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4-1984

Germ Plasm EvaluationProgram- Progress Report No. 11

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Cundiff, Larry V.; Gregory, Keith E.; Koch, Robert M.; and Roman L. Hruska U.S. Meat Animal Research Center, "Germ Plasm EvaluationProgram- Progress Report No. 11" (1984). *Roman L. Hruska U.S. Meat Animal Research Center*. 184.

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United States
Department of
Agriculture

Agricultural
Research
Service

ARS-1

April 1984

Germ Plasm Evaluation Program

Progress Report No. 11

Roman L. Hruska U.S. Meat Animal Research Center
in Cooperation with Kansas State University and
University of Nebraska Institute of Agriculture and
Natural Resources, Nebraska Agricultural
Experiment Station

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The cattle Germ Plasm Evaluation Program at the Roman L. Hruska U.S. Meat Animal Research Center is designed to characterize different biological types represented by breeds varying widely in characteristics such as milk production, growth, mature size, and carcass composition. A major objective is to characterize breeds representing different biological types in different feed environments and production situations for the full spectrum of biological traits relating to economic beef production.

A coordinated research effort is employed involving scientists from the disciplines of animal breeding, reproductive physiology, nutrition, meats, and production systems. The program was initiated in 1969. Progress reports have been published annually summarizing current results from each cycle and phase of the program for traits of principal economic importance to the beef cattle industry.

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ROMAN L. HRUSKA U.S. MEAT ANIMAL RESEARCH CENTER

CATTLE GERM PLASM EVALUATION PROGRAM

PROGRESS REPORT NO. 11

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

INTRODUCTION

A vast array of both resources and cattle breeds are available for beef production in the United States. Although feeding concentrates has provided for a relatively high degree of uniformity in the growing-finishing segment of beef production, resources used for cow-calf production have remained and will continue to remain very diverse. In the United States, stocking rates range from one cow per 2 acres or less to only one cow per 300 or 400 acres because of differences in climate, land, and feed resources.

The germ plasm base for beef cattle production in North America was broadened considerably during the 1970's, primarily, as a result of the introduction of new breeds of European origin made possible by the development of appropriate quarantine facilities and procedures by Agriculture Canada. The newly introduced breeds, in addition to those already available, provide a wide range of performance characteristics in beef cattle.

In 1969, the Roman L. Hruska U.S. Meat Animal Research Center implemented a program to characterize a broad range of biological types of cattle as represented by breeds that differ widely in characteristics such as growth rate, carcass composition, mature size and milk production level. The primary objective was to characterize breeds representing diverse biological types for the full spectrum of traits relating to beef production. The breeds used in this program have been classified into six different biological types based on the criteria of (1) growth rate and mature size, (2) lean to fat ratio, (3) age at puberty and (4) milk production (table 1).

The intent of this program was to collaborate with research organizations at other locations so that characterizations would be done in different climatic and feed environments to gain information needed for "matching" biological types with production resources for optimum conversion rate. Collaborative efforts involving a sample of biological types have been implemented with Agriculture Canada; the Beef Cattle Research Station at Brooksville, Florida, involving both the USDA and the Florida Agricultural Experiment Station; the Louisiana Agricultural Experiment Station at Baton Rouge; and the Livestock and Range Research Station at Miles City, Montana, involving the USDA and the Montana Agricultural Experiment Station. Simmental, Maine-Anjou, Chianina, and Brahman crosses with Hereford and Angus dams were produced by the Louisiana Agricultural Experiment Station; Angus-Hereford crosses, Pinzgauer, Sahiwal, and Brahman crosses with Hereford and Angus dams are included in the program at Brooksville; and Angus, Simmental, Red Poll, and Pinzgauer crosses with Hereford dams were produced at Miles City, Montana. Comparative results are not yet available from these locations.

TABLE 1. BREED CROSSES GROUPED IN BIOLOGICAL TYPE ON BASIS OF FOUR MAJOR CRITERIA^a

Breed group	Growth rate & mature size	Lean to fat ratio	Age at puberty	Milk production
Jersey-X	X	X	X	XXXXX
Hereford-Angus-X	XX	XX	XXX	XX
Red Poll-X	XX	XX	XX	XXX
Devon	XX	XX	XXX	XX
South Devon-X	XXX	XXX	XX	XXX
Tarentaise-X	XXX	XXX	XX	XXX
Pinzgauer-X	XXX	XXX	XX	XXX
Brangus-X	XXX	XX	XXXX	XX
Santa Gertrudis-X	XXX	XX	XXXX	XX
Sahiwal-X	XX	XXX	XXXXX	XXX
Brahman-X	XXXX	XXX	XXXXX	XXX
Holstein	XXXX	XXX	XX	XXXXXX
Brown Swiss-X	XXXX	XXXX	XX	XXXX
Gelbvieh-X	XXXX	XXXX	XX	XXXX
Simmental-X	XXXXX	XXXX	XXX	XXXX
Maine Anjou-X	XXXXX	XXXX	XXX	XXX
Limousin-X	XXX	XXXXX	XXXX	X
Charolais-X	XXXXX	XXXXX	XXXX	X
Chianina-X	XXXXX	XXXXX	XXXX	X

^a The number of "X's" indicates increasing relative differences among breed groups for (1) growth rates and mature size, (2) lean to fat ratio, (3) age at puberty and (4) milk production found in the Germ Plasm Evaluation Program at the Roman L. Hruska U.S. Meat Animal Research Center, Clay Center, Nebraska.

Previous progress reports have presented complete data on birth, survival, and preweaning growth of steers and heifers; postweaning growth and puberty of females; postweaning growth and feed efficiency of steers; and carcass and meat characteristics of steers produced in the program¹. This report provides an up-to-date summary of reproduction and maternal performance data for cows in each cycle of the Germ Plasm Evaluation Program.

PROCEDURE

The cattle Germ Plasm Evaluation Program has been conducted in a series of three cycles (referring to different sets of sire breeds) and phases (referring to different sets of cows). Foundation cows (Hereford and Angus, in Cycles I, II, and III, plus Red Poll and Brown Swiss in Cycle II) are referred to as Phase I. Their progeny are referred to as Phase 2, and progeny from Phase 2 are designated as Phase 3. Specific mating plans for each cycle and phase of the program are provided in the appendix.

Mating Plans and Management

Cycle I-Phase 2. The foundation Hereford and Angus cows used in the program were purchased as calves at weaning from commercial producers in Nebraska. The cows were 2 through 5, 2 through 6 and 3 through 7 years old at calving in the spring (mid-March through April) in 1970, 1971, and 1972, respectively. The Hereford and Angus cows were bred by artificial insemination (AI) to 32 Hereford, 35 Angus, 33 Jersey, 28 South Devon, 20 Limousin, 28 Simmental, and 26 Charolais bulls to produce the Cycle I-Phase 2 calves. The Hereford and Angus bulls used in this program were sampled from bulls that had been selected on individual performance information, which was the basis for entering into the progeny testing programs of commercial AI organizations. The Jersey bulls were selected at random from two commercial AI organizations, and the South Devon bulls were sampled from an importation made in 1969 by a commercial organization. Simmental, Limousin, and Charolais bulls were sampled from bulls available from commercial AI organizations and from the Research Branch, Agricultural Canada for the Simmental and Limousin.

Cycle I-Phase 2, yearling heifers were mated to Hereford, Angus, Brahman, Devon, and Holstein bulls during a 45- to 46-day AI season and to Hereford and Angus bulls for a 21- to 24-day clean up period in 1971, 1972, and 1973 (appendix table 3). As 2-year-old cows, they were mated to Hereford, Angus, Chianina, Gelbvieh and Maine Anjou bulls for a 42- to 45-day AI season and to Hereford and Angus bulls during a 22-day cleanup in 1972, 1973, and 1974. As 3-year-olds and at subsequent ages through 8 years of age, the cows were mated by natural service to Brown Swiss (predominantly European) bulls. Progeny out of Cycle I-Phase 2 cows were born in the spring, reared without creep feed and weaned in the fall of each year (1972-80) at about 200 days of age.

Cycle I-Phase 3. The mating plans to produce Cycle I-Phase 3 calves are shown in appendix table 3. These calves were out of Cycle I-Phase 2 females

¹ See Beef Research Progress Report No. 1, U.S. Department of Agriculture, Agricultural Research Service, Roman L. Hruska U.S. Meat Animal Research Center. ARM-NC-21, April 1982.

bred AI as yearling heifers to 16 Hereford, 25 Angus, 14 Brahman, 12 Devon, and 13 Holstein sires for 45 to 46 days followed by a 21- to 24-day clean up natural service mating period to Hereford and Angus sires. The three-way cross females resulting from these matings were retained to evaluate their reproduction and maternal performance when mated naturally to Red Poll bulls. The Red Poll sired progeny were born in the spring of 1974, 1975, 1976 and 1977. The progeny were raised by their three-way cross dams without creep feed until weaning in October of each year at about 200 days of age.

Cycle II-Phase 2. The mating plans to produce Cycle II-Phase 2 calves are shown in appendix table 2. The Cycle II-Phase 2 progeny resulted from AI matings to 15 Hereford, 16 Angus, 16 Red Poll, 11 Brown Swiss (7 European, 4 domestic), 11 Gelbvieh, 18 Maine Anjou, and 20 Chianina sires. The Hereford and Angus sires had also been used in Cycle I of the program, and the other bulls were sampled from commercial organizations. The foundation Hereford and Angus dams used in Cycle I were continued in Cycle II. Thus, the Cycle II-Phase 2 progeny produced in 1973 were out of 4- to 8-year-old cows and those produced in 1974 were out of 4- to 9-year-old cows. As indicated in appendix table 2, mature Brown Swiss and Red Poll cows were added to the foundation herd to produce 4x4 diallel progeny involving Herefords, Angus, Red Poll and Brown Swiss breeds in 1973 and 1974; results involving progeny out of Red Poll and Brown Swiss dams are not included in this present summary.

Cycle II-Phase 2, yearling heifers were mated to Hereford, Angus, Brangus and Santa Gertrudis sires used by AI to produce 2 calf crops (Cycle II-Phase 3 progeny) in the spring of 1975 and 1976 (see appendix table 4). As 2-year-olds and at subsequent ages through 7 years of age, the cows were mated by natural service to 3/4 or 7/8 Simmental bulls. Progeny out of Cycle II-Phase 2 cows were born in the spring, reared without creep feed and weaned in the fall of each year (1975-82) at about 200 days of age.

Cycle II-Phase 3. The mating plans to produce Cycle II-Phase 3 calves are shown in appendix table 4. The Cycle II-Phase 3 females were out of Cycle II-Phase 2 females bred AI as yearlings to 13 Hereford, 14 Angus, 14 Brangus and 13 Santa Gertrudis sires. Females resulting from cleanup natural service matings to Hereford and Angus sires were also included in the study. The three-way cross females resulting from these matings were retained to evaluate their reproduction and maternal performance when mated naturally to Shorthorn bulls. The Shorthorn-sired progeny were born in the spring of 1977, 1978, 1979 and 1980. The progeny were raised by their three-way cross dams without creep feed until weaned in October of each year at about 200 days of age.

Cycle III-Phase 2. The mating plans to produce Cycle III-Phase 2 calves are shown in appendix table 5. The Cycle III-Phase 2 progeny resulted from AI matings to 13 Hereford, 14 Angus, 17 Brahman, 6 Sahiwal, 9 Pinzgauer and 7 Tarentaise sires. The Hereford and Angus sires had been used AI in all previous cycles and phases of the program. The Brahman bulls were sampled from commercial AI organizations or purebred Brahman herds. Semen was available from commercial sources for the Sahiwal (semen originally imported

from Australia), Tarentaise and Pinzgauer bulls sampled. The foundation Hereford and Angus cows used to produce Cycle III-Phase 2 progeny included females that had been used to produce Cycle I-Phase 2 and Cycle III-Phase 2 progeny supplemented by additional Hereford and Angus sampled from the same general area (foundation Hereford and Angus females were purchased as calves from commercial producers in western Nebraska). The Cycle III-Phase 2 progeny were produced in 1975 and 1976 out of dams ranging from 4 to 11 years of age.

Cycle III-Phase 2 yearling heifers were mated by natural service to Red Poll bulls to produce their first calf crop as 2-year-olds and to 7/8 or purebred Simmental bulls to produce their second through sixth calf crop at 3 through 7 years of age. The progeny were born in the spring, reared without creep feed and weaned at about 200 days of age in October of each year from 1977 through 1982.

Traits measured

Calving difficulty. Calving difficulty scores were assigned to each calf at birth. For this report, calves born with no assistance or hand assistance were classified as not difficult and calves requiring assistance with calf puller or delivered by caesarian section were classified as difficult (0 = no difficulty, 1 = difficult).

Calf crop. Calf crop percentages reflect the percentage of cows giving birth to or weaning a calf relative to all cows alive at calving time (0 = no calf, 1 = calf). Since cows were removed from the experiment only for serious injury, or for being open 2 successive years or for death, percentage calf crop relative to all cows calving is virtually the same as percentage calf crop relative to all cows exposed to breeding.

Calf weights. Calf birth weights reported are adjusted to a steer basis by adjustment factors calculated directly from the least squares analyses of the data. The 200-day weight per calf weaned was computed as $((\text{actual weaning weight} - \text{birth weight}) / \text{weaning age}) \times 200 + \text{birth weight}$. The 200-day weight per cow exposed was computed as $(200\text{-day weight}) \times (\text{calf crop percentage}) \times (0.01)$.

Milk production. Cows and calves were separated for 12 hours, after which calves were weighed, allowed to nurse their dams, and reweighed. The change in calf weight was used to estimate 12-hour milk productions. This procedure was used to estimate milk production at three different times during lactation (about 130, 160 and 190 days postpartum) on a sample of the Cycle I-Phase 2, Cycle II-Phase 2 and Cycle III-Phase 2 of the program (see footnotes in tables 2, 4 and 6).

Cow weights. Cow weights and hip heights reported were obtained in the fall at weaning time.

Analyses

All data were analyzed by least squares procedures using models that included fixed effects for breed groups, cow age-year, sex of calf (calving difficulty and calf weights only), and most two-factor interactions.

RESULTS

Cycle I-Phase 2. Results on production of the F₁ females (as 2-through 8-year-olds) are summarized for Cycle I, Phase 2 females in table 2. Results presented in table 2 are adjusted for differences in sire breed of calf, for age of dam, and year, and to a steer basis. Jersey cross females experienced less calving difficulty than other breed groups in Cycle I, especially as 2-year-olds (see table 1, in Progress Report No. 1). Differences in calving difficulty of F₁ cows were associated with birth weight of their calves. The relatively heavy weaning weights of calves from Simmental and Jersey cross dams in Cycle I reflect their greater milk production. Jersey cross dams produced more milk, but calves with Simmental and Charolais cross dams were heavier at weaning than calves with Jersey cross dams because of greater growth rate transmitted by Simmental and Charolais cross dams. Calf weight at 200 days per F₁ cow exposed to breeding among the breed groups included in Cycle I had a range of 8% (i.e., 100% for Limousin and Hereford-Angus crosses to 108% for Simmental crosses).

Cycle I-Phase 3. Results on production of the 3-way cross females (as 2-through 5-year-olds) from Cycle I, Phase 3 of the program are summarized in table 3. Calving difficulty was less in Brahman cross and Devon cross females than Hereford-Angus cross and Holstein cross females. Calves out of Brahman cross females were significantly lighter at birth than calves out of all other crosses. Calves out of Holstein cross females were significantly heavier at birth than calves out of Hereford-Angus cross and Devon cross females; however, Holstein crosses did not differ significantly from Hereford-Angus crosses in calving difficulty. Differences between breed groups for percentage calf crop born and percentage calf crop weaned were not significant ($P>.05$). Weaning weight per calf weaned and per cow exposed to breeding was significantly higher for progeny of Holstein cross and Brahman cross females than for progeny of Hereford-Angus cross and Devon cross females.

Cycle II-Phase 2. Results on production of the F₁ females as 2- through 7-year-olds from Cycle II, Phase 2 of the program are presented in table 4. Calving difficulty has been lower for Brown Swiss and Chianina cross females than other breed groups, especially as 2-year-olds (table 13, Progress Report No. 9). Chianina cross females have had relatively low calving difficulty considering the heavy birth weight of their calves. Brown Swiss cross and Gelbvieh cross females milked at the highest level and produced calves that were 12% heavier at 200 days than Hereford-Angus cross females. Maine Anjou cross and Chianina cross females were comparable with Hereford-Angus crosses in milk production but produced calves that were 10% heavier in 200-day weight. Red Poll cross females were intermediate in the range among breed groups for milk production and 200-day weight of progeny. Calf weight weaned per cow exposed was 12% to 16% greater for Brown Swiss, Gelbvieh, Maine-Anjou, and Chianina crosses than for Red Poll and Hereford-Angus crosses.

Cycle II-Phase 3. Results on production of the 3-way cross females (as 2-through 5-year-olds) from Cycle II, Phase 3 of the program are summarized in table 5. Calving difficulty was less in Santa Gertrudis crosses than in Brangus and Hereford-Angus crosses because of less calving difficulty

as 2-year-olds (see table 18 in Progress Report No. 9). Calves out of Brangus and Santa Gertrudis crosses were 5% and 6%, heavier, respectively, at 200 days than calves out of Hereford-Angus crosses.

Cycle III-Phase 2. Results on production of the F₁ females (as 2- through 7-year-olds) from Cycle III, Phase 2 of the program are summarized in table 6. Sahiwal and Brahman cross females experienced significantly less calving difficulty than the other breed groups in Cycle III. This difference in calving difficulty in favor of Sahiwal and Brahman crosses was of greatest magnitude for the first parturition as 2-year-olds (table 23, Progress Report No. 9). Birth weight of calves out of Pinzgauer and Tarentaise crosses have been heavier than calves out of Hereford-Angus crosses while birth weight of calves out of Sahiwal and Brahman crosses have been lighter than Hereford-Angus crosses. Differences in milk production between Tarentaise, Pinzgauer, Sahiwal, and Brahman cross females were not large; all exceeded Hereford-Angus cross females. Brahman crosses exceeded all crosses in 200-day weight weaned per calf and per cow exposed to breeding. Weaning weights of progeny out of Pinzgauer, Tarentaise, and Sahiwal cross females were 6% to 10% heavier per calf weaned and 8% to 12% heavier per cow exposed to breeding than progeny out of Hereford-Angus cross females.

TABLE 2. ROMAN L. HRUSKA U.S. MEAT ANIMAL RESEARCH CENTER GERM PLASM EVALUATION PROGRAM
BREED GROUP MEANS FOR REPRODUCTION AND MATERNAL PERFORMANCE OF F₁ COWS AT 2 THROUGH 8 YEARS OF AGE
CYCLE I-PHASE 2 - COWS BORN 1970-71-72^a

Breed of cow		Number births	Calving diffi- culty ^b %	Calf crop		Birth weight ^c lb	Milk prod ^d lb	Cow weight ^e lb	200-day weight			
Sire	Dam			Born %	Weaned %				Per calf weaned ^c lb	Ratio ^f %	Per cow exposed lb	Ratio ^f %
Angus Hereford	Hereford	360	9	93	84	86		1219	480	102	403	101
	Angus	378	12	93	86	87		1231	465	99	400	100
	Average	738	10	93	85	86	6.6	1225	472	100	401	100
Jersey	Hereford	346	3	94	89	81		1071	495	105	441	110
	Angus	282	5	89	81	77		1067	486	103	394	98
	Average	628	4	92	85	79	9.7	1069	490	104	417	104
South Devon	Hereford	319	13	90	86	93		1277	490	104	421	105
	Angus	284	11	90	85	89		1254	489	104	416	104
	Average	603	12	90	86	91	7.0	1266	489	104	421	105
Limousin	Hereford	425	8	89	81	89		1240	485	103	393	98
	Angus	426	10	93	85	86		1230	479	101	407	102
	Average	851	9	91	83	88	6.0	1235	481	102	399	100
Simmental	Hereford	488	16	92	87	93		1273	520	110	452	113
	Angus	384	13	90	82	90		1291	516	109	423	105
	Average	872	14	91	84	91	8.8	1282	518	110	435	108
Charolais	Hereford	412	12	92	83	93		1367	500	106	415	103
	Angus	281	12	89	80	92		1347	500	106	400	100
	Average	693	12	90	81	93	6.0	1357	500	106	405	101
Average all sire breeds	Hereford	2350	10	92	85	89		1241	495	105	421	105
	Angus	2035	10	91	83	87		1237	489	104	406	101
	Average	4385	10	91	84	88	7.4	1239	492	104	413	103

^a These cows were bred to Hereford, Angus, Brahman, Devon, and Holstein bulls for their first calf crop; to Hereford, Angus, Gelbvieh, Maine Anjou, and Chianina bulls for their second calf crop; and to Brown Swiss bulls for subsequent calf crops.

^b Includes calves requiring calf puller or C-section.

^c Adjusted to a steer basis.

^d Average of three 12-hour milk production measures on a sample of 18 cows per breed group at 3 and 4 years of age.

^e Cow weight taken in fall at weaning time when cows were 7-year-olds.

^f Ratio computed relative to average for Hereford-Angus reciprocal cross dams.

TABLE 3. ROMAN L. HRUSKA U.S. MEAT ANIMAL RESEARCH CENTER GERM PLASM EVALUATION PROGRAM
BREED GROUP MEANS FOR REPRODUCTION AND MATERNAL PERFORMANCE OF CROSSBRED COWS AT 2 THROUGH 5 YEARS OF AGE
CYCLE I-PHASE 3 - COWS BORN 1972-73-74^a

Breed of cow		Number births	Calving diffi- culty ^c %	Calf crop		Birth weight ^d lb	Cow weight ^e lb	200-day weight			
				Born %	Weaned %			Per calf weaned ^d lb	Ratio ^f %	Per cow exposed lb	Ratio ^f %
Sire	Dam ^b										
Angus Hereford	Hereford-X	116	15	94	81	80	1002	432	101	350	96
	Angus-X	127	26	93	89	80	972	423	99	376	104
	Average	243	20	94	85	80	987	427	100	363	100
Brahman	Hereford-X	72	4	87	79	75	1029	474	111	374	103
	Angus-X	51	6	96	89	76	1069	484	113	431	119
	Average	123	5	92	84	76	1049	479	112	402	111
Devon	Hereford-X	89	14	92	85	81	989	428	100	364	100
	Angus-X	83	18	93	83	79	995	422	99	350	96
	Average	172	16	93	84	80	992	425	100	357	98
Holstein	Hereford-X	64	12	97	87	86	1049	492	115	428	118
	Angus-X	49	20	100	87	87	1047	487	114	424	117
	Average	113	16	98	87	86	1048	490	115	426	117
Average all sire breeds	Hereford-X	341	11	93	83	80	1017	456	107	378	104
	Angus-X	310	17	96	87	80	1021	454	106	395	109
	Average	651	14	94	85	80	1019	455	107	387	107

^a These cows were bred to Red Poll bulls for all calf crops.

^b Hereford-X denotes Hereford crosses and Angus-X denotes Angus crosses. Dams of these cows were sired by Hereford, Angus, Jersey, South Devon, Limousin, Simmental, and Charolais bulls.

^c Includes calves requiring calf puller or C-section.

^d Adjusted to a steer basis.

^e Cow weight taken in fall at weaning time when cows were 3-year-olds.

^f Ratio computed relative to average for Hereford and Angus sired dams.

TABLE 4. ROMAN L. HRUSKA U.S. MEAT ANIMAL RESEARCH CENTER GERM PLASM EVALUATION PROGRAM
BREED GROUP MEANS FOR REPRODUCTION AND MATERNAL PERFORMANCE OF F₁ COWS AT 2 THROUGH 7 YEARS OF AGE
CYCLE II-PHASE 2 - COWS BORN 1973-74^a

Breed of cow		Number births	Calving diffi- culty ^b %	Calf crop		Birth weight ^c lb	Milk prod ^d lb	Cow weight ^e lb	200-day weight			
Sire	Dam			Born %	Weaned %				Per calf weaned ^c lb	Ratio ^f %	Per cow exposed lb	Ratio ^f %
Angus Hereford	Hereford	185	12	91	85	87		1273	482	100	410	101
	Angus	253	20	91	84	89		1200	482	100	405	100
	Average	438	16	91	84	88	6.2	1236	481	100	404	100
Red Poll	Hereford	205	20	91	81	93		1187	511	106	414	102
	Angus	256	14	88	78	88		1179	504	105	393	97
	Average	461	17	90	79	91	7.6	1183	508	106	401	99
Brown Swiss	Hereford	349	13	92	83	95		1265	540	112	448	111
	Angus	332	9	93	86	92		1243	541	112	465	115
	Average	681	11	92	85	93	8.4	1254	540	112	459	114
Gelbvieh	Hereford	207	15	96	88	94		1313	539	112	474	117
	Angus	222	13	94	86	90		1280	539	112	464	115
	Average	429	14	95	87	92	8.4	1297	539	112	469	116
Maine Anjou	Hereford	209	15	93	86	99		1389	534	111	459	114
	Angus	259	14	94	86	96		1365	522	109	449	111
	Average	468	14	94	86	98	6.5	1377	528	110	454	112
Chianina	Hereford	233	10	93	87	98		1392	529	110	460	114
	Angus	242	11	92	85	96		1370	529	110	450	111
	Average	475	11	93	86	97	6.2	1381	529	110	455	113
Average all sire breeds	Hereford	1388	14	93	85	94		1303	522	109	444	110
	Angus	1564	14	92	84	92		1273	519	108	436	108
	Average	2952	14	92	85	93	7.2	1288	521	108	443	110

^a These cows were bred to Hereford, Angus, Brangus, and Santa Gertrudis bulls for their first calf crop and to 3/4 or 7/8 Simmental bulls for subsequent calf crops.

^b Includes calves requiring calf puller or C-section.

^c Adjusted to a steer basis.

^d Average of three 12-hour milk production measures on a sample of 18 cows per breed group at 3 years of age.

^e Cow weight taken in fall at weaning time when cows were 7-year-olds.

^f Ratio computed relative to average for Hereford-Angus reciprocal cross dams.

TABLE 5. ROMAN L. HRUSKA U.S. MEAT ANIMAL RESEARCH CENTER GERM PLASM EVALUATION PROGRAM
BREED GROUP MEANS FOR REPRODUCTION AND MATERNAL PERFORMANCE OF CROSSBRED COWS AT 2 THROUGH 5 YEARS OF AGE
CYCLE II-PHASE 3 - COWS BORN 1975-76^a

Breed of cow		Number births	Calving diffi- culty ^c %	Calf crop		Birth weight ^d lb	Cow weight ^e lb	Per calf weaned ^d lb	200-day weight		
Sire	Dam ^b			Born %	Weaned %				Ratio ^f %	Per cow exposed lb	Ratio ^f %
Angus Hereford	Hereford-X	101	16	92	79	83	1103	488	100	386	99
	Angus-X	116	22	87	80	84	1073	486	100	389	100
	Average	217	19	90	80	84	1088	487	100	390	100
Brangus	Hereford-X	91	17	87	82	86	1083	507	104	416	107
	Angus-X	70	19	88	77	87	1087	513	105	395	101
	Average	161	18	87	80	86	1085	510	105	408	105
Santa Gertrudis	Hereford-X	58	11	88	75	85	1117	513	105	385	99
	Angus-X	53	7	88	70	86	1120	521	107	365	94
	Average	111	9	87	72	86	1119	517	106	372	95
Average all sire breeds	Hereford-X	111	15	89	79	84	1101	503	103	397	102
	Angus-X	239	14	88	76	86	1093	506	104	385	99
	Average	489	14	88	77	85	1097	505	104	389	100

^a These cows were bred to Shorthorn bulls for their first calf crop and to Simmental bulls for subsequent calves.

^b Hereford-X denotes Hereford crosses and Angus-X denotes Angus crosses. Dams of these cows were sired by Hereford, Angus, Red Poll, Brown Swiss, Gelbvieh, Maine Anjou, and Chianina bulls.

^c Includes calves requiring calf puller or C-section.

^d Adjusted to a steer basis.

^e Cow weight taken in fall at weaning time when cows were 3-year-olds.

^f Ratio computed relative to average for Hereford and Angus sired dams.

TABLE 6. ROMAN L. HRUSKA U.S. MEAT ANIMAL RESEARCH CENTER GERM PLASM EVALUATION PROGRAM
BREED GROUP MEANS FOR REPRODUCTION AND MATERNAL PERFORMANCE OF F₁ COWS AT 2 THROUGH 7 YEARS OF AGE
CYCLE III-PHASE 2 - COWS BORN 1975-76^a

Breed of cow		Number births	Calving diffi- culty ^b %	Calf crop		Birth weight ^c lb	Milk prod ^d lb	Cow weight ^e lb	200-day weight			
				Born %	Weaned %				Per calf weaned ^c lb	Ratio ^f %	Per cow exposed lb	Ratio ^f %
Sire	Dam											
Angus	Hereford	154	10	89	84	86		1219	480	102	403	103
Hereford	Angus	355	17	90	83	84		1205	463	98	384	98
	Average	509	14	90	83	85	5.4	1212	471	100	391	100
Pinzgauer	Hereford	204	16	92	82	92		1209	508	108	417	107
	Angus	304	12	91	85	89		1205	502	107	427	109
	Average	508	14	92	84	90	7.3	1207	505	107	424	108
Tarentaise	Hereford	147	12	91	85	90		1227	528	112	449	115
	Angus	222	9	88	83	83		1159	511	108	424	108
	Average	369	11	90	84	87	7.2	1193	520	110	437	112
Brahman	Hereford	210	2	93	83	83		1295	535	114	444	114
	Angus	309	2	94	88	81		1250	534	113	470	120
	Average	519	2	93	85	82	8.4	1272	535	114	455	116
Sahiwal	Hereford	160	4	95	89	77		1133	504	107	449	115
	Angus	271	2	94	87	72		1080	493	105	429	110
	Average	431	3	94	88	75	7.8	1107	498	106	438	112
Average all sire breeds	Hereford	875	9	92	85	86		1217	511	108	434	111
	Angus	1461	9	92	85	82		1180	501	106	426	109
	Average	2336	9	92	85	84	7.2	1198	506	107	430	110

^a These cows were bred to Red Poll bulls for their first calf crop and to 7/8 Simmental bulls for subsequent calf crops.

^b Includes calves requiring calf puller or C-section.

^c Adjusted to a steer basis.

^d Average of three 12-hour milk production measures on a sample of 18 cows per breed group at 3 years of age.

^e Cow weight taken in fall at weaning time when cows were 6-year-olds.

^f Ratio computed relative to average for Hereford-Angus reciprocal cross dams.

APPENDIX

TABLE 1. MATING PLANS TO PRODUCE CYCLE I-PHASE 2 CALVES

1969, 1970, 1971 Breeding Seasons

Dam breeds ^a	Sire Breeds						
	Hereford	Angus	Jersey	South Devon	Limousin	Simmental	Charolais
Hereford	X	X	X	X	X	X	X
Angus	X	X	X	X	X	X	X

^a The cows were 1, 2, 3, and 4-year-olds in 1969; 1, 2, 3, 4, and 5-year-olds in 1970; and 2, 3, 4, 5, and 6-year-olds in 1971.

APPENDIX

TABLE 2. MATING PLANS TO PRODUCE CYCLE II-PHASE 2 CALVES

1972 and 1973 Breeding Seasons

Dam breeds ^a	Sire breeds						
	Hereford ^b	Angus ^b	Red Poll	Brown Swiss	Gelbvieh	Maine Anjou	Chianina
Hereford ^c	X	X	X	X	X	X	X
Angus ^c	X	X	X	X	X	X	X
Red Poll	X	X	X	X			
Brown Swiss	X	X	X	X			

^a The cows were 3-, 4-, 5-, 6-, and 7-year-olds in 1972; and 3-, 4-, 5-, 6-, 7-, and 8-year-olds in 1973.

^b Sample of same Hereford and Angus sires used in Cycle I, 1969-71 breeding seasons.

^c Cows used for GPE Cycle I, 1969-71 breeding seasons.

APPENDIX

TABLE 3. MATING PLANS TO PRODUCE CYCLE I-PHASE 3 CALVES^a

1971 - 1978 Breeding Seasons

	Sire Breeds										
	First calf crop ^b					Second calf crop ^c					Subsequent calf crops ^d
Breed Group	Here- ford ^e	Angus ^e	Brahman	Devon	Hol- stein	Here- ford ^e	Angus ^e	Gelb- vieh	Maine Anjou	Chia- nina	Brown Swiss
H x H		X					X				X
A x A	X					X					X
A x H			X	X	X			X	X	X	X
H x A			X	X	X			X	X	X	X
J x H		X	X	X	X		X	X	X	X	X
J x A	X		X	X	X	X		X	X	X	X
SD x H		X	X	X	X		X	X	X	X	X
SD x A	X		X	X	X	X		X	X	X	X
L x H		X	X	X	X		X	X	X	X	X
L x A	X		X	X	X	X		X	X	X	X
S x H		X	X	X	X		X	X	X	X	X
S x A	X		X	X	X	X		X	X	X	X
C x H		X	X	X	X		X	X	X	X	X
C x A	X		X	X	X	X		X	X	X	X

^a Females of each breed group distributed equally among cells marked "X" for each calf crop.

^b Each group of heifers bred as yearlings to produce one calf crop as 2-year-olds by these breeds in 1972-74.

^c Each group of cows bred as 2-year-olds to produce one calf crop as 3-year-olds by these breeds in 1973-75.

^d Each group of cows bred to produce at least four calf crops by this breed from 1974 through 1979.

^e Sample of same sires used in Cycle I, 1969-71 breeding seasons.

APPENDIX

TABLE 4. MATING PLANS TO PRODUCE CYCLE II-PHASE 3 CALVES^a

1974-1981 Breeding Season

Female breeding groups	First calf crop ^b				Subsequent calf crops ^c
	Hereford ^d	Angus ^d	Brangus	Santa Gertrudis	Simmental
Hereford		X	X	X	X
Angus	X		X	X	X
Red Poll	X	X			X
Brown Swiss	X	X			X
H x A & Recip.			X	X	X
H x R.P. & Recip.		X	X	X	X
H x B.S. & Recip.		X	X	X	X
A x R.P. & Recip.	X		X	X	X
A x B.S. & Recip.	X		X	X	X
Gelbvieh x Hereford			X	X	X
Gelbvieh x Angus	X		X	X	X
Maine Anjou x Hereford		X	X	X	X
Maine Anjou x Angus	X		X	X	X
Chianina x Hereford		X	X	X	X
Chianina x Angus	X		X	X	X

^a Females of each breed group distributed equally among the cells marked "X" for each calf crop.

^b Each group of heifers bred as yearlings to produce one calf crop as 2-year-olds by these breeds in 1975 and 1976.

^c Each group of cows mated to produce at least three calf crops by 3/4 or 7/8 Simmental bulls in 1976 through 1982.

^d Sample of same Hereford and Angus sires used in Cycle I-Phase, 1969-71 breeding seasons.

APPENDIX

TABLE 5. MATING PLANS TO PRODUCE CYCLE III-PHASE 2 CALVES^a

1974 and 1975 Breeding Seasons

Dam breeds ^b	Sire breeds					
	Hereford ^c	Angus ^c	Pinzgauer	Tarentaise	Brahman	Sahiwal
Hereford		X	X	X	X	X
Angus	X		X	X	X	X

^a Approximately 256 heifers (32 of each breed group, except Tarentaise) were transferred to Brooksville, Fla.

^b Cows used for GPE Cycle I, 1969, 1970 and 1971 and Cycle II, 1972 and 1973 breeding seasons.

^c Sample of same Hereford and Angus sires used to produce Cycle II-Phase 2 and Cycle II-Phase 2 calves.

APPENDIX

TABLE 6. MATING PLANS TO PRODUCE CYCLE II-PHASE 3 CALVES^a

1976-1981 Breeding Seasons

Breed group	Sire breeds	
	First Calf Crop ^b	Subsequent Calf Crops ^c
	Red Poll	Simmental
A x H	X	X
H x A	X	X
P x H	X	X
P x A	X	X
T x H	X	X
T x A	X	X
Br x H	X	X
Br x A	X	X
Sw x H	X	X
Sw x A	X	X

^a Females of each breed group distributed equally among cells marked "X" for each calf crop.

^b Each group of heifers bred as yearlings to produce one calf crop as 2-year-olds by Red Poll bulls in 1977 and 1978.

^c Each group of cows bred to produce at least four calf crops by Simmental bulls from 1978 through 1982.