Performance and Carcass Characteristics of Different Cattle Types--A Preliminary Report

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This report contains results from the U. S. Meat Animal Research Center Cattle Germ Plasm Evaluation Program. Dr. Keith Gregory and Dr. Hudson Glimp, U. S. Meat Animal Research Center, Clay Center, Nebraska, initiated and designed the cattle germ plasm evaluation program. Kansas State University and the Livestock Division, C&MS, U.S.D.A. are cooperating on the project.

The project was designed to characterize breeds from different cattle types in the full spectrum of economic traits that relate to reproduction, maternal ability, growth, feed efficiency, and carcass and meat traits. Hereford, Angus, Jersey, South Devon, Limousin, Simmental, and Charolais breeds are represented as different biological types. Results of the first calf crop, including calving data, preweaning growth, postweaning feedlot growth and feed efficiency, and carcass and meat traits are presented here, along with postweaning growth and reproductive performance of the heifers in the first calf crop. This report is only preliminary; data from two additional calf crops will be combined with the data presented here.

Experimental Procedure

Commercial Hereford and Angus females were bred artificially to seven breeds of sires. The females were purchased as calves at weaning from commercial producers in Nebraska and were two, three, four and five years old at calving in 1970. The calves were born in late March, April and early May, and were creep fed a ration of whole oats beginning in mid-July.

Fourteen Hereford, 14 Angus, ten Charolais, eight Simmental, 14 South Devon, 12 Jersey and six Limousin sires were used in 1969. The Hereford and Angus bulls had been selected on individual performance information as a basis to be accepted for progeny testing by an artificial insemination organization.

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[1]Appreciation is extended to Miss Jean Riggs and Mr. Coy Allen, Housing and Food Service, Kansas State University, for their excellent cooperation in this study.

The Charolais breed included three domestic and seven French bulls, The eight Simmental bulls included five available commercially in 1969, and three bulls that the Canada Department of Agriculture had imported for research. The Limousin bulls were the six available commercially after early July, 1969. The South Devon bulls were sampled from a commercial importation made early in 1969, and the Jersey bulls were selected at random from two artificial insemination organizations.

Because the number of progeny per sire is relatively low, general releases of information on individual sires is not released.

Calving difficulty scores presented in table 47 for two-year-old females and table 48 for three-, four-, and five-year-old females were assigned to each calf at birth using this scoring system:

Score		Description
1. No difficulty	-	Calves unassisted; however, sometimes necessary to straighten head and/or front legs.
2. Little difficulty	-	Assistance by hand, but no jack or puller used; assistance sometimes not required.
3. Moderate difficulty	-	Assistance with jack or calf puller; some difficulty encountered even then.
4. Major difficulty	-	Calf jack used and major difficulty encountered; usually 30 minutes or more required to deliver calf.
5. Caesarean birth	-	
6. Posterior presentation	-	

At weaning, steer calves with adjusted weaning weights three standard deviations below the mean (nine head) were removed from the study, The remaining steers were placed in the feedlot by breed of sire group (replicated with two lots per breed of sire) to obtain data on growth rate and feed efficiency. Weaning weights (table 49) were adjusted to a steer basis and to a four- or five-year-old cow basis. The adjustment factors were developed from these data and were as follows:

	Birth wt.	Preweaning A.D.G.	200-day wt.
Heifer calf adj.	+6	+.113	+29
Steer calf adj.	0	0	0
2-year-old dam	+8	+.265	+61
3-year-old dam	+3	+.033	+ 9
4- or 5-year-old dam	0	0	0

Feedlot rations are presented in table 50. Postweaning average daily gains (table 51) are based on actual weaning weights (no weaning shrink) and final weights at slaughter. Final weights at slaughter were the average of two weights (on feed and water) taken on different days to reduce errors from differences in fill. Adjusted final weight was obtained by adding postweaning average daily gain x days on feed to weaning weight adjusted to 200 days of age and to a four- or five-year-old dam basis. Average daily gains and adjusted final weights (415 days, 443 days, 471 days of age) (table 51) for each of the three slaughter groups are for steers slaughtered in that group only. Feed efficiency for each breeding group was obtained by dividing the cumulative average daily TDN consumption per steer by the average daily gain of the steers.

Approximately one-third of the steers in each breed of sire by breed of dam group was slaughtered at each of three slaughter dates (215, 243 and 271 days on feed after weaning). Steers to be slaughtered from each breeding group at each of the three times were identified at random across all birth dates. The steers averaged 28 days between slaughter groups 1 and 2 and between slaughter groups 2 and 3. However, birth dates did not average the same for all breeding groups because of differences in conception date and gestation length. Average birth dates are presented in table 49 by breeding group. The steers were transported to a commercial slaughter plant approximately 12 hours before slaughter, and were allowed to chill 24 hours after slaughter before carcass data were obtained. Carcasses were evaluated for conformation, maturity, marbling, color, texture, and firmness. U.S.D.A. Quality Grade was determined by representatives of the Livestock Division, C&MS, U.S.D.A., and Kansas State University. Loin eye area (tables 52 and 53). Additional selected linear carcass measurements and measures of other traits were obtained that are not included in this report.

The right side of each carcass was transported to Kansas State University approximately 56 hours after slaughter to obtain detailed cut-out and meat quality data. Each side was separated into wholesale cuts, and the wholesale cuts were processed into closely trimmed, boneless cuts with no more than 0.30 in. of fat on any surface. Amounts of retail product, fat trim, and bone were determined for each wholesale cut (table 54).

One steak was removed from each carcass at the 11th rib for Warner-Bratzler shear determination. The steaks were cooked at 350°F to an internal temperature of 150°F. After cooling for approximately 30 minutes at room temperature, one-half inch cores were removed for shear determination. Steaks were removed at the 10th rib from four representative carcasses per breed group per slaughter date (168 carcasses), cooked at 350°F to an internal temperature of 150°F, and subjected to taste panel evaluation for tenderness, flavor, juiciness and overall acceptability by trained taste panelists (table 55).

Data for carcass and meat traits were analyzed by least squares procedures for unequal subclass numbers using a model that included effects of age of dam (two-, three, four-, and five-year-olds); breed of sire (straightbred Hereford and Angus, Hereford-Angus reciprocal crosses, Jersey, South Devon, Limousin, Simmental and Charolais); breed of dam (Hereford, Angus); time of slaughter, and breed of sire-breed of dam-time of slaughter; and birth date was included as a covariate to adjust for differences in age of calf within slaughter groups. Thus, the least-squares means for the carcass and meat traits are adjusted for age of dam and to 415, 443 and 471 days of age for the three slaughter groups.

Postweaning average daily gain and adjusted final weight for both steers and heifers were analyzed by least squares procedures using the same model except that birth date was not included as a covariate.

Postweaning growth, puberty and pregnancy data on the heifers in the first calf crop are presented in table 56. The heifers were kept in drylot from weaning through the artificial insemination breeding period (November 17-July 7). Their postweaning ration was 50% corn silage and 50% grass silage fed ad libitum. The adjusted 400-day weight is based on a full weight; the adjusted 550-day weight is based on a shrunk weight.

Date of puberty, defined as date of first observed standing estrus, was determined by checking animals for estrus twice daily. Body weights were taken every 28 days from weaning to the breeding period and again when the breeding period terminated. Heifers were inseminated only after standing for vasectomized bulls or other heifers. Following the artificial insemination breeding season (May 24-July 7, 45 days), heifers were placed on pasture for a 26-day natural service breeding period. The percentage of heifers reaching puberty by 15 months and the average age of those that reached puberty are for heifers observed in estrus upto the end of the artificial insemination breeding season only; the percentage pregnant includes heifers that may have reached puberty and bred during the 26-day natural service breeding period.

Results and Discussion

Many differences reported here are large enough that additional data should add to their significance. However, many differences are too small to be interpreted as statistically valid or actual differences.

Calving difficulty scores on two-year-old females indicate calving difficulty in all crossbred combinations. However, more difficulty occurred with Limousin, Simmental, South Devon, and Charolais sired calves than with others. The Jersey sired calves caused the least difficulty in calving, as expected. Slightly more difficulty was encountered with Hereford than Angus dams.

Fewer calving problems occurred in the three-, four-, and five-year-old females than in two-year-old females with little difference between Hereford and Angus dams. However, Simmental and Charolais calves still caused some problems with Limousin and South Devon calves intermediate in calving difficulty.

Adjusted weaning weights for Simmental and Charolais calves were higher than weights of other calves. Limousin calves were slightly lighter than Simmental or Charolais calves. South Devon calves were intermediate in weight and simialr to the Angus-Hereford reciprocal cross calves. Purebred calves were lightest except for Jersey crosses. Calves from Angus cows tended to be slightly heavier than calves from Hereford cows at weaning.

All steers averaged a modest 2.45 pounds during the feedlot period, undoubtedly due to the high roughage ration. Simmental and Charolais calves appeared to have an edge over the other calves. Jersey calves were lowest in average daily gain while the purebred calves, Angus-Hereford reciprocal crosses, and Limousin calves were intermediate in gain. South Devon calves were slightly above average in postweaning growth. In general, TDN efficiency was related to postweaning growth rate, with the faster gaining calves having some advantage in feed efficiency. One exception to that generalization was Limousin's feed efficiency being nearly as good as any sire breed, but their daily gain was only about average. Calves from Hereford dams appeared to out-perform calves from Angus dams.

Differences in dressing percentages were not large, but Jerseys were the lowest of all breeds. Purebred and Simmental steers appeared to be intermediate in dressing percentage, while South Devons, Limousins, Charolais, and Angus-Hereford reciprocal crosses dressed slightly higher.

The 452 steers averaged low Choice on the rail. On a scoring system of 9 for high Good, 10 for low Choice, and 11 for average Choice, the calves out of Angus dams had a higher U.S.D.A. quality grade (10.6) than those out of Hereford dams (10.1). Only the Limousin steers failed to average low Choice (9.4). Jersey and Simmental steers averaged low Choice, slightly lower than the remaining breeds. There was essentially no increase in quality grade between cattle slaughtered at the three time periods. Variation in grade between breeds was less than expected.

Wider differences showed up in carcass cutability. Limousin, Simmental, and Charolais sired steers had larger rib eyes with better U.S.D.A. yield grades than other sire breeds did. Limousin, Simmental, Charolais and Jersey steers tended to have less fat at the 12th rib than the other sire breeds. Purebred Angus and Hereford and their reciprocal crosses had more fat cover than any of the other breeds.

The Limousins appeared to have a higher cutability percentage than other breeds (56.6%); Simmental and Charolais steers were considerably above average (53.8 and 54.6%, respectively). Differences were small among the remaining breeds. Limousins had the least fat trim, followed closely by Simmental and Charolais steers. The South Devons were intermediate in fat trim, while Angus-Hereford reciprocal crosses seemed to have the most fat trim. Percentage of carcass bone varied only about one percent among all breeds.

Warner-Bratzler shear data suggests little variation among breeds and that all breeds had steaks with desirable tenderness. Taste panel tenderness scores also showed steaks "moderately tender" with little variation among breeds. Scores for steak flavor, juiciness, and overall acceptability were "moderately desirable" with rather small differences among breeds.

Preliminary data for growth and reproductive performance of heifers indicate that heifers from Angus dams had higher 200-day postweaning gains and a higher percentage reaching puberty at 15 months. Also, a higher percentage of heifers from Angus dams were pregnant than heifers from Hereford dams after the breeding season.

Except for Jersey heifers, crossbreeding showed some advantage in postweaning growth over straightbreeding. Simmental and Charolais heifers appeared to have an edge in postweaning growth over all other breeds. Except for South Devon crosses, crossbreeding also showed some advantage in fertility. At 15 months of age, 87% of all crossbred heifers had showed signs of estrus versus 69% for the straightbred Angus and Herefords. After a ten-week breeding

season, 92& of all crossbred heifers were pregnant versus 74% for straightbred cattle. A higher percentage of the Jersey and Angus-Hereford reciprocal crosses were pregnant than for other breeds.

Table 47. U.S. Meat Animal Research Center Germ Plasm Evaluation calving difficulty summary, 1970 calf crop, 2-year-old females.

Breed of sire	Breed of dam	No of calves	Calving difficulty score												Dead at or shortly after birth	
			1		2		3		4		5		6			
			No.	%	No.	%	No.	%	No.	%	No.	%	No.	%		
Hereford	Hereford	25	8	32.0	2	8.0	1	4.0	13	52.0	1	4.0	0		0	
Angus	Angus	44	29	65.9	1	2.3	0		14	31.8	0		0		4	9.1
	Average	69	37	53.6	3	4.3	1	1.4	27	39.3	1	1.4	0		4	5.8
Angus	Hereford	37	16	43.2	3	8.1	1	2.7	17	46.0	0		0		5	13.5
Hereford	Angus	50	34	68.0	1	2.0	1	2.0	14	28.0	0		0		3	6.0
	Average	87	50	57.5	4	4.6	2	2.3	31	35.6	0		0		8	9.2
Jersey	Hereford	27	19	70.4	3	11.1	1	3.7	4	14.8	0		0		0	
	Angus	44	41	93.1	2	4.6	0		1	2.3	0		0		1	2.3
	Average	71	60	81.8	5	7.9	1	1.8	5	8.6	0		0		1	1.2
South Devon	Hereford	15	5	33.3	2	13.3	2	13.3	5	33.3	1	6.7	0		1	6.7
	Angus	33	12	36.4	1	3.0	2	6.1	17	51.5	1	3.0	0		4	12.0
	Average	48	17	34.9	3	8.2	4	9.7	22	42.4	2	4.9	0		5	9.4
Limousin	Hereford	37	4	10.8	1	2.7	2	5.4	26	70.3	3	8.1	1	2.7	3	8.1
	Angus	27	8	29.6	2	7.4	2	7.4	15	55.6	0		0		1	3.7
	Average	64	12	20.2	3	5.1	4	6.4	41	63.0	3	4.1	1	1.4	4	5.9
Simnental	Hereford	16	2	12.5	0		0		8	50.0	6	37.5	0		1	6.3
	Angus	17	8	47.0	1	5.9	1	5.9	5	29.5	2	11.7	0		2	11.7
	Average	33	10	29.8	1	3.0	1	3.0	13	39.8	8	24.6	0		3	9.0
Charolals	Hereford	21	4	19.0	2	9.5	0		11	52.4	3	14.3	1	4.8	3	14.3
	Angus	22	6	27.3	0		1	4.6	15	68.1	0		0		3	13.6
	Average	43	10	23.2	2	4.8	1	2.3	26	60.3	3	7.2	1	2.4	6	14.0
Average	Hereford	178	58	32.6	13	7.3	7	3.9	84	47.2	14	7.9	2	1.1	13	7.3
All Sire	Angus	237	138	58.2	8	3.4	7	3.0	81	34.2	3	1.3	0		18	7.6
Breeds	Average	415	196	45.4	21	5.4	14	3.5	165	40.7	17	4.6	2	.6	31	7.5

Table 48. U.S. Meat Animal Research Center Germ Plasm Evaluation calving difficulty summary, 1970 calf crop, 3-, 4-, 5-year-old females.

Breed of sire	Breed of dam	No. of calves	Calving difficulty score 1		2		3		4		5		6		Dead at or shortly after birth	
			No.	%		%		%		%		%		%	No.	%
Hereford	Hereford	37	34	91.9	1	2.7	1	2.7	0		0		1	2.7	2	5.4
Angus	Angus	32	30	93.8	0		1	3.1	1	3.1	0		0		2	6.3
	Average	69	64	92.6	1	1.5	2	2.9	1	1.5	0		1	1.5	4	5.8
Angus	Hereford	29	29	100.0	0		0		0		0		0		0	
Hereford	Angus	47	44	93.6	2	4.3	0		1	2.1	0		0		0	
	Average	76	73	96.1	2	2.6	0		1	1.3	0		0		0	
Jersey	Hereford	29	28	97.0	0		1	3.0	0		0		0		1	3.0
	Angus	32	32	100.0	0		0		0		0		0		0	
	Average	61	60	98.5	0		1	1.5	0		0		0		1	1.5
South Devon	Hereford	17	12	70.0	1	6.0	2	12.0	2	12.0	0		0		1	6.0
	Angus	12	12	100.0	0		0		0		0		0		0	
	Average	29	24	85.0	1	3.0	2	6.0	2	6.0	0		0		1	3.0
Limousin	Hereford	44	38	87.0	1	2.0	1	2.0	3	7.0	0		1	2.0	2	5.0
	Angus	42	33	78.0	2	5.0	2	5.0	4	10.0	0		1	2.0	3	7.0
	Average	86	71	82.5	3	3.5	3	3.5	7	8.5	0		2	2.0	5	6.0
Simmental	Hereford	64	45	71.0	6	9.0	4	6.0	9	14.0	0		0		10	16.0
	Angus	72	59	82.0	2	3.0	3	4.0	7	10.0	0		1	1.0	4	6.0
	Average	136	104	76.5	8	6.0	7	5.0	16	12.0	0		1	0.5	14	11.0
Charolais	Hereford	64	46	72.0	3	5.0	6	9.0	7	11.0	0		2	3.0	8	13.0
	Angus	67	53	79.0	0		2	3.0	9	13.0	0		3	5.0	5	7.0
	Average	131	99	75.5	3	2.5	8	6.0	16	12.0	0		5	4.0	13	10.0
Average	Hereford	284	232	81.7	12	4.2	15	5.3	21	7.4	0		4	1.4	24	8.5
All Sire	Angus	304	263	86.5	6	2.0	8	2.6	22	7.2	0		5	1.7	14	4.6
Breeds	Average	588	495	84.1	18	3.1	23	4.0	43	7.3	0		9	1.5	38	6.6

Table 49. U.S. Meat Animal Research Center Germ Plasm Evaluation preweaning summary, 1970 calf crop.

Breed of sire	Breed of dam	No. of calves	Birth date	Birth wt.	Preweaning A.D.G.	Adjusted 200-day wt.	200-day wt. ratio
Hereford	Hereford	55	April 17	80	1.82	445	94.7[b]
Angus	Angus	66	April 6	72	1.95	463	96.0[c]
	Average	121	April 12	76	1.89	454	95.4[d]
Angus	Hereford	59	April 13	81	1.90	460	97.9
Hereford	Angus	87	April 8	78	2.01	479	99.4
	Average	146	April 11	80	1.96	470	98.7
Jersey	Hereford	53	April 13	73	1.90	452	96.4
	Angus	71	April 2	66	1.90	444	92.2
	Average	124	April 7	69	1.90	448	94.3
South Devon	Hereford	28	April 13	85	1.90	466	99.1
	Angus	39	April 9	81	2.00	482	100.0
	Average	67	April 11	83	1.95	474	99.5
Limousin	Hereford	70	May 2	87	1.94	476	101.5
	Angus	63	April 26	84	2.06	496	102.9
	Average	133	April 29	86	2.00	486	102.2
Simmental	Hereford	65	April 21	93	1.99	491	104.5
	Angus	78	April 11	85	2.09	503	104.4
	Average	143	April 16	89	2.04	497	104.4
Charolais	Hereford	68	April 18	92	2.03	498	106.1
	Angus	76	April 11	85	2.11	507	105.2
	Average	144	April 14	88	2.07	502	105.6
Average All Sire Breeds	Hereford	398	April 18	84	1.93	470	100.0
	Angus	480	April 10	78	2.02	482	100.0
	Average	878	April 14	81	1.97	476	100.0

[a] Includes all steer and heifer calves weaned.
[b] Ratio computed relative to average for Hereford cows, adjusted to a steer calf and to a 4- and 5-year-old cow basis.
[c] Ratio computed relative to average for Angus cows, adjusted to a steer calf and a 4-and 5-year-old cow basis.
[d] Ratio computed relative to overall average adjusted to a steer calf and a 4- and 5-year-old cow basis.

Table 50. U.S. Meat Animal Research Center Germ Plasm Evaluation postweaning steer, feedlot rations.

Ingredient	Nov. 17-Nov. 24	Nov. 25-Jan. 10	Jan. 11-Apr. 28
	%	%	%
Corn silage	89.0	77.5	60.0
Concentrate[1]	7.5	17.5	35.0
Supplement, 38% crude protein[2]	3.5	5.0	5.0
Ration analyses, 90% dry matter basis			
Crude protein, %	10.6	11.6	10.8
Digestible protein, %	8.1	8.9	8.6
Total digestible nutrients, %	64.8	68.0	71.6

[1]The concentrate portion included varying amounts of ground shelled corn, ground sorghum grain, and ground wheat.

[2]Composition of a ton of supplement: 1492 lb. soybean meal; 200 lb. salt; 100 lb. dicalcium phosphate; 130 lb. ground limestone; 7.0 lb. vitamin ADE premix (4,000,000 IU Vitamin A/lb.); 1.4 lb. Aureomycin (50 grams/lb.); 10 lb. trace mineral premix; 60 lb. ammonium chloride.

Table 51. U.S. Meat Animal Research Center Germ Plasm Evaluation least squares means for postweaning average daily gains, adjusted final weights, and TDN efficiencies

Breed of sire	Breed of dam	No. of steers[a]				Postweaning average daily gain[b], lb.				Adjusted final weight[c], lb.				TDN efficiency[d]			
		215	243	271	Total	215	243	271	Avg.	215	243	271	Avg.	215	243	271	Avg.
Hereford	Hereford	8	8	7	23	2.43	2.38	2.38	2.40	969	1017	1098	1028				
Angus	Angus	13	12	13	38	2.48	2.26	2.26	2.34	1006	1016	1072	1032				
	Average	21	20	20	61	2.45	2.32	2.32	2.37	988	1017	1085	1030	5.97	6.45	6.58	6.33
Angus	Hereford	10	11	10	31	2.45	2.52	2.40	2.45	980	1077	1108	1055				
Hereford	Angus	18	17	16	51	2.38	2.37	2.36	2.37	986	1066	1116	1056				
	Average	28	28	26	82	2.42	2.44	2.38	2.41	983	1071	1112	1055	6.11	6.47	6.76	6.45
Jersey	Hereford	7	8	8	23	2.36	2.15	2.24	2.25	953	965	1072	997				
	Angus	15	14	14	43	2.22	2.18	2.08	2.16	931	973	1024	976				
	Average	22	22	22	66	2.29	2.16	2.16	2.20	942	969	1048	986	6.58	6.88	7.11	6.86
South Devon	Hereford	3	4	3	10	2.37	2.58	2.73	2.56	970	1069	1217	1085				
	Angus	6	8	7	21	2.62	2.56	2.31	2.50	1053	1096	1104	1084				
	Average	9	12	10	31	2.50	2.57	2.52	2.53	1012	1082	1161	1085	5.88	6.38	6.66	6.31
Limousin	Hereford	12	12	11	35	2.61	2.54	2.22	2.45	1069	1100	1076	1082				
	Angus	11	12	13	36	2.39	2.43	2.26	2.36	1014	1107	1115	1079				
	Average	23	24	24	71	2.50	2.48	2.24	2.41	1042	1103	1096	1080	5.86	6.20	6.57	6.21
Simmental	Hereford	10	10	10	30	2.78	2.64	2.68	2.70	1069	1125	1216	1137	5.54	6.04	6.19	5.92
	Angus	12	13	14	39	2.58	2.49	2.59	2.55	1064	1105	1222	1130	5.96	6.47	6.60	6.34
	Average	22	23	24	69	2.68	2.57	2.63	2.63	1067	1115	1219	1133	5.75	6.26	6.40	6.13
Charolais	Hereford	10	10	10	30	2.82	2.67	2.66	2.71	1106	1148	1223	1159	5.55	5.89	6.23	5.89
	Angus	14	14	14	42	2.52	2.47	2.44	2.48	1036	1105	1185	1108	6.06	6.56	6.72	6.45
	Average	24	24	24	72	2.67	2.57	2.55	2.60	1071	1126	1204	1134	5.80	6.22	6.48	6.17
Average All Sire Breeds	Hereford	60	62	59	181	2.54	2.50	2.47	2.50	1017	1071	1144	1077				
	Angus	89	91	91	270	2.46	2.40	2.33	2.39	1013	1067	1120	1066				
	Average	149	153	150	452	2.50	2.45	2.40	2.45	1015	1069	1132	1072	5.99	6.41	6.65	6.35

[a]Number of steers slaughtered after 215, 243, and 271 days on feed.
[b]Average daily gain = (final weight - weaning weight) ÷ days on feed.
[c]Adjusted final weight = adjusted 200-day weight + (postweaning average daily gain x days on feed postweaning).
[d]TDN efficiency = lb. TDN consumer per lb. gain; 90% dry matter basis for feed consumed.

Table 52. U.S. Meat Animal Research Center Germ Plasm Evaluation least squares means for adjusted hot carcass weight, dressing percentage and U.S.D.A. Quality Grade[a].

Breed of sire	Breed of dam	Adjusted hot carcass weight, lb.				Dressing %				U.S.D.A. Quality Grade[b]			
		215	243	271	Avg.	215	243	271.	Avg.	215	243	271	Avg.
Hereford	Hereford	585	614	659	619	60.9	60.4	60.5	60.6	10.0	10.3	10.0	10.1
Angus	Angus	608	618	657	628	60.9	61.2	61.6	61.2	11.3	11.2	11.1	11.2
	Average	596	616	658	623	60.9	60.8	61.1	60.9	10.7	10.7	10.5	10.6
Angus	Hereford	587	653	685	642	60.6	61.0	62.1	61.2	10.7	11.2	10.8	10.9
Hereford	Angus	594	654	692	647	60.6	61.6	62.4	61.5	10.0	10.6	10.4	10.3
	Average	591	653	688	644	60.6	61.3	62.3	61.4	10.3	10.9	10.6	10.6
Jersey	Hereford	577	566	638	594	59.0	59.4	59.7	59.4	9.7	9.7	9.8	9.7
	Angus	557	580	610	582	60.4	60.3	59.9	60.2	10.5	10.8	10.5	10.6
	Average	567	573	624	588	59.7	59.8	59.8	59.8	10.1	10.3	10.1	10.2
South Devon	Hereford	586	653	743	661	61.0	61.3	61.4	61.2	10.7	9.6	11.0	10.4
	Angus	642	676	682	667	61.3	62.1	62.2	61.9	11.0	10.7	10.9	10.9
	Average	614	665	713	664	61.1	61.7	61.8	61.5	10.8	10.1	11.0	10.6
Limousin	Hereford	649	684	672	669	61.1	62.4	62.7	62.1	9.2	9.1	9.6	9.3
	Angus	614	685	688	662	60.7	62.3	62.0	61.7	9.7	9.3	9.6	9.5
	Average	632	685	680	665	60.9	62.4	62.3	61.9	9.4	9.2	9.6	9.4
Simmental	Hereford	628	674	739	681	59.2	60.3	61.0	60.2	9.5	10.1	9.5	9.7
	Angus	646	663	743	684	60.9	60.3	61.1	60.8	10.7	10.4	10.5	10.5
	Average	637	669	741	682	60.1	60.3	61.1	60.5	10.1	10.3	10.0	10.1
Charolais	Hereford	677	689	761	709	61.6	60.3	62.0	61.3	10.1	9.9	10.8	10.3
	Angus	619	688	740	682	60.1	62.5	62.6	61.7	10.3	10.9	11.1	10.8
	Average	648	689	750	696	60.9	61.4	62.3	61.5	10.2	10.4	10.9	10.5
Average All Sire Breeds	Hereford	613	648	700	653	60.5	60.7	61.3	60.9	10.0	10.0	10.2	10.1
	Angus	612	652	687	650	60.7	61.5	61.7	61.3	10.5	10.6	10.6	10.6
	Average	612	650	694	652	60.6	61.1	61.5	61.1	10.2	10.3	10.4	10.3

a Data for all carcass traits adjusted by regression on birthdate to the average age of each slaughter group, and adjusted for age of dam.

b U.S.D.A. Quality Grade: 9 = high good; 10 = low choice; 11 = average choice; 12 = high choice; etc.

Table 53. U.S. Meat Animal Research Center Germ Plasm Evaluation least squares means for yield grade, rib eye area, fat thickness, and percentages of kidney, pelvic, and heart fat[a].

Breed of sire	Breed of dam	U.S.D.A. Yield Grade				Rib eye area, sq. in.				Fat thickness, in.				Estimated kidney, pelvic, and heart fat, %			
		215	243	271	Avg.	215	243	271	Avg.	215	243	271	Avg.	215	243	271	Avg.
Hereford	Hereford	3.1	3.2	3.5	3.3	10.4	11.4	11.5	11.1	.50	.59	.65	.58	2.2	2.7	2.9	2.6
Angus	Angus	3.5	3.4	3.9	3.6	10.8	11.4	11.4	11.2	.61	.60	.87	.70	3.5	3.3	3.4	3.4
	Average	3.3	3.3	3.7	3.4	10.6	11.4	11.4	11.1	.56	.60	.76	.64	2.9	3.0	3.2	3.0
Angus	Hereford	3.2	3.5	3.6	3.4	11.0	11.7	12.3	11.6	.54	.67	.73	.65	3.2	3.3	3.2	3.2
Hereford	Angus	3.4	3.7	4.3	3.8	10.8	11.2	11.3	11.1	.61	.72	.89	.74	3.0	3.0	3.3	3.1
	Average	3.3	3.6	3.9	3.6	10.9	11.4	11.8	11.3	.57	.70	.81	.69	3.1	3.1	3.3	3.2
Jersey	Hereford	3.2	3.1	3.7	3.3	10.1	10.9	11.4	10.8	.31	.43	.52	.42	4.4	4.5	5.7	4.8
	Angus	3.5	3.3	3.7	3.5	10.5	11.1	10.9	10.8	.54	.51	.62	.56	4.6	4.6	5.1	4.8
	Average	3.3	3.2	3.7	3.4	10.3	11.0	11.1	10.8	.43	.47	.57	.49	4.5	4.6	5.4	4.8
South Devon	Hereford	2.8	3.1	3.6	3.2	11.8	11.5	11.9	11.8	.41	.47	.62	.50	3.4	3.4	4.1	3.6
	Angus	3.1	3.1	3.6	3.3	11.8	12.4	12.3	12.2	.53	.54	.68	.58	3.6	3.2	4.2	3.7
	Average	2.9	3.1	3.6	3.2	11.8	12.0	12.1	12.0	.47	.51	.65	.54	3.5	3.3	4.1	3.6
Limousin	Hereford	2.3	2.4	2.8	2.5	12.8	13.7	12.7	13.1	.37	.42	.56	.45	2.7	3.1	3.0	2.9
	Angus	2.4	2.6	2.7	2.6	12.2	13.1	13.3	12.9	.37	.49	.51	.46	2.8	3.4	3.3	3.2
	Average	2.3	2.5	2.8	2.5	12.5	13.4	13.0	13.0	.37	.46	.54	.46	2.8	3.2	3.1	3.1
Simmental	Hereford	2.4	2.6	2.8	2.6	11.9	12.5	13.2	12.5	.32	.42	.52	.42	2.8	2.9	2.9	2.9
	Angus	2.8	3.0	3.1	2.9	12.3	12.2	13.3	12.6	.46	.47	.53	.49	3.3	3.5	3.9	3.6
	Average	2.6	2.8	3.0	2.8	12.1	12.3	13.2	12.6	.39	.45	.53	.45	3.0	3.2	3.4	3.2
Charolais	Hereford	3.0	2.4	2.9	2.7	11.8	13.0	12.8	12.5	.42	.35	.42	.40	3.0	2.9	3.1	3.0
	Angus	2.5	3.0	2.8	2.8	11.6	12.8	13.8	12.7	.35	.49	.50	.45	2.7	3.6	4.0	3.4
	Average	2.7	2.7	2.8	2.8	11.7	12.9	13.3	12.6	.39	.42	.46	.42	2.8	3.3	3.6	3.2
Average All Sire Breeds	Hereford	2.8	2.9	3.3	3.0	11.4	12.1	12.2	11.9	.41	.48	.57	.49	3.1	3.3	3.6	3.3
	Angus	3.0	3.2	3.4	3.2	11.4	12.0	12.3	11.9	.50	.55	.66	.57	3.3	3.5	3.9	3.6
	Average	2.9	3.0	3.4	3.1	11.4	12.1	12.3	11.9	.45	.51	.62	.53	3.2	3.4	3.7	3.4

[a] Data for all carcass traits adjusted by regression on birth date to the average age of each slaughter group, and adjusted for age of dam.

Table 54. U.S. Meat Animal Research Center Germ Plasm Evaluation least squares means for cutability, retail product, fat trim, and bone percentages[a].

Breed of sire	Breed of dam	Cutability, %[b]				Retail product, %[c]				Fat trim, %				Bone, %			
		215	243	271	Avg.	215	243	271	Avg.	215	243	271	Avg.	215	243	271	Avg.
Hereford	Hereford	52.1	51.2	49.9	51.4	65.5	64.9	61.6	64.1	20.9	22.3	25.9	22.9	13.6	12.8	12.6	13.0
Angus	Angus	50.3	50.0	48.2	49.5	64.0	63.5	60.2	62.5	23.4	24.5	28.4	25.5	12.6	12.1	11.4	12.0
	Average	50.9	50.5	48.8	50.2	64.6	64.1	60.7	63.1	22.3	23.4	27.3	24.4	13.1	12.4	12.0	12.5
Angus	Hereford	51.6	51.3	50.5	51.1	65.4	63.8	62.8	64.0	21.7	23.7	25.2	23.6	12.8	12.5	11.9	12.4
Hereford	Angus	50.3	49.2	47.7	49.1	63.5	61.4	59.0	61.4	23.6	26.4	29.8	26.5	12.9	12.2	11.2	12.1
	Average	50.8	50.0	48.8	49.9	64.2	62.3	60.5	62.4	22.9	25.3	28.0	25.4	12.9	12.4	11.6	12.3
Jersey	Hereford	51.2	50.6	49.6	50.4	64.6	63.5	61.5	63.2	21.6	23.6	25.6	23.6	13.9	12.9	12.8	13.2
	Angus	48.6	49.8	48.8	49.1	61.3	62.5	60.9	61.5	26.1	25.1	26.7	26.1	12.6	12.4	12.3	12.5
	Average	49.4	50.1	49.1	49.6	62.4	62.9	61.1	62.1	24.3	24.4	26.3	25.1	13.2	12.7	12.6	12.8
South Devon	Hereford	52.7	53.6	49.5	52.1	65.7	67.1	61.0	64.8	20.1	19.9	26.0	21.8	14.2	13.0	13.0	13.4
	Angus	51.5	52.7	49.6	51.3	64.8	66.3	61.8	64.4	22.7	21.0	26.3	24.1	12.9	12.6	11.9	12.5
	Average	51.9	53.0	49.6	51.6	65.1	66.6	61.6	64.5	21.3	20.6	25.9	22.6	13.5	12.8	12.5	12.9
Limousin	Hereford	58.1	56.9	55.6	56.9	72.1	70.8	68.3	70.5	14.2	16.3	18.7	16.3	13.8	12.9	13.0	13.2
	Angus	58.2	56.1	54.9	56.3	72.6	70.1	67.7	70.0	13.5	17.2	19.8	17.0	13.9	12.7	12.5	13.0
	Average	58.2	56.5	55.2	56.6	72.3	70.5	68.0	70.3	13.8	16.8	19.3	16.6	13.8	12.8	12.7	13.1
Simmental	Hereford	56.4	54.5	54.8	55.2	70.7	68.0	67.8	68.8	14.6	18.2	18.5	17.1	14.7	13.8	13.7	14.0
	Angus	53.3	52.4	52.6	52.7	66.9	65.3	65.2	65.7	19.6	21.5	21.8	21.0	13.5	13.3	13.0	13.3
	Average	54.7	53.3	53.5	53.8	68.6	66.5	66.3	67.1	17.3	20.0	20.4	19.3	14.1	13.5	13.3	13.6
Charolais	Hereford	54.3	56.5	54.4	55.1	68.1	70.2	67.3	68.5	18.1	17.2	19.5	18.0	13.8	13.6	13.3	13.6
	Angus	55.2	53.7	54.2	54.3	69.1	67.2	67.1	67.8	16.5	20.2	20.4	19.1	14.4	12.6	12.5	13.2
	Average	54.8	54.9	54.3	54.6	68.7	68.5	67.2	68.1	17.2	18.4	19.9	18.6	14.1	13.1	12.9	13.4
Average	Hereford	54.2	54.6	52.6	53.8	67.7	68.2	65.0	67.0	18.5	18.7	22.1	19.8	13.8	13.1	12.9	13.3
All Sire	Angus	52.2	51.2	50.9	51.4	65.9	64.2	63.1	64.4	20.8	23.2	24.8	22.9	13.3	12.6	12.1	12.6
	Average	53.0	52.6	51.6	52.4	66.6	65.8	63.9	65.5	19.8	21.4	23.6	21.5	13.5	12.8	12.5	13.0

[a]Data for all carcass traits adjusted by regression on birth date to the average age of each slaughter group, and adjusted for age of dam.
[b]Cutability, % = Actual yield of boneless, closely trimmed beef from round, loin, rib, and chuck (lean trim adjusted to 25% fat content).
[c]Retail Product, % = Actual yield of boneless, closely trimmed beef from carcass (lean trim adjusted to 25% fat content).

Table 55. U.S. Meat Animal Research Center Germ Plasm Evaluation least squares means for Warner-Bratzler shear and taste panel evaluation of cooked steaks[a].

Breed of sire	Breed of dam	Warner-Bratzler shear, lb.[b]				Taste panel[c]													
		tenderness				flavor				juiciness				acceptability					
		215	243	271	Avg.	215	243	271	Avg.	215	243	271	Avg.	215	243	271	Avg.	215	243	271	Avg.
Hereford	Hereford	7.6	6.7	7.3	7.2	7.4	7.2	7.3	7.3	7.3	7.5	7.3	7.4	7.0	6.7	6.8	6.8	7.1	7.2	7.2	7.1
Angus	Angus	7.1	6.4	6.3	6.6	7.3	7.9	7.1	7.4	7.5	7.6	7.4	7.5	6.7	7.3	6.4	6.8	7.3	7.6	7.1	7.3
	Average	7.3	6.5	6.8	6.9	7.4	7.5	7.2	7.3	7.4	7.5	7.4	7.4	6.8	7.0	6.6	6.8	7.2	7.4	7.1	7.2
Angus	Hereford	6.9	6.5	6.7	6.7	7.8	7.9	6.8	7.5	7.7	7.5	7.1	7.4	7.1	6.8	6.1	6.7	7.5	7.4	6.5	7.2
Hereford	Angus	8.0	6.7	7.0	7.3	6.9	7.0	7.6	7.2	7.2	7.2	7.9	7.4	6.9	6.2	7.2	6.8	7.0	6.9	7.6	7.2
	Average	7.5	6.6	6.8	7.0	7.4	7.5	7.2	7.4	7.4	7.4	7.5	7.4	7.0	6.5	6.6	6.7	7.3	7.2	7.1	7.2
Jersey	Hereford	7.1	5.9	6.2	6.4	7.5	7.8	7.2	7.5	7.3	7.6	7.6	7.5	6.7	6.7	7.3	6.9	7.2	7.5	7.3	7.3
	Angus	6.8	5.9	6.6	6.4	7.8	7.9	6.9	7.5	7.5	7.6	7.4	7.5	7.3	6.8	7.2	7.1	7.4	7.5	7.0	7.3
	Average	6.9	5.9	6.4	6.4	7.6	7.8	7.0	7.5	7.4	7.6	7.5	7.5	7.0	6.8	7.2	7.0	7.3	7.5	7.2	7.3
South Devon	Hereford	6.2	5.8	6.3	6.1	7.4	7.4	7.2	7.4	7.2	7.5	6.9	7.2	6.8	7.0	7.3	7.0	7.2	7.3	7.0	7.2
	Angus	6.2	6.6	6.2	6.3	8.1	7.4	7.7	7.7	7.7	7.1	7.5	7.4	7.2	7.0	7.1	7.1	7.6	7.0	7.6	7.4
	Average	6.2	6.2	6.3	6.2	7.8	7.4	7.5	7.5	7.4	7.3	7.2	7.3	7.0	7.0	7.2	7.1	7.4	7.1	7.3	7.3
Limousin	Hereford	7.5	7.6	7.7	7.6	7.0	6.7	6.5	6.8	7.2	7.6	7.6	7.5	7.1	6.7	7.0	6.9	7.1	6.8	7.0	6.9
	Angus	6.7	7.5	7.0	7.1	7.8	7.0	6.8	7.2	7.4	7.0	7.4	7.3	7.4	6.5	6.7	6.9	7.5	6.9	7.0	7.1
	Average	7.1	7.6	7.3	7.3	7.4	6.9	6.7	7.0	7.3	7.3	7.5	7.4	7.2	6.6	6.8	6.9	7.3	6.8	7.0	7.0
Simmental	Hereford	8.3	7.1	7.2	7.5	6.1	7.5	6.7	6.8	7.1	7.9	7.5	7.5	7.1	7.1	7.2	7.1	6.6	7.6	7.0	7.0
	Angus	7.2	7.4	6.7	7.1	7.8	7.2	7.6	7.5	7.8	7.8	7.5	7.7	7.6	7.4	7.2	7.4	7.7	7.4	7.3	7.5
	Average	7.8	7.2	6.9	7.3	6.9	7.3	7.1	7.1	7.5	7.8	7.5	7.6	7.3	7.3	7.2	7.3	7.1	7.5	7.2	7.2
Charolais	Hereford	7.5	7.2	6.7	7.1	7.7	6.7	7.4	7.3	7.3	7.3	7.7	7.4	7.0	6.5	7.3	6.9	7.2	7.4	7.4	7.3
	Angus	7.3	6.0	6.9	6.7	7.5	7.4	7.5	7.5	7.3	7.6	7.8	7.6	7.2	6.6	7.2	7.0	7.2	7.3	7.5	7.3
	Average	7.4	6.6	6.8	6.9	7.6	7.1	7.4	7.4	7.3	7.5	7.8	7.5	7.1	6.5	7.2	6.9	7.2	7.3	7.5	7.3
Average All Sire Breeds	Hereford	7.3	6.7	6.9	7.0	7.3	7.3	7.0	7.2	7.3	7.6	7.4	7.4	7.0	6.8	7.0	6.9	7.1	7.3	7.0	7.2
	Angus	7.0	6.6	6.7	6.8	7.6	7.4	7.3	7.4	7.5	7.4	7.6	7.5	7.2	6.8	7.0	7.0	7.4	7.2	7.3	7.3
	Average	7.2	6.7	6.8	6.9	7.4	7.4	7.2	7.3	7.4	7.5	7.5	7.5	7.1	6.8	7.0	7.0	7.3	7.3	7.2	7.2

[a]Data for all carcass traits adjusted by regression on birth date to the average age of each slaughter group, and adjusted for age of dam.

[b]Measure of pounds of force required to shear one-half inch cores of steaks cooked at 350°F to 150°F internal temperature and cooled for 30 minutes at room temperature. Warner-Bratzler shear values were obtained on steaks from all 425 steers.

[c]Taste panel scores based on a 9-point scale, with higher scores indicating greater acceptability. Taste panel traits measured on steaks from 4 steers per breed group per slaughter date (168).

Table 56. U.S. Meat Animal Research Center Germ-Plasm Evaluation postweaning growth and reproductive performance of heifers.

Breed of sire	Breed of dam	No. of heifers	200-day postweaning avg. daily gain, lb.	Adj. 400-day wt., lb.[a]	Adj. 550-day wt., lb.[b]	% reaching puberty by 15 mos.	Avg. age at puberty, days[c]	% pregnant[d]
Hereford	Hereford	27	0.91	598	658	48	390	67
Angus	Angus	24	1.13	660	683	92	372	80
	Average	51	1.02	629	670	69	381	74
Angus	Hereford	23	1.13	657	704	83	371	87
Hereford	Angus	23	1.14	678	737	91	351	96
	Average	46	1.13	668	721	87	361	92
Jersey	Hereford	29	0.96	615	665	97	319	93
	Angus	16	0.99	613	657	100	324	88
	Average	45	0.98	614	661	98	322	91
South Devon	Hereford	18	1.10	657	721	72	371	67
	Angus	18	1.28	709	740	100	358	78
	Average	36	1.19	683	730	86	365	73
Limousin	Hereford	33	1.02	651	710	42	359	68
	Angus	25	1.14	695	751	96	358	88
	Average	58	1.08	673	730	69	359	78
Simmental	Hereford	28	1.13	688	746	71	369	71
	Angus	22	1.22	718	761	100	360	91
	Average	50	1.18	703	753	86	365	81

(continued on next page)

Table 56. (continued)

Breed of sire	Breed of dam	No. of heifers	200-day postweaning avg. daily gain, lb.	Adj. 400-day wt., lb.[a]	Adj. 550-day wt., lb.[b]	% reaching puberty by 15 mos.	Avg. age at puberty, days[c]	% pregnant[d]
Charolais	Hereford	35	1.09	687	746	83	366	78
	Angus	16	1.22	722	796	88	371	75
	Average	51	1.15	704	771	85	369	77
Average All Sire Breeds	Hereford	193	1.04	651	707	71	362	75
	Angus	144	1.16	686	733	95	356	85
	Average	337	1.10	668	720	83	359	80

[a]Adjusted 400-day weight = Adjusted 200-day weight + (200-day postweaning average daily gain x 200 days).

[b]Adjusted 550-day weight = Adjusted 200-day weight + (350-day postweaning average daily gain x 350 days), shrunk weight.

[c]Includes only heifers reaching puberty by 15 months, and should be interpreted in relation to the percentage reaching puberty by 15 months.

[d]Breeding period was 45 days by artificial insemination (May 24 to July 7) and 26 days by natural service (July 8 to August 2).