1985

Characterization of Breeds Representing Diverse Biological Types: Reproduction and Maternal Performance of F_1 Cows

Larry V. Cundiff
U.S. Meat Animal Research Center, Larry.Cundiff@ars.usda.gov

Keith E. Gregory
U.S. Meat Animal Research Center

Robert M. Koch
U.S. Meat Animal Research Center

Characterization of Breeds Representing Diverse Biological Types: Reproduction and Maternal Performance of F_1 Cows

Larry V. Cundiff, Keith E. Gregory, and Robert M. Koch[1]

Introduction

It is estimated that today about 70 percent of the calves marketed from beef cattle herds in the U.S. are crossbred and that between 50 and 60 percent of the cows are crossbred. This represents a major shift to crossbreeding from the straightbreeding programs which prevailed in the 1950's and early 1960's. This trend has been influenced by research demonstrating the favorable effects of heterosis and other advantages of crossbreeding. Also, increased use of feed grains in growing-finishing diets caused fatter carcasses contributing to increased consumer demand for leaner beef, which stimulated interest in breeds with greater potential for lean tissue growth and less fat. As a result, a large number of breeds, introduced from Europe via quarantine facilities in Canada, became available to North American beef producers. Interest in the newly introduced breeds and in other breeds already available coincided with the establishment and development of the Roman L. Hruska U.S. Meat Animal Research Center (MARC) in the late 1960's. The Germ Plasm Evaluation (GPE) Program was initiated in 1969 at MARC to characterize a broad range of biological types of cattle as represented by breeds that differed widely in genetic potential for milk production, growth rate, carcass composition, and mature size. The purpose of this paper will be to review results from the GPE Program for reproduction and maternal characteristics of first cross (F_1) cows.

Procedure

The Germ Plasm Evaluation (GPE) Program has included three cycles of sire breeds that were mated by artificial insemination (AI) to Hereford and Angus cows. The first cycle involved breeding Hereford (H), Angus (A), Jersey (J), Limousin (L), South Devon (SD), Simmental (S), and Charolais (C) sires by AI to Hereford and Angus dams (ranging from 2 to 7 yr of age at calving) to produce three calf crops in March and April of 1970, 1971, and 1972. In Cycle II, the Hereford and Angus dams used in Cycle I were bred by AI to Hereford, Angus, Red Poll (R), Brown Swiss (B, predominantly European), Gelbvieh (G), Maine Anjou (MA), and Chianina (Ci) sires to produce two calf crops in 1973 and 1974. Cycle III involved the same or comparable Hereford and Angus dams (ranging from 4 to 11 yr old at calving) mated by AI to Hereford, Angus, Tarentaise (T), Pinzgauer (P), Sahiwal (Sw), and Brahman (Br) sires to produce two calf crops in 1975 and 1976.

The same Hereford and Angus sires were used in all three cycles of the program to provide a control population of Hereford-Angus reciprocal crosses (HA) for comparing breeds used in different cycles of the program. The females produced in the program were retained to evaluate reproduction and maternal performance when raising three-way cross calves by sires of a different breed. Calves were born in the spring (March and April) when the cows ranged from 2 to 8 years of age. The data will be presented for 15 F_1 crosses classified into six biological types based on growth rate and mature size, lean to fat ratio, age at puberty, and milk production (Table 1).

Results

Results on production of F_1 cows are summarized in Table 2. The data on Cycle I cows (HA, J, L, SD, S, and C) were for ages 2 through 8 years; Cycle II cows (HA, R, B, G, MA, and Ci), ages 2 through 7 years; and Cycle III cows (HA, P, T, Br, and Sw), ages 2 through 7 years, except for milk production estimates taken when the cows were 3 and 4 years of age. Data for the F_1 cows in this report were pooled over all three cycles of the program by adding the average differences between Hereford-Angus reciprocal crosses and other breed groups within each cycle to the average of Hereford-Angus crosses over all three cycles.

Breed group means for percentage calf crop born ranged from 88 to 95 percent and, for percentage calf crop weaned, from 83 to 89 percent. Only the most extreme differences are statistically significant (about 4 pct for comparisons in the same cycle and 6 pct for comparisons in different cycles). Differences between breed groups in calf crop percentage born reflect variation among breeds in reproduction rate and prenatal survival, while calf crop percentage weaned reflects variation in these factors plus postnatal survival. Sahiwal, Brahman, Gelbvieh, Maine Anjou, and Pinzgauer crosses tended to have the highest calf crop percentages, especially at birth. The advantages for Brahman and Sahiwal crosses may be associated with greater effects of heterosis on reproduction which have been reported for *Bos indicus* x *Bos taurus* breed crosses compared to *Bos taurus* x *Bos taurus* breed crosses. The relatively high reproductive rates for a number of breeds representing biological types with high milk production potential and medium to large size indicate that the nutritional environment at MARC has been adequate to meet the requirements for growth, lactation, and maintenance, of even the highest producing breed groups. Results from other experiments have indicated that, if the added nutrient requirements of cows with large size and higher milk production potential are not met, the interval from calving to estrus increases and conception rate declines.

Sahiwal and Brahman cross females experienced less calving difficulty than other breed groups. Results summarized in Table 2 are for ages from 2 through 7 years, but the advantage of Sahiwal and Brahman cross females was of greatest magnitude for heifers calving as 2-year-olds. The low calving difficulty for Sahiwal and Brahman F_1 dams was associated with the low birth weights of their progeny. Indications are that the low birth weight and low calving difficulty for Sahiwal and Brahman F_1 females were associated with a strong maternal effect rather than a direct genetic effect transmitted from parent to offspring. In the earlier phase of the experiment, when F_1 calves out of Hereford and Angus dams were compared, Brahman-sired calves were above average in birth weight (3rd out of 15) and calving difficulty (6th out of 15), and Sahiwal crosses were about average (9th and 11th out of 15, respectively).

Among the *Bos taurus* x *Bos taurus* breed crosses, the association between breed-of-dam means for calving difficulty and birth weight of progeny is low. For example, Chianina and Brown Swiss dams experienced relatively low calving difficulty (8 pct, ranking 4th and 5th) considering the relatively high birth weight of their progeny (95 and 91 lb, ranking 2nd and 3rd, respectively). In the earlier phase of the experiment, the association between birth weight and calving difficulty was much stronger when only direct genetic effects transmitted from sire to offspring were involved—breeds that sired calves with the heaviest birth weights also required the greatest assistance at calving.

Breeds that have had a history of selection for milk production (e.g., J, B, G, S, P, T) excelled in milk production, while

[1]Cundiff is the research leader, Genetics and Breeding Unit; Gregory is the research leader, Production Systems Unit, MARC; and Koch is a professor of animal science, University of Nebraska-Lincoln, stationed at MARC.

those with a history of selection only for meat production or draft had lower levels of milk production (HA-X, L, C, Ci). The Red Poll and South Devon produced intermediate levels of milk. Brahman and Sahiwal crosses produced relatively high levels of milk, comparable to that of *Bos taurus* breeds with a long history of selection for milk production.

Breed group means for cow weight shown in Table 2 were taken at weaning time after a lactation period of about 7 months. Thus, differences among breed groups in cow weight reflect differences in fatness inversely associated with variation in milk production as well as differences in mature size that are associated positively with skeletal size and lean tissue growth rate.

The differences among F_1 cow breed groups for 200-day weight per calf weaned reflect variation in milk production and genetic potential for growth, while those for 200-day weight per cow exposed also reflect variation in calf crop percentage weaned. There were large differences among F_1 cow breed groups for 200-day weaning weight per cow exposed. Output was greatest for *Bos indicus* x *Bos taurus* crosses (Br and Sw), and large-sized, dual purpose breeds (B, G, S, MA) excelling in milk production and genetic potential for growth. Relative to mature size of the cows, outputs were especially high for the Sahiwal crosses. Calf weight output of dual purpose breeds with intermediate size (P, T, and SD) was intermediate to that of Hereford-Angus crosses and larger, higher milking, dual purpose types (B, G, S, and MA). Output of Limousin and Charolais cross cows was similar to that of Hereford x Angus crosses. The extra growth rate of progeny out of Charolais cows was offset by a relatively higher calf crop percentage for Hereford-Angus cows. Output of Chianina cross cows was high relative to Hereford-Angus, Limousin, and Charolais, due to relatively high calf crop percentages and weaning weight. Output of Jersey crosses exceeded that of Hereford-Angus crosses by about 4 percent, reflecting higher milk production. The higher milk production of Red Poll crosses was offset by a lower calf crop weaned, so that differences between Red Poll and Hereford x Angus F_1 cross cows were small for 200-day weaning weight per cow exposed.

Table 1.—Breed crosses grouped in biological type on basis of four major criteria and number of females initially assigned to breeding as yearling heifers

	Biological type criteria[a]				
Breed group	Growth rate & mature size	Lean to fat ratio	Age at puberty	Milk prod.	No. females
Jersey-X (J)	X	X	X	XXXXX	117
Hereford-Angus-X (HA)	XX	XX	XXX	XX	322
Red Poll-X (R)	XX	XX	XX	XXX	95
South Devon-X (SD)	XXX	XXX	XX	XXX	120
Tarentaise-X (T)	XXX	XXX	XX	XXX	85
Pinzgauer-X (P)	XXX	XXX	XX	XXX	114
Sahiwal-X (Sw)	XX	XXX	XXXXX	XXX	87
Brahman-X (Br)	XXXX	XXX	XXXXX	XXX	103
Brown Swiss-X (B)	XXXX	XXXX	XX	XXXX	126
Gelbvieh-X (G)	XXXX	XXXX	XX	XXXX	81
Simmental-X (S)	XXXXX	XXXX	XXX	XXXX	157
Maine Anjou-X (MA)	XXXXX	XXXX	XXX	XXX	89
Limousin-X (L)	XXX	XXXXX	XXXX	X	161
Charolais-X (C)	XXXXX	XXXXX	XXXX	X	132
Chianina-X (Ci)	XXXXX	XXXXX	XXXX	X	92

[a]Increasing number of "X's" indicate relative difference between breeds.

Table 2.—Breed group means for reproduction and maternal performance of F_1 cows out of Hereford and Angus dams by 16 sire breeds

		Calf crop						200-day weight			
Breed group	No. births	Born, pct	Weaned, pct	Calving difficulty,[a] pct	Birth weight,[b] lb	Milk prod.,[c] lb	Cow weight,[d] lb	Per calf weaned,[b] lb	Ratio,[e] pct	Per cow exposed, lb	Ratio,[e] pct
Jersey-X (J)	628	90	84	7	79	9.2	1,068	493	104	417	104
Hereford-Angus-X (HA)	1,685	91	84	13	86	6.1	1,224	475	100	401	100
Red Poll-X (R)	461	90	79	14	89	7.5	1,171	502	106	396	99
South Devon-X (SD)	603	88	85	15	91	6.5	1,265	492	104	419	105
Tarentaise-X (T)	369	91	85	10	88	7.9	1,205	524	110	445	112
Pinzgauer-X (P)	508	93	85	13	91	8.0	1,219	509	107	432	108
Sahiwal-X (Sw)	431	95	89	2	76	8.5	1,119	502	106	446	112
Brahman-X (Br)	519	94	86	1	83	9.1	1,284	539	114	463	116
Brown Swiss-X (B)	681	92	85	8	91	8.3	1,242	534	112	454	114
Gelbvieh-X (G)	429	95	87	11	90	8.3	1,285	533	112	464	116
Simmental-X (S)	872	89	83	17	91	8.3	1,281	521	110	433	108
Maine Anjou-X (MA)	468	94	86	11	96	6.4	1,365	522	110	449	112
Limousin-X (L)	851	89	82	12	88	5.5	1,234	484	102	397	100
Charolais-X (C)	693	88	80	15	93	5.5	1,356	503	106	403	101
Chianina-X (Ci)	475	93	86	8	95	6.1	1,369	523	110	450	113

[a]Includes calves requiring calf puller or Caesarean section.
[b]Adjusted to a steer basis.
[c]Average of three 12-h milk production measures on a sample of 18 cows per breed group at 3 and 4 years of age.
[d]Cow weight taken in fall at weaning time when cows were 7-year-olds.
[e]Ratio computed relative to average for Hereford-Angus reciprocal cross dams.