EVALUATION OF CROSSBRED CALF AND COW TYPES; SUBJECTIVE TRAITS

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ABSTRACT

Data in this experiment consisted of birth weight, calving score, thickness and grade records of 600 crossbred calves. 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). The traits evaluated were birth weight, thickness and feeder grade of calves and degree of calving difficulty. Calving difficulty, grade, muscling or thickness evaluation is a subjective assessment. Progeny of Angus cattle were lighter and born easier than progeny of Brangus and Gelbvieh cattle. Gelbvieh crosses had the highest frequency of thickness 1 calves and Brangus crosses had the highest frequency of medium size calves. Angus calves were lighter than Brangus calves in all the data sets but they had thicker muscles. Adding Bos Indicus genes to a cross may increase birth weight while decreasing muscling and calving ease.

KEYWORDS: calving difficulty, thickness, grade, Angus, Brangus, Gelbvieh, crossbreeding, multinomial data

1. INTRODUCTION

This study was designed to test specific crossbred calf- and cow-types for the coastal plain of North Carolina, which has high temperatures and humidity. Improvement through crossbreeding is cost efficient and useful. Though numerous studies [6, 11] have shown the advantage of using crossbreeds in improving weight performances, effects of heterosis on carcass and beef quality attributes may be relatively small [1] . One of the objectives of this experiment was to evaluate feeder calf quality traits of crossbred calves sired by Angus, Brangus and Gelbvieh bulls. Another objective was to evaluate maternal traits of F_1 cows produced by mating Angus, Brangus and Gelbvieh bulls to Hereford cows. Simmental and Salers were evaluated as terminal sire breeds.

Traits considered were degree of calving difficulties of the dams and birth weight, thickness and feeder grade of calves.

2. MATERIALS AND METHODS

Data used in this study were collected from cattle maintained at the Tidewater Research Station (TRS), located at Plymouth, North Carolina. The station is located at longitude 76º39’ and latitude 35º52’. Elevation is only 6 m. This area can be classified as a stressful environment because of high temperatures and high humidity.

Data consisted of records from 600 crossbred calves. The F_1 generation of calves was produced by crossing Angus (A), Brangus (B), and Gelbvieh (G) bulls on Hereford (H) cows (data set 1). Angus-Hereford (AH), Brangus-Hereford (BH) and Gelbvieh-Hereford (GH) cows were bred to Polled Hereford sires as yearlings and 2yr olds (data set 2). Either later parity F1 females were bred to Salers or Simmental bulls (data set 3). A detailed description of the experimental procedures is given in Pala et al. [10].

Least squares procedures for analysis of variance were employed using the GLM procedure of SAS [12] 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 and calving score

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 and 3)

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 $\sigma 2_e$

For the subjective traits thickness and grade, which has multinomial distributions, GENMOD procedure of SAS [12] was employed to perform likelihood ratio analyses and odds ratio calculations. Data sets were separated as in the calving score analyses and analyzed using thickness or the grade as the dependent variable. Because the distribution was multinomial, cumulative logit function [9] was used in analyses and the differences were tested using the ESTIMATE statement of SAS. Log odds ratios were computed to compare the breeds’ odds ratio (Ψ) estimates. All levels of the grade factor were kept for significant tests while odd ratios were calculated for the odds of having a medium size calf versus a small or a large calf, since medium grade is preferred over both large and small grade.

Distributions of calves for each sire and dam breed by thickness score and frame size grade were calculated. Calves were sorted into large, medium and small size groups. Values of size were computed both by a formula using hip heights of the animals and the judgement of a person. The formula was taken from the USDA 1980. Different equations used for males and females were:

For males: FS=-11.548+0.4878*ht-0.0289*weanage + 0.00001947*(weanage**2) +0.0000334*ht*weanage

For females: FS=-11.7086+0.4723*ht-0.0239*weanage+ 0.0000146*(weanage**2) +0.0000759*ht*weanage

WEANAGE represents age of calf at weaning and ht is hip height. If the calculated value of frame size (FS) was smaller than 3.8, then grade was set to “small”. If the value of FS was greater than 5.8, then grade was “large”; if between 3.8 and 5.8, grade was “medium”.

Grade, muscling or thickness evaluation is a subjective assessment. Animals having “large” as their grade are considered to be thrifty, have a long and tall body, and have large frames for their age. Usually males in this category do not produce U.S. Choice grade carcasses until their live weight surpasses 544 kg [13]. Females of this grade usually reach that point when their live weight surpasses 454 kg. Cattle having typical minimum qualifications for “medium” grade are thrifty, are medium height and long bodied, and have fairly large frames. Males of medium frame size usually reach Choice carcasses at live weights 454 to 544 kg with females usually at 386 to 454 kg [13]. Cattle included in "small" grade are thrifty, have shorter bodies and shorter than specified for the "medium" grade. Males of this grade usually produce Choice carcasses at live weights < 454 kg and females at live weights < 386 kg. [13].

Thickness of feeder calves is subjectively categorized as 1, 2, or 3. Feeder calves possessing minimum qualifications for grade 1 are thrifty, and slightly thick throughout. They are full in the forearm and gaskin, exhibiting a rounded appearance through the back and loin with moderate width between the legs. Feeder cattle included in grade 2 are thrifty and are narrow through the forequarter and the middle part of the round. The forearm and gaskin are thin and the back and loin have a concave appearance. The legs are very close. Animals included in grade 3 are thrifty but have less thickness than the animals specified for the number 2 grade [13].

3. RESULTS AND DISCUSSION

3.1 Birth weight and calving difficulty

AN sired calves were lighter (P < .01) than BR and GV sired calves at birth in data set 1 (Table I). There were no significant differences between BR and GV sired calves. There were no significant differences among the breed-groups for calving difficulty. However, breed-groups ranked the same for calving ease as for birth weight. Angus sired calves had the lowest score for calving difficulty and the lightest birth weights. Gregory et al. [4] also observed that Brahman crosses had significantly more calving difficulty than Angus crosses. Differences between Brangus and Gelbvieh were not significant for either birth weight or calving score.

Breed of dam effects were not significant for birth weight in data set 2 and 3. Only the difference between AH and GH approached significance in data set 2 (P = .095) and in data set 3 (P = .051). AH cows had the lowest calving score and the smallest calves at birth in data set 2. BH had the second lowest calving score followed by GH. Gregory et al. [5] reported that calves that are heavier at birth had significantly more difficult births.

AH and GH, in data set 3, differed for calving score (P < .01) and that was the only significant difference (Table II). BH ranked second and GH ranked last (hardest birth). This result agrees with the rank of breeds in data set 2 for calving score and for birth weight. Studies in the literature support the rank of breed groups. Gregory et al. (1979) observed that Brahman crosses had significantly more calving difficulties than Angus crosses and found more calving difficulty in Gelbvieh-Angus crosses than purebred Angus [4].

In all of the data sets, except calving score, 3-year-old cows had higher performance than 2-year-old-cows. All dependent factors showed an increasing trend as age of cow increased. Lubritz et al. [8] reported that as age of dam increased (2 to 4), all traits increased in their study. In contrast, Gregory et al. [4] reported that younger cows (4-year-old) had 1.2kg heavier calves at birth than 5yr and older cows (P < .01). Lee [7] reported that calving ease scores observed from calves born by heifers and that from calves born by cows had high genetic correlations in Gelbvieh cattle.

In none of the data sets were the differences between Gelbvieh and Brangus breed-groups of sufficient magnitude to be significant. Angus ranked last in all data sets for birth weight after Brangus and Gelbvieh, while Angus had the easiest births.

3.2 Thickness

Angus (80 per cent) ranked after Gelbvieh (83.3 per cent) for the number of thickness 1 calves. Brangus followed Angus with 64.3 per cent thickness 1 calves. Angus calves were lighter than Brangus calves in all the data sets but they had thicker muscles. Angus crossbred dams and purebred sires had the lowest scores of calving difficulty in all data sets. It is very natural since Angus ranked last

Table 1. Least squares means for calving score (cs) by sire and dam breed (data sets 1, 2 and.3).

BREED (data sets 1, 2)	CS	BREED (data set 3)	CS
Angus	1.16 ±.16	Salers	1.11 ±.07
Brangus	1.37 ±.13	Simmental	1.17 ±.07
Gelbvieh	1.29 ±.14	AngusHereford	1.02 ±.07
AngusHereford	1.37 ±.13	BrangusHereford	1.12 ±.09
BrangusHereford	1.45 ±.13	GelbviehHereford	1.28 ±.08
GelbviehHereford	1.66 ±.12		

Table II. Parameter estimates and contrasts for thickness and grade by sire and dam breed (data sets 1 and 2; young F_1 cows).

BREED	Thickness	CONTRASTS	Thickness odds ratios	Grade odds ratios
Angus	1.40^a	Angus-Brangus	0.42	1.30
Brangus	0.52^b	Angus-Gelbvieh	1.21	1.05
Gelbvieh	1.59^a	Brangus-Gelbvieh	2.90	0.81
AngusHereford	1.21^x	AngusHereford-BrangusHereford	1.05	1.69
BrangusHereford	1.27^x	AngusHereford-GelbviehHereford	0.95	0.91
GelbviehHereford	1.16^x	BrangusHereford-GelbviehHereford	0.90	0.54

^{a,b}Column values with different superscripts differ (P < 0.10)
^{x,y}Column values with different superscripts differ (P < 0.10)

Table III. Parameter estimates and contrasts for thickness and grade by sire and dam breed (data set 3; mature F_1 cows).

BREED	Thickness	CONTRASTS	Thickness odds ratios	Grade odds ratios
Salers	1.09^a	Salers-Simmental	0.94	2.08
Simmental	1.03^a			
AngusHereford	$1.09^{x,y}$	AngusHereford-BrangusHereford	1.01	0.71
BrangusHereford	1.10^x	AngusHereford-GelbviehHereford	0.93	1.09
GelbviehHereford	1.02^y	BrangusHereford-GelbviehHereford	0.92	1.55

^{a,b}Column values with different superscripts differ (P < 0.10)
^{x,y}Column values with different superscripts differ (P < 0.10)

in all data sets for birth weight. Calves that were heavier at birth had significantly more difficult births in the study of Gregory et al. [5].

Simmental sires had higher frequency of thickness 1 calves than Salers did. GH cows had 92.31 percent thickness 1 calves while AH had 84.85 percent and BH had 81.91 percent. These results agree with the sire breed results since Gelbvieh was also the sire breed with the highest frequency of thickness 1 calves. The other breed-groups were also ranked the same as they were ranked in sire breed-groups.

Parameter estimates and odd ratio estimates for sire and dam breeds are given in Table II and III for thickness. The odds ratios indicate the relative differences between the sires Angus, Brangus and Gelbvieh (Table II). The raw numbers (frequencies) would suggest that adding Bos Indicus genes to a cross may decrease muscling. However, the odds of Angus sired calves being in lower thickness categories (thicker muscles) was 0.4 times the odds of Brangus being in lower thickness categories. Because the lower categories represent thicker muscles; this indicates that Brangus sired calves had thicker muscles than Angus sired calves. The odds of Angus sired calves having thicker muscles was 1.2 times the odds of Gelbvieh crosses and the odds of Brangus crosses having thicker muscles was about 3 times the odds of Gelbvieh crosses. All of this indicates that Gelbvieh sired calves had the thinnest muscles although the raw data indicated them to have the thickest muscles. Brangus crosses have the thickest muscles followed by Angus and Gelbvieh crosses, which is the exact opposite of what the raw data suggested. All this indicates that raw frequencies may be misleading and the appropriate analysis methods should be employed when reporting multinomial research data in animal science. Differences among the dam breeds in data set 2 were non-significant for thickness (Table II). Differences among the dam breeds were non-significant (P> 0.10) for dam breeds in data set 3 also, except the difference between calves of BH and GH dams (P< 0.10). The odds ratio for this contrast was 0.92; meaning that the odds of BH dams having a thickness one calf was 0.92 times the odds of GH dams having a thickness one calf (Table III). The parameter estimate of BH dams was 1.10 while that value was 1.02 for GH dams. Because thicker muscles are represented by lower thickness values, GH dams with an estimate of 1.02 indicates thicker muscles for calves of GH dams compared to calves of BH dams.

3.3 Grade

Frame size of the animal is important because it has a large effect on determining the price of the feeder calf. Grades of animals for frame size are small, medium, and large [13]. The most valuable feeder calves are the medium size animals. This is because animals with small frame size cost more to process per kilogram weight than medium size animals and animals with large frame size will reach the same grade later than medium size animals [13]. Medium and large frame size animals will weigh more than small frame size animals when they reach the same grade.

Salers had 12.22 and Simmentals had 23.33 per cent medium size while the other sire-breeds ranged over 52.86 percent medium size calves. Brangus had the highest (60.47) percentage of medium size calves. Polled Herefords had 55.66 percent, Gelbvieh had 54.17 percent and Angus had 52.86 percent medium size calves.

The dam breed with the highest frequency of medium size calves was BH with 43.3 percent, followed by AH with 35.9 percent and GH with 35.9 percent. Both sire breed Brangus and dam breed BH had the largest proportion of medium size calves. In contrast, Cundiff et al. [2] reported that Brangus had small size grade in their research. However, Gelbvieh and Brahman had middle mature sizes while Hereford-Angus had also small mature size.

Odd ratio estimates for sire and dam breeds are given in Table II and III for grade. Differences among the sire breeds in data set 1 (Angus, Brangus and Gelbvieh) and in data set 3 (Salers and Simmental) were non-significant. The response profile was ordered to have the medium level smaller than the large or small level, meaning that odds of Angus having a medium grade calf were 1.3 times the odds of Brangus having a medium grade calf and 1.05 times the odds of Gelbvieh having the same grade calf (Table II). Similarly, odds of Brangus having a medium grade calf were 0.81 times the odds of Gelbvieh having the same grade calf.

Differences between Angus-Hereford and Brangus-Hereford dams for grade was large ($P<0.05$) while all other differences were small ($P>0.10$) in data set 2. The odds that calves of Angus-Hereford dams are graded medium were 1.69 times the odds that calves of Brangus-Hereford dams are graded medium (Table II). None of the differences among dam breeds and sire breeds were large enough to be significant in data set 3 for grade ($P> 0.10$). Though the differences were non-significant, Salers sired calves were twice as likely to be medium grade as Simmental sired calves and calves of BH dams were 1.6 times as likely to be medium grade as calves of GH dams (Table III).

Gelbvieh crosses were heaviest at birth and had the highest number of thickness 1 calves. Angus calves had the easiest births. Lighter calves at birth lead to easier births. Angus calves were lighter than Brangus calves in all the data sets but they had thicker muscles when raw frequencies were used for investigation. However, the likelihood ratio analyses and odd ratios showed that Brangus crosses tend to have thicker muscles compared to Angus and Gelbvieh crosses. This indicates that multinomial data in animal science should be approached using the appropriate analysis techniques. Adding Bos Indicus genes to a cross in a hot-humid environment may increase birth weight and muscle thickness while decreasing calving ease. Though raw frequencies indicated that Brangus crosses had the highest number of medium size calves, likelihood ratio analyses and odd ratios showed that Angus crosses had higher probabilities of having medium size calves than Brangus crosses.

REFERENCES

[1] Burrow H. M., Moore S. S., Johnston D. J., Barendse W., Bindon B. M, Quantitative and molecular genetic influences on properties of beef: a review. Australian Journal of Experimental Agriculture 41 (2001) 893 – 919.

[2] Cundiff L. V., Szabo F., Gregory K. E., Koch R. M., Dikeman M. E., Crouse J. D., Breed comparisons in the germplasm evaluation program at Marc. Proc. Beef Imp. Fed., Asheville, NC. (1993).

[3] Gregory, K. E., Cundiff L.V., Smith G. M., Laster D. B., Fitzhugh Jr. H. A., Characterization of biological types of cattle-Cycle III: I. Birth and weaning traits. Journal of Animal Science 47 (1978) 1022.

[4] Gregory, K. E., Laster D. B., Cundiff L. V., Smith G. M., Koch R. M., Characterization of biological types of cattle-cycle III: I. Birth and weaning traits. Journal of Animal Science 48 (1979), 271-279.

[5] Gregory K. E., Cundiff L. V., Koch R. M., Breed effects and heterosis in advanced generations of composite populations for birth weight, birth date, dystocia, and survival as traits of dam in beef cattle. Journal of Animal Science 69 (1991) 3574.

[6] Lamb M. A., Tess M. W., Robison O. W., Evaluation of mating systems involving five breeds for integrated beef production systems: IV. Accounting for variability and genetic trends. Journal of Animal Science 71 (1993) 587-594.

[7] Lee DH., Estimation of genetic parameters for calving ease by heifers and cows using multi-trait threshold animal models with Bayesian approach. Asian-Australasian Journal of Animal Science 15 (2002) 1085-1090.

[8] Lubritz D. L., Forrest K., Robison O. W., Age of cow and age of dam effects on milk production of Hereford cows. Journal of Animal Science 67 (1989)

2544.

[9] McCullagh, P., Nelder, J.A. Generalized Linear Models, Second Edition, London: Chapman and Hall. (1989).

[10] Pala A., Mccraw R.L., Robison O.W., Evaluation of crossbred calf and cow types for the coastal plain of North Carolina. Journal of Animal Science 78 (2000) 2253–2256.

[11] Prayaga K. C., Evaluation of beef cattle genotypes and estimation of direct and maternal genetic effects in a tropical environment. 1. Growth traits. Australian Journal of Agricultural Research. 54 (2003) 1013-1025

[12] SAS Institute Inc., SAS OnlineDoc®, Version 8 SAS Institute Incorporation, Cary, NC. (1999)

[13] United States Department of Agriculture, April, Facts About U.S. Standards for Grades of Feeder Cattle. (1980) AMS-586.