Evaluation of crossbred calf and cow types for the coastal plain of North Carolina

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ABSTRACT: Data in this experiment consisted of 418 lactation records, and weaning and birth weight records from 600 crossbred calves. The traits evaluated included birth weight, weaning weight, weaning weight per cow exposed, weaning weight per weight of cow, weaning weight per weight of cow exposed, and predicted milk yield. Angus, Brangus, and Gelbvieh sires were mated to purebred Hereford cows. Yearling and 2-yr-old Angus-Hereford, Brangus-Hereford, and Gelbvieh-Hereford daughters then were bred to Polled Hereford bulls (Data Set 2). Later-parity Angus-Hereford, Brangus-Hereford, and Gelbvieh-Hereford daughters were mated to Salers or Simmental sires (Data Set 3). Differences between Gelbvieh- and Brangus-sired calves or Gelbvieh-Hereford and Brangus-Hereford daughters were never significant for weaning weight, birth weight, or milk yield. Angus crosses had the lowest weaning weight, birth weight, and milk yield, but the highest kilograms of calf weaned per cow exposed in all data sets. Angus-Hereford and Brangus-Hereford dams had higher weaning weight per weight of cow exposed than Gelbvieh-Hereford dams ($P < .01$) in Data Set 3. There were no other significant differences related to cow weight.

Key Words: Crossbreeding, Aberdeen-Angus, Brangus, Gelbvieh, Salers, Simmental

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Introduction

This experiment was conducted to evaluate specific crossbred cow and calf types for the Coastal Plains of North Carolina. This area has high temperatures and high humidity and can be classified as a "stressful" environment. Several studies have shown benefits of Brahman crosses in hot and humid environments (Turner et al., 1968; Winder et al., 1992; Cundiff et al., 1984). Thus, Brangus were used to include *Bos indicus* influences in the study.

The Gelbvieh breed was included because of studies that report superior reproduction and milk production for this breed (Laster et al., 1979; Cundiff et al., 1993). Because Angus is the predominant breed in North Carolina, they were used also. The base female population was Hereford.

Thus, the major objective of the study was to evaluate Angus-Hereford, Brangus-Hereford, and Gelbvieh-Hereford as calves and as dams. A second objective was to compare Simmental and Salers as terminal sires used on F_1 females.

Materials and Methods

Data used in this study were collected from cattle maintained at the Tidewater Research Station, located at Plymouth, North Carolina. The station is located at longitude 76° 39′ and latitude 35° 52′. Elevation is only 6 m. Data consisted of 418 lactation records, and weaning and birth weight records from 600 crossbred calves. Data were collected from 1990 to 1995. The traits evaluated included birth weight, weaning weight, weaning weight per cow exposed, weaning weight per weight of cow, weaning weight per weight of cow exposed, and predicted milk yield.

Initial cows located at the research station consisted of three genetic lines of Herefords produced either by random selection or by selection for either increased weaning weight or increased postweaning gain. Sires of each breed were used within each line of cows. No effects due to selection line of cow were evident in the results. All heifer calves were kept as replacements and exposed to breeding first as yearlings. All matings were by AI. A large sample of bulls from national AI studs was used. Heifers that failed to conceive as yearlings were retained and exposed as 2 yr olds. After 2 yr of age, all nonpregnant cows were culled. Failure to conceive was the only culling criterion.

Calves for the F_1 generation were produced by crossing 11 Angus, 12 Brangus, and 13 Gelbvieh bulls on Hereford cows (Data Set 1). Resulting Angus-Hereford,

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Brangus-Hereford, and Gelbvieh-Hereford daughters were bred to a total of 24 Polled Hereford sires as yearlings and 2 yr olds (Data Set 2). Later parity, 4- to 7-yr-old, F_1 females were bred to 10 Salers or 14 Simmental bulls (Data Set 3).

In addition to birth weight and weaning weight, weaning weight per cow exposed, weaning weight per weight of cow, and weaning weight per kilogram of cow exposed were analyzed. All measures involving weight of cow used the weight of the cow when calves were weaned. Milk yield was measured three times during each lactation using the weigh-suckle-weigh procedure as defined by Rutledge et al. (1971). Calves were removed from cows at 0800, and milk weights were obtained at 1600. This was accomplished by calculating the difference between weight of the calves when they were hungry and weight of the calves after they suckled. Cows and calves were then separated overnight. The following day at 0800, the weigh-suckle-weigh procedure was repeated. Predicted milk yield was calculated using regression coefficients defined by Rutledge et al. (1972). This method provided an estimate of the sum of 1-d milk yield in each month of the lactation (7 mo).

Least squares procedures for analysis of variance were employed using the GLM procedure of SAS (1996) to determine effects of year, sex, breed of dam, breed of sire, and age of dam on the dependent variables. The statistical model used was

$$Y_{iklmn} = \mu + A_i + B_k + C_l + D_m + E_n + e_{iklmn}$$

where

Y_{iklmn} = individual observation for birth weight, weaning weight, weaning weight per cow exposed, cow weight, ratio of weaning weight to weight of cow, ratio of weaning weight to weight of cow exposed, and predicted milk yield
μ = overall mean
A_i = fixed effect due to breed of sire (i = Angus, Brangus, and Gelbvieh for Data Set 1, and Salers and Simmental for Data Set 3)
B_k = fixed effect due to breed of dam (k = Angus-Hereford, Brangus-Hereford, and Gelbvieh-Hereford for Data Sets 2, 3, and 4)
C_l = fixed effect due to age of dam (l = 2, …, 10)
D_m = fixed effect due to sex of calf (m = male and female)
E_n = fixed effect due to year in which the calf was born (n = 1990, …, 1995)
e_{iklm} = random element assumed to be normally and independently distributed with mean of zero and variance σ^2_e

For weaning weight-related traits, age of calf at weaning was added as a covariate.

Table 1. Least squares means for weights at birth and weaning for calves sired by Angus, Brangus, and Gelbvieh sires (Data Set 1)

	Breed			
Item	Angus	Brangus	Gelbvieh	SE[a]
Birth weight, kg	36.3[b]	41.6[c]	39.7[c]	1.1
Weaning weight, kg	209.8	212.7	215.0	6.8

[a]Pooled standard error based on most conservative number in a breed group.
[b,c]Row values with different superscripts differ ($P < .05$).

Results and Discussion

In Data Set 1, Angus sires produced calves with lighter birth weights ($P < .01$) than Brangus or Gelbvieh bulls. Brangus-sired calves were nonsignificantly heavier than Gelbvieh sired calves at birth. Although weaning weights from the three sire breeds were not different ($P > .05$; Table 1), Gelbvieh-sired calves were numerically about 2.5 kg heavier than Brangus-sired calves and about 5 kg heavier than Angus-sired calves.

Birth weights of calves from the F_1 dams, when evaluated as 2 and 3 yr olds, were not different ($P > .05$; Table 2). However, at weaning, both Gelbvieh-Hereford and Brangus-Hereford cows had heavier calves ($P < .05$) than Angus-Hereford cows. Laster et al. (1979) and Gregory et al. (1979b) reported heavier 200-d weights for Gelbvieh- and Brahman-sired F_1 heifer calves, respectively. However, when crosses were evaluated on the basis of weaning weight per cow exposed to breeding, different results were obtained. Brangus-Hereford and Angus-Hereford had similar ($P > .05$) but larger weaning weights per cow exposed ($P < .05$) than Gelbvieh crosses. This resulted from pregnancy rates of 90.7, 84.5, and 79.3% for 2- and 3-yr-old Angus-Hereford, Brangus-Hereford, and Gelbvieh-Hereford cows, respectively. Chi-square values were calculated to measure significance among the breeds for the pregnancy rates. Angus-Hereford differed from Brangus-Hereford and Gelbvieh-Hereford ($P = .09$ and $P < .01$, respectively). However, no difference ($P > .05$) was found between Brangus-Hereford and Gelbvieh-Hereford. Crockett et al. (1973) reported a 15% greater pregnancy rate for purebred Angus than for purebred Brahman cows. In a computer simulation study, Lamb et al. (1992) reported that crosses containing Angus tended to wean more calves and lighter calves than other breed combinations (Simmental, Charolais, and Limousin). Lamb et al. (1992) also wrote that their results are in agreement with Congleton and Goodwill (1980a,b). Thus, Angus and Angus crosses had the lightest weaning weights but the heaviest weights per cow exposed to breeding.

A third method to use in evaluating production is weight of calf per kilogram of cow maintained. The desired method would depend on economic considerations. These may differ if major costs are associated

Table 2. Least squares means for weight traits of calves from 2- and 3-yr-old F_1 cows

	Breed			
Item	Angus-Hereford	Brangus-Hereford	Gelbvieh-Hereford	SE[a]
Birth weight, kg	36.0	36.6	37.6	.79
Weaning weight, kg	212.0[e]	226.4[f]	221.0[f]	3.74
ww/exp, kg[b]	196.4[e]	195.7[e]	180.0[f]	7.76
www1, %[c]	41.01	51.54	44.31	5.05
www2, %[d]	37.37	43.53	35.07	4.20

[a]Pooled standard error based on most conservative number in a breed group.
[b]Weaning weight per cow exposed.
[c]Weaning weight per weight of cow.
[d]Weaning weight per weight of cow exposed.
[e,f]Row values with different superscripts differ ($P < .05$).

with number of cows, as compared with major costs being associated with mature weight of cows maintained. Table 2 presents least squares means for weaning weight expressed as a percentage of dam weight and as a percentage of dam weight in the breeding herd. Although the differences were not significant, Brangus-Hereford cows tended to produce higher weaning weight per weight of cow and Angus-Hereford dams tended to have heavier weaning weights per weight of cow exposed than Gelbvieh-Hereford.

Older cows (4 yr and older) were mated to either Simmental or Salers bulls (Table 3). There were no interactions between cow and sire breeds. In older cows, the only comparison for birth weight that approached significance ($P = .051$) was Gelbvieh-Hereford vs Angus-Hereford. The ranking for breed of dam was the same as for young cows. Gregory et al. (1979a) reported heavier birth weights for Brahman crosses than for Angus-Hereford crosses.

For mature cows, Gelbvieh-Hereford crosses (Table 3) produced heavier weaning weights than either Brangus-Hereford ($P > .10$) or Angus-Hereford ($P < .05$). The difference between Brangus-Hereford and Angus-Hereford was not significant. Gotti and Benyshek (1988) reported lighter weaning weights from straightbred Angus as compared with Gelbvieh-sired calves out of Angus cows. Brangus-sired dams had heavier calves than Angus-sired dams in the study of Cundiff et al. (1984). As was the case for young cows, Angus-Hereford crosses produced more weaning weight per cow exposed than either Brangus-Hereford ($P = .02$) or Gelbvieh-Hereford ($P < .01$). Further, Brangus-Hereford exceeded Gelbvieh-Hereford ($P < .01$) for this measure. In contrast, Cundiff et al. (1984) reported that Brangus-sired dams produced 5% more weaning weight per cow exposed than Angus-sired dams. Crockett et al. (1973) reported 15% more calves from purebred Angus cows compared with purebred Brahman cows. Gottie et al. (1985) reported a 14% advantage of Angus dams over Santa Gertrudis dams for percentage of calves born per cows exposed.

Also shown in Table 3 is weaning weight as a percentage of cow weight. Dam breeds were not different ($P > .05$). However, when weaning weight was expressed as a percentage of cow weight maintained in the breeding herd, Angus-Hereford crosses had heavier weights than Brangus-Hereford dams ($P > .05$). Both Angus-Hereford and Brangus-Hereford dams produced more calf weight per weight of cow exposed ($P < .05$) than Gelbvieh-Hereford.

Simmental calves were heavier than ($P < .05$) Salers calves at weaning and nonsignificantly heavier at birth. They weighed 42.5 kg at birth, whereas Salers calves were 40.9 kg. Simmental-sired calves reached 274 kg at weaning, whereas Salers-sired calves were 260.6 kg. Most conservative standard errors were .87 for birth weight and 3.59 for weaning weight.

Table 3. Least squares means for weight traits of calves from mature F_1 cows

	Breed			
Item	Angus-Hereford	Brangus-Hereford	Gelbvieh-Hereford	SE[a]
Birth weight, kg	40.5	41.8	42.7	1.06
Weaning weight, kg	261.5[e]	269.2[ef]	271.2[f]	4.37
ww/exp, kg[b]	237.2[e]	227.6[f]	215.7[g]	3.69
www1, %[c]	46.79	48.51	46.80	1.31
www2, %[d]	42.43[e]	40.99[e]	37.18[f]	1.10

[a]Pooled standard error based on most conservative number in a breed group.
[b]Weaning weight per cow exposed.
[c]Weaning weight per weight of cow.
[d]Weaning weight per weight of cow exposed.
[e,f,g]Row values with different superscripts differ ($P < .05$).

Milk production by Gelbvieh-Hereford dams was not different from Brangus-Hereford ($P > .10$). Both Gelbvieh-Hereford and Brangus-Hereford had higher milk yields ($P < .01$) than Angus-Hereford. Predicted milk yield was 60.63 kg for Gelbvieh-Hereford, 60.56 kg for Brangus-Hereford, and 55.68 kg for Angus-Hereford. Thus, despite higher milk production and heavier calves at weaning for Gelbvieh-Hereford, they ranked lower than Angus-Hereford and Brangus-Hereford dams for traits that included reproductive measures.

Angus-Hereford dams had the lowest birth weight, weaning weight, and milk yield, but produced the most weaning weight per cow exposed because of superior reproductive performance. Some studies support these results (Crockett et al., 1973; Lamb et al., 1992). Although traits of purebred cows cannot be compared with those of crossbred cows, Turner et al. (1968) reported higher calving rate for purebred Brahman cows than for either Angus or Hereford cows.

These results suggest that ranking of breed crosses depends on the method of evaluation. Weaning weight, weaning weight per cow exposed, and weaning weight as a percentage of weight of cow provide different results. The appropriate trait to use in evaluation of breed crosses depends on the relative economic aspects of a particular enterprise.

Implications

Evaluation of breed crosses as dams depends on how traits are expressed. Ranking of dams may change depending on this expression. Whether weaning weight, weaning weight per cow exposed, or weaning weight as a percentage of weight of cow is the appropriate measure probably depends on the economics of a particular enterprise.

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