

COMPARISONS OF CROSSBRED CALVES BY SOUTH DEVON, MAINE-ANJOU AND SIMMENTAL SIRES FOR SOME BEEF PRODUCTION TRAITS

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Breed of sire comparisons are made amongst calves born to commercial Hereford cows and sired by bulls of the South Devon (SD, 10 bulls used), Maine-Anjou (MA, two bulls used) and Simmental (SIM, eight bulls used) breeds. Numbers of observations ranged from 239 bulls and 224 heifers for "ease of birth" to 98 bulls for carcass traits. The feedlot test period was 91 days and three feedlot treatments were imposed. Slaughter criteria were subjective and "breed-of-sire" differences in slaughter age and carcass weight were not statistically significant ($P > 0.05$). Differences amongst breed-of-sire means attained statistical significance for "birth weight" ($MA > SIM > SD$; $P < 0.001$), weaning weight of males ($MA > SIM > SD$; $P < 0.001$), "on-test" weight ($MA > SIM > SD$; $P < 0.001$), average daily gain on test ($MA > SIM > SD$; $P < 0.001$) average fat depth/100 kg carcass weight ($SD > MA = SIM$, $P < 0.05$), trimmed, deboned, defatted primal cuts per day of age ($MA > SIM > SD$; $P < 0.01$), meat marbling score (SD more marbled than SIM more marbled than MA; $P < .05$). A significant interaction existed between breed of sire and feeding group for average daily gain on test ($P < 0.01$) and cutability ($P < 0.025$). Breed-of-sire differences did not attain statistical significance for weaning weight of female calves, loin area/100 kg carcass weight, cutability, or meat color score.

On a comparé les races de géniteurs sur des veaux issus de vaches Hereford de catégorie commerciale et saillies par des taureaux des races Sud-Devon (SD, 10 taureaux), Maine-Anjou (MA, 2 taureaux) et Simmental (SIM, 8 taureaux). Le nombre d'observations a varié de 239 taureaux et 224 génisses pour "la facilité du vêlage" à 98 taureaux pour les caractères de la carcasse. La durée de l'épreuve en parc d'engraissement a été de 91 jours et on a effectué trois traitements d'alimentation. Les critères d'abattage ont été subjectifs et les différences entre "les races de géniteurs" à l'égard de l'âge à l'abattage et du poids de la carcasse n'ont pas montré de différences significatives ($P > 0.05$). Les différences entre les moyennes des races de géniteurs ont été significatives pour le poids à la naissance ($MA > SIM > SD$, $P < 0.001$), le poids des veaux mâles au sevrage ($MA > SIM > SD$, $P > 0.001$), le poids lors de l'épreuve ($MA > SIM > SD$, $P < 0.001$), le gain journalier moyen à l'épreuve ($MA > SIM > SD$, $P < 0.001$), l'épaisseur moyenne du gras/100 kg de poids de carcasse ($SD > MA = SIM$, $P < 0.05$), les meilleurs morceaux parés, désossés et dégraissés par jour d'âge ($MA > SIM > SD$, $P < 0.01$) et le pourcentage de persillé de la viande ($SD > SIM > MA$, $P < 0.05$). Il y a eu une interaction significative entre les races de géniteurs et les groupes de traitements d'alimentation, pour le gain journalier moyen à l'épreuve ($P < 0.01$) et le rendement en viande ($P < 0.025$). Les différences entre les races de géniteurs n'ont pas montré de corrélation positive en ce qui concerne le poids des veaux femelles au sevrage, la surface de la noix de côte/100 kg de poids de carcasse, le rendement ni la couleur de la viande.

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The recent introduction into Canada of several European cattle breeds has stimulated a demand for objective information about the beef production potential of these breeds when crossed with traditional Canadian beef cattle. It is the purpose of this paper to report the results of a comparison amongst groups of Hereford cross calves sired by South Devon, Maine-Anjou and Simmental bulls for calving and weaning traits of male and female calves and for feedlot gain and carcass traits of uncastrated males.

MATERIALS AND METHODS

This project was a cooperative one between the Lacombe Research Station and Palmer Ranch, Hillspring, Alberta, which supplied all the cattle and facilities used in the project. The primary cows were individually identified Hereford range cows that had had at least one previous calf, and averaged 5.4 yr of age. In June 1970 they were bred by artificial insemination to bulls of the following breeds, South Devon (SD; 10 bulls used), Maine-Anjou (MA; 2 bulls used) and Simmental (SIM; 8 bulls used). Breeding was carried out at three locations with all sires used at each location and no preselection of the cows bred to each bull or breed. Cows were wintered, calved, and pastured with their calves at two locations (Cochrane and Big Coulee Ranches) with calves by all sires present at each location. The average age of cow groups calving to different breeds of sire ranged from 5.2 to 5.6 yr. The male calves were all reared as bulls. All calves were weaned in September and October at an average age of 164 ± 1.0 days. A few bull calves were sold at this time and those remaining were kept on a growing ration till 13 December when they were weighed into a custom feedlot at an average age of 253 ± 3.4 days.

To comply with normal practice in the feedlot, the calves were allocated to feeding pens according to their weight, but in order to retain a valid basis for comparisons the allocation was done within breed-of-sire subgroups. Thus the "heavy" pen received the heaviest one-third, the "medium" pen the middle one-third, and the "light" pen the lightest one-third of the calves from each breed-of-sire subgroup. The rations contained rolled grains, potato silage and chopped hay. Initially, the heavy and medium pens were fed a higher energy level than the light pen. Subsequently, the amount and composition of

feed provided to each pen was adjusted according to the judgment of the feedlot staff.

After 91 days on feed the cattle were weighed. Several SIM-sired and MA-sired bulls were withdrawn for sale as breeding bulls, and the feeding groups were changed. The remaining bulls were fed until the feedlot operator considered them to have reached the "Good" carcass grade (on the "old" Canadian Grading System). They were then slaughtered at a commercial packing plant where carcass measurements were taken. The average slaughter age was 440 ± 2.3 days.

Data

Cow age was determined from Ranch records. Breeding, calving and weaning records were kept by Ranch staff. Ease of calving was classed as "easy" that included cases in which little or no calving assistance was required, and "difficult" that included cases requiring major calving assistance or surgery. Such a scoring system is necessarily subjective, but the same subjective judgment was applied to each breed-of-sire subgroup. Birth weights were recorded at only one calving location (Big Coulee), resulting in observations on fewer than half the calves born. Weights, taken at the feedlot, were supervised by Research Station staff. These included a single unshrunk weight taken when the animals entered the feedlot and again after 91 days on feed. Changes in feeding groups after that time made it impractical to compare feedlot gain over a longer period.

The carcass data were recorded by the Agriculture Canada grading staff in the packing plant. The data recorded included: hot carcass weight; loin eye area (11–12 rib); fat depth at "top", "middle" and "bottom" of the loin eye (11–12 rib); meat color code (a subjective code which increases from 1 to 3 as the meat becomes darker); and marbling code (a subjective code which increases from 1 to 9 as the degree of marbling decreases). From these data, "cutability" (estimated percent of trimmed, deboned, defatted primal cuts in the carcass) was estimated according to the formula:

Cutability = $53 + 0.11$ (loin eye area, cm^2) $- 2.76$ (avg rib fat depth, cm), a formula developed at the Lacombe Research Station (A. H. Martin, unpublished data). The weight of trimmed, deboned, defatted primal cuts (TDDPC) per day of age was estimated as:

$\text{TDDPC/day} = (\text{hot carcass wt}) \times (\text{cutability}) \div (\text{age at slaughter})$.

Analysis

Birth records were carefully checked against breeding records, and where inconsistencies were found in gestation interval or calf color, the individual involved was removed from the analysis.

Ease-of-calving data are presented as the percent classed as easy calving and the significance of breed-of-sire differences was assessed by the χ^2 test. For all other traits group means were calculated by the method of least squares and the significance of differences between means was assessed by analysis of variance. Since the mean differences in calving ease and 200-day weaning weight between groups reared at the two locations (Cochrane and Big Coulee Ranches) did not achieve statistical significance ($P > 0.05$), preweaning groups were pooled for subsequent analyses.

Since the samples of calves withdrawn for sale as breeding bulls were biased toward the heavier and faster gaining end of the distribution, and since the proportion of calves withdrawn varied amongst breed-of-sire groups, some action was required to restore comparability amongst them. The method used was as follows: Weaning weights were available for 69, 67, and 63 bull calves sired by (respectively) SD, MA and SIM sires. These calves were ranked within breed of sire for 200-day weaning weight and the distribution was divided into deciles. Calves withdrawn after weaning (for any reason) were identified and the proportions of calves withdrawn from each decile were equalized across breeds of sire by withdrawing additional calves where necessary (at random within decile). The above procedure left 44, 41 and 42 bulls sired by (respectively) SD, MA and SIM sires for analysis of feedlot growth rate.

At the completion of the 91-day feedlot test period, another group of bulls was withdrawn for sale as breeding stock and again it became necessary to equalize the effects of this sampling across breeds of sire. This was done by ranking all animals for weight at the end of the feedlot test period and then withdrawing additional animals where necessary until the same proportion of animals had been withdrawn from each quartile of each breed-of-sire - feeding-group subset. Almost all of the withdrawals were from feeding group 1 (high on-test weight and nutritional level), so the numbers of animals remaining in those subgroups were considerably reduced. In total, there remained 35 SD-sired, 31 MA-sired and 32 SIM-sired bulls with carcass data included in the analysis.

The feedlot, slaughter and carcass data were analysed for breed-of-sire and feeding group

effects. In all least squares analyses, a model including interaction was used first. If interaction effects did not attain statistical significance (i.e., $P_{INT} > 0.05$), the analysis was repeated using a model without interaction. All effects were assumed to be fixed.

RESULTS

Trait means, standard errors, and levels of statistical significance are recorded in the tables. Table 1 deals with birth and weaning traits, Table 2 with feedlot traits and Table 3 with carcass traits. Highly significant breed-of-sire differences were present for calving difficulty and birth weights of both sexes and for 200-day weaning weight, initial feedlot weight, and feedlot average daily gain of males ($MA > SIM > SD$; $P = 0.01 - P < 0.001$). For 200-day weaning weight of females however, breed-of-sire differences did not achieve statistical significance.

Amongst the carcass traits examined, breed-of-sire differences were statistically significant only for rib fat depth per 100 kg hot-carcass weight ($SD > MA = SIM$; $P < 0.05$), TDDPC per day of age ($MA > SIM > SD$; $P < 0.01$) and degree of marbling ($SD > SIM > MA$; $P < 0.05$). Differences between feeding group means for weight and growth traits were built into this design, since feeding groups differed in on-test weight of calves and feeding levels. The fact that feeding-group 2 exceeded feeding-group 1 in mean carcass weight resulted, at least in part, from the fact that many of the faster growing bulls in pen 1 were not included in the analysis of carcass data. Statistically significant feeding group effects were present also for rib fat depth per 100 kg hot-carcass weight ($FG 1 > FG 2 = FG 3$; $P = 0.001$), TDDPC per day of age ($FG 1 > FG 2 > FG 3$; $P < 0.001$) and meat color score ($FG 1$ darker than $FG 2$ darker than $FG 3$; $P < 0.05$).

A statistically significant interaction between breeds of sire and feeding groups was noted for carcass cutability ($P < 0.025$) but the average differences due to breed of sire and feeding group were small.

Table 1. Birth and weaning traits by breed of sire, sex and location†

	Breed of sire						Probability that differences are due to chance alone†
	South Devon		Maine-Anjou		Simmental		
	No.	Mean	No.	Mean	No.	Mean	
Percent easy calving							
Male	76	95.8	87	75.6	76	88.2	86.5
Female	76	98.6	77	83.6	71	95.5	92.6
Birth weight (Big Coulee location only) (kg)							
Male	32	38.8±.7	36	44.7±.7	35	41.5±.7	41.7±.5
Female	23	35.4±.7	27	41.4±.7	25	38.2±.7	38.3±.5
Avg		37.1±.6		43.0±.6		39.8±.6	40.0±.4
Weaning wt adj 200 days, males (kg)							
Loc 1§	27	190.9±4.5	26	213.1±4.5	27	206.4±4.6	203.4±3.3
Loc 2	42	192.7±4.5	41	214.8±4.5	36	208.1±4.6	205.2±3.3
Avg		191.9±3.9		213.9±3.9		207.2±4.0	204.3±2.3
Weaning wt adj 200 days, females (kg)							
Loc 1	20	184.6±3.7	22	189.4±3.7	20	193.4±3.7	189.2±2.7
Loc 2	49	188.7±3.7	41	193.6±3.7	46	197.6±3.7	193.3±2.7
Avg		186.7±3.1		191.5±3.2		195.5±3.2	191.3±1.9

Percent easy calving is expressed as a simple percentage, other traits are expressed as least squares means and standard errors.

#LOC = location means; BOS = breed-of-sire means.
\$Loc 1 = Big Coulee Ranch; Loc 2 = Cochrane Ranch.

§Loc 1 = Big Coulee Ranch; Loc 2 = Cochrane Ranch.

Table 2. Least squares means and standard errors for feedlot traits of males by breed of sire and feeding group

	Breed of sire				Probability that differences are due to chance alone [†]
	South Devon	Maine-Anjou	Simmental	Average	
No. feedlot records				(Total)	
FG 1	10	12	15	37	
FG 2	17	14	12	43	
FG 3	17	15	15	47	
Total	44	41	42	127	
On-test weight (kg)					
FG 1	273.9±2.7	297.6±2.8	293.3±2.8	288.2±2.2	$P_{FG} < 0.001$
FG 2	239.4±2.7	263.2±2.7	258.9±2.7	253.8±2.1	$P_{BOS} < 0.001$
FG 3	200.7±2.7	224.4±2.7	220.1±2.7	215.1±2.1	
Avg	238.0±2.1	261.8±2.1	257.5±2.1	252.4±1.2	
Avg daily gain on test (kg)					
FG 1	1.16±.06	1.71±.06	1.39±.06	1.42±.04	$P_{FG} < 0.001$
FG 2	1.24±.06	1.36±.06	1.31±.06	1.30±.04	$P_{BOS} < 0.001$
FG 3	1.13±.06	1.19±.06	1.08±.06	1.14±.03	$P_{INT} < 0.01$
Avg	1.18±.04	1.42±.04	1.26±.04	1.28±.02	

[†]FG = feeding group; BOS = breed-of-sire means; INT = interaction between feeding groups and breeds of sire.

DISCUSSION AND CONCLUSIONS

The results reported here are derived from substantial numbers of calves all born in the same season to cows of the same breed and managed under similar commercial ranch conditions. The samples of sires chosen to represent the breeds of sire were in all cases a high proportion of those available in Canada at that time. They were designated by Research Station staff without reference to their performance or pedigrees. The 10 South Devon and 8 Simmental sires used are considered large enough samples to provide performance data reasonably typical of their breeds. However, with only two sires represented, the Maine-Anjou sample cannot be assumed to be typical of the rest of that breed. Strictly speaking, it must be considered typical only of the progeny of the two sires used. Nonrandom sampling of breed-of-sire groups prior to feedlot test and slaughter resulted from death losses and withdrawal of animals for sale as breeding bulls. Although this sampling may have affected the absolute value of breed-of-sire means, steps were taken as described in the analysis section to ensure that it did not impair their comparability.

The Maine-Anjou-sired calves showed the greatest growth rate as reflected by birth weight, weaning weight, initial feedlot weight, feedlot gain and TDDPC per day of age. However, in this herd of Hereford cows, which included no first calf heifers, the calving difficulty experienced with MA-sired calves was greater than could be accepted in a commercial operation. The SIM-sired calves were intermediate between the MA-sired and SD-sired calves for the growth traits and for TDDPC per day of age, as well as for calving difficulty which was still greater than would be readily accepted by most commercial operators. The SD-sired calves grew more slowly than the other groups and showed tendency to finish earlier. Their calving ease was in the same range as that commonly experienced in commercial herds of domestic beef breeds (i.e., > 95% easy calving).

These results agree well with the extensive comparisons of SD × Hereford and SIM × Hereford steers reported by the U.S. Dep. Agric. Meat Animals Research Center (Anonymous 1973), except that in their comparisons, SD-sired calves were superior in calving ease to SIM-sired calves only for

Table 3. Least squares means and standard errors for carcass traits of males by breed of sire and feeding group

	Breed of sire				Probability that differences are due to chance alone†
	South Devon	Maine-Anjou	Simmental	Average	
No. carcass records				(Total)	
FG 1	5	6	9	20	
FG 2	14	11	9	34	
FG 3	16	14	14	44	
Total	35	31	32	98	
Slaughter age (days)					
FG 1	417.4±5.3	407.8±5.4	416.1±5.4	413.8±4.4	$P_{FG} < 0.001$
FG 2	448.8±5.0	439.2±5.0	447.4±5.0	445.1±3.9	$P_{BOS} > 0.05$
FG 3	464.3±4.9	454.7±4.9	463.0±4.9	460.7±3.8	
Avg	443.5±3.9	433.9±3.9	442.2±3.9	439.9±2.3	
Hot-carcass wt (kg)					
FG 1	291.3±5.6	304.4±5.7	297.2±5.7	297.6±4.6	$P_{FG} < 0.001$
FG 2	296.8±5.3	309.9±5.3	302.7±5.3	303.2±4.2	$P_{BOS} > 0.05$
FG 3	271.8±5.2	285.1±5.2	277.8±5.2	278.2±4.0	
Avg	286.6±4.1	299.8±4.1	292.6±4.1	293.0±2.4	
Loin area/100 kg hot carcass (cm ²)					
FG 1	28.45±.71	28.45±.71	28.88±.71	29.87±.57	$P_{FG} > 0.05$
FG 2	29.02±.57	29.02±.57	29.45±.57	29.16±.43	$P_{BOS} > 0.05$
FG 3	29.73±.57	29.73±.57	30.16±.57	29.87±.43	
Avg	29.16±.43	29.02±.43	29.45±.43	29.16±.28	
Avg fat depth/100 kg hot carcass (cm)‡					
FG 1	.481±.028	.414±.028	.414±.028	.436±.022	$P_{FG} = 0.001$
FG 2	.364±.028	.302±.028	.302±.028	.324±.022	$P_{BOS} < 0.05$
FG 3	.369±.028	.302±.028	.302±.028	.324±.022	
Avg	.403±.022	.341±.022	.341±.022	.364±.011	
Cutability (% estimated trimmed, deboned, defatted primal cuts in carcass)§					
FG 1	59.3±.51	57.7±.50	59.0±.50	58.7±.29	$P_{FG} > 0.05$
FG 2	59.2±.44	60.0±.45	60.5±.45	59.9±.26	$P_{BOS} > 0.05$
FG 3	58.7±.43	60.4±.43	59.4±.43	59.5±.25	$P_{INT} < 0.025$
Avg	59.1±.27	59.4±.27	59.6±.26	59.4±.15	
Trimmed, deboned, defatted primal cuts per day of age (kg)					
FG 1	.408±.009	.439±.009	.421±.009	.423±.007	$P_{FG} < 0.001$
FG 2	.394±.008	.425±.009	.407±.009	.409±.006	$P_{BOS} < .01$
FG 3	.345±.008	.376±.008	.359±.008	.360±.006	
Avg	.382±.006	.414±.006	.396±.006	.397±.004	
Meat color score					
FG 1	1.23±.07	1.21±.07	1.18±.07	1.20±.06	$P_{FG} < 0.05$
FG 2	1.11±.07	1.09±.07	1.07±.07	1.08±.05	$P_{BOS} > 0.05$
FG 3	1.02±.06	1.00±.07	.98±.07	1.00±.05	
Avg	1.12±.05	1.10±.05	1.08±.05	1.10±.03	
Meat marbling score¶					
FG 1	7.16±.18	7.64±.18	7.38±.18	7.39±.15	$P_{FG} > 0.05$
FG 2	7.34±.17	7.82±.17	7.57±.17	7.58±.14	$P_{BOS} < 0.05$
FG 3	7.52±.17	8.01±.17	7.75±.17	7.76±.13	
Avg	7.34±.13	7.82±.13	7.56±.13	7.58±.08	

†FG = feeding group; BOS = breed-of-sire means; INT = interaction between feeding groups and breeds of sire.

‡Average of three measurements taken over the rib eye.

§Estimated as $C = 53 + 0.11 (\text{loin area, cm}^2) - 7 (\text{avg fat depth, cm})$.

||Score increases from 1 to 3 as meat color gets darker.

¶Score increases from 1 to 9 as meat becomes less marbled.

2-yr-old dams. The authors are not aware of any comparable published reports involving MA-sired calves.

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