CALVING AND WEANING CHARACTERISTICS OF ANGUS-, GRAY BRAHMAN-, GIR-, INDU-BRAZIL-, NELLORE-, AND RED BRAHMAN-Sired F_1 CALVES

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ABSTRACT

Calving and weaning data from crossbred calves sired by five Bos indicus breeds and one Bos taurus breed were evaluated. Data included calving and weaning records of F_1 calves out of multiparous Hereford cows and sired by Angus, Gray Brahman, Gir, Indu-Brazil, Nellore, and Red Brahman bulls. At calving, Angus-sired calves had shorter gestations and lower (more desirable) calving ease scores and were smaller than Bos indicus-sired calves. Among the Bos indicus crosses, Gir calves had the shortest gestations, lowest calving ease scores, lightest birth weights (\(P < .05\)), and smallest cannon bone lengths and heart girths. Nellore calves had the longest gestations (\(P < .05\)) and largest heart girths. Calves by Indu-Brazil sires had the highest calving ease scores, highest birth weights (\(P < .05\)), and greatest cannon bone lengths (\(P < .05\)). Gray Brahman- and Red Brahman-sired calves were similar and intermediate for all calving characters. At weaning, Angus-sired calves had gained slightly faster than the Gir crosses and weighed more but were shorter at the hip than Gir crosses. Gir calves gained the least preweaning, weighed the least, and were shortest at weaning of the Bos indicus crosses. The Nellore and Indu-Brazil crosses were intermediate in preweaning gain and weaning weight to the Gir and the Red and Gray Brahman but were tallest at weaning. Gray Brahman and Red Brahman calves gained the most and were heaviest at weaning but were not as tall as the Nellore and Indu-Brazil.

Key Words: Calving, Weaning, Breed Differences, Zebu


Introduction

Bos indicus (Zebu) cattle have had a large influence on beef cattle production, through crossbreeding, in the Gulf Coast region of the United States for more than 60 yr (Koger, 1980). Until 1980, the Brahman (both red and gray) was the only Bos indicus breed maintained in significant numbers in the United States, and, as stated by Cartwright (1980), the Brahman contributes to the U.S. commercial beef cattle industry “almost exclusively for crossbreeding purposes.”

The usefulness of Bos indicus-Bos taurus crossbreeds in the southern United States is due to their heat tolerance, parasite resistance and(or) tolerance, ability to use low-quality forages (Turner, 1980), longevity (Cartwright, 1980), and their cow productivity (reproduction rate and maternal effects on weaning weight) and maternal calving ease (Cundiff et al., 1981). However, when Bos indicus (primarily Brahman) bulls are bred to Bos taurus females, the crossbreds have been characterized as having higher birth weights and calving difficulty levels than would be expected from the size of the Bos indicus sire breed (Gregory et al., 1979b; Reynolds et al., 1980; Roberson et al., 1986). They have been shown to be more sensitive to cold weather and to have higher mortality levels when born
in cold weather (Josey et al., 1987), to be older at puberty (Gregory et al., 1979a), to have lower carcass quality (marbling) and meat tenderness (Butler et al., 1956; Koch et al., 1982; Cundiff et al., 1988), and to be less docile, especially when raised under extensive conditions.

In 1980, 1981, and 1982, Bos indicus cattle from Brazil were imported into the United States through the Harry Truman Import Center off the Florida coast. Bulls and heifers of the Gir, Indu-Brazil, Nellore, and Guzerat breeds were imported. These were the first importations of Indian or Brazilian breeds of Zebu cattle into North America since the 1946 importation from Brazil. This study was initiated in 1980 with the objective of comparing the different aspects of productivity of these newly imported breeds, Gir, Indu-Brazil, and Nellore, with each other and with the American Gray Brahman and American Red Brahman from crosses out of Hereford cows. Only two Guzerat bulls were imported, so the Guzerat was not included in this study.

Materials and Methods

The data for this study were collected as part of the Texas Agricultural Experiment Station project S-6509, “Evaluation of Zebu Breeds for Beef Production.” The research was conducted at the USDA Blackland Conservation Research Center at Riesel, TX, and at the Texas Agricultural Research Center at McGregor, TX. The breeds involved included the American Gray Brahman and American Red Brahman and the Brazilian Gir, Indu-Brazil, and Nellore. The Angus breed was included as an experimental control.

The sires included 10 Angus bulls from two locations (six from the R. L. Hruska U.S. Meat Animal Research Center at Clay Center, NE and four from the USDA Brookville Beef Cattle Research Station in Florida) selected to represent the type of Angus bulls used in commercial herds. Eleven Gray Brahman and 10 Red Brahman sires were selected from both commercial artificial insemination (AI) services and purebred herds and represented major bloodlines in these breeds. Six Gir, 10 Indu-Brazil, and 10 Nellore sires were selected from the 1980 and 1981 importations of these breeds from Brazil and represented the type and bloodlines of those importations.

Of the Zebu breeds evaluated in this study, the Nellore (called the Ongole in India) and the Gir are Indian breeds that are maintained in a pure state in Brazil; the Indu-Brazil was developed in Brazil from imported Indian cattle, and the Gray Brahman and Red Brahman were developed in the United States from cattle imported from Indian and Brazil (Sanders, 1980).

These bulls were mated by AI to Hereford cows in 1982, 1983, 1984, and 1985. The calves were born in the fall of each year. All cows had previously produced at least one calf. The cows were acquired from 15 different sources in Central Texas and were both horned and polled, purebred and grade in breeding. Cows from 13 of these locations were born from 1979 to 1980 and were 3 to 4 yr old when they had their first calf in the project in 1983. All 1982 calves (the project’s first year) were from mature cows from the other two locations, and they produced calves in the remaining 3 yr of the project.

The Hereford cows were pastured on warm-season perennial grass pastures of predominantly Coastal bermudagrass, Common bermudagrass, and Klein grass. During the winter months the cows grazed Coastal bermudagrass and hybrid Sudan grass hay. Salt was provided for the entire year, a high-phosphorus mineral was provided for cattle grazing warm season perennial grasses, and a high-magnesium supplement was provided for cattle grazing oat pastures. Some grain was fed during the breeding season.

The calves were born from late September through early January. Calving ease scores were assigned at or shortly after birth, and the other birth measurements including birth weight, cannon bone length, and heart girth circumference were taken within 72 h of birth. Gestation length was calculated as the difference in days from the date of last AI service to the date of calving. The postpartum weight and postpartum height of each cow was also recorded at this time. Most of the bull calves were castrated when the birth measurements were taken; a few born during extremely cold and wet weather were castrated later, but all were castrated before 3 mo of age. All the calves were weaned in late June at about 7 mo of age and their weights and heights were recorded, as were the weights and heights of their dams. Table 1 shows the distribution of calves by sire breed for the birth and weaning characters.
Calving ease scores were originally assigned on a 5-point scale. These scores were recoded 0 (no assistance required) or 1 (assistance required, including abnormal presentations) for the statistical analysis of this character. All assisted calves required either slight hand assistance or mechanical assistance. No Caesarean sections were performed.

The traits evaluated in this project are the result of both additive and nonadditive effects of Bos indicus breeding. The heterosis generated in a cross between a Bos indicus and a Bos taurus breed is generally about twice (Cundiff et al., 1989) or even three times as high (Koger, 1980) as that between pairs of Bos taurus breeds. Mainly due to cow productivity and maternal calving ease, the Bos indicus influence has increased in commercial herds in the more temperate areas of the United States in recent years.

Data were analyzed by least squares, mixed-model procedures for unequal subclass numbers (Harvey, 1977). Sire breed was the major effect of concern in all analyses, and sire within sire breed (sirebreed) was considered a random effect and was used to test sire breed. All other effects were considered fixed. The model for birth characters included the main effects of sire breed (B), sire:breed, calf sex (S), birth year, and origin of dam. The interaction effect for B × S was also included in the final analyses of gestation length and birth weight. In addition, dam's postpartum weight was used as a covariate in the analyses of calf birth weight and heart girth circumference, and dam's postpartum height was used in the analysis of calf cannon bone length.

The weaning characters included preweaning ADG, weaning weight, and weaning height. The statistical model for weaning characters included the main effects of B, sire: breed, S, birth year, origin of dam, and the covariate of age of calf at weaning. The B × S interaction was included in earlier analyses of the weaning characters but was found to be nonsignificant and removed from the final analyses.

Least squares mean separation for significant sire breed effects were conducted using Fisher's lsd method (Snedecor and Cochran, 1980).

### Results and Discussion

**Birth Characters.** Least squares means and standard errors for all birth characters are presented by breed of sire in Table 2. Birth year, origin of dam, and the measures of dam's size were partially confounded with each other for all birth and weaning characters. One or more of these factors had significant effects on all the birth characters in the study.

Breed of sire and sex of calf had important effects on all birth characters, and the interaction of breed × sex was significant for gestation length. However, this interaction was partly due to an apparent sampling error; the Angus-sired heifer calves had longer average gestations (283.6 ± 1.6 d) than the Angus-sired bull calves (281.2 ± 1.7 d). However, the differences between the sexes was relatively large in each of the Bos indicus crosses; sex of calf least squares means for the bulls and heifers sired by Gray Brahman, Gir, Indu-Brazil, Nellore, and Red Brahman were 294.2 ± 1.6, 286.9 ± 1.5; 290.8 ± 1.2, 287.4 ± 1.7; 291.4 ± 1.4, 289.2 ± 1.6; 297.0 ± 1.5, 290.2 ± 1.4; and 292.2 ± 1.3, 287.6 ± 1.4 d, respectively.

The sex differences for each of the Bos indicus sire breeds are larger (some only slightly) than published sex differences in gestation lengths. For example, Cundiff et al. (1974), Smith et al. (1976), Notter et al. (1978), and Gregory et al. (1978, 1979b) reported sex of calf differences that ranged from .6 to 2.0 d, and the B × S interaction was not reported to be significant in any of these
studies. Because birth weight and gestation length are positively correlated (Bourdon and Brinks [1982] reported genetic and phenotypic correlations of .25 and .32 in bull calves and .22 and .31 in heifer calves), and because S × B interactions on birth weight are typically found when Bos indicus and Bos taurus sire breeds are compared, the interaction of B × S on gestation length in the present study may indicate a real tendency for the sex difference in gestation length to be greater in Bos indicus- than in Bos taurus-sired calves.

The B × S interaction was included in the final model for birth weight (P = .29) because of the importance of this interaction and because the results are consistent with other published results. Least squares means for bull and heifer calves sired by Angus, Gray Brahman, Gir, Indra-Brazil, Nellore, and Red Brahman bulls were 33.1 ± 1.1, 30.5 ± 1.1; 39.8 ± 1.1, 34.4 ± .9; 35.5 ± .7, 30.6 ± 1.1; 42.5 ± .9, 35.7 ± 1.1; 40.2 ± .9, 33.2 ± .9; and 39.6 ± .8, 35.2 ± .8, respectively. The larger difference between sexes in the Bos indicus-sired calves than in the Angus-sired calves is consistent with the results of numerous studies. For example, Gregory et al. (1979b) reported an interaction (P < .01) between sex of calf and breed of sire on birth weight when Brahman and Sahiwal (Bos indicus breeds) and Hereford, Angus, Pinzgauer, and Tarentaise (Bos taurus breeds) bulls were mated to Hereford and Angus cows. In their study (K. E. Gregory, personal communication), bull calves by Brahman bulls and out of Hereford and Angus cows, respectively, were 4.5 and 5.7 kg heavier than heifer calves at birth; the corresponding differences are Sahiwal-sired calves were 6.2 and 5.5 kg. In the Bos taurus-sired calves, the corresponding sex differences were 2.9 and 2.0 kg in Pinzgauer crosses and 3.7 and 4.4 kg in Tarentaise crosses; in the Hereford-Angees crosses, the sex difference was 2.5 kg in Angus-sired calves and 2.0 kg in Hereford-sired calves. In the studies reported by Smith et al. (1976) and Gregory et al. (1978), in which bulls of various Bos taurus breeds were mated to Hereford and Angus cows, the sex difference (K. E. Gregory, personal communication) ranged from 1.8 to 3.9 kg.

Notter et al. (1978) also reported a S × B interaction (P < .01) when Brahman, Hereford, Angus, Holstein, and Devon bulls were mated to various types of crossbred (all Bos taurus) heifers. Brahman-sired bull calves averaged 4.4 kg heavier at birth than heifers, and the mean sex difference for all crosses in their study was 2.1 kg. Franke et al. (1965) and Bailey and Moore (1980) also reported larger sex differences in Brahman-sired calves than in Bos taurus-sired calves.

Because of the close association between birth weight and dystocia and the threshold nature of dystocia, breeds with a large difference between sexes for birth weight can experience higher frequencies of dystocia than would be expected from the average birth weight for the breed. In addition to the threshold nature of dystocia (calves below a certain size experience little or no dystocia), large sex differences in birth weight can contribute to higher dystocia frequencies if frequency of dystocia increases at an increasing rate as birth weight increases. Notter et al. (1978) reported quadratic regression equations for predicting dystocia frequencies from calf birth weights in 2- and 3-year-old cows. For 2-year-olds, dystocia frequency increased at an increasing rate through the range of their data.

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**TABLE 2. LEAST SQUARES MEANS AND STANDARD ERRORS FOR BIRTH CHARACTERS BY SIRE BREED**

<table>
<thead>
<tr>
<th>Sire breed</th>
<th>Gestation length, d</th>
<th>Calving ease</th>
<th>Birth weight, kg</th>
<th>Cannon bone length, cm</th>
<th>Heart girth, cm</th>
</tr>
</thead>
<tbody>
<tr>
<td>Angus</td>
<td>282 ± 1&lt;sup&gt;b&lt;/sup&gt;</td>
<td>.05 ± .05</td>
<td>31.8 ± .7&lt;sup&gt;b&lt;/sup&gt;</td>
<td>26.7 ± .2&lt;sup&gt;b&lt;/sup&gt;</td>
<td>71.6 ± .5&lt;sup&gt;b&lt;/sup&gt;</td>
</tr>
<tr>
<td>Gray Brahman</td>
<td>294 ± 1&lt;sup&gt;c&lt;/sup&gt;</td>
<td>.13 ± .04</td>
<td>37.1 ± .6&lt;sup&gt;c&lt;/sup&gt;</td>
<td>29.2 ± .2&lt;sup&gt;c&lt;/sup&gt;</td>
<td>74.9 ± .5&lt;sup&gt;c&lt;/sup&gt;</td>
</tr>
<tr>
<td>Gir</td>
<td>289 ± 1&lt;sup&gt;d&lt;/sup&gt;</td>
<td>.06 ± .04</td>
<td>33.0 ± .7&lt;sup&gt;d&lt;/sup&gt;</td>
<td>28.9 ± .2&lt;sup&gt;d&lt;/sup&gt;</td>
<td>72.9 ± .5&lt;sup&gt;d&lt;/sup&gt;</td>
</tr>
<tr>
<td>Indra-Brazil</td>
<td>290 ± 1&lt;sup&gt;e&lt;/sup&gt;</td>
<td>.22 ± .05</td>
<td>39.1 ± .7&lt;sup&gt;e&lt;/sup&gt;</td>
<td>30.3 ± .2&lt;sup&gt;e&lt;/sup&gt;</td>
<td>75.7 ± .5&lt;sup&gt;e&lt;/sup&gt;</td>
</tr>
<tr>
<td>Nellore</td>
<td>294 ± 1&lt;sup&gt;f&lt;/sup&gt;</td>
<td>.14 ± .04</td>
<td>36.7 ± .6&lt;sup&gt;f&lt;/sup&gt;</td>
<td>29.9 ± .2&lt;sup&gt;f&lt;/sup&gt;</td>
<td>75.9 ± .5&lt;sup&gt;f&lt;/sup&gt;</td>
</tr>
<tr>
<td>Red Brahman</td>
<td>290 ± 1&lt;sup&gt;g&lt;/sup&gt;</td>
<td>.08 ± .04</td>
<td>37.4 ± .6&lt;sup&gt;g&lt;/sup&gt;</td>
<td>29.4 ± .2&lt;sup&gt;g&lt;/sup&gt;</td>
<td>74.8 ± .5&lt;sup&gt;g&lt;/sup&gt;</td>
</tr>
</tbody>
</table>

*Calving ease score as follows: 0 = no assistance; 1 = assisted birth.
<sup>b,c,d</sup>Means within a column with no superscripts in common differ (P < .05).
for birth weight. For 3-yr-old cows, dystocia frequency increased at an increasing rate for birth weights over 32.4 kg.

Notter et al. (1978) included the S × B interaction (P < .05) in their analysis of dystocia in calves out of 2-yr-old dams; the Brahman-sired calves had the largest sex difference for dystocia frequency (40%) as well as the highest frequency of dystocia (67%). Gregory et al. (1979b) also reported an interaction (P < .05) between sex of calf and sire breed on dystocia; the sex differences for dystocia frequency (bulls minus heifers) were larger in Brahman and Sahiwal crosses (11.6 and 5.2%, respectively) than in the various Bos taurus crosses (9 to 3.0%).

In the present study, the B × S interaction (P > .4) was not used in the final analysis of dystocia, but most of the dystocia was in bull calves, and, therefore, the largest within-breed sex differences in dystocia frequency were in the breeds with the highest levels of dystocia. Of the calves requiring assistance, 19 out of 24 were bulls; 9 of the 24 required mechanical assistance (calf puller), and all were bulls.

Gestations of the various Bos indicus-sired crosses were from 7 to 12 d longer than those of the Angus-Hereford crosses (Table 2), which is consistent with other published results. Notter et al. (1978) reported that Brahman-sired calves gestated 6 d longer than the average Angus- and Hereford-sired calves. Gregory et al. (1979b) reported that Brahman- and Sahiwal-sired calves out of Hereford cows gestated 9.2 and 11.4 d longer, respectively, than Angus-sired calves out of Hereford cows.

Reynolds et al. (1980) reported 9.7 and 8.4 d longer gestations in Brahman- vs Angus-sired calves out of Brangus and Africander-Angus cross cows, respectively; straightbred Brahman calves were carried 11.1 d longer than Angus calves (291.1 vs 280.0 d). McElhenney et al. (1985) reported a 9 d longer gestation in Brahman vs Angus straightbreds. In studies in which bulls of two (or more) different breeds are mated to cows of a third breed or type (as in the present study), sire breed differences represent one-half the difference in direct breed effects plus differences in the direct heterosis of the different sire breeds with the dam breed. However, differences between purebred averages represent the total of the breed direct and breed maternal effects. Reynolds et al. (1980) also reported gestation lengths for the reciprocal F₁s between Angus and Brahman-sired (284 and 286.6 d for the Angus- and Brahman-sired F₁s, respectively). This allows an estimate of heterosis for direct effects of −25 d (essentially, zero) and of the maternal breed difference of −2.6 d (Brahman as a deviation from Angus). Lemos et al. (1984) also calculated a negative maternal Bos indicus effect on gestation length when various crosses of Guzerate and Holstein were evaluated. If the Bos indicus maternal effect is negative, differences in F₁ averages should be more than half the difference between the respective purebreds; this is consistent with the results of the present study and other comparisons of the Angus and Bos indicus breeds.

Among the Bos indicus breeds, Nellore crosses had the longest (P < .05) gestations (294 d), which is consistent with the results of Villares and De Abreu (1949) in straightbred cattle in Brazil, where the Nellore had a significantly longer gestation (291.5 d) than the Gir and Indu-Brazil (288.9 and 287.6 d, respectively). Sharma and Prabhu (1968) reported longer gestations (289.5 d) in Nellore (Ongole) than in Gir (281.5 d) straightbreds in India.

The Angus- and Gir-sired calves had lighter birth weights (P < .05) than the other crosses (Table 2). The difference between the Angus crosses and the Gray Brahman and Red Brahman crosses (31.8 vs 37.1 and 37.4 kg, respectively) is similar to the difference between Angus-Hereford crosses and Brahman-Hereford (Gray Brahman and Red Brahman combined in their analysis) crosses reported by Gregory et al. (1979b; 35.8 vs 41.7 kg, respectively). Notter et al. (1978) and Reynolds et al. (1980) also reported similar differences in birth weights between Brahman-sired and Angus-sired crossbred calves. The differences between Angus and Nellore crosses (31.8 vs 36.7 kg) is similar to the difference between Angus-Hereford crosses and Nellore crosses (35.8 and 38.0 kg for two different samples of Angus and Hereford sires vs 40.2 kg in Nellore crosses) reported by Cundiff et al. (1988).

The lighter birth weights (P < .05) of the Gir crosses compared with the other Bos indicus crosses is consistent with the results of straightbred comparisons in India and Brazil; the heavier birth weights of the Indu-Brazil crosses is consistent with straightbred results in Brazil. In some of the reports, cattle of the different breeds were located on different

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farms, and, therefore, breed is confounded with location. Littlewood (1936) reported an average birth weight (sexes averaged) of 24 kg in Gir calves in India; Littlewood (1937) reported an average birth weight of 27 kg in Nellore (Ongole). In Brazil, Felicio et al. (1976), Jordao and Veiga (1939), and Jordao and Assis (1942) reported birth weights for Gir and Nellore calves; Veiga et al. (1949) and Villares (1948) reported birth weights for Gir, Nellore, and Indu-Brazil. In each case, the Gir was the lightest and the Indu-Brazil was the heaviest.

The sire breed differences for cannon bone length and heart girth (Table 2) are consistent with that would be expected from the average birth weights. The sire breed differences in calving ease \( (P > .1) \) are also consistent with the birth weight differences.

**Weaning Characters.** Least squares means and standard errors for weaning characters are presented by breed of sire in Table 3 for each character.

**Origin of dam** was confounded with age of dam and had a significant effect on weaning weight and height. Birth year affected preweaning daily gain and weaning weight \( (P < .001) \) and was also confounded with age of dam. Sex of calf affected \( (P < .01) \) all three weaning characters; the sex effects (steers minus heifers) were similar to those in the literature \( (.04 \text{ kg/d}, 13.7 \text{ kg}, \text{ and } 2.4 \text{ cm for preweaning daily gain, weaning weight, and weaning height, respectively}).\)

Age of calf did not have a significant effect on preweaning gain, indicating no major departure from linearity in preweaning growth. The regression of weaning weight on age of calf \( (.77 \text{ kg/d}) \) was similar to the overall mean for preweaning gain \( (.79 \text{ kg/d}) \), also indicating near linearity in preweaning growth. The regression coefficient for average daily gain on age of calf was extremely small \( (-.0002 \text{ kg/d}) \) but was retained in the model to account for any tendency for younger calves to have an advantage for this growth character that is maternally related. The results were essentially the same regardless of whether age of calf was in the model. The average age of the calves at weaning was \( 217 \pm 27 \text{ d} \).

Among the sire breeds, Gir, Indu-Brazil, and Angus crosses gained the least before weaning and Gray Brahman and Red Brahman crosses gained the most \( (P < .05) \); Nellore crosses were intermediate and not significantly different from either group. Gir and Angus crosses, with the lowest birth weights and among the lowest preweaning gains, were lightest at weaning. Gray Brahman and Red Brahman crosses were heavier at weaning \( (P < .05) \) than the Gir and Angus crosses. The Nellore and Indu-Brazil crosses were intermediate and not significantly different from each other or from either of the above groups. The Indu-Brazil-sired calves were heaviest at birth but gained less from birth to weaning than the Nellore, Gray Brahman, and Red Brahman crosses, resulting in their intermediate weaning weights.

The lower preweaning gain and weaning weight of the Angus crosses vs the Gray Brahman and Red Brahman crosses is consistent with other published results. For example, Gregory et al. (1979b) reported differences of \( .02 \text{ kg/d} \) and \( 10 \text{ kg} \) for preweaning gain and weaning weight in Brahman-Hereford vs Angus-Hereford crosses. Because these differences represent one-half the additive genetic difference between the sire breeds plus the difference in hybrid vigor between the respective sire breeds and the dam breed, and because the hybrid vigor between a *Bos indicus* and a *Bos taurus* breed is typically much higher than the hybrid vigor between two *Bos taurus* breeds, at least part of the

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**TABLE 3. LEAST SQUARES MEANS AND STANDARD ERRORS FOR WEANING CHARACTERS BY SIRE BREED**

<table>
<thead>
<tr>
<th>Sire breed</th>
<th>Preweaning daily gain, kg/d</th>
<th>Weaning weight, kg</th>
<th>Weaning hip height, cm</th>
</tr>
</thead>
<tbody>
<tr>
<td>Angus</td>
<td>77 ± .02 (^a)</td>
<td>198.7 ± 3.9 (^a)</td>
<td>101.3 ± 7 (^a)</td>
</tr>
<tr>
<td>Gray Brahman</td>
<td>82 ± .02 (^b)</td>
<td>212.9 ± 3.7 (^bc)</td>
<td>109.7 ± 6 (^bc)</td>
</tr>
<tr>
<td>Gir</td>
<td>76 ± .02 (^a)</td>
<td>197.8 ± 3.6 (^a)</td>
<td>108.3 ± 6 (^a)</td>
</tr>
<tr>
<td>Indu-Brazil</td>
<td>77 ± .02 (^a)</td>
<td>205.1 ± 3.9 (^ab)</td>
<td>111.3 ± 6 (^b)</td>
</tr>
<tr>
<td>Nellore</td>
<td>79 ± .02 (^ab)</td>
<td>206.3 ± 3.5 (^abc)</td>
<td>111.3 ± 6 (^c)</td>
</tr>
<tr>
<td>Red Brahman</td>
<td>82 ± .02 (^b)</td>
<td>214.4 ± 3.6 (^e)</td>
<td>110.8 ± 6 (^b)</td>
</tr>
</tbody>
</table>

\(^a,b,c\) Means within a column with no superscripts in common differ \( P < .05 \).
difference between the various Bos indicus sire groups and the Angus-sired calves (Table 3) can be assumed to be due to hybrid vigor. Among the Bos indicus sire breeds, the lower weaning weight of the Gir crosses is consistent with results in straightbreds in Latin America. Felicio et al. (1976) and Lima (1974) reported weaning weights for Gir and Nellore straightbreds; Dubuc (1957) and Veiga et al. (1949) compared Gir, Nellore, and Indu-Brazil. In each case, the Gir calves had the lowest weaning weights. However, the similar gains and weaning weights in the Nellore and Indu-Brazil crosses in the present study are not consistent with the Latin American results, in which the Indu-Brazil has consistently been reported to be larger than the Nellore at all ages. Because straightbred averages represent both direct and maternal effects, higher weaning weights in Indu-Brazil vs Nellore calves could be due to higher milk production in Indu-Brazil cows; however, larger birth weights and mature weights in the Indu-Brazil would indicate higher direct effects for growth. The similar ( actually, slightly lower) gain and weaning weight of the Indu-Brazil crosses compared to the Nellore crosses in the present study could possibly be due to failure of the Hereford dams to provide adequate milk to meet the nutritional requirements of the Indu-Brazil crosses, to the stress of dystocia on the Indu-Brazil crosses (22 vs 14% dystocia in the Indu-Brazil and Nellore crosses), and(or) to sampling error.

Sex differences (steers minus heifers) were considerably larger in the other Bos indicus crosses than in the Indu-Brazil crosses, possibly due to the preweaning growth of the Indu-Brazil crosses, which was less than expected. The B x S interaction was not significant, but, with the exception of the Indu-Brazil crosses, the sex differences were larger in the Bos indicus-sired calves than in the Angus crosses. When evaluated with a model that included the breed of B x S interaction, the sex differences for preweaning daily gain were .07, .06, .05, and .05 kg/d in Gray Brahman, Nellore, Red Brahman, and Gir crosses but only .02 and .00 kg/d in Angus and Indu-Brazil crosses, respectively. These crosses had weaning weight sex differences of 18.7, 16.9, 16.8, 15.4, 7.3, and 4.3 kg, respectively, and hip height sex differences of 3.7, 2.9, 2.7, 2.6, 2.0, and .8 cm, respectively. The Indu-Brazil-sired male calves experienced 29.6% dystocia and 14.8% preweaning mortality, but the mortality apparently does not account for their relatively low preweaning growth rate; the average birth weight of the Indu-Brazil male calves that survived to weaning was 6.09 kg heavier than for the Indu-Brazil-sired heifers that survived to weaning.

Gregory et al. (1979b) reported a significant B x S interaction for weaning weight. The Sahiwal- and Brahman- (Bos indicus) sired calves had sex differences of 22.8 and 18.8 kg, respectively; the various Bos taurus-sired calves had sex differences ranging from 11.8 to 17.7 kg (K. E. Gregory, personal communication).

The weaning hip heights are consistent with the sire breed averages for cannon bone length at birth (Table 2).

In summary, differences between Angus crosses and Red and Gray Brahman crosses were similar to differences reported in the literature for birth and weaning characters. Among the Bos indicus crosses, the Gir-sired calves were smallest at birth and experienced the least dystocia; however, the Gir crosses were also considerably smaller at weaning. The small size of the Gir crosses is consistent with the size of Gir purebreds. The Indu-Brazil crosses were heaviest at birth and experienced the most dystocia, but they were intermediate to the other Bos indicus crosses in weaning weight. The Gray Brahman, Nellore, and Red Brahman crosses were intermediate to the Gir crosses and Indu-Brazil crosses in average birth weight and incidence of dystocia, but they were heavier than both the Gir crosses and the Indu-Brazil crosses at weaning.

Implications

Large differences existed among these Zebu breeds for birth and growth characteristics. These differences should enhance effective selection among these breeds for purposes of straightbreeding, crossbreeding, or synthetic breed development. These results are especially important because Zebu influence is rapidly becoming appreciated in beef production in the more temperate areas of the United States, rather than in just the southern regions, as beef producers continue to use the maternal qualities and heterosis obtained from Zebu crosses.
Literature Cited


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