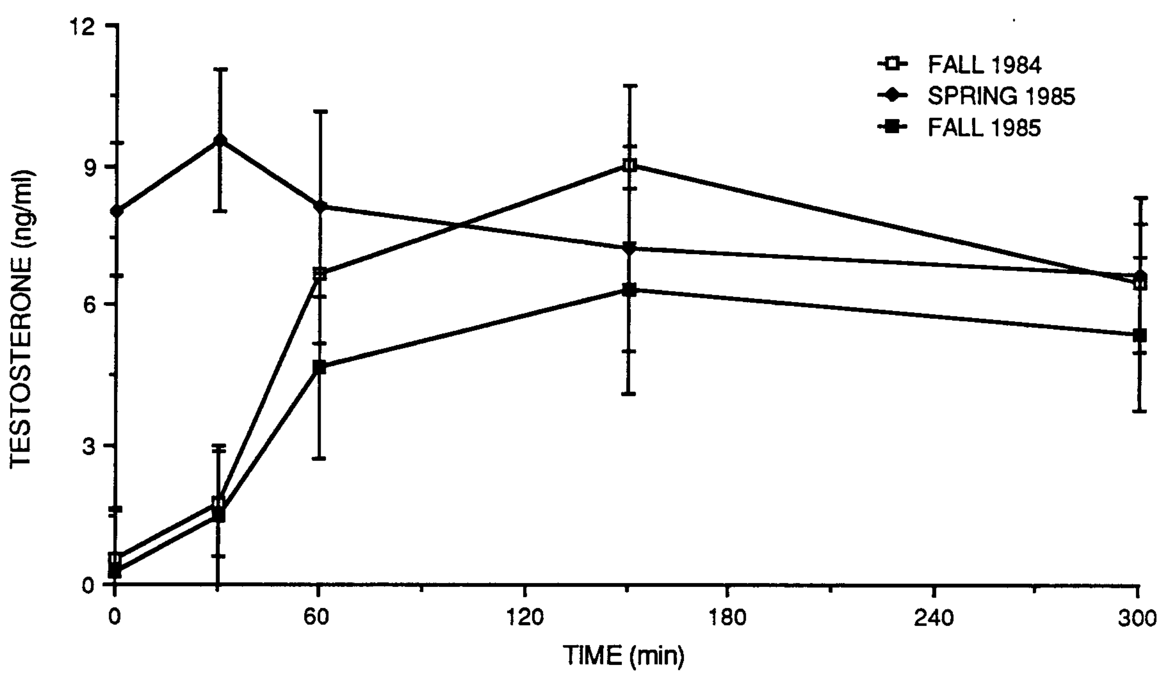

Figure 6. GnRH induced testosterone secretion in relocated Brahman bulls during three seasons

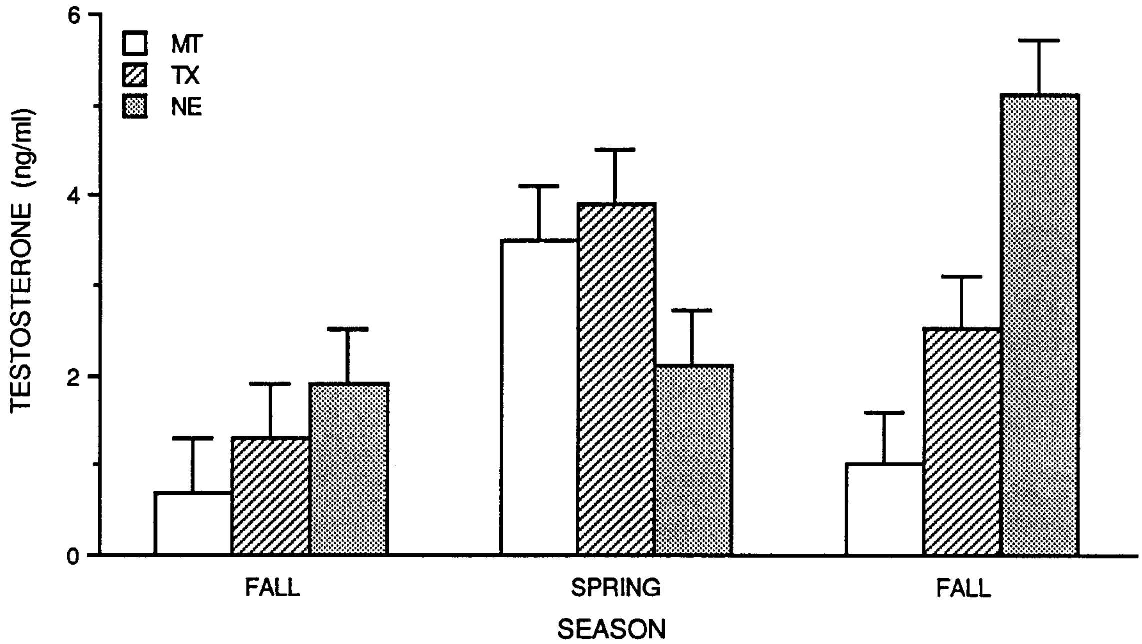

Figure 7. Mean circulating testosterone concentrations in Brahman bulls at three locations over three seasons

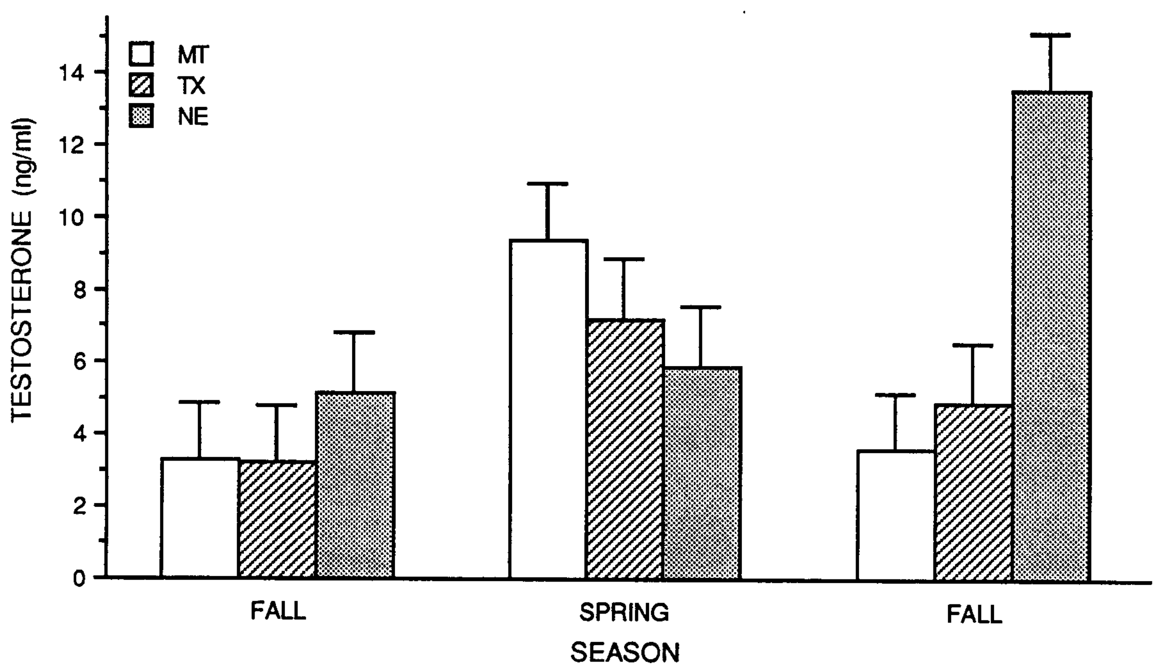

Figure 8. Amplitude of endogenous testosterone peaks in Brahman bulls at three locations over three seasons