New Developments (Cow-Calf Section)

Dr. Horace Barron, Chairman

Preliminary Report of the U. S. Meat Animal Research Center Germ Plasm Evaluation Program*

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The cattle germ plasm evaluation program at the U.S. Meat Animal Research Center is designed to characterize breeds from different biological types in the full spectrum of economic traits relating to growth, feed efficiency, reproduction, maternal ability and carcass and meat traits. The basic objective of this program is to develop an understanding relating to optimizing such biological factors as cow size, milk level, etc., in different feed environments and production situations.

The program was started in 1969 and consists of two cycles and at least two phases within each cycle. The first cycle (Cycle 1, Phase I) involved the breeding, by artificial insemination (AI), Hereford, Angus, Jersey, South Devon, Limousin, Simmental and Charolais bulls to Hereford and Angus cows. The three calf crops for Cycle 1, Phase I of the program were born in March, April and early May of 1970, 1971 and 1972 and were weaned in October or November at approximately 200 days of age. All male calves were fed out as steers and slaughtered to evaluate growth, feed efficiency, and carcass and meat traits. All female progeny are retained for evaluation of reproduction and maternal traits.

This report includes data on calving difficulty and preweaning growth of calves from all three calf crops; postweaning growth, feed efficiency, and carcass and meat traits for calves from the 1970 and 1971 calf crops; postweaning growth, puberty, and conception as yearlings on the heifers from the 1970 and 1971 calf crops; and calving and rebreeding information obtained in 1972 on the two-year-old heifers born in 1970.

A complete analysis of the data and an interpretation of the results will be made and published after all the data for each component of the program have been obtained.

Cycle 1, Phase I

The foundation Hereford and Angus cows used in the program were purchased as calves at weaning from commercial producers in Nebraska. The cows were two-, three-, four- and five-year-olds

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at calving in 1970, two-, three-, four-, five-, and six-year-olds at calving in 1971, and three-, four-, five-, six-, and seven-year-olds in 1972.

In 1969, 14 Hereford, 14 Angus, 12 Jersey, 14 South Devon, six Limousin, eight Simmental and ten Charolais bulls were used. The Hereford and Angus bulls used in this program had been selected on individual performance information as a basis for gaining entry into the progeny testing program of an artificial insemination organization. The Jersey Bulls were selected at random from two commercial AI organizations and the South Devon bulls were sampled from an importation made early in 1969 by a commercial organization. The Limousin bulls were the six bulls that were available commercially after early July of 1969 (Dandy, Decor, Diplomate, Prairie Danseur, Prairie Pride and Prince Pompadour). The eight Simmental bulls included the five bulls that were available from commercial sources in 1969, and three bulls that had been imported for research purposes by the Canada Department of Agriculture (Bismark, Capitaine, Firn, Pacific, Parisien, Petunia, Quartier and Sultan). The Charolais bulls included three domestic and seven French bulls, either imported or with imported parents (Ali Baba Bramard, Ali Baba Dessauny, Bingo, Bonaparte, Carnaval, Chatenay Snow Ball, El Fortin 38, FWT Linn Barr 255, J. G. Otono and Sir Sam 88).

In 1970, 10 Hereford, 11 Angus, 14 Jersey, 14 South Devon, 12 Limousin, 11 Simmental and 8 Charolais bulls were used. Criteria for selecting Hereford, Angus and Jersey bulls to use in the program were the same as those used in 1969. The South Devon bulls were sampled from the same source used in 1969. The Limousin bulls were Dandin Chastinet, Dandy, Dan Pompadour, Decor, Diese, Dimanche, Diplomate, Domino, Dudule, Prairie Danseur, Prairie Pride and Prince Pompadour. The Simmental bulls were Bismark, Capitaine, Firn, Florian, Galant, Lohner, Pacific, Parisien, Petunia, Quartier and Sultan. The Charolais bulls included Ankonian Pure Power, Boxeur, Charrolle Boy, Champagne, Damascus, Darius, El Fortin 38 and Poker Chip.

In 1971, 10 Hereford, 10 Angus, 7 Jersey, 8 South Devon, 12 Limousin, 18 Simmental and 20 Charolais bulls were used. Criteria for selecting the Hereford, Angus and Jersey bulls to use were the same as those used in 1969 and 1970. The South Devon bulls were sampled from the same source used in 1969 and 1970. The Limousin bulls used were Dandy, Echo, Eclairuer, Edmund, Elite, El Toro, Endormi, Erode, Espoir, Prairie Danseur, Prince Pompadour and Prairie Pride. The Simmental bulls were Balbo, Baron, Beat, Eiger, Extra, Firn, Granit, Held, Kilian, Mars, Polar, Renz, Saturn, Saxo, Sfax, Soleil, Ueli and Ural. The Charolais bulls were Ali Baba Bramard, Ali Baba Dessauny, Ankonian Pure Power, Bingo, Carnaval, Charbona Bachus A901, Charrolle Boy, Darius, Eagle, El Fortin 38, Excalibur, FP Edmund, F Stud Poker, HM Bayards Extravaganza, Nutmeg's Avignou FR2, J. G. Otono, PCR Buffalo 2nd, PCR Vanguard I, Poker Chip and Snowball.

It is not planned to make general releases of information on individual sires. The objective of the program is to characterize breeds representing different biological types. To do this effectively, it is necessary to sample a large number of sires of each breed. Thus, the number of progeny per sire is generally low. A relatively large number of progeny per sire are required for a high level of accuracy in ranking individual sires on their breeding value for most economic traits. The individual sire information is provided to the owners and/or semen distributors. The bull(s) he controls are identified to him and all other bulls of that breed are coded. The progeny information provided to the owners of the bulls can be combined with that obtained from other efforts to obtain adequate numbers of progeny per sire necessary for a high level of accuracy in ranking individual sires for economic traits. We believe this is the fairest procedure to both the owners and users of the semen service since erroneous conclusions may be drawn on the ranking of the individual sires with the relatively small number of progeny per sire in this program.

For a cooperative study with the Canada Department of Agriculture, Hereford x Angus, Jersey x Angus, Simmental x Angus, and Charolais x Angus heifers were randomly selected at weaning time and shipped, four to eight weeks after weaning, to the Research Station, Lethbridge, Alberta. There were 12 heifers per breeding group in 1970 and 10 heifers per breeding group in 1971 and 1972.

Calving Difficulty. Data were obtained on 2,595 calves: 1,003 in 1970, 877 in 1971, and 715 in 1972. Calving difficulty scores were assigned to each calf at birth on the basis of the following scoring system:

Score 1, no difficulty. Calves unassisted; however, it may be necessary to straighten head and/or front legs.

Score 2, little difficulty. Assistance given by hand but no jack or puller used; assistance actually may not have been required.

Score 3, moderate difficulty. Assistance given

with jack or calf-puller; some difficulty was encountered even with the pullers being used.

Score 4, major difficulty. Calf jack used and major difficulty encountered; usually 30 minutes or more required to deliver calf.

Score 5, Caesarean birth. Performed after it was determined calf could not be delivered with a calf-puller.

Score 6, posterior presentation. Assistance given.

Table 1 shows the calving difficulty summary for cows calving at two years of age and Table 2 the summary for cows calving at three to seven years of age. For these summaries (Tables 1 and 2) scores of 1 and 2 were combined and are designated no difficulty and scores of 3 and 4 were combined and are designated calf-puller. No females were bred in this program to calve as two-year-olds in 1972.

Preweaning Growth. Preweaning growth information for the 1970, 1971 and 1972 calf-crops were combined and are presented in Table 3. The summary in Table 3 includes 2264 calves, 872 in 1970, 709 in 1971, and 683 in 1972. These data were analyzed by least-squares procedures for unequal subclass numbers using a model that included the effects of years, calf sex, age of dam, breed of sire (straightbred Hereford and Angus, Hereford-Angus and reciprocal crosses, Jersey, South Devon, Limousin, Simmental and Charolais), breed of dam (Hereford and Angus), breed of sire-breed of dam interaction, and calf birth date as a covariate. The data were adjusted to a steer basis and to a five-, six- and seven-year-old cow basis. Adjustment factors were developed from the combined data and were as follows:

	Birth Wt.	Preweaning A.D.G.	200-day Wt.
Heifer calf adj.	+5.4	+0.103	+26
Steer calf adj.	0	0	0
2-year-old dam	+8.0	+0.396	+87
3-year-old dam	+6.3	+0.191	+44
4-year-old dam	+2.5	+0.066	+16
5-6-7-year-old dam	0	0	0

Calves were creep fed a ration of whole oats from about mid-July until weaning. Creep feed consumption averaged 1.5 lb./head/day in 1970, 1.8 lb./head/day in 1971, and 1.8 lb./head/day in 1972.

Postweaning Growth and Feed Efficiency. Postweaning growth and feed efficiency were obtained on 451 steers from the 1970 calf-crop and 334 steers from the 1971 calf-crop. Rations for the 1970 calf-crop are presented in Table 4 and those for the 1971 calf-crop in Table 10. Postweaning average daily gains, adjusted final weights and TDN efficiencies for the 1970 calf-crop are presented in Table 5 and those for the 1971 calf-crop in Table 11.

At weaning, steer calves with adjusted weaning weights more than three standard deviations below the mean for their breeding group were removed from the study. The remaining steers were placed in the feedlot by breed of sire groups (replicated, two lots per breed of sire) to obtain data on growth rate and feed efficiency. In 1970, steers sired by Simmental and Charolais sires were further divided into lots by breed of dam and replicated during the feedlot period.

The postweaning average daily gains are based on *actual* weaning weights (no weaning shrink) and final weights at slaughter. Final weights at slaughter were obtained as the average of two weights (on feed and water) taken on different days to reduce errors due to differences in fill. Adjusted final weight was obtained by adding the sum of postweaning average daily gain x days on feed to weaning weight adjusted to 200 days of age and to a four-, five-year-old dam basis for the 1970 calf-crop and to a four-, five-, six-year-old dam basis for the 1971 calf-crop. Average daily gains and adjusted final weights for the three slaughter groups (415, 443 and 471 days of age for the 1970 calf-crop and 400, 442 and 484 days of age for the 1971 calf-crop) are only for the steers slaughtered in that group. 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 remaining on feed up to each of the three slaughter dates.

The data were analyzed by least-squares procedures for unequal subclass numbers using a model that included the effects of age of dam (two, three, and four-five-year-olds for the 1970 calf-crop and two, three, and four-five-six-year-olds for the 1971 calf-crop); 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 (215, 243 and 271 days postweaning for the 1970 calf-crop and 200, 242, and 284 for the 1971 calf-crop); the interactions of breed of sire-breed of dam, breed of sire-time of slaughter, breed of dam-time of slaughter, and breed of sire-breed of dam-time of slaughter.

Carcass and Meat. Data from the 451 steers from the 1970 calf-crop are presented in Tables 6

to 9 and data on the 334 steers from the 1971 calf-crop are presented in Tables 12 to 15.

Approximately one-third of the steers in each breed of sire by breed of dam group were slaughtered at each of three slaughter dates, which were 215, 243 and 271 days on feed after weaning for the 1970 calf-crop, and 200, 242, and 284 days on feed after weaning for the 1971 calf-crop. The steers to be slaughtered from each breeding group at each of the three times were identified at random across the full range of birth dates. Thus, the steers slaughtered at each of the three times had approximately the same average birth date, resulting in an average difference in age of steers at slaughter of 28 days for the 1970 calf-crop and 42 days for the 1971 calf-crop between slaughter groups 1 and 2 and between slaughter groups 2 and 3. The birth dates did not average the same for all breeding groups because of differences in conception date and gestation length. Average birth dates for the three calf-crops combined are presented in Table 3 by breeding group. Steers were transported to a commercial slaughter plant approximately 12 hours prior to slaughter and were allowed to chill 24 hours after slaughter before obtaining the carcass data. Carcasses were evaluated for conformation, maturity, marbling, color, texture and firmness and USDA Quality Grade determined by representatives of the Standardization Branch, AMS, USDA, and Kansas State University. Loin eye area and external fat thickness were measured and USDA Yield Grade determined. These results are presented in Tables 6 and 7 for the 1970 calf-crop and in Tables 12 and 13 for the 1971 calf-crop. In addition, 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. The right side was separated into wholesale cuts, and the wholesale cuts were processed into closely trimmed, boneless cuts with no more than 0.30 inch of fat on any surface. The amounts of retail product, fat trim and bone were determined for each wholesale cut. These results are presented on a percentage of carcass basis in Table 8 for the 1970 calf-crop and in Table 14 for the 1971 calf-crop.

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, cooked at 350°F to an internal temperature of 160°F, and subjected to taste panel evaluation for tenderness, flavor, juiciness and overall acceptability by trained taste panelists. These results are presented in Table 9 for the 1970 calf-crop and in Table 15 for the 1971 calf-crop.

The following additional carcass information was obtained on the 1971 calf-crop, but is not included in this report. The 9-10-11th ribs were removed from the left side of each carcass for chemical analyses. Total chemical composition (water, nitrogen and fat) was determined on the left side of the carcass from three representative steers of the Hereford x Angus, Simmental x Angus, and Limousin x Angus breeding groups per slaughter group (a total of 27 carcass sides, nine per breeding group).

The data for the carcass and meat traits were analyzed by least-squares procedures for unequal subclass numbers using a model that included the effects of age of dam (2, 3, and 4-5-year-olds in the 1970 calf-crop and 2, 3, and 4-5-6-year-olds in the 1971 calf crop); 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 (215, 243 and 271 days postweaning for the 1970 calf-crop and 200, 242 and 284 for the 1971 calf-crop); the interactions of breed of sire-breed of dam, breed of sire-time of slaughter, breed of dam-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 1970 calf-crop and 400, 442 and 484 days of age for the 1971 calf-crop for the three slaughter groups.

Cycle 1, Phase II

Postweaning Growth, Puberty and Conception. Postweaning growth, age at puberty and conception of yearling heifers produced in the 1970 and 1971 calf-crops are presented in Tables 16 and 17. The percentage reaching puberty by 15 months of age and the percentage pregnant are simple averages, and the other values in Tables 16 and 17 are adjusted least-squares means. The adjusted weights in Tables 16 and 17 are based on non-shrunk weights, except the 550-day weight in Table 16.

The heifers were maintained in the feedlot from weaning (November in 1970, October in

1971) through the AI breeding period (early July). The postweaning ration was 50% corn silage and 50% grass silage fed *ad libitum* or a grass silage and grain mixture to provide an equivalent energy intake.

Date of puberty, defined as date of the 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 at the termination of the breeding period. Heifers were inseminated only after standing for vasectomized bulls or other heifers. Following a 45-day AI breeding period for the 1970 calf-crop and a 46-day AI breeding period for the 1971 calf-crop, the heifers were placed on pasture for a 21-day (1970 calf-crop) or a 24-day (1971 calf-crop) natural service (cleanup) breeding period. The percentage of heifers reaching puberty by 15 months and the average age of those that reached puberty are only for heifers observed in estrus up to the end of the AI breeding season, while the percent pregnant would include heifers that may have reached puberty and bred during the cleanup breeding period.

Calving and Rebreeding of Two-Year-Olds. Data on calving and rebreeding as two-year-olds are complete on the heifers born in 1970. Calving difficulty data are shown in Table 18 and other reproduction data are shown in Table 19. These heifers were bred by AI to Hereford, Angus, Brahman, Devon and Holstein bulls and to Hereford and Angus bulls during the cleanup period in 1971. The heifers born in 1971 and 1972 (Cycle 1, Phase I) were or will be bred as yearlings to these same breeds of sires. Thus, the data presented in Tables 18 and 19 are only one of three years and should be considered as preliminary.

Because the numbers of calves by each breed of sire group were disproportionate among the cow breeding groups and there were very few calves in some of the breed of sire-breed of cow subgroups, weaning weights of the calves are not given and the data in Tables 18 and 19 were not subjected to statistical analyses. After data for the three calf crops are available, this information will be evaluated and published.

Cows in Cycle 1, Phase II were or will be bred by AI to calve as three-year-olds to Hereford, Angus, Gelbvieh, Maine Anjou and Chianina bulls and during a cleanup period to Hereford and Angus bulls. These cows will be bred naturally to Brown Swiss bulls for their third and fourth calf-crops.

Table 1. U.S. Meat Animal Research Center Germ Plasm Evaluation Program Calving Difficulty Summary
1970-71 Calf Crops – Two-Year-Old Females Cycle 1, Phase I

Breed of Sire	Breed of Dam	No. Calves	Type of Parturition, %				
			No Calving Difficulty[a]	Calf-Puller	C-Section	Posterior Presentation	Dead at or Shortly After Birth
Hereford	Hereford	81	46.9	45.7	4.9	2.5	7.4
Angus	Angus	83	62.7	36.1	1.2	0.0	8.4
	Average[b]	164	54.8	40.9	3.1	1.3	7.9
Angus	Hereford	77	54.5	41.6	1.3	2.6	7.8
Hereford	Angus	86	61.6	37.2	1.2	0.0	3.5
	Average[b]	163	58.1	39.4	1.3	1.3	5.7
Jersey	Hereford	61	80.3	19.7	0.0	0.0	1.6
	Angus	76	85.5	13.2	1.3	0.0	5.3
	Average[b]	137	82.9	16.5	0.7	0.0	3.5
South Devon	Hereford	28	53.6	42.9	3.6	0.0	7.1
	Angus	45	35.6	62.2	2.2	0.0	13.3
	Average[b]	73	44.6	52.6	2.9	0.0	10.2
Limousin	Hereford	63	17.5	74.6	6.3	1.6	11.1
	Angus	58	32.8	65.5	1.7	0.0	6.9
	Average[b]	121	25.2	70.1	4.0	0.8	9.0
Simmental	Hereford	27	11.1	63.0	25.9	0.0	14.8
	Angus	37	40.5	51.4	5.4	2.7	10.8
	Average[b]	64	25.8	57.2	15.7	1.4	12.8
Charolais	Hereford	37	21.6	54.1	21.6	2.7	16.2
	Angus	34	23.5	67.6	8.8	0.0	11.8
	Average[b]	71	22.6	60.9	15.2	1.4	14.0
Average All Sire Breeds	Hereford	374	44.4	47.3	6.7	1.6	8.6
	Angus	419	54.4	43.0	2.4	0.2	7.6
	Average[b]	793	49.4	45.2	4.6	0.9	8.1

[a] No assistance or minor hand assistance.
[b] Unweighted means.

Table 2. U.S. Meat Animal Research Center Germ Plasm Evaluation Program Calving Difficulty Summary 1970-71-72 Calf Crops – 3-4-5-6-7-Year-Old Females Cycle 1, Phase I

Breed of Sire	Breed of Dam	No. Calves	Type of Parturition, %				Dead at or Shortly After Birth
			No Calving Difficulty[a]	Calf-Puller	C-Section	Posterior Presentation	
Hereford	Hereford	118	92.4	3.4	0.0	4.2	2.5
Angus	Angus	94	94.7	4.3	1.1	0.0	2.1
	Average[b]	212	93.6	3.9	0.6	2.1	2.3
Angus	Hereford	112	91.1	1.8	0.0	7.1	0.9
Hereford	Angus	150	95.3	2.7	0.0	2.0	0.0
	Average[b]	262	93.2	2.3	0.0	4.6	0.5
Jersey	Hereford	67	98.5	1.5	0.0	0.0	3.0
	Angus	108	99.1	0.0	0.0	0.9	1.9
	Average[b]	175	98.8	0.8	0.0	0.5	2.5
South Devon	Hereford	92	77.2	16.3	1.1	5.4	4.3
	Angus	76	88.2	7.9	0.0	3.9	3.9
	Average[b]	168	82.7	12.1	0.6	4.7	4.1
Limousin	Hereford	140	85.0	11.4	0.0	3.6	5.7
	Angus	127	89.8	6.3	0.0	3.9	2.4
	Average[b]	267	87.4	8.9	0.0	3.8	4.1
Simmental	Hereford	178	80.9	15.2	0.6	3.4	7.9
	Angus	186	84.4	12.4	0.0	3.2	3.8
	Average[b]	364	82.7	13.8	0.3	3.3	5.9
Charolais	Hereford	164	70.7	24.4	0.0	4.9	11.0
	Angus	190	81.1	13.7	0.0	5.3	6.3
	Average[b]	354	75.9	19.1	0.0	5.1	8.7
Average	Hereford	871	83.5	12.1	0.2	4.2	5.7
All Sire	Angus	931	89.3	7.6	0.1	3.0	3.1
Breeds	Average[b]	1802	86.4	9.9	0.2	3.6	4.4

[a] No assistance or minor hand assistance.
[b] Unweighted means.

Table 3. U.S. Meat Animal Research Center Germ Plasm Evaluation Program Preweaning Summary – 1970-71-72 Calf-Crops Cycle 1, Phase I

Breed of Sire	Breed of Dam	No. Calves[a]	Birth Date[b]	Birth Wt., lb.[b]	Preweaning ADG, lb.[b]	Adjusted 200-Day Wt., lb.[b]	200-Day Wt. Ratio
Hereford	Hereford	132	April 1	83.5	1.83	450	95.7[c]
Angus	Angus	203	March 27	76.0	1.96	469	95.9[d]
	Average	335	March 29	79.8	1.90	459	95.8[e]
Angus	Hereford	179	March 31	82.0	1.91	464	98.7[c]
Hereford	Angus	157	March 28	81.1	2.03	487	99.6[d]
	Average	336	March 30	81.6	1.97	475	99.2[e]
Jersey	Hereford	116	March 31	74.8	1.87	449	95.5[c]
	Angus	167	March 24	71.1	1.92	455	93.0[d]
	Average	283	March 28	73.0	1.90	452	94.4[e]
South Devon	Hereford	107	April 2	88.1	1.89	467	99.4[c]
	Angus	108	March 31	83.3	2.03	490	100.2[d]
	Average	215	April 1	85.7	1.96	478	99.8[e]
Limousin	Hereford	179	April 11	88.4	1.93	473	100.6[c]
	Angus	174	April 7	84.7	2.06	498	101.8[d]
	Average	353	April 9	86.5	1.99	485	101.3[e]
Simmental	Hereford	182	April 6	93.5	1.99	492	104.7[c]
	Angus	202	April 1	88.6	2.10	510	104.3[d]
	Average	384	April 3	91.1	2.05	501	104.6[e]
Charolais	Hereford	163	April 4	93.9	2.00	493	104.9[c]
	Angus	195	March 31	90.0	2.13	516	105.5[d]
	Average	358	April 2	91.9	2.06	505	105.4[e]
Average	Hereford	1058	April 3	86.3	1.92	470	100.0
All Sire	Angus	1206	March 31	82.1	2.03	489	100.0
Breeds	Average	2264	April 1	84.2	1.98	479	100.0

[a] Includes all steer and heifer calves that were weaned.
[b] Adjusted to a steer and a 5-, 6- and 7-year-old cow basis.
[c] Ratio computed relative to average for Hereford cows, adjusted to a steer calf and a 5-, 6- and 7-year-old cow basis.
[d] Ratio computed relative to average for Angus cows, adjusted to a steer calf and a 5-, 6- and 7-year-old cow basis.
[e] Ratio computed relative to overall average adjusted to a steer calf and a 5-, 6- and 7-year-old cow basis.

Table 4. U.S. Meat Animal Research Center Germ Plasm Evaluation Program
Postweaning Steer Feedlot Rations Cycle 1, Phase I – 1970 Calf-Crop

Ingredient	Nov. 17-Nov. 24	Nov. 25-Jan. 10	Jan. 11-Slaughter
	%	%	%
Corn Silage	89.0	77.5	60.0
Concentrate[a]	7.5	17.5	35.0
Supplement, 38% Crude Protein[b]	3.5	5.0	5.0
Ration Analyses, 90% Dry Matter Basis[c]			
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

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

[b] 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 I.U. Vitamin A/lb.); 1.4 lb. Aureomycin (50 grams/lb.); 10 lb. trace mineral premix; 60 lb. ammonium chloride.

[c] Estimated composition based on N.C.R. values.

Table 5. U.S. Meat Animal Research Center Germ Plasm Evaluation Program Least Squares Means for Postweaning Average Daily Gains, Adjusted Final Weights and TDN Efficiencies Cycle 1, Phase I – 1970 Calf-Crop

Breed of Sire	Breed of Dam	No. Steers[a]				Postweaning Average Daily Gain[b]				Adjusted Final Weight[c]				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	17	17	16	50	2.38	2.37	2.36	2.37	986	1066	1116	1056				
	Average	27	28	26	81	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	11	11	34	2.61	2.54	2.22	2.45	1069	1100	1076	1082				
	Angus	11	13	13	37	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	Hereford	60	62	59	181	2.54	2.50	2.47	2.50	1017	1071	1144	1077				
All Sire	Angus	88	91	91	270	2.46	2.40	2.33	2.39	1013	1067	1120	1066				
Breeds	Average	148	153	150	451	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 = (actual final weight - actual 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 consumed per lb. gain; 90% dry matter basis for the feed consumed.

Table 6. U.S. Meat Animal Research Center Germ Plasm Evaluation Program Least Squares Means for Adjusted Hot Carcass Weight, Dressing Percent, U.S.D.A. Quality Grade and Marbling Score[a] Cycle 1, Phase I – 1970 Calf-Crop

Breed of Sire	Breed of Dam	Adjusted Hot Carcass Weight, lb.				Dressing Percent				U.S.D.A. Quality Grade[b]				Marbling Score[c]			
		215	243	271	Avg.	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	11.3	12.3	11.9	11.8
Angus	Angus	608	618	657	628	60.9	61.2	61.6	61.2	11.3	11.2	11.1	11.2	15.4	15.2	14.7	15.1
	Average	596	616	658	623	60.9	60.8	61.1	60.9	10.7	10.7	10.5	10.6	13.4	13.7	13.3	13.5
Angus	Hereford	587	653	685	642	60.6	61.0	62.1	61.2	10.7	11.2	10.8	10.9	13.2	13.1	14.6	13.6
Hereford	Angus	594	654	692	647	60.6	61.6	62.4	61.5	10.0	10.6	10.4	10.3	12.3	13.9	13.2	13.1
	Average	591	653	688	644	60.6	61.3	62.3	61.4	10.3	10.9	10.6	10.6	12.7	13.5	13.9	13.4
Jersey	Hereford	577	566	638	594	59.0	59.4	59.7	59.4	9.7	9.7	9.8	9.7	14.4	13.5	14.4	14.1
	Angus	557	580	610	582	60.4	60.3	59.9	60.2	10.5	10.8	10.5	10.6	17.7	15.0	16.4	16.4
	Average	567	573	624	588	59.7	59.8	59.8	59.8	10.1	10.3	10.1	10.2	16.0	14.3	15.4	15.2
South Devon	Hereford	586	653	743	661	61.0	61.3	61.4	61.2	10.7	9.6	11.0	10.4	14.2	12.1	14.9	13.7
	Angus	642	676	682	667	61.3	62.1	62.2	61.9	11.0	10.7	10.9	10.9	14.7	14.2	15.1	14.6
	Average	614	665	713	664	61.1	61.7	61.8	61.5	10.8	10.1	11.0	10.6	14.5	13.1	15.0	14.2
Limousin	Hereford	649	684	672	669	61.1	62.4	62.7	62.1	9.2	9.1	9.6	9.3	9.7	10.1	10.8	10.2
	Angus	614	685	688	662	60.7	62.3	62.0	61.7	9.7	9.3	9.6	9.5	10.9	10.8	10.9	10.9
	Average	632	685	680	665	60.9	62.4	62.3	61.9	9.4	9.2	9.6	9.4	10.3	10.5	10.9	10.5
Simmental	Hereford	628	674	739	681	59.2	60.3	61.0	60.2	9.5	10.1	9.5	9.7	12.0	13.0	10.3	11.8
	Angus	646	663	743	684	60.9	60.3	61.1	60.8	10.7	10.4	10.5	10.5	14.1	12.9	13.9	13.6
	Average	637	669	741	682	60.1	60.3	61.1	60.5	10.1	10.3	10.0	10.1	13.0	12.9	12.1	12.7
Charolais	Hereford	677	689	761	709	61.6	60.3	62.0	61.3	10.1	9.9	10.8	10.3	11.8	12.1	15.5	13.1
	Angus	619	688	740	682	60.1	62.5	62.6	61.7	10.3	10.9	11.1	10.8	12.6	14.1	15.3	14.0
	Average	648	689	750	696	60.9	61.4	62.3	61.5	10.2	10.4	10.9	10.5	12.2	13.1	15.4	13.5
Average	Hereford	613	648	700	653	60.5	60.7	61.3	60.9	10.0	10.0	10.2	10.1	12.4	12.3	13.2	12.6
All Sire	Angus	612	652	687	650	60.7	61.5	61.7	61.3	10.5	10.6	10.6	10.6	13.9	13.7	14.2	14.0
Breeds	Average	612	650	694	652	60.6	61.1	61.5	61.1	10.2	10.3	10.4	10.3	13.2	13.0	13.7	13.3

[a] The data for all carcass traits are adjusted by regression on birthdate to the average age of each slaughter group, and are 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.
[c] Marbling Score: 9 = slight+; 10 = small-; ..... 21 = slightly abundant+; etc.

Table 7. U.S. Meat Animal Research Center Germ Plasm Evaluation Program Least Squares Means for Yield Grade, Rib Eye Area, Fat Thickness and Percent Kidney, Pelvic and Heart Fat[a] Cycle 1, Phase I – 1970 Calf-Crop

Breed of Sire	Breed of Dam	U.S.D.A. Yield Grade				Rib Eye Area, sq. in.				Fat Thickness, in.				Estimated Percent 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	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
All Sire	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
Breeds	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] The data for all carcass traits are adjusted by regression on birth date to the average age of each slaughter group, and are adjusted for age of dam.

Table 8. U.S. Meat Animal Research Center Germ Plasm Evaluation Program Least Squares Means for Actual Percent Cutability, Percent Retail Product, Percent Fat Trim and Percent Bone[a] Cycle 1, Phase I – 1970 Calf-Crop

Breed of Sire	Breed of Dam	Actual 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	49.7	51.0	65.3	63.5	61.5	63.4	21.1	23.7	26.0	23.6	13.6	12.8	12.6	13.0
Angus	Angus	50.3	49.9	48.5	49.5	63.8	63.2	60.5	62.5	23.6	24.8	28.1	25.5	12.6	12.1	11.4	12.0
	Average	51.2	50.5	49.1	50.3	64.6	63.3	61.0	63.0	22.3	24.2	27.0	24.5	13.1	12.4	12.0	12.5
Angus	Hereford	51.3	50.9	49.8	50.7	64.9	63.1	61.8	63.3	22.2	24.4	26.2	24.3	12.8	12.5	11.9	12.4
Hereford	Angus	50.5	49.3	48.0	49.3	63.8	61.6	59.5	61.6	23.3	26.2	29.3	26.3	12.9	12.2	11.2	12.1
	Average	50.9	50.1	48.9	50.0	64.3	62.3	60.7	62.5	22.8	25.3	27.8	25.3	12.9	12.4	11.6	12.3
Jersey	Hereford	51.2	50.4	49.3	50.3	64.6	63.1	61.0	62.9	21.6	24.0	26.1	23.9	13.9	12.9	12.8	13.2
	Angus	49.4	50.2	49.3	49.6	62.5	62.9	61.4	62.3	24.9	24.7	26.2	25.3	12.6	12.4	12.3	12.5
	Average	50.3	50.3	49.3	50.0	63.5	63.0	61.2	62.6	23.2	24.3	26.2	24.6	13.2	12.7	12.6	12.8
South Devon	Hereford	51.9	52.3	49.9	51.4	64.6	65.0	61.6	63.7	21.2	22.0	25.4	22.9	14.2	13.0	13.0	13.4
	Angus	51.0	52.1	49.6	50.9	64.1	65.1	61.7	63.6	23.0	22.2	26.4	23.9	12.9	12.6	11.9	12.5
	Average	51.5	52.2	49.7	51.1	64.3	65.1	61.6	63.7	22.1	22.1	25.9	23.4	13.5	12.8	12.5	12.9
Limousin	Hereford	56.2	55.0	54.1	55.1	69.2	67.9	66.1	67.7	17.1	19.2	20.9	19.1	13.8	12.9	13.0	13.2
	Angus	56.7	54.5	53.7	55.0	70.1	67.6	65.9	67.9	16.0	19.7	21.6	19.1	13.9	12.7	12.5	13.0
	Average	56.4	54.7	53.9	55.0	69.6	67.8	66.0	67.8	16.5	19.5	21.3	19.1	13.8	12.8	12.7	13.1
Simmental	Hereford	55.3	53.4	53.3	54.0	68.8	66.3	65.4	66.8	16.5	19.9	20.9	19.1	14.7	13.8	13.7	14.0
	Angus	53.3	52.0	52.1	52.5	66.6	64.5	64.3	65.1	19.9	22.3	22.7	21.6	13.5	13.3	13.0	13.3
	Average	54.3	52.7	52.7	53.2	67.7	65.4	64.9	66.0	18.2	21.1	21.8	20.4	14.1	13.5	13.3	13.6
Charolais	Hereford	53.8	55.1	53.6	54.1	67.0	67.8	66.1	67.0	19.2	18.6	20.7	19.5	13.8	13.6	13.3	13.6
	Angus	54.4	53.0	53.5	53.7	67.9	65.9	65.9	66.6	17.7	21.5	21.6	20.3	14.4	12.6	12.5	13.2
	Average	54.1	54.0	53.6	53.9	67.4	66.9	66.0	66.8	18.5	20.0	21.1	19.9	14.1	13.1	12.9	13.4
Average	Hereford	53.1	52.6	51.4	52.4	66.3	65.2	63.4	65.0	19.9	21.7	23.7	21.8	13.8	13.1	12.9	13.3
All Sire	Angus	52.2	51.6	50.7	51.5	65.5	64.4	62.8	64.2	21.2	23.0	25.1	23.1	13.3	12.6	12.1	12.6
Breeds	Average	52.7	52.1	51.0	51.9	65.9	64.8	63.1	64.6	20.5	22.4	24.4	22.4	13.5	12.8	12.5	13.0

[a] The data for all carcass traits are adjusted by regression on birth date to the average age of each slaughter group, and are adjusted for age of dam.
[b] Actual Cutability, % = Actual yield of boneless, closely trimmed beef from the round, loin, rib and chuck.
[c] Retail Product, % = Actual yield of boneless, closely trimmed beef from the carcass.

Table 9. U.S. Meat Animal Research Center Germ Plasm Evaluation Program Least Squares Means for Warner-Bratzler Shear and Taste Panel Evaluation of Cooked Steaks[a] Cycle 1, Phase I – 1970 Calf-Crop

Breed of Sire	Breed of Dam	Warner-Bratzler Shear, lb.[b]				Taste Panel Tenderness[c]				Taste Panel Flavor[c]				Taste Panel Juiciness[c]				Taste Panel Acceptability[c]			
		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	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
All Sire	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
Breeds	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] The data for all carcass traits are adjusted by regression on birth date to the average age of each slaughter group, and are adjusted for age of dam.
[b] A measure of the 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 was obtained on steaks from all 451 steers.
[c] Taste panel scores are based on a 9-point hedonic scale, with higher scores indicating greater acceptability. Taste panel traits were measured on steaks from 4 steers per breed group per slaughter date (168).

Table 10. U.S. Meat Animal Research Center Germ Plasm Evaluation Program Postweaning Steer Feedlot Rations Cycle 1, Phase I – 1971 Calf-Crop

Ingredient	Oct. 25-Nov. 22	Nov. 23-Dec. 21	Dec. 22-Feb. 15	Feb. 16-Slaughter
	%	%	%	%
Corn Silage	85.0	75.0	60.0	60.0
Concentrate[a]	7.5	18.5	32.0	33.0
Supplement, 38% Crude Protein[b]	7.5	6.5	8.0	7.0
Ration Analyses, 90% Dry Matter Basis[c]				
Crude Protein, %	13.4	12.6	13.1	12.6
Digestible Protein, %	9.8	9.1	9.5	9.1
Total Digestible Nutrients, %	64.9	68.2	70.0	71.0

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

[b] Composition of the supplement: 1600 lb. soybean meal; 150 lb. salt; 60 lb. dicalcium phosphate; 172 lb. ground limestone; 14.0 lb. Vitamin A premix (2,000,000 I.U. Vitamin A/lb.); 1.4 lb. Aureomycin (50 grams/lb.); 2 lb. trace mineral premix; 60 lb. ammonium chloride from April 12 to slaughter.

[c] Dry matter and crude protein based on proximate analyses.

Table 11. U.S. Meat Animal Research Center Germ Plasm Evaluation Program Least Squares Means for Postweaning Average Daily Gains, Adjusted Final Weights and TDN Efficiencies Cycle 1, Phase I – 1971 Calf-Crop

Breed of Sire	Breed of Dam	No. Steers[a]				Postweaning Average Daily Gain[b]				Adjusted Final Weight[c]				TDN Efficiency[d]			
		200	242	284	Total	200	242	284	Avg.	200	242	284	Avg.	200	242	284	Avg.
Hereford	Hereford	9	9	9	27	2.87	2.54	2.40	2.60	1075	1069	1093	1079				
Angus	Angus	8	9	9	26	2.77	2.74	2.33	2.61	1060	1172	1080	1104				
	Average	17	18	18	53	2.82	2.64	2.37	2.61	1068	1121	1087	1092	5.56	6.09	7.00	6.22
Angus	Hereford	12	13	12	37	2.91	2.71	2.65	2.76	1095	1130	1195	1140				
Hereford	Angus	10	10	11	31	2.89	2.58	2.51	2.66	1110	1123	1183	1139				
	Average	22	23	23	68	2.90	2.65	2.58	2.71	1103	1127	1189	1140	5.59	6.10	6.51	6.07
Jersey	Hereford	8	7	8	23	2.82	2.51	2.43	2.59	1043	1059	1104	1069				
	Angus	7	7	8	22	2.63	2.48	2.25	2.45	1038	1073	1062	1058				
	Average	15	14	16	45	2.73	2.50	2.34	2.52	1041	1066	1083	1063	5.70	6.29	6.73	6.24
South Devon	Hereford	5	7	6	18	2.87	2.79	2.52	2.73	1046	1158	1129	1111				
	Angus	6	5	6	17	2.96	2.72	2.50	2.73	1104	1143	1158	1135				
	Average	11	12	12	35	2.92	2.76	2.51	2.73	1075	1151	1144	1123	5.92	6.31	6.89	6.37
Limousin	Hereford	5	5	5	15	2.64	2.79	2.63	2.69	1074	1164	1137	1125				
	Angus	7	6	6	19	2.75	2.69	2.51	2.65	1099	1142	1170	1137				
	Average	12	11	11	34	2.70	2.74	2.57	2.67	1087	1153	1154	1131	5.17	5.62	6.20	5.66
Simmental	Hereford	9	9	8	26	3.32	3.12	2.93	3.12	1217	1254	1278	1250				
	Angus	9	9	9	27	2.89	2.86	2.71	2.82	1137	1222	1246	1202				
	Average	18	18	17	53	3.11	2.99	2.82	2.97	1177	1238	1262	1226	5.57	6.04	6.67	6.09
Charolais	Hereford	9	9	9	27	3.24	2.98	2.83	3.02	1167	1207	1250	1208				
	Angus	5	7	7	19	3.01	2.86	2.67	2.85	1176	1179	1229	1195				
	Average	14	16	16	46	3.13	2.92	2.75	2.93	1172	1193	1240	1202	5.21	5.68	6.12	5.67
Average	Hereford	57	59	57	173	2.95	2.78	2.63	2.79	1102	1149	1169	1140				
All Sire	Angus	52	53	56	161	2.84	2.70	2.50	2.68	1103	1151	1161	1138				
Breeds	Average	109	112	113	334	2.90	2.74	2.56	2.73	1103	1150	1165	1139	5.53	6.02	6.59	6.05

[a] Number of steers slaughtered after 200, 242 and 284 days on feed.
[b] Average daily gain = (actual final weight - actual 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 consumed per lb. gain; 90% dry matter basis for the feed consumed.

Table 12. U.S. Meat Animal Research Center Germ Plasm Evaluation Program Least Squares Means for Adjusted Hot Carcass Weight, Dressing Percent, U.S.D.A. Quality Grade and Marbling Score[a] Cycle 1, Phase I – 1971 Calf-Crop

Breed of Sire	Breed of Dam	Adjusted Hot Carcass weight, lb.				Dressing Percent				U.S.D.A. Quality Grade[b]				Marbling Score[c]			
		200	242	284	Avg.	200	242	284	Avg.	200	242	284	Avg.	200	242	284	Avg.
Hereford	Hereford	595	642	678	638	60.3	62.1	62.1	61.5	9.0	8.4	10.0	9.1	9.9	8.8	12.3	10.3
Angus	Angus	600	710	676	662	61.1	62.8	62.5	62.1	10.2	10.5	11.5	10.7	12.2	14.1	17.4	14.6
	Average	598	676	677	650	60.7	62.5	62.3	61.8	9.6	9.5	10.8	9.9	11.1	11.5	14.9	12.5
Angus	Hereford	608	674	740	674	60.4	62.0	62.3	61.6	9.7	9.6	10.8	10.0	11.2	11.1	15.4	12.6
Hereford	Angus	627	675	744	682	61.4	62.1	62.9	62.1	9.9	10.0	10.3	10.1	12.0	12.1	14.0	12.7
	Average	618	675	742	678	60.9	62.1	62.6	61.9	9.8	9.8	10.6	10.1	11.6	11.6	14.7	12.6
Jersey	Hereford	565	612	680	619	59.2	59.9	61.6	60.2	8.6	9.5	10.2	9.4	9.8	13.9	16.0	13.2
	Angus	581	625	639	615	60.3	59.8	60.7	60.3	9.5	10.0	10.4	10.0	12.6	14.6	17.4	14.9
	Average	573	619	660	617	59.8	59.9	61.2	60.2	9.1	9.8	10.3	9.7	11.2	14.3	16.7	14.1
South Devon	Hereford	568	692	703	654	59.7	62.3	62.6	61.5	8.7	9.8	9.3	9.3	9.3	11.9	12.1	11.1
	Angus	613	693	723	676	60.9	63.2	62.7	62.3	9.5	10.6	10.7	10.3	10.6	12.9	15.0	12.8
	Average	591	693	713	665	60.3	62.8	62.7	61.9	9.1	10.2	10.0	9.8	10.0	12.4	13.6	12.0
Limousin	Hereford	628	698	687	671	63.1	62.5	60.9	62.2	8.6	8.8	9.0	8.8	8.7	9.5	9.6	9.3
	Angus	638	693	748	693	62.8	63.0	64.1	63.3	8.1	9.2	9.5	8.9	8.3	11.0	12.0	10.4
	Average	632	696	718	682	63.0	62.8	62.5	62.8	8.4	9.0	9.3	8.9	8.5	10.3	10.8	9.9
Simmental	Hereford	666	736	772	725	60.0	61.4	60.7	60.7	9.1	9.0	9.1	9.1	9.7	9.7	11.4	10.3
	Angus	643	731	774	716	61.3	62.2	62.4	61.9	9.1	9.2	9.7	9.3	10.1	10.3	13.0	11.1
	Average	654	734	773	720	60.6	61.8	61.6	61.3	9.1	9.1	9.4	9.2	9.9	10.0	12.2	10.7
Charolais	Hereford	649	711	760	707	61.2	61.4	61.3	61.3	7.8	8.6	10.2	8.9	7.8	9.1	12.9	9.9
	Angus	678	693	767	713	62.2	61.5	62.7	62.1	9.5	9.3	10.0	9.6	10.2	10.0	11.7	10.6
	Average	664	702	764	710	61.7	61.5	62.0	61.7	8.7	9.0	10.1	9.3	9.0	9.6	12.3	10.3
Average	Hereford	611	681	717	670	60.6	61.7	61.6	61.3	8.8	9.1	9.8	9.2	9.5	10.6	12.8	11.0
All Sire	Angus	626	689	724	680	61.4	62.0	62.6	62.0	9.4	9.8	10.3	9.8	10.8	12.2	14.4	12.4
Breeds	Average	619	685	721	675	61.0	61.9	62.1	61.7	9.1	9.5	10.1	9.5	10.2	11.4	13.6	11.7

[a] The data for all carcass traits are adjusted by regression on birthdate to the average age of each slaughter group, and are 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.
[c] Marbling Score: 9=slight+; 10=small-; ..... 21=slightly abundant+; etc.

Table 13. U.S. Meat Animal Research Center Germ Plasm Evaluation Program Least Squares Means for Yield Grade, Rib Eye Area, Fat Thickness and Percent Kidney, Pelvic and Heart Fat[a] Cycle 1, Phase I – 1971 Calf-Crop

Breed of Sire	Breed of Dam	U.S.D.A. Yield Grade				Rib Eye Area, sq. in.				Fat Thickness, in.				Estimated Percent Kidney, Pelvic and Heart Fat			
		200	242	284	Avg.	200	242	284	Avg.	200	242	284	Avg.	200	242	284	Avg.
Hereford	Hereford	3.0	3.1	3.4	3.2	11.0	11.9	11.7	11.5	.45	.66	.63	.58	2.7	2.2	2.4	2.4
Angus	Angus	3.6	4.0	3.8	3.8	10.9	12.0	11.6	11.5	.71	.91	.83	.82	3.1	3.8	2.8	3.2
	Average	3.3	3.6	3.6	3.5	11.0	12.0	11.6	11.5	.58	.79	.73	.70	2.9	3.0	2.6	2.8
Angus	Hereford	3.5	3.8	4.0	3.8	10.9	11.5	12.1	11.5	.66	.72	.87	.75	2.8	3.3	2.6	2.9
Hereford	Angus	3.3	3.7	4.1	3.7	11.7	11.8	12.7	12.1	.67	.77	.90	.78	2.6	2.7	3.0	2.8
	Average	3.4	3.8	4.1	3.8	11.3	11.7	12.4	11.8	.67	.75	.89	.77	2.7	3.0	2.8	2.8
Jersey	Hereford	3.0	3.4	3.7	3.4	11.4	11.1	11.6	11.4	.35	.40	.58	.44	5.2	5.0	4.3	4.8
	Angus	3.3	3.6	3.6	3.5	11.5	11.1	11.6	11.4	.53	.54	.60	.56	5.0	4.9	4.9	4.9
	Average	3.2	3.5	3.7	3.5	11.5	11.1	11.6	11.4	.44	.47	.59	.50	5.1	5.0	4.6	4.9
South Devon	Hereford	3.0	3.7	3.7	3.5	11.1	12.1	11.5	11.6	.41	.66	.53	.53	4.2	3.8	3.4	3.8
	Angus	2.7	3.9	3.5	3.4	11.8	11.7	12.5	12.0	.40	.70	.68	.59	3.1	4.5	3.7	3.8
	Average	2.9	3.8	3.6	3.4	11.5	11.9	12.0	11.8	.41	.68	.61	.57	3.7	4.2	3.6	3.8
Limousin	Hereford	2.0	2.5	2.6	2.4	13.3	13.6	13.2	13.4	.38	.48	.47	.44	2.7	3.2	3.0	3.0
	Angus	2.4	2.8	3.1	2.8	13.1	13.0	13.8	13.3	.43	.60	.62	.55	3.6	3.4	4.0	3.7
	Average	2.2	2.7	2.9	2.6	13.2	13.3	13.5	13.3	.41	.54	.55	.50	3.2	3.3	3.5	3.3
Simmental	Hereford	2.5	2.6	2.7	2.6	12.6	13.0	13.2	12.9	.41	.39	.38	.39	2.9	3.0	2.7	2.9
	Angus	2.9	2.9	3.5	3.1	12.2	13.1	12.6	12.6	.47	.54	.64	.55	3.7	3.5	3.3	3.5
	Average	2.7	2.8	3.1	2.9	12.4	13.1	12.9	12.8	.44	.47	.51	.47	3.3	3.3	3.0	3.2
Charolais	Hereford	1.9	2.3	2.6	2.3	13.2	13.4	13.8	13.5	.28	.39	.50	.39	2.6	2.3	2.6	2.5
	Angus	2.7	2.5	3.2	2.8	13.0	13.4	13.4	13.3	.45	.47	.73	.55	3.5	3.4	3.1	3.3
	Average	2.3	2.4	2.9	2.5	13.1	13.4	13.6	13.4	.37	.43	.62	.47	3.1	2.9	2.9	3.0
Average	Hereford	2.7	3.1	3.2	3.0	11.9	12.4	12.4	12.2	.42	.53	.57	.50	3.3	3.3	3.0	3.2
All Sire	Angus	3.0	3.3	3.5	3.3	12.0	12.3	12.5	12.3	.52	.65	.71	.63	3.5	3.7	3.5	3.6
Breeds	Average	2.8	3.2	3.4	3.1	12.0	12.3	12.5	12.3	.47	.59	.64	.57	3.4	3.5	3.3	3.4

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

Table 14. U.S. Meat Animal Research Center Germ Plasm Evaluation Program Least Squares Means for Actual Percent Cutability, Percent Retail Product, Percent Fat Trim and Percent Bone[a] Cycle 1, Phase I – 1971 Calf-Crop

Breed of Sire	Breed of Dam	Actual Cutability, %[b]				Retail Product, %[c]				Fat Trim, %				Bone, %			
		200	242	284	Avg.	200	242	284	Avg.	200	242	284	Avg.	200	242	284	Avg.
Hereford	Hereford	54.3	55.0	54.1	54.5	67.1	67.6	66.1	66.9	20.1	20.4	22.5	21.0	12.8	12.1	11.5	12.1
Angus	Angus	53.5	50.1	52.1	51.9	66.8	63.0	64.4	64.8	21.4	26.6	24.9	24.3	11.7	10.4	10.6	10.9
	Average	53.9	52.6	53.1	53.2	67.0	65.3	65.3	65.9	20.8	23.5	23.7	22.7	12.2	11.2	11.1	11.5
Angus	Hereford	51.9	51.5	51.8	51.7	64.6	64.1	63.6	64.1	23.2	24.8	25.1	24.4	12.1	11.0	11.2	11.5
Hereford	Angus	53.2	51.8	51.1	52.0	65.9	64.3	62.9	64.4	22.2	24.8	26.5	24.5	11.9	11.0	10.6	11.1
	Average	52.6	51.7	51.5	51.9	65.2	64.2	63.3	64.3	22.7	24.8	25.8	24.4	12.0	11.0	10.9	11.3
Jersey	Hereford	53.7	52.4	52.8	53.0	66.8	64.9	64.7	65.5	20.4	22.7	23.5	22.2	12.7	12.4	11.7	12.3
	Angus	52.4	51.6	52.7	52.2	66.9	64.7	65.4	65.7	21.0	23.6	23.1	22.6	12.1	11.7	11.5	11.8
	Average	53.0	52.0	52.7	52.6	66.9	64.8	65.1	65.6	20.7	23.2	23.3	22.4	12.4	12.1	11.6	12.0
South Devon	Hereford	53.9	51.8	53.0	52.9	67.2	65.0	64.7	65.6	19.8	23.2	23.9	22.3	13.0	11.7	11.3	12.0
	Angus	54.8	50.8	53.5	53.0	68.6	63.6	65.8	66.0	19.1	25.4	22.9	22.5	12.3	11.1	11.2	11.8
	Average	54.4	51.3	53.2	53.0	67.9	64.3	65.3	65.8	19.4	24.3	23.4	22.4	12.7	11.4	11.3	11.8
Limousin	Hereford	58.5	55.4	56.5	56.8	71.3	68.9	69.3	69.8	16.2	19.2	18.8	18.0	12.6	11.9	12.0	12.2
	Angus	56.5	55.9	55.8	56.1	69.8	68.7	67.8	68.8	17.9	20.0	21.2	19.7	12.3	11.3	11.0	11.5
	Average	57.5	55.6	56.1	56.4	70.6	68.8	68.6	69.3	17.0	19.6	20.0	18.9	12.4	11.6	11.5	11.8
Simmental	Hereford	55.7	56.1	56.2	56.0	68.3	68.9	68.7	68.6	17.8	18.2	18.4	18.2	13.8	12.9	12.9	13.2
	Angus	54.4	54.7	54.9	54.7	67.2	67.5	67.1	67.3	20.1	20.3	20.9	20.4	12.7	12.2	12.0	12.3
	Average	55.0	55.4	55.5	55.3	67.8	68.2	67.9	68.0	19.0	19.2	19.6	19.3	13.2	12.6	12.5	12.7
Charolais	Hereford	58.8	57.6	58.0	58.1	72.1	70.7	70.1	71.0	14.8	16.3	17.3	16.1	13.1	13.0	12.6	12.9
	Angus	55.7	56.8	55.3	55.9	69.0	70.2	67.5	68.9	18.7	17.9	20.8	19.2	12.3	11.9	11.7	12.0
	Average	57.2	57.2	56.6	57.0	70.6	70.4	68.8	69.9	16.8	17.1	19.0	17.6	12.6	12.5	12.2	12.4
Average	Hereford	55.3	54.3	54.6	54.7	68.2	67.2	66.7	67.4	18.9	20.7	21.4	20.3	12.9	12.1	11.9	12.3
All Sire	Angus	54.4	53.1	53.6	53.7	67.7	66.0	65.8	66.5	20.1	22.7	22.9	21.9	12.2	11.4	11.2	11.6
Breeds	Average	54.8	53.7	54.1	54.2	68.0	66.6	66.3	67.0	19.5	21.7	22.1	21.1	12.5	11.7	11.6	11.9

[a] The data for all carcass traits are adjusted by regression on birth date to the average age of each slaughter group, and are adjusted for age of dam.
[b] Actual Cutability, % = actual yield of boneless, closely trimmed beef from the round, loin, rib and chuck.
[c] Retail Product, % = actual yield of boneless, closely trimmed beef from the carcass.

Table 15. U.S. Meat Animal Research Center Germ Plasm Evaluation Program Least Squares Means for Warner-Bratzler Shear and Taste Panel Evaluation of Cooked Steaks[a] Cycle 1, Phase I – 1971 Calf-Crop

Breed of Sire	Breed of Dam	Warner-Bratzler Shear, lb.[b]				Taste Panel Tenderness[c]				Taste Panel Flavor[c]				Taste Panel Juiciness[c]				Taste Panel Acceptability[c]			
		200	242	284	Avg.	200	242	284	Avg.	200	242	284	Avg.	200	242	284	Avg.	200	242	284	Avg.
Hereford	Hereford	7.1	6.7	7.0	6.9	7.3	8.4	8.1	7.9	7.5	7.8	7.7	7.7	7.0	8.0	7.8	7.6	7.2	8.1	7.9	7.7
Angus	Angus	7.2	7.8	7.7	7.6	7.7	6.6	7.4	7.2	7.7	7.3	7.6	7.5	7.3	6.8	7.6	7.2	7.5	6.8	7.5	7.3
	Average	7.2	7.3	7.4	7.3	7.5	7.5	7.8	7.6	7.6	7.6	7.7	7.6	7.2	7.4	7.7	7.4	7.4	7.5	7.7	7.5
Angus	Hereford	6.5	8.4	6.9	7.3	7.6	7.1	7.7	7.5	7.4	7.4	7.8	7.5	7.5	7.2	7.8	7.5	7.5	7.2	7.8	7.5
Hereford	Angus	7.7	7.0	6.9	7.2	7.5	7.6	7.2	7.4	7.1	7.4	7.6	7.4	7.1	7.3	7.4	7.3	7.2	7.5	7.4	7.4
	Average	7.1	7.7	6.9	7.2	7.6	7.4	7.5	7.5	7.3	7.4	7.7	7.5	7.3	7.3	7.6	7.4	7.4	7.4	7.6	7.5
Jersey	Hereford	7.2	7.9	7.4	7.5	7.1	6.8	8.0	7.3	7.9	7.5	7.2	7.5	7.7	7.0	7.8	7.5	7.5	7.1	7.5	7.4
	Angus	6.5	6.5	6.7	6.6	7.6	7.3	6.5	7.1	8.0	7.4	7.7	7.7	7.6	7.3	7.4	7.4	7.7	7.3	7.1	7.4
	Average	6.9	7.2	7.1	7.1	7.4	7.1	7.3	7.2	8.0	7.5	7.5	7.6	7.7	7.2	7.6	7.5	7.6	7.2	7.3	7.4
South Devon	Hereford	8.2	8.1	7.7	8.0	7.3	7.0	7.3	7.2	7.6	7.5	7.4	7.5	7.1	7.0	7.6	7.2	7.3	7.2	7.2	7.2
	Angus	7.1	6.4	6.8	6.8	7.1	7.4	7.3	7.3	7.2	7.3	7.6	7.3	7.6	7.1	7.4	7.4	6.9	7.3	7.4	7.2
	Average	7.7	7.3	7.3	7.4	7.2	7.2	7.3	7.2	7.4	7.4	7.5	7.4	7.3	7.1	7.5	7.3	7.1	7.3	7.3	7.2
Limousin	Hereford	8.2	7.7	8.4	8.1	6.8	7.1	6.2	6.7	7.4	7.4	7.6	7.5	7.6	6.8	7.4	7.2	6.8	7.0	6.6	6.8
	Angus	7.7	7.4	9.1	8.1	7.2	7.6	6.4	7.1	7.6	7.7	7.6	7.6	6.6	7.2	7.3	7.0	7.1	7.5	7.2	7.3
	Average	8.0	7.6	8.8	8.1	7.0	7.4	6.3	6.9	7.5	7.6	7.6	7.6	6.9	7.0	7.4	7.1	7.0	7.3	6.9	7.1
Simmental	Hereford	8.3	8.0	8.1	8.1	6.9	7.0	7.4	7.1	7.4	7.6	7.4	7.5	7.5	6.9	7.1	7.2	7.3	7.1	7.3	7.2
	Angus	8.0	7.8	8.4	8.1	7.1	7.7	6.4	7.1	7.3	7.7	7.5	7.5	7.0	7.7	7.3	7.3	6.9	7.7	6.9	7.2
	Average	8.2	7.9	8.3	8.1	7.0	7.4	6.9	7.1	7.4	7.7	7.5	7.5	7.3	7.3	7.2	7.3	7.1	7.4	7.1	7.2
Charolais	Hereford	6.6	7.8	7.9	7.4	6.0	6.8	7.2	6.7	7.6	7.4	7.8	7.6	6.3	7.2	7.5	7.0	6.2	7.1	7.4	6.9
	Angus	7.4	7.1	8.1	7.5	7.1	6.6	6.9	6.9	7.4	7.4	7.3	7.4	7.0	6.8	7.0	6.9	7.3	6.9	7.1	7.1
	Average	7.0	7.5	8.0	7.5	6.6	6.7	7.1	6.8	7.5	7.4	7.6	7.5	6.7	7.0	7.3	7.0	6.8	7.0	7.3	7.0
Average	Hereford	7.4	7.8	7.6	7.6	7.0	7.2	7.4	7.2	7.5	7.5	7.6	7.5	7.2	7.2	7.6	7.3	7.1	7.3	7.4	7.3
All Sire	Angus	7.4	7.1	7.8	7.4	7.3	7.3	6.9	7.2	7.5	7.5	7.6	7.5	7.2	7.2	7.4	7.3	7.2	7.3	7.2	7.2
Breeds	Average	7.4	7.5	7.7	7.5	7.2	7.3	7.2	7.2	7.5	7.5	7.6	7.5	7.2	7.2	7.5	7.3	7.2	7.3	7.3	7.3

[a] The data for all carcass traits are adjusted by regression on birth date to the average age of each slaughter group, and are adjusted for age of dam.
[b] A measure of the 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 was obtained on steaks from all 334 steers.
[c] Taste panel scores are based on a 9-point hedonic scale, with higher scores indicating greater acceptability. Taste panel traits were measured on steaks from 3 steers per breed group per slaughter date.

Table 16. U.S. Meat Animal Research Center Germ Plasm Evaluation Program Postweaning Growth and Reproductive Performance of Yearling Heifers Cycle 1, Phase II – 1970 Calf-Crop

Breed of Sire	Breed of Dam	No. 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. of Age	Avg. Age at Puberty days[c]	Percent 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
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	Hereford	193	1.04	651	707	71	362	75
All Sire	Angus	144	1.16	686	733	95	356	85
Breeds	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). This is based on a shrunk weight.
[c] Includes only the heifers reaching puberty by 15 months of age, and should be interpreted in relation to the percent reaching puberty by 15 months of age.
[d] The breeding period was 45 days by artificial insemination and 21 days by natural service.

Table 17. U.S. Meat Animal Research Center Germ Plasm Evaluation Program Postweaning Growth and Reproductive Performance of Yearling Heifers Cycle 1, Phase II – 1971 Calf-Crop

Breed of Sire	Breed of Dam	No. 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. of Age	Avg. Age at Puberty days[c]	Percent Pregnant[d]
Hereford	Hereford	16	0.99	616	742	81	415	88
Angus	Angus	21	1.07	653	764	100	370	90
	Average	37	1.03	635	754	92	393	89
Angus	Hereford	27	1.18	665	783	96	394	89
Hereford	Angus	24	1.13	681	782	96	385	92
	Average	51	1.16	674	783	96	390	90
Jersey	Hereford	27	1.01	609	723	100	348	93
	Angus	21	0.99	620	736	100	326	76
	Average	48	1.00	614	729	100	337	85
South Devon	Hereford	20	1.21	664	788	100	381	95
	Angus	23	1.16	680	778	100	345	91
	Average	43	1.19	673	784	100	363	93
Limousin	Hereford	14	1.11	656	763	64	427	57
	Angus	28	1.08	678	769	100	383	96
	Average	42	1.10	668	767	88	405	83
Simmental	Hereford	31	1.16	681	836	97	376	94
	Angus	28	1.22	720	829	100	362	86
	Average	59	1.19	700	832	98	369	90
Charolais	Hereford	20	1.17	679	826	85	422	70
	Angus	12	1.18	704	813	100	393	92
	Average	32	1.18	693	821	91	408	78
Average	Hereford	155	1.12	653	781	92	395	86
All Sire	Angus	157	1.12	677	782	99	366	89
Breeds	Average	312	1.12	665	781	96	380	88

[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).
[c] Includes only the heifers reaching puberty by 15 months of age, and should be interpreted in relation to the percent reaching puberty by 15 months of age.
[d] The breeding period was 46 days by artificial insemination and 24 days by natural service.

Table 18. U.S. Meat Animal Research Center Germ Plasm Evaluation Program Calving Difficulty for the First Calf-Crop of the Cycle 1, Phase II Two-Year-Old Females[a]

Cow Genotype		No. of Calves				Type of Parturition, %				Dead at or Shortly After Birth
Breed of Sire	Breed of Dam	Total	Males	Females	Birth wt,lb.[b]	No Difficulty[c]	Calf-Puller	C-Section	Abnormal Presentation	(No.)
Hereford	Hereford	17[d]	10	6	63.3	50.0	25.0	6.3	18.8	1
Angus	Angus	18[d]	11	6	63.2	52.9	35.3	0.0	5.9	0
	Average	35	21	12	63.3	51.5	30.3	3.0	12.1	1
Angus	Hereford	18	7	11	70.3	55.6	38.9	5.6	0.0	0
Hereford	Angus	23	10	13	67.3	65.2	30.4	4.3	0.0	2
	Average	41	17	24	68.8	61.0	34.1	4.9	0.0	2
Jersey	Hereford	27	12	15	65.3	85.2	14.8	0.0	0.0	0
	Angus	14	8	6	59.7	78.6	21.4	0.0	0.0	1
	Average	41	20	21	62.5	82.9	17.1	0.0	0.0	1
South Devon	Hereford	11	7	4	71.5	36.4	63.6	0.0	0.0	0
	Angus	13	8	5	73.6	38.5	53.8	7.7	0.0	2
	Average	24	15	9	72.6	37.5	58.3	4.2	0.0	2
Limousin	Hereford	22	14	8	67.7	59.1	36.4	0.0	4.5	1
	Angus	23	9	14	70.1	52.2	43.4	4.3	0.0	2
	Average	45	23	22	68.9	55.6	40.0	2.2	2.2	3
Simmental	Hereford	20	10	10	70.9	45.0	50.0	5.0	0.0	0
	Angus	19	14	5	71.5	52.6	36.8	10.5	0.0	1
	Average	39	24	15	71.2	48.7	43.6	7.7	0.0	1
Charolais	Hereford	27[d]	14	13	73.8	63.0	25.9	7.4	3.7	0
	Angus	12[d]	7	4	77.2	45.5	45.5	0.0	9.1	1
	Average	39	21	17	75.5	57.9	31.6	5.3	5.3	1
Average	Hereford	142	74	67	69.0	59.6	33.3	3.5	3.5	2
All Sire	Angus	122	67	53	68.9	56.3	37.8	4.2	1.7	9
Breeds	Average	264	141	120	69.0	58.1	35.4	3.8	2.7	11

[a] Calves from these cows were sired by Hereford, Angus, Devon, Holstein and Brahman bulls. The number of calves by each sire group was disproportionate among the cow breeding groups.
[b] Unweighted for calf sex.
[c] No assistance or minor hand assistance
[d] One premature birth.

Table 19. U.S. Meat Animal Research Center Germ Plasm Evaluation Program Calving and Breeding for the Cycle 1, Phase II Two-Year-Old Females During 1972[a]

Cow genotype		No. Exposed to Breeding in 1971	Calving in 1972		Average Calving Date[b]	Percent Detected in Estrus[c]	Percent Bred by AI[c]	Postpartum Interval, Days	Percent Pregnant[c]	Cow Wt. at 2½ Yrs. of Age, lb.[c]
Breed of Sire	Breed of Dam		No.	%						
Hereford	Hereford	26	17	65.4	91	94.1	76.5	80.6	94.1	853
Angus	Angus	23	18	78.3	83	100.0	88.9	86.4	83.3	834
	Average[d]	49	35	71.9	87	97.1	82.7	83.5	88.7	844
Angus	Hereford	22	18	81.8	86	94.4	83.3	89.4	88.9	874
Hereford	Angus	24	23	95.8	89	95.7	95.7	75.3	87.0	914
	Average[d]	46	41	88.8	88	95.1	89.5	82.4	88.0	894
Jersey	Hereford	29	27	93.1	82	100.0	88.9	82.9	96.3	800
	Angus	16	14	87.5	77	100.0	100.0	76.4	85.7	755
	Average[d]	45	41	90.3	80	100.0	94.5	79.7	91.0	778
South Devon	Hereford	18	11	61.1	94	90.9	90.9	75.8	81.8	912
	Angus	17	13	76.5	82	100.0	92.3	80.8	100.0	930
	Average[d]	35	24	68.8	88	95.5	91.6	78.3	90.9	921
Limousin	Hereford	30	22	73.3	104	90.9	63.6	73.2	86.4	899
	Angus	26	23	88.5	89	95.7	91.3	73.0	69.6	911
	Average[d]	56	45	80.9	97	93.3	77.5	73.1	78.0	905
Simmental	Hereford	27	20	74.1	86	90.0	85.0	86.4	75.0	948
	Angus	22	19	86.4	80	94.7	89.5	89.2	73.7	933
	Average[d]	49	39	80.3	83	92.4	87.3	87.8	74.4	941
Charolais	Hereford	34	27	79.4	89	100.0	81.5	86.4	88.9	970
	Angus	16	12	75.0	77	91.7	91.7	93.0	66.7	1076
	Average[d]	50	39	77.2	83	95.9	86.6	89.7	77.8	1023
Average	Hereford[d]	186	142	76.3	90	94.3	81.4	82.1	87.3	894
All Sire	Angus[d]	144	122	84.7	82	96.8	92.8	82.0	80.9	908
Breeds	Average[d]	330	264	80.5	86	95.6	87.1	82.1	84.1	901

[a] Calves from these cows were sired by Hereford, Angus, Devon, Holstein and Brahman bulls.
[b] Julian calendar date.
[c] Percentage of those that calved.
[d] Unweighted means.