BEEF CATTLE FIELD DAY

U.S. Range Livestock Experiment Station

Miles City, Montana **MAY 3, 1968**

BREEDING

PHYSIOLOGY

GRAZING

MANAGEMENT

ANIMAL HUSBANDRY ←*Research Divisions*→ **CROPS**

Agricultural Research Service
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ADAPTATION AND CATTLE PRODUCTIVITY
PROGRESS REPORT

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The performance of animals serves as an indicator of their adaptation to the environment to which they are subjected. Environment includes climate, nutrition and a host of general management factors. A single trait or a combination of traits may be considered in evaluating performance. In beef cattle, interest is normally in heritable traits that contribute to productivity and economic value.

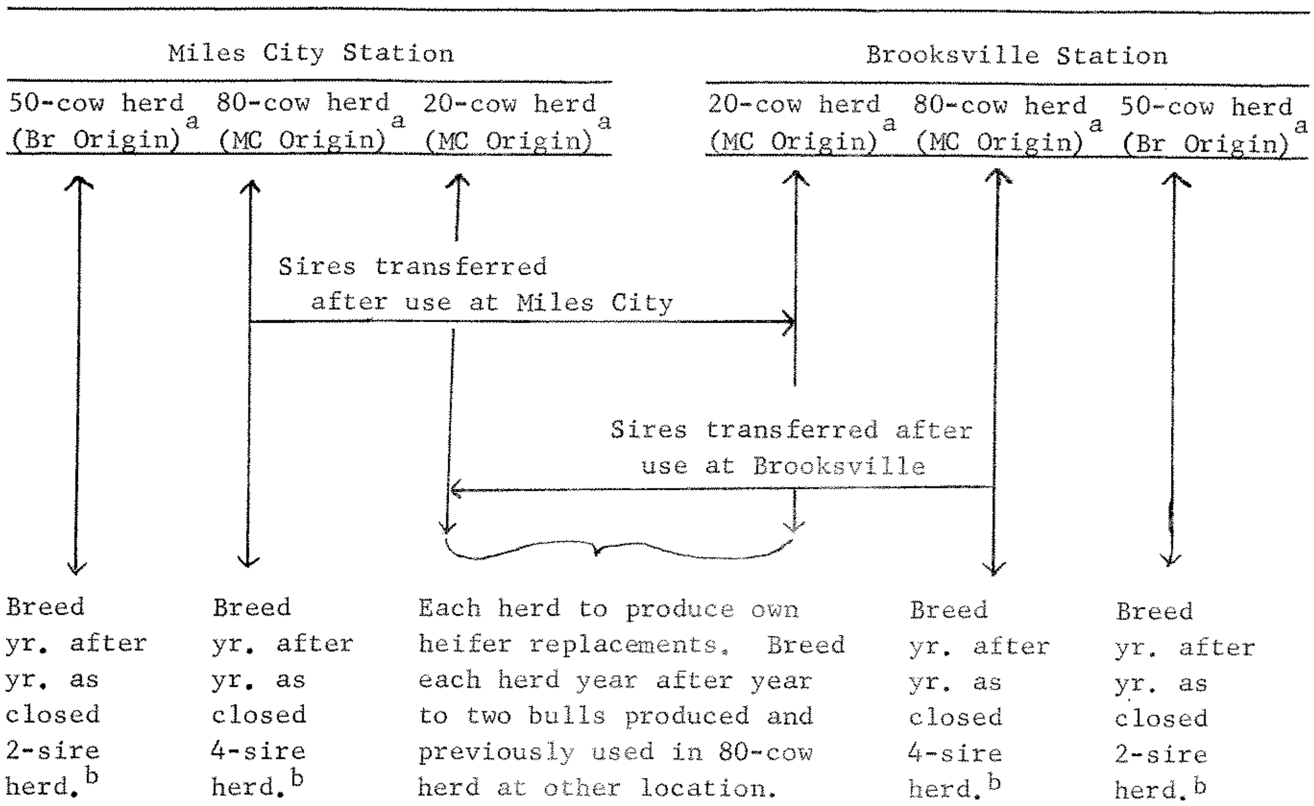
If cattle are selected for their inherent ability to perform well in a given locality or environment, how does this affect their ability to perform in a different locality or environment? Is the effectiveness of selection for certain heritable traits influenced appreciably by the locality or environment in which the selection is practiced? These are matters of practical significance. To obtain information needed to answer the preceding questions, a project commonly known as a genetic-environmental interaction project was activated in 1961. This is a cooperative study with the United States Department of Agriculture (Beef Cattle Research Branch-AHRD, ARS) and the Agricultural Experiment Stations of Montana and Florida participating. Studies of like design are in progress at the U. S. Range Livestock Experiment Station near Miles City, Montana, and at the Beef Cattle Research Station near Brooksville, Florida.

It is the purpose of this report to describe the project and comment on some of the results to date at the Miles City location. Several additional years will be required to obtain the full body of information for which the project is designed. Observations presented in this report, therefore, should be considered preliminary.

Project Plan

The long-term plan for the project is illustrated in Figure 1. Cattle from the Line 1 Hereford herd at the U. S. Range Livestock Experiment Station were divided as uniformly as feasible between the Miles City and Brooksville Stations from 1961 to 1963. These cattle provided foundations of the same breeding for the 80-cow and 20-cow herds at both stations. In 1962, a sample half of a Hereford herd at the Brooksville Station was transferred to Miles City, and the remaining half was retained at Brooksville. These cattle provided foundations of like origin for the 50-cow herds at both locations.

Transfers included females and a sufficient number of bulls for use until replacements from within the appropriate herd at each location could be produced. Herd sizes at time of transfer were somewhat smaller than specified in Figure 1. It was planned that herd sizes would be increased through the addition of progeny produced within the herds at each location in subsequent years.



[a]Br--Foundation stock from Brooksville Station.
MC--Foundation stock from Miles City Station.

[b]Closed herd--Both sire and female replacements to come from within the herd.

Figure 1. Long-term breeding plans for Miles City, Montana, and Brooksville, Florida, Stations.

Bulls produced in the 80-cow herd at each location are now selected for use in the parent herd for two years. These bulls are then transferred to the other location and are used for one year in the 20-cow herd. Two bulls are transferred each year. The first bulls that were transferred sired calves dropped in the control herd in 1967.

Records kept at each location include those on fertility, cow and calf survival, periodic weights of breeding females and growing stock, conformation and condition scores of growing cattle, a variety of observations on carcasses of performance-tested bulls slaughtered each year, body measurements, and physiological data of probable value.

Culling and selection procedures are kept as uniform as possible for all three herds within and between stations. Management practices differ between stations only to the extent required for the area in which each station is located.

Meaningful results may not be available until about 1975 unless adaptation to environment should be of pronounced importance or unless effectiveness of selection should be markedly different between stations. The following are some of the situations that could arise. The interpretations as stated here may be somewhat oversimplified. If the 80-cow and 20-cow herds remain about the same within each station, this will indicate that adaptation to environment is of little importance and that effectiveness of selection is similar under the two environments. If the 80-cow herd becomes better than the 20-cow herd within each station, this will indicate that adaptation to environment has an important affect on performance. If the 80-cow herd becomes better than the 20-cow herd at one station but not at the other, differences in the effectiveness of selection under the two station environments will be indicated. The trend shown at each location by comparison of the 50-cow herd of Brooksville origin with the other two herds will provide supplemental information.

Preliminary Observations

Some of the observations presented in this report involve comparisons of the cattle of Miles City and Brooksville origin. There are perhaps two factors that should be considered in making such comparisons. The inbreeding of the cattle of Miles City origin averaged about 20 to 24 percent at the beginning of the study. Inbreeding of the Brooksville cattle at the beginning of the study, as indicated by pedigree examination, appeared very low. It is, therefore, possible that the Miles City cattle might be affected more than the Brooksville cattle, at least in the early years, by inbreeding depression. In addition, the cattle of Brooksville origin appear to have been favored nutritionally during the first year at the Miles City Station (November 1962 to November 1963). This resulted from the isolation of the introduced cattle for a period of time as a precautionary measure. It was observed that the forage growth in the areas occupied by the introduced cattle during the isolation period was better than in the areas supporting the other cattle. This could have contributed favorably to the performance of the cattle of Brooksville origin during the first year at Miles City and to the performance of their calves dropped in 1963. After November 1963, treatment of the cattle of Brooksville and Miles City origin was essentially equal.

Early observations from this study were discussed at the field day at the U. S. Range Livestock Experiment Station in 1966. It was then reported that females in the cow herd of Miles City origin averaged about 170 to 180 pounds heavier than cows in the herd of Brooksville origin in the spring and fall over the first four years. Offspring of the Miles City foundation, in 1963 and 1964, were growthier than those of the Brooksville foundation. During the severe winter of 1964-65, about 40 percent of the females introduced from Brooksville at two years of age or older required special treatment. None of the cattle of Miles City origin in this age range required such treatment. These were the major differences observed in the two groups of cattle in the early years of the study.

Calving percentages from 1963 through 1967 failed to indicate any clear change in adaptation of the Brooksville cattle to Miles City conditions. These percentages were variable from year to year when based on total calves born, calves born alive or calves weaned. No definite trends were apparent when calving percentages of cattle of Miles City and Brooksville origin were compared for the years of 1963 through 1967. The calving percentages based on calves born, born alive, and weaned over the five years averaged about 2.5, 4.7 and 3.5 percentage points higher, respectively, for the cattle of Brooksville origin than for the cattle of Miles City origin. The incidence of stillbirths was higher in the Miles City group, while the incidence of death loss from birth to weaning was somewhat higher in the Brooksville group.

Differences in weights and gains of heifers produced in the herds of Miles City and Brooksville origin at Miles City are shown by years in Table 1. Both the closed and control cattle were included in the Miles City group through 1965 (Table 1) as cows of these groups were of the same origin and were bred to the same bulls through the 1964 breeding season.

Table 1. Heifer growth differences through fall yearling age (MC minus Br)[a].

Year Born	Number MC	Number Br	180-day weight (lb.)	ADG (lb.)	365-day weight (lb.)	ADG (lb.)	540-day weight (lb.)
1963	17	7	46	.06	57	.26	102
1964	17	13	41	.16	71	.25	115
1965	22	12	21	.05	32	.14	56
1966	18	14	26	.21	65	.01	66

[a]Weights adjusted for difference in age of heifers and further adjusted to a five-year-old age-of-dam basis.

As shown by the differences in Table 1, the Miles City cattle weighed heavier and gained faster than the Brooksville cattle at each stage of development in all four years. The differences in weights at 180 and 540 days and daily gain from 365 to 540 days did, however, decrease markedly after the first two years. The difference in 180-day weight was still relatively small in 1967 (Table 3).

The abrupt decrease in differences between the two groups of cattle after 1964 is not easily explained. It can hardly be attributed to replacement breeding stock selected from the Brooksville cattle for performance under Miles City conditions. Only one sire thus selected had an opportunity to produce calves. This was one of the two sires of the 1966 Brooksville calves. All other sires up to that point were selected at Brooksville and sent to Miles City in the original cattle transfer in 1962. Furthermore, little selection of female replacements was practiced in these early years of the study, as most of the heifers produced were returned to the herd to attain the prescribed herd size. Culling of the cows was not intense. Cows culled were mainly old or unsound cows and cows that failed to conceive or lost calves. There was no direct culling of cows because of poor calf performance.

If the females originally shipped from Brooksville underwent physiological adjustments better adapting them to the Miles City environment and improving their maternal ability, this could contribute to a trend such as that shown by the differences in 180-day weight. Improved maternal ability, however, would not contribute directly to the similar trend shown by differences in daily gain from 365 to 540 days. At this point, evidence that changes in adaptation of the Brooksville herd contributed to the trends heretofore discussed seems inconclusive.

Differences between the Miles City and Brooksville cattle in average daily gain from 180 to 365 days and in 365-day weight (Table 1) do not show the trends evidenced by differences in traits measured earlier or later. No clear trend in these traits is apparent. These traits were, however, measured under late fall and winter conditions, while the other traits were measured during the spring, summer and fall.

Differences in the growth of bull calves produced in the herds of Miles City and Brooksville origin are shown in Table 2. Weight and gain differences show no definite trends over the four years. These differences, as shown, do not seem suggestive of improvement in adaptation of the Brooksville cattle. The nutritional advantage apparently received by the cows of Brooksville origin to November 1963 may, however, have masked the true herd difference in 180-day weight of bull calves in 1963 (Table 2). For the same reason, it is possible that the difference in 180-day weight of 1963 heifers should be greater than shown in Table 1.

Table 2. Bull growth differences through postweaning feedlot test of 196-days (MC minus Br)[a].

Year Born	Number		180-day weight (lb.)	Feedlot gain (lb.)	Final weight (lb.)
	MC	Br			
1963	16	13	- 4	37	33
1964	34	11	39	15	54
1965	31	12	18	16	34
1966	18	13	46	57	103

[a]Weights adjusted for differences in age of bulls and further adjusted to a five-year-old age-of-dam basis.

Calves sired in the control herd at Miles City by bulls produced in the closed herd in Florida and selected on performance under Florida conditions were first dropped in 1967. The average weaning weights of these calves and of the calves in the closed and Brooksville herds at Miles City are shown in Table 3. If adaptation is important, the repeated introduction of sires from Florida should reduce weights or retard weight increases in the control herd and thus make the closed and control herds different at Miles City. Whether this will occur cannot be predicted from the limited data presented in Table 3.

Table 3. Adjusted weaning weights of 1967 calves from closed, control and Brooksville herds at Miles City.

	Adjusted wean. wts.[a]			Closed minus control	Closed minus Br.
	Closed	Control	Br.		
Heifers:					
Number	16	6	15		
Weights (lb.)	383	402	354	-19	29
Bulls:					
Number	26	8	11		
Weights (lb.)	416	408	393	8	23

[a]Weights adjusted to a constant age of 180 days and further adjusted to a five-year-old age-of-dam basis.

Summary

The experimental plan to evaluate the importance of adaptation to beef cattle productivity was explained. Meaningful information of the type for which the project was designed may not be available for about seven years.

From 1963 through 1966, differences between cattle originating in the Miles City area and cattle introduced from Brooksville, Florida, have decreased as measured by weights of heifer progeny at 180, and 540 days of age and daily gains from 365 to 540 days of age. To what extent adjustment of the Brooksville cattle to the Miles City environment contributed to the reduction in differences is not clear at this time. Data on bull progeny produced by the two herds did not indicate like reductions in differences between the two herds.

EFFECTS OF LINECROSSING ON POSTWEANING PERFORMANCE OF BEEF CATTLE

by
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A four-year study of the first phase of linecrossing to estimate the effect of hybrid vigor on various traits in heifers and bulls was completed in October of 1966. From this study, much-needed information was obtained to appraise our beef cattle lines and to determine methods and follow-up of using them for increasing beef production.

Preweaning and weaning results of this study were reported by J. S. Brinks at the 1966 Field Day. In that report, it was shown that hybrid vigor amounted to 3.0 and 3.8% for birth weights and increased to 9.3 and 5.2% at weaning for heifers and bulls, respectively. These results, coupled with those from other stations, suggest that linecross offspring to weaning are benefited quite importantly by hybrid vigor. Futhermore, the results suggest that the use of certain linecrossing systems could account for as much as 20-30 pounds increase in weaning weight per calf under these or similar range conditions.

Hybrid vigor in this study may be defined as the percent advantage of the crossline offspring over the average of the parent lines. Hybrid vigor, however, is considered most effective when the linecrosses excel the better parental type in over-all production. While the previous paper in 1966 covered the importance of hybrid vigor on preweaning traits in considerable detail, this paper will deal with growth traits covering an age span from weaning to about 13 months in the bulls and from weaning to 18 months in the heifers.

Experimental Procedures

Four calf crops were produced in years 1962 through 1965 from Lines 1, 4, 6, 9 and 10 and all possible linecross combinations. Sires and dams of these calves were all inbred, and average inbreeding in each line was from 25 to 35% at the beginning of the experiment. The experimental design along with the total number of offspring in this study is shown in table 1.

All calves in this study were produced under range conditions and weaned at about 190 days of age near the end of October. Weaned heifers were carried on the range and supplemented during the winter with hay and concentrates to gain approximately .75 lb. daily. In April they were turned on the range with no supplement to October when their 18-month weights and scores were taken. Bulls were placed in dry lot and full-fed a ration averaging about 2/3 concentrates and 1/3 hay for a 196-day test following a 2-week warm-up period.

Table 1. Experimental design and number of animals by breeding group and sex.

Line of dam	Line of sire: Line 1 M	F	Line 4 M	F	Line 6 M	F	Line 9 M	F	Line 10 M	F	Total M	F
Line 1	/9	8/[a]	11	8	9	9	9	11	12	5	50	41
Line 4	12	10	/9	12/	8	11	13	6	6	7	48	46
Line 6	6	9	9	10	/9	8/	6	10	8	7	38	44
Line 9	9	9	9	10	6	8	/13	6/	8	8	45	41
Line 10	10	10	10	9	9	11	8	13	/11	11/	48	54
Total	46	46	48	49	41	47	49	46	45	38	229	226

[a]The numbers in the boxes as arranged diagonally in the table are the number of straightline matings. Those above and below the boxes are the number of cross-line offspring.

Results

Performance by line-of-sire and line-of-dam.

The performance of animals in this study by line-of-sire and line-of-dam is shown in table 2 for bulls and table 3 for heifers. Calves by line-of-sire are those resulting from sires of each line when mated to dams of all lines; calves by line-of-dam are those resulting from dams of each line mated to sires of all lines.

There was a marked difference exhibited in production characteristics between these lines as shown in tables 2 and 3. Also, some of the lines performed differently as sire lines than as dam lines; this was most evident in Lines 4 and 6. In the bull offspring, shown in table 2, Line 6 was above average by line-of-dam for the entire postweaning period for weights; but it was below average by line-of-sire. Line 4 bulls, however, were the opposite being high by line-of-sire and low by line-of-dam. Since line-of-dam reflects maternal ability, and line-of-sire growth, these two lines are opposite in these two characteristics. Previous line performance history compares favorably with these results.

Line 1 cattle, the oldest line at the Station, ranked above average by both line-of-sire and line-of-dam for all weights and gains in both heifers and bulls except for 12-18 month gain in the heifers where it was only 3 lbs. below the average. This line is considered to have good maternal and growth ability and has consistently been a good topcrossing line in other herds. Because of these desirable qualities Line 1 should tend to out perform the other lines in over-all production through topcrossing.

Table 2. Averages by line-of-sire and line-of-dam for bull offspring.

Line	Initial weight	Feedlot Performance Period 5 weight 140 days	Final weight 196 days	Total gain 196 days
	lb.	lb.	lb.	lb.
Line-of-sire[a]				
1	427	803	983	556
4	424	798	996	572
6	413	762	933	520
9	414	755	937	523
10	411	789	970	560
Average	418	781	964	546
Line-of-dam[b]				
1	421	790	978	557
4	407	773	962	555
6	426	795	972	545
9	419	768	943	524
10	416	780	965	549
Average	418	781	964	546

[a] These values represent average offspring performance of sires of each line mated to dams of all lines.
[b] These values represent average offspring performance of dams of each line mated to sires of all lines.

Line 9 displayed production characteristics about the opposite of Line 1, showing below average performance for most all weights and gains in heifer and bull offspring by both line-of-sire and line-of-dam. The below average performance following weaning is reflected to some extent by the smaller birth weights exhibited in this line. Other line characteristics can be observed in tables 2 and 3.

Generally when lines were evaluated by sire or dam performance, 18-month weight of heifers and final weight of bulls appeared to be the best indications of over-all growth performance. For these growth traits the ranking of line-of-sire and line-of-dam in heifers was about the same as for line-of-sire for final weight of bulls.

Table 3. Averages by line-of-sire and line-of-dam for heifer offspring.

Line	Weaning weight	12-month weight	18-month weight	Gain weaning to 12-mo.	Gain weaning to 18-mo.	Gain 12-mo. to 18-mo.	18-month score
	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	%
Line-of-sire[a]							
1	398	514	749	116	351	235	78
4	397	512	753	115	356	241	80
6	378	499	736	121	357	236	80
9	393	499	739	105	345	240	78
10	393	498	736	105	343	238	80
Average	392	504	742	112	350	238	79
Line-of-dam[b]							
1	402	523	772	121	370	249	79
4	396	504	745	109	349	240	80
6	392	510	737	118	346	227	81
9	381	482	714	101	333	233	77
10	389	502	744	113	354	241	79
Average	392	504	742	112	350	238	79

[a]Representing offspring performance of sires of each line mated to dams of all lines.

[b]Representing offspring performance of dams of each line mated to sires of all lines.

Hybrid vigor in bulls.

Comparisons of the performance of linecross and straightline bulls and percent hybrid vigor during a postweaning feed test are shown in table 4.

The linecross bulls maintained almost a 5% advantage from weaning to the final test weight over straightlines as shown in table 4. Each 28-day weight during the test tended to reflect almost the same advantage for the linecrosses. The greatest advantages shown by the linecross bulls was at the initial weight on test and the first 28-day period weight. These two, period-weight advantages, following weaning, indicate that the linecross bulls may have adjusted more satisfactorily to weaning stress than the straightlines. This could also reflect some compensatory gains in the case of the linecross bulls if they were limited in milk supply at weaning.

Table 4. Comparisons of linecross and straightline bull offspring and percent hybrid vigor.

Item	Weaning weight	Initial weight	Period 1 weight	Period 2 weight	Period 3 weight	Period 4 weight	Period 5 weight	Period 6 weight	Final weight
	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.
Linecross	420	423	488	553	622	705	789	892	972
Straightline	400	398	455	520	589	669	751	850	930
Difference	20	25	33	33	33	36	38	42	42
Percent hybrid vigor	5.0	6.3	7.2	6.4	5.6	5.3	5.0	4.9	4.5

	Warmup gain	Period 1 gain	Period 2 gain	Period 3 gain	Period 4 gain	Period 5 gain	Period 6 gain	Period 7 gain	196-day gain
	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.
Linecross	1.1	65.0	65.5	69.0	82.5	84.0	103.6	79.6	549.0
Straightline	-1.1	57.5	64.6	68.8	80.3	82.0	98.8	81.4	533.6
Difference	2.2	7.5	0.9	0.2	2.2	2.0	4.8	-1.8	15.4
Percent hybrid vigor	---	13.0	1.4	0.3	2.7	2.4	4.9	-2.2	2.9

As shown in table 4, the over-all 196-day gain advantage for the linecross bulls was 2.9% and amounted to 15.4 pounds. Almost one-half of this gain advantage, however, occurred in period 1 which may be attributed in part to the ability of the linecross bulls to overcome weaning stresses more favorably than the straightlines. Thus, the over-all effect of hybrid vigor exhibited in postweaning gains by the linecross bulls appears to be somewhat less important than was the case for weaning weights and all weights during the postweaning trial.

Of interest in this study was the display of "nicking" ability of various lines. For illustration purpose, several of these favorable "nicking" combinations are mentioned here. In the case when Line 4 sires were mated to Line 1 dams, the bull offspring excelled the average of all crossline matings by 47 pounds in total gain. The bulls from Line 4 sires x Line 10 dams excelled the average of all crosslines by 40 pounds in total gain. The two above examples along with several others not mentioned illustrate the importance of using herd sires from good nicking lines for increasing production.

Hybrid vigor in heifers.

Percent advantage for linecross heifers over the straightlines for all weights, gain periods, and scores is shown in table 5.

The linecross heifers showed more hybrid vigor than the bulls for all weights and gains to yearling age. As in the bulls, the linecross heifers maintained their weaning weight hybrid vigor advantage to yearling age. At weaning and at 12 months the heifers showed a 9.3 and 9.2% advantage respectively over the straightlines as shown in table 5, but by 18 months this advantage was reduced to 6.6%. Only one linecross type was below the mid-parent average for weaning weight and 12 month weight, and another for 18 months.

As was the case for bulls, the linecross heifers showed consistent advantages over the straightlines for all weights. During the summer grazing period, however, the gain advantage was only 1.1% and amounted to 3 pounds. The reason for this reduction in amount of hybrid vigor for linecross heifers during this period is not clear, but could be due partly to reaching maturity. Other studies have shown that the amount of hybrid vigor expressed is more evident at the earlier ages, but appears to diminish as animals reach maturity.

The 18 month scores showed a 5% hybrid vigor advantage for linecross heifers over the straightlines. In this case all linecross types excelled the average of the parents, and 17 of the crosses excelled the better parent in each type. Since the linecrosses tended to exceed the top performing parent in each cross, it appears that hybrid vigor would be quite effective for getting improvement for 18 month score in herds of beef cattle.

Table 5. Comparisons of linecross and straightline heifer offspring and percent hybrid vigor.

Item	Weaning weight	12-month weight	18-month weight	Gain W-12	Gain W-18	Gain 12-18	18-month score
	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	%
Linecross	399	513	752	114.4	353.0	238.6	80
Straightline	365	470	705	104.5	340.7	235.9	76
Difference	34	43	47	9.9	12.3	2.7	4
Percent hybrid vigor	9.3	9.2	6.6	9.5	3.6	1.1	5

Summary

Results of four years of crossline and straightline heifer and bull offspring from five inbred lines of cattle, indicate that these lines have different production characteristics for maternal and growth ability. Several lines "nicked" more favorably than others to increase production.

The heifers displayed more hybrid vigor than bulls for weights at all ages. In both heifers and bulls the amount of hybrid vigor for weights was maintained from weaning to yearling age, but was reduced in the heifers at 18 months. Hybrid vigor advantage for gain on test in the bulls was less than for the preweaning period. The gain advantage of linecross heifers was reduced, also, as they approached 18-months-of-age.

A knowledge of the extent to which hybrid vigor may expect to increase beef production through increased weaning weight, feedlot gain, gain on grass, and conformation scores is important to the industry. Careful selection procedures utilizing seedstock from lines that excel for certain growth and maternal qualities, and the use of sires from good topcrossing lines on commercial herds, all appear to offer opportunity for obtaining an increase in production along with greater efficiency.

EFFECTS OF CROSSBREEDING ON POSTWEANING PERFORMANCE OF BEEF CATTLE

by
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A study to determine the merits of crossing beef cattle breeds was initiated at the U. S. Range Livestock Experiment Station during the breeding season of 1961. In the initial phase of this study, the major objectives was to measure the hybrid vigor obtainable for economically important traits in first-cross offspring. When the average of crossbreds is superior to the average of straightbreds of the parental breeds for a trait of interest, this is indicative of hybrid vigor.

In this report, postweaning results obtained in the initial phase of the crossbreeding study are summarized. Results presented in this report should be considered preliminary, as it may be necessary to modify some of the values or interpretations when detailed statistical analyses are completed.

Experimental Procedure

The mating scheme used to produce four crops of calves (1962-through 1965) is shown in table 1. This table also shows the number of offspring, by breeding group and sex, on which postweaning data were obtained.

Table 1. Mating scheme and number of offspring on which postweaning data are obtained.

Breed of dam[a]	Breed of sire: Hereford M[b]	Hereford F[b]	Angus M	Angus F	Charolais M	Charolais F	Total M	Total F
H	19	29	14	33	13	27	46	89
A	25	29	25	20	17	32	67	81
C	19	27	14	26	15	30	48	83
B	14	12	15	9	8	12	37	33
Total	77	97	68	88	53	101	198	286

[a] H=Hereford, A=Angus, C=Charolais, B=Brown Swiss.
[b] M=Steers, F=Heifers. Numbers in boxes are numbers of straightbred offspring; numbers above and below boxes are numbers of crossbred offspring.

The main portion of the study was based on crossing of the Hereford, Angus and Charolais breeds. As shown in table 1, straightbred calves of all three beef breeds and calves of all possible two-breed combinations of these breeds were obtained. Data on these straightbreds and crossbreds were used to measure hybrid vigor.

In addition to the main study, calves of 50% Brown Swiss breeding were obtained by mating bulls of the three beef breeds to Brown Swiss cows. These calves were not used in the assessment of hybrid vigor as reciprocal crosses resulting from the use of Brown Swiss bulls on cows of the beef breeds were not obtained.

The calves produced for this study were dropped between March 15 and May 31. Male calves were castrated at the end of each calving season. All cows and calves were grazed on pasture or native range until weaning time in October.

At weaning time, the steer calves were fed hay and started on grain during an adjustment period averaging about 11 days in length. The steers were then performance tested on a feedlot ration of about 68% total digestible nutrients (TDN). Steers dropped in 1962 were group fed. Steers produced in the three following years were individually fed. Feedlot efficiency was, therefore, based on a three-year block of data. Slaughter of the animals as they reached relatively uniform final weights was desirable. The steers averaged about 1016 lb. in weight when removed from test.

The heifer calves were placed on pasture after weaning. Hay and grain was fed during the winter months as necessary to obtain an average daily gain of about 0.8 lb. per head from weaning to 12 months of age. After the winter period, the first two crops of heifers were maintained on pasture or range until they were weighed as open heifers in October (18 month weights). The last two crops of heifers were bred as yearlings. These animals were taken off range and were maintained in drylot on hay during the breeding seasons (June 15 to July 31) because of a shortage of breeding pastures. After July 31, they were returned to the range.

Results

Steers:

The total weight changes of the steers during the adjustment after weaning were standardized to an 11-day period. During this period the straightbred steers of the beef breeds gained a total of 0.4 lb. per head. The beef X beef crossbreds and the Brown Swiss crossbreds lost an average of 1.4 lb. and 6.1 lb. per head, respectively. These weight changes showed an inverse relationship to actual weaning weight averages which were 455, 477 and 525 lb. for the straightbreds, beef crossbreds and Brown Swiss crossbreds, respectively.

Results of the feedlot performance tests on the steers are summarized in table 2.

As shown in table 2, the beef X beef crossbreds averaged somewhat higher in daily feedlot gain, efficiency of feed utilization (gain per 100 lb. of TDN), slaughter grade and carcass grade than did the straightbreds of the beef breeds. At this point, note should be taken of the scoring system used for slaughter and carcass grades, whereby the higher grading animals received the lower numerical scores. The superior values for the crossbred steers in the four traits named suggest hybrid vigor from crossing in the range of 2.3 to 4.4% (table 2).

Table 2. Postweaning performance of straightbred and crossbred steers.

Breeding & comparisons	Feedlot record[a]				
	Av. da. gain	Days on feed	Gain cwt/TDN[b]	Slaughter grade[c]	Carcass grade[c]
	(lb.)	(no.)	(lb.)	(units)	(units)
			Beef breeds and beef X beef crosses		
Crossbred	2.23	242	18.16	13.0	13.0
Straightbred	2.16	255	17.76	13.4	13.6
Difference:					
Actual meas.[d]	0.07	-13	0.40	- .4	- .6
Percent[e]	3.2		2.3	-3.0	-4.4
			Beef X Brown Swiss crosses		
Crossbred	2.22	229	17.58	17.4	13.9
Difference[f]	.06	-26	- .18	4.0	0.3

[a] Steers fed to average weight of about 1016 lb.
[b] Efficiency values based on performance of individually fed steers from three calf crops. First group of steers (1962 calves) was group fed.
[c] High, medium and low choice = 8, 10, 12, respectively.
High, medium and low good = 14, 16, 18, respectively.
[d] Crossbreds of beef breeds minus straightbreds of beef breeds.
[e] Percentage of straightbred average.
[f] Brown Swiss crossbreds minus straightbreds of beef breeds.

The crossbreds of the beef breeds also required an average of about 13 days less time in the feedlot to reach slaughter weight than did the straightbreds. The shorter time required in the feedlot by the crossbreds was the net effect of a somewhat faster rate of gain in the feedlot and a weight advantage of about 20 lb. at the beginning of the feedlot period.

The beef X Brown Swiss crossbreds averaged 0.06 lb. higher than the straightbreds of the beef breeds in daily feedlot gain (bottom of table 2) and were nearly equal to the beef X beef crossbreds in rate of gain. The Brown Swiss crossbreds required 26 days less time in the feedlot than the straightbred steers of the beef breeds and 13 days less time than the beef X beef crossbreds. The shorter feedlot time was the net result of differences in rate of gain combined with initial weight advantages of about 63 lb. and 43 lb. over the straightbreds and beef X beef crossbreds, respectively.

The beef X Brown Swiss crossbreds averaged somewhat lower in efficiency (gain per 100 lb. TDN) than the other two groups of steers. The beef X Brown Swiss crossbreds also averaged between low and medium good in slaughter grade while the straightbreds and beef X beef crossbreds averaged between high good and low choice. The beef X Brown Swiss crossbreds compared more favorably with the other two groups in carcass grade, with the average grades of all three groups falling between high good and low choice.

The low slaughter grade average of the beef X Brown Swiss crossbreds relative to their carcass grade average was characteristic of each breeding group involving Brown Swiss, regardless of the beef breed going into the cross. This was seemingly due to some deviation from conventional beef conformation and to the observed tendency for the beef X Brown Swiss crossbreds to reach market weight with a relatively small amount of subcutaneous fat or "bark" and thus appear somewhat lacking in finish. On the rail, however, these animals showed sufficient marbling and merit in other carcass traits to grade higher and more favorably in comparison with the other two groups of cattle.

Heifers:

The postweaning growth records and scores of straightbred and crossbred heifers are summarized in table 3.

The beef X beef crossbreds exceeded the straightbred heifers of the three beef breeds in all weights and gains considered. The heavier average weights of these crossbreds at 12-mo. of age (14 lb. advantage) and 18-mo. of age (17 lb. advantage) were the combined results of an advantage of about 10 lb. in average weaning weight (205 days of age) and an advantage of about 0.02 lb. in average daily gain per head during each of the postweaning gain periods.

The superiority of the beef X beef crossbreds over the straightbreds in all observed growth traits after weaning suggests hybrid vigor from crossbreeding in the range of about 1.8 to 2.5%. The average score of the beef X beef crossbreds also exceeded the average of the straightbred heifers by 2.5 points, suggesting about 3.3% hybrid vigor from breed crossing.

The beef X Brown Swiss crossbreds averaged higher in all postweaning growth traits than the straightbred heifers of the beef breeds by the amounts shown in the bottom section of table 3. The values in table 3 also show that the Brown Swiss crossbreds gained faster than the beef X beef crossbreds in both postweaning periods. The higher rates of gain after weaning and advantages of 68 and 78 lb. over the straightbreds and beef X beef crossbreds, respectively, in 205-day weaning weight accounted for the relatively heavy 12-mo. and 18-mo. weights of the Brown Swiss crossbreds. It is believed that a relatively high level of milk production of Brown Swiss dams contributed materially to the heavy weaning weights of their crossbred offspring.

Table 3. Postweaning performance of straightbred and crossbred heifers.

Breeding & comparisons	ADG wean. to 12-mo. (lb.)	12-mo. wt.[a] (lb.)	ADG 12-18 mo. (lb.)	18-mo. wt.[a] (lb.)	18-mo. score[b] (units)
			Beef breeds and beef X beef crosses		
Crossbreds	0.82	610	1.11	804	77.4
Straightbreds	0.80	596	1.09	787	74.9
Difference:[c]					
Actual meas.	0.02	14	0.02	17	2.5
Percent	2.5	2.3	1.8	2.2	3.3
			Beef X Brown Swiss crosses		
Crossbreds	0.85	683	1.19	891	70.6
Difference[c]	0.05	87	0.10	104	-4.3

[a]Adjusted to standard ages of 365 and 540 days by using individual daily gains birth to weaning, weaning to 12-mo. and 12-mo. to 18-mo.
[b]Scores on 100-point basis, with the higher values being more desirable.
[c]Differences and percentages as defined in table 2.

The Brown Swiss crossbreds averaged lower than the straightbreds of the beef breeds and the beef X beef crossbreds in 18-mo. score.

Summary

Steers and heifers representing all possible two-breed combinations of the Hereford, Angus and Charolais breeds were used to measure hybrid vigor in postweaning traits from crossbreeding. These animals were compared with straightbred steers and heifers of the three parent breeds. Beef X Brown Swiss crossbreds (from mating Hereford, Angus and Charolais bulls with Brown Swiss cows) were included for supplemental information.

The beef X beef crossbred steers averaged higher than the straightbred steers in daily gain in the feedlot, efficiency of feed utilization, slaughter grade and carcass grade. The differences suggested hybrid vigor in the range of 2.3 to 4.4% for the observed postweaning traits as a result of crossbreeding.

Beef X Brown Swiss crossbred steers averaged higher than the straightbreds of the beef breeds and were nearly equal to the beef X beef crossbreds in rate of feedlot gain. The Brown Swiss crossbred steers averaged somewhat below the other two

groups of steers in efficiency of feed utilization, lower than the other two groups in slaughter grade, but more nearly equal to the other two groups in carcass grade.

Beef X beef crossbred heifers averaged higher than the straightbred heifers of the beef breeds in rate of gain from weaning to 12-mo. of age and from 12 to 18-mo. of age, in 12-mo. weight, in 18-mo. weight and in 18-mo. score. This suggested hybrid vigor from crossing in the range of 1.8 to 3.3% for these traits. Beef X Brown Swiss crossbred heifers averaged higher than the other two groups of heifers in all postweaning traits except 18-mo. score.

MATERNAL EFFECT ON WEANING WEIGHTS AND GRADES OF CALVES FROM CROSSBRED AND LINECROSS DAMS

by
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The use of systematic crossbreeding and linecrossing appears to offer some advantage to the beef industry for obtaining increased production. Results of Phase 1 crossbreeding and linecrossing, to estimate the effect of hybrid vigor on certain performance traits in beef cattle, have been reported in other papers today. From these reports, it was shown that hybrid vigor influences some important performance traits in the first generation hybrid offspring.

A possible second benefit to be derived through crossing is that which might occur through the use of the crossbred dam. In sheep and swine, this advantage was found to be important. In beef cattle, however, the practice of using crossbred dams in systematic breeding programs is apparently not widespread, and comparative research information on production from crossbred and straightbred dams is limited.

The Phase 2 crossbreeding and crossline studies were initiated in 1964 to compare some maternal qualities of the crossbred and crossline heifers with the straightbreds and straightlines. Data were obtained on calves born in 1965, 1966 and 1967. One additional calf crop is still to be dropped in the crossline study. Thus, the data are not complete. Results are of a preliminary nature but furnish information in addition to the results presented at the 1966 Field Day.

For an evaluation of the maternal ability of dams in the present report, only, the birth and weaning weights and weaning scores were considered. Because of the limited amount of data at this time, calf survival percentages are not presented, but are considered important to over-all assessment of a crossing program.

The performance of heifer and steer calves from crossbred and straightbred dams of beef breeding only is summarized in table 1. Performance of heifer and steer progeny of beef-Brown Swiss dams, with comparisons of probable interest, is summarized in table 2. Performance of the progeny of straightline and crossline dams is shown in table 3.

Maternal qualities of crossbred and straightbred dams (beef breeding only).

In this crossbreeding study all heifer and steer offspring were from 2-breed cross sires mated to straightbred and 2-breed cross heifers. Matings were made so that all the offspring were 3-breed crosses representing Angus, Charolais and Hereford breeds. Since the calves from both the straightbred and 2-breed cross dams were all 3-breed crosses, and thus considered to have similar genetic growth potential, the difference in performance of calves to weaning should be due to the maternal qualities of the respective types of dams. All dams were bred to produce one calf crop in this study. Nearly one-half of them were 2 years old and the rest were 3 years of age when first calving.

Table 1. Calf records of straightbred and crossbred dams.

	Heifers				Steers			
Type of dam	Calves	Birth weight	Wean. weight[a]	Wean. score	Calves	Birth weight	Wean. weight[a]	Wean. score
	No.	lbs.	lbs.	%	No.	lbs.	lbs.	%
Crossbred[b]	61	73.0	370.3	79.7	53	77.3	391.0	81.0
Straightbred[b]	32	72.0	369.0	79.3	33	74.7	377.3	79.7
Difference[c]		1.0	1.3	0.4		2.6	13.7	1.3
% Advantage		1.4	0.4	0.5		3.5	3.6	1.6

[a] Adjusted to 180 days of age.
[b] Straightbred dams from Angus (A), Charolais (C), and Hereford (H) breeds. The crossbred dams were AxC, CxA, AxH, HxA, CxH and HxC.
[c] Crossbred dams minus straightbred dams.

As shown in table 1, the steer calves benefited somewhat more than the heifers as the result of being from crossbred dams to weaning. The steers from crossbred dams excelled those from straightbred dams by 2.6 lbs. at birth, 13.7 lbs. at weaning and about 0.1 of one grade in weaning score. The small advantage observed in the heifers from the crossbred dams appeared to be of no importance. Steers in this case represent the faster growing sex, and it appears that they were able to take advantage of some extra maternal ability as provided by the crossbred dams, perhaps through added milk production.

In a three-year crossbreeding study at Fort Robinson Station, Nebraska, the average advantage for heifer and steer calves from crossbred dams was 23 lbs. which appears to be considerably more than was obtained at Miles City.

Maternal qualities of crossbred dams with Brown Swiss breeding.

Crossbred dams in this study were the result of Brown Swiss dams being mated to Angus, Hereford and Charolais sires. These crossbred dams were mated to 2-breed (beef) crossbred sires. Offspring were all 3-breed crosses with 25% Brown Swiss breeding.

The crossbred dams with Brown Swiss breeding presumably excelled other crossbred dams in milk production as indicated by a weaning weight advantage of 34.3 and 27.0 lbs. in heifers and steers, respectively, as shown in table 2. Heifers and steers by the Brown Swiss crossbred dams weighed 35.6 and 40.7 lbs. more, respectively, than those from the straightbred dams of the beef breeds. Thus, the Brown Swiss breeding through the crossbred dam appears to contribute importantly to milk production in a crossbreeding program. The weaning weight advantages of the Brown Swiss crossbred dams over the straightbred dams does not reflect true crossbred advantage, however, since the straightbreds in this study did not include the Brown Swiss straightbred dams needed for making such comparisons.

Table 2. Calf records of crossbred dams with Brown Swiss breeding.

Type of dam	Heifers Calves	Heifers Birth weight	Heifers Wean. wt.[a]	Heifers Wean. score	Steers Calves	Steers Birth weight	Steers Wean. wt.[a]	Steers Wean. score
	No.	lbs.	lbs.	%	No.	lbs.	lbs.	%
Br. Swiss (BS) crossbred[b]	10	78.0	404.6	79.3	17	86.0	418.0	80.7
Crossbred[c]	61	73.0	370.3	79.7	53	77.3	391.0	81.0
Difference		5.0	34.3	-0.4		8.7	27.0	-0.3
% Advantage		6.8	9.3	-0.5		11.2	6.9	-0.4
Br. Swiss (BS) crossbred[b]	10	78.0	404.6	79.3	17	86.0	418.0	80.7
Straightbred[d]	32	72.0	369.0	79.3	33	74.7	377.3	79.7
Difference		6.0	35.6	0		11.3	40.7	1.0
% Advantage		8.3	9.6	0		15.1	10.8	1.3

[a]Adjusted to 180 days of age.
[b]Were produced from mating Brown Swiss dams to Angus, Charolais and Hereford sires.
[c]Representing all 2-breed crosses of Angus, Charolais and Hereford breeds.
[d]Representing straight Angus, Charolais and Hereford breeds.

Some of the weaning weight advantage of calves from Brown Swiss crossbred dams resulted from heavier birth weights as these heifer and steer calves excelled those from other crossbred dams by 5.0 and 8.7 lbs. and excelled those from straightbred dams by 6.0 and 11.3 lbs., respectively. Weaning scores were not materially influenced by the Brown Swiss breeding as shown in table 2.

Maternal qualities of crossline and straightline dams.

Straightline and 2-line cross dams in this study were mated to 2-line cross sires to produce 3-line cross offspring.

The calf performance from the crossline and straightline dams over a two-year period is shown in table 3. The first year of this study, calves produced were too few for comparisons and were not included.

Bull and heifer calves averaged 13.5 and 9.5 lbs., more, respectively, from the crossline dams than from the straightline dams. These results compare favorably to the crossbreeding study (see tables 1 and 2) where the male calves from the crossbred dams also had a slight advantage for weaning weight. The amount of data collected are still somewhat limited to be conclusive, but by comparing the results of both crossline and crossbreeding studies, it appears that the hybrid dam exhibits a greater influence in male calves, in terms of heavier weaning weights, than in the heifers. This could be of sizable economic importance to the industry when hybrid dams are used in the herd and when steer calves represent a major portion of the rancher income.

Table 3. Calf records of straightline and crossline dams.

	Heifers				Bulls			
Type of dam	Calves	Birth weight	Wean. weight[a]	Wean. score	Calves	Birth weight	Wean. weight[a]	Wean. score
	No.	lbs.	lbs.	%	No.	lbs.	lbs.	%
Crossline[b]	83	73.5	344.5	79.0	91	78.5	368.0	80.0
Straightline[b]	13	72.5	335.0	79.0	15	77.5	354.5	78.5
Difference		1.0	9.5	0		1.0	13.5	1.5
% Advantage		1.4	2.8	0		1.3	3.8	1.9

[a] Adjusted to 180 days of age.
[b] The straightlines represent Lines 1, 4, 6, 9 and 10; while the crosslines are the result of crossing the straightlines in all possible 2-line combinations.

The effect of the crossline dam on birth weights seemed of little importance and produced only a 1.0 lb. advantage in both the heifers and bulls over those from the straightline dams. When comparing weaning scores, only the bull calves from crossline dams showed a small advantage and this amounted to about one-ninth of one grade.

Summary

Preliminary observations from three years of data in the beef-crossbreeding study and two years in the linecrossing study suggest that weaning weights of male calves are increased more importantly by the hybrid dam than are weaning weights of heifers. This seemed more evident in the beef-crossbreeding where the heifer calves had no important weaning weight advantage from the crossbred dam.

The effect of the hybrid dam on birth weights seemed of little importance in both the beef-crossbreeding and linecrossing study. Only the male calves from these hybrid dams appeared to gain any improvement in weaning score.

The advantage in weaning weights of calves by the Brown Swiss crossbred dams over the beef crossbred dams indicates that the Brown Swiss breeding contributed to some additional milk production. The Brown Swiss breeding also contributed to heavier birth weights but seemed to have no effect on weaning scores.

GENETIC ASPECTS OF PROTEIN COMPONENTS IN MILK OF BEEF COWS

by
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In a recent publication, Smith (1967) discussed the possibility of improving productive characteristics (metric traits) of farm livestock by the use of known genetic factors (in the author's terms "known loci"). Known loci refers to any identified gene loci for which individuals may be typed. Smith states that the usefulness of known genetic factors in selection will depend on the amount and accuracy of the information they provided about an animal's breeding value for the metric traits concerned. Information on known loci is likely to be of most value when normal selection methods are not very effective, as when heritability is low or when indirected selection on relatives is necessary. Some advantages may also be gained if a more intense or earlier selection is made possible. When normal selection is effective, additional information provided by known loci can add only a little to the rate of improvement.

The occurrence of allelic series of genes controlling certain protein components of milk from dairy cattle has been established. Some of these components appear to affect the manufacturing qualities of milk. Only limited information of this kind is available for beef cows. New methods with higher resolving power for determining the various milk protein factors have been developed by Dr. A. M. El-Negoumy at Montana State University. This makes it possible to accurately "type" cattle for milk protein components. The program of line-crossing and breed-crossing at the U. S. Range Livestock Experiment Station provided a source of genetic material with which to work.

This project, supported in part with funds from ARS, was started with the collection of milk samples in 1966 and 1967. Samples from the cattle in the breed-crossing project were from Hereford, Angus and Charolais females and from the two-breed crosses listed at the top of table 1. Samples were also obtained from females of inbred Hereford Lines 1, 4, 6, 9 and 10 and from first-cross females (two-line crosses). Milk samples obtained from 238 cows in 1966 have been processed through the laboratory. Preliminary results are reported here. No detailed studies will be undertaken until the 1967 samples are "typed" for the various protein components.

Table 1 shows the percentage of the samples which contained the various protein fractions. All the information on the inbred lines and line-crosses are presented together in the first column. There appears to be little if any difference in the occurrence of the Alpha and Beta fractions for these cattle and the Hereford cattle used in the breed-crossing project (second column). The occurrence of Kappa A and Kappa B indicates a real difference between these two groups of Hereford cattle. The incidence of Beta B in the Angus is substantially lower than in any of the other straightbred cattle and most of the breed-crosses.

Also the Angus appears to have a smaller percentage of Kappa AB (both Kappa A and Kappa B). The protein fraction Beta C is known to be rare. However, in the Angus X Brown Swiss cross, two of the six samples had this fraction. The differences between breeding groups tend to be greater for the Kappa fractions than for the Alpha or Beta fractions.

At this point in our study, it is unwise to speculate on the value of this kind of information. There is the possibility that it will prove useful in selection. We first must learn more about the genetic implications of variability in milk protein components. Then we will need to study the assocations with performance traits of beef cattle. Certainly we will know more about beef cattle when we complete the study. Hopefully some information of direct benefit to Stockmen will be obtained.

Reference

Smith, Charles 1967. Improvement of Metric traits through specific genetic loci. Animal Production. 9:349.

Table 1. Percentage of samples containing the various protein fractions.

	Hereford[1]	Hereford[2]	Angus	Charolais	Hereford X Angus	Hereford X Charolais	Hereford X Brown Swiss	Angus X Charolais	Angus X Brown Swiss	Charolais X Brown Swiss
$Alpha_{s1}A$	1.1	00.0	00.0	00.0	00.0	00.0	00.0	2.9	00.0	00.0
$Alpha_{s1}B$	97.6	100.0	94.1	100.0	100.0	100.0	100.0	97.0	100.0	100.0
$Alpha_{s1}C$	3.5	00.0	5.8	15.8	10.7	8.7	33.3	17.6	33.3	00.0
Beta A	96.5	85.7	94.1	100.0	100.0	100.0	100.0	100.0	83.3	100.0
Beta B	42.4	50.0	5.8	21.0	25.0	39.1	66.6	14.7	33.3	33.3
Beta C	00.0	00.0	00.0	00.0	00.0	00.0	00.0	00.0	16.7	00.0
Kappa A	94.1	78.6	82.4	89.5	96.4	47.8	100.0	94.1	100.0	83.3
Kappa B	45.9	71.4	41.2	68.4	57.1	87.0	66.6	55.9	83.3	66.6
Kappa AB	40.0	50.0	23.5	57.9	53.4	39.1	66.6	50.0	83.3	50.0
Number Samples	85	14	17	19	28	23	6	34	6	6

[1]All straightline and linecross Herefords in Lines 1, 4, 6, 9, 10.

[2]Herefords used in the crossbreeding experiment.

COMPARISONS OF WEANLING CALVES PRODUCED UNDER TWO SYSTEMS OF LINECROSSING

by
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Earlier linecrossing studies with beef cattle have provided evidence of hybrid vigor in first cross progeny obtained by crossing inbred lines. Evidence that these linecross animals have some advantage over straightline animals in growth, grade and maternal ability has been found.

The present study was designed mainly to measure the amount of hybrid vigor that can be obtained and maintained over a long period of time by systematic two-way and three-way rotational crossing of inbred beef cattle lines.

This project was initiated at the U. S. Range Livestock Experiment Station in 1966. The mating scheme, thus far resulting in the production of the 1967 calf crop only, is shown in table 1. This mating scheme permits the comparisons of calves from straightline matings with the rotational two-line and three-line rotational matings. A synthetic variety started by mating linecross sires to linecross dams was initiated in the breeding season of 1967. This breeding scheme will involve all lines in various combinations.

Preliminary Results

In comparing the two-line and three-line crosses produced in 1967, it should be kept in mind that the comparative performance of these groups may change as the rotations continue further. The two-line crosses in 1967 resulted from backcross matings. Each calf thus has about 75% of the blood of one line and 25% of the blood from another. As the rotation progresses, the ratio will become 75- and 25+. In each initial three-line cross calf, the ratio is about 50, 25, and 25. As the rotation progresses it will become 50+, 25+, and 25-.

A comparison of the performance of offspring from the 1966 straightbred matings with those from the two-way and three-way rotations is shown in table 2. Because of the number of linecross dams available for this study in 1966 was limited, only a few offspring were produced in the two- and three-way crosses for comparisons. For this reason, bull and heifer calves were averaged together for the one-year comparisons of the three breeding systems. Because of the limited number of calves, particularly those that represent the two and three linecrossing systems, the results as shown in table 2 cannot be accurately assessed at this time. Certain trends, however, may be observed.

Table 1. Breeding scheme for Phase 3 Linecrossing--1966.

	Line of dam											
Line of sire	1	4	6	10	1x4 4x1	1x6 6x1	1x10 10x1	4x6 6x4	4x10 10x4	6x10 10x6		Total
1	30				1	1	1	/1/	/1/	/1/	:	36
4		30			1	/1/	/1/	1	1	/1/	:	36
6			30		/1/	1	/1/	1	/1/	1	:	36
10				30	/1/	/1/	1	/1/	1	1	:	36
	30	30	30	30	4	4	4	4	4	4	:	144

/ /represents three-linecross mating. Numbers above and below these boxes represent two-linecross matings. The numbers to the left of the boxes represent straightline matings.

As shown in table 2, the two- and three-way matings produced calves weighing 19.0 and 40.5 lbs. heavier, respectively, than the straightbreds. Weaning scores were also increased in the two- and three-way cross calves over the straightbreds with the three-way crosses having the greatest advantage. From these limited data, it appears that a systematic linecrossing system might be effective for increasing weaning weights and scores. The advantage of the three-way cross calves over the two-way crosses also suggest the possibility of using the three-way rotational scheme to an advantage over the two-way system.

Table 2. Calf records of straightline, two-line and three-linecross matings.

	Heifer and bull offspring.1/			
Type	Calves	Birth weight	Wean.2/ weight	Wean. score
	No.	lbs.	lbs.	%
3-Line cross	7	81.0	435.0	87.0
2-Line cross	8	81.5	413.5	84.0
Straightlines	67	77.0	394.5	82.5
Advantage 2-Linecross over Straightlines--lbs.		4.5	19.0	1.5
-- %		5.8	4.8	1.8
Advantage 3-Linecross over Straightlines--lbs.		4.0	40.5	4.5
-- %		5.2	10.3	5.4

1/ Weights and scores represent average of two sexes.
2/ Adjusted to 180-days of age and for age of dam to a six-year-old basis.

Birth weight advantages of the two- and three-way cross calves over the straightbreds were almost identical and amounted to 4.5 and 4.0 lbs., respectively. Though birth weights are generally of little importance in an over-all selection program, they do, however, reflect growth potential.

Summary

This preliminary report, comparing two systems of linecrossing, was presented mainly to inform livestock producers of the study that is being conducted.

Results obtained from the one year's data and with limited number of animals cannot be accurately assessed at this time. The limited data indicate a trend which favors both rotational linecrossing schemes over straightbreeding, with the three-way crossing showing some advantage over the two-way cross rotational scheme.

A COMPARISON OF WEANLING CALVES PRODUCED UNDER TWO SYSTEMS OF CROSSBREEDING

by

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A crossbreeding study in three phases was designed at the U. S. Range Livestock Experiment Station. Phase 1 had as its major objective the measurement of hybrid vigor in two-breed crosses of beef cattle breeds. The Hereford, Angus and Charolais breeds were crossed in all possible two-breed combinations in this phase. As a supplement to the main study, bulls of the three beef breeds were mated with Brown Swiss cows. Data collection for this phase is completed, and data on traits through weaning have been analyzed. Phase 2 was designed to measure maternal ability in the crossbred females (two-breed crosses) produced in Phase 1. Data collection for this phase is near completion. It is the purpose of the present report to describe the plan used to start phase 3 and to summarize the results obtained on the first two crops of calves in this phase through weaning age.

Phase 3 is designed primarily to measure the amount of hybrid vigor that can be obtained and maintained over an extended period by systematic two-way and three-way rotational crossing of the Hereford, Angus and Charolais breeds. A synthetic variety, to consist of a closed group started from a crossbred foundation representing the three beef breeds, has been started as a part of the main study in phase 3. It is contemplated that a second synthetic variety, to consist of a closed group started from a beef-Brown Swiss crossbred foundation, will be started secondary to the main study in the breeding season in 1968. The synthetic varieties have not progressed to a point warranting further discussion in this report.

Experimental Procedure

The mating scheme used to initiate phase 3 of the crossbreeding project, with the exception of the synthetic varieties, is shown in table 1. Calves dropped in 1966 and 1967 resulted from this mating scheme.

Table 1. Mating scheme for the production of calves dropped in 1966 and 1967.

Breed of sire[a]	Breed of dam[a]								
	H	A	C	HA[b]	HC[b]	AC[b]	HB[c]	AB[c]	CB[c]
H	X			X	X	X		X	X
A		X		X	X	X	X		X
C			X	X	X	X	X	X	

[a]H=Hereford, A=Angus, C=Charolais, B=Brown Swiss.
[b]Includes reciprocal crosses.
[c]From use of beef bulls on Brown Swiss cows.

The females making up the initial breeding herd for phase 3 were all straightbred and two-breed crosses produced in phase 1.

Bulls used to initiate phase 3 were registered bulls from off-station sources. The bulls were changed each year. One bull of each breed was used in the breeding season of 1965. Two bulls of each breed were used in the 1966 breeding season.

Straightbred females and crossbred females of beef breeding will be returned to their respective breeding groups to continue the two-breed and three-breed rotational crossing and provide within-breed matings for comparison. With the initiation of the synthetic variety involving Brown Swiss breeding in 1968, the mating of crossbreds with Brown Swiss breeding will no longer be as shown in table 1.

The 1966 and 1967 calves were dropped about March 20 to mid-May. Except during the 45-day breeding seasons requiring segregation into single-sire herds, the cows and calves were managed as one large herd under range conditions until weaning time. The weaning dates were October 17 to October 18.

A random half of the male calves in each breeding group were castrated at the end of the calving seasons to provide both bulls and steers for comparison in postweaning feedlot tests.

Preliminary Results

Weights and scores through weaning age on calves dropped in 1966 and 1967 are summarized in table 2. The number of observations are still quite limited, particularly in the bull and steer calf classes. Additional data will be forthcoming, so that data presented in this report have not been analyzed statistically. Information presented in this report is of a preliminary nature.

Straightbred and crossbred calves of the beef breeds will be discussed first. The discussion of crossbred calves with Brown Swiss breeding will follow.

Straightbreds and Crossbreds (Beef Breeds Only):

When examining the data presented in table 2, it should be born in mind that the results may not be indicative of the relative merits of within-breed mating, two-breed rotational crossing and three-breed rotational crossing over an extended period of time. The percentages of blood of two breeds combined in the backcross calves considered in this report were, on the average, 75 and 25. In the future, as heifers produced in the two-breed rotational crossing scheme are returned to the herd as breeding females, the percentages of blood of calves produced will become 75- and 25+. The average percentage of blood will also change in the future under the three-breed, rotational crossing scheme. In the calves considered in this report the average percentages were 50, 25 and 25. These percentages will change, in later generations to 50+, 25+ and 25-.

Table 2. Average preweaning and weaning performance of straightbred and crossbred calves dropped in 1966 and 1967.

	Breeding of calves			
			Three-breed crosses	
Sex of calves & traits	Straight-bred	Back-cross	Beef breeds	Beef-Brown Swiss
Bulls:				
Number	17	12	9	5[a]
Birth wt. (lb.)	85	86	88	93
Wean. wt. (lb.)[b]	418	432	444	488
Wean. score (units)[c]	80	83	84	85
Steers:				
Number	16	13	12	4[a]
Birth wt. (lb.)	81	89	89	92
Wean. wt. (lb.)[b]	389	432	421	445
Wean. score (units)[c]	80	82	82	83
Heifers:				
Number	30	26	27	11
Birth wt. (lb.)	77	77	79	86
Wean. wt. (lb.)[b]	386	387	411	438
Wean. score (units)[c]	80	81	83	83

[a]Male calves of 1967 only. Because of chance arising from the small number of calves produced, there were no male calves with Brown Swiss breeding in 1966.
[b]Weaning weights adjusted to 180 days of age.
[c]Middle choice = 76-80; High choice = 81-85.

The data in table 2 show inconsistencies in the ranking of the three groups of calves of beef breeding in the different sex classes. These inconsistencies are probably due, at least in part, to the relatively small number of animals on which data have been accumulated thus far. Additional data are needed to more clearly determine the relative merits of the three breeding groups. From a close examination of the consistencies and inconsistencies in table 2, combined with what was learned of sex differences earlier in the crossbreeding study, it appears that the major inconsistencies may be in the data on steer calves. Birth and weaning weight averages of the straightbred steers seem to be somewhat low. Both the birth and weaning weight averages of the backcross steers appear to be somewhat high. If these averages are low or high due to chance, the true ranking of straightbred, backcross and three-breed cross steers may be more in line with the ranking suggested by the data on bull and heifer calves.

The three-breed crosses in both the bull and heifer classes were heavier at birth and weaning than the straightbreds and backcrosses. Straightbred bull calves averaged lighter at birth and weaning than did backcross bull calves.

The straightbred and backcross steer averages show a relative ranking similar to the bull averages, even with allowances on the assumption that chance made the average weights in the steer class too low for straightbreds and too high for backcrosses. There was essentially no difference between straightbred and backcross heifers in either birth or weaning weight.

Weaning scores in all three sex classes averaged higher for crossbreds than for straightbreds, with the three-breed crosses tending to have the greatest advantage in score. All average scores were, however, within a relatively narrow range. The straightbred averages were consistently at the top of the middle choice range and the averages of the backcrosses and three-breed crosses were in the high choice range.

Crossbreds with Brown Swiss Breeding:

The birth weights, weaning weights and weaning scores of crossbred calves with Brown Swiss breeding are summarized in table 2. It should be noted, however, that there were no male calves of this breeding in 1966.

The crossbred calves with Brown Swiss breeding were all from first-cross dams (beef bulls X Brown Swiss cows). The first-cross dams were bred to beef bulls as indicated in table 1. The progeny, all three-breed crosses with about 25% Brown Swiss breeding, are therefore compared with the three-breed crosses of strictly beef breeding.

Over a two year period (1966 and 1967), the beef-Brown Swiss, crossbred heifers excelled the three-breed crosses of strictly beef breeding by 7 lbs. in birth weight and 27 lb. in weaning weight. Average weaning scores of the two groups of heifers were alike (table 2). Data on the 1967 bull and steer calves are also shown in table 2. They exceeded the 1967 three-breed crosses of strictly beef breeding in birth and weaning weight and were essentially the same as the crossbred contemporaries of strictly beef breeding in weaning score. The advantage in weaning weight of beef-Brown Swiss crossbreds was presumably due, at least in part, to a relatively high level of milk production brought about by the Brown Swiss breeding in the dams.

Summary

Birth weights, weaning weights and weaning scores of straightbred, backcross and three-breed cross calves were compared. The straightbreds were Hereford, Angus and Charolais. The backcrosses and three-breed crosses were from first-cross dams appropriately mated to Hereford, Angus or Charolais bulls. Although only limited data were available, the three-breed crosses tended to be the growthiest and highest in weaning score, and were usually followed by the backcrosses. Inconsistencies among the sex classes in the ranking of the three groups of calves did, however, occur. Additional data is needed to determine the relative merits of these three groups with greater certainty.

Preweaning and weaning data on three-breed crosses with 25% Brown Swiss breeding were also presented. These calves were from first-cross dams (beef X Brown Swiss) and were sired by Hereford, Angus and Charolais bulls. The three-breed crosses with Brown Swiss breeding exceeded the contemporary three-breed crosses of strictly beef breeding in growthiness. They were essentially equal to these beef contemporaries in weaning score. A relatively high level of milk production because of the Brown Swiss breeding of the dams was presumed to have contributed to the advantage in weaning weight of calves.

RANGE SUPPLEMENT, GRASS MOISTURE AND REPRODUCTIVE EFFICIENCY

by

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An experiment has been conducted at the U. S. Range Livestock Experiment Station, Miles City, to determine the reproductive performance of lactating, beef cows fed grain supplement in addition to range forage prior to and during breeding.

Procedures

The study involved a total of 57 cows. Twenty-nine were second-calf, 3-year-olds and 28 ranged in age from 4-10 years. All cows were wintered on range, and hay was fed in amounts ranging from 12-18 lb. per head daily from December 15 until calving. Weight losses from December 1 until the precalving weighing on March 9 averaged 31.9 lb. and 69.3 lb. per head for young and mature cows, respectively. Cows were held in dry lots in the headquarters area from March 9 until calving.

All cows were weighed within 12 hours following calving. Calves were weighed, branded, eartagged, dehorned, and male calves were castrated within 12 hours after birth. The mean calving date was April 15.

Three to five days following calving all cows nursing calves were returned to range and all supplemental feeding was terminated.

On May 12, which was 35 days prior to the beginning of the breeding season, cows were randomly assigned within age group to the experiment shown in table 1. Feed groups involved were: 1--range forage with no grain supplement; 2--range forage plus grain supplement for 35 days immediately prior to the breeding season but range forage only during the breeding season; 3--range forage only prior to the breeding season followed by range forage plus grain supplement during breeding; 4--range forage plus grain supplement for 35 days prior to and during the breeding season. All cows were weighed and palpated at 14-day intervals throughout the study.

At the midpoint of each 14-day weigh period, grass samples were obtained from range areas frequently grazed by the cows. Fresh samples were weighed and placed in an oven for drying. After drying, the samples were reweighed and the percent moisture and dry matter calculated.

All cows were pastured together in the same range area. Cows designated to receive grain supplement were gathered and held in a corral during the daily grain feeding period. This resulted in supplemented cows being off range for approximately two hours each day. The pelleted grain supplement was group fed at the rate of 8.5 lb. per head per day. Supplement composition was 75% barley, 20% wheat millrun and 5% molasses. This provided approximately 6.2 lb. of total digestible nutrients (TDN) per head daily.

Table 1. Design of range nutrition study.

Time period	Feed Group 1	2	3	4
Calving to 35 days prior to beginning of breeding (Calving to May 12)	Range only (16)[a]	Range only (14)	Range only (14)	Range only (13)
Thirty-five days prior to beginning of breeding season (May 12-June 15)	Range only	Grain supplement	Range only	Grain supplement
Breeding season (June 15-July 29)	Range only	Range only	Grain supplement	Grain supplement

[a]Number of animals per group.

Calves were weighed May 12, June 15, July 29 and August 30. The breeding season began June 15 and continued for 45 days. Breeding was by artificial insemination, following routine procedures.

Results and Discussion

Data were analyzed to determine if cow response to grain supplementation was affected by age of cow or sex of calf. These effects were found to be nonsignificant in all comparisons, thus summaries were made ignoring these variables.

The effects of supplemental grain feeding on reproductive performance of the cows and on calf weight gains are summarized in table 2. Grain feeding had little effect on the interval from calving to first estrus or conception, on services per conception, or on October pregnancy rate. There was a suggestion grain feeding shortened the interval from calving to uterine involution, but this was found to be nonsignificant. In addition, feeding grain to the dams did not appear to be beneficial to the calves as indicated by nonsignificant feed-group differences in calf weight gains. Thus, this study indicates supplemental grain feeding to range cows prior to or during breeding was of little value in 1965.

However, let's look closely at 1965 to see if a reason might be found as to why grain feeding was of little value. A concurrent study conducted to determine amounts of range forage produced from 1958 through 1967 is summarized in table 3. These figures reveal that total range forage production in 1965 was exceeded by production in 1963 and 1967. However, forage production from perennial grasses was low in 1963 indicating the major portion was due to the increased production from forbs and annual grasses. In many instances these annual plants are of low palatability for cattle. Thus, of the 10-year period covered by this study, 1965 ranks second only to 1967 in forage production from the palatable perennial grasses. We must then modify our conclusions to allow for the available range forage. Data obtained on this study indicate reproductive performance of cows grazing abundant, palatable range forage, as was available during the grazing season of 1965, is at or near optimum. Grain supplementation under these conditions had little effect.

Table 2. Summary of range nutrition study reproduction data and calf gains.

	Feed Group							
	Range only		Grain before breeding		Grain during breeding		Grain before and during breeding	
	No. Cows	Avg.	No. Cows	Avg.	No. Cows	Avg.	No. Cows	Avg.
Interval (days)-calving to:								
Uterine involution	16	50.2	14	41.5	14	46.5	13	42.8
First estrus	15	62.5	14	66.6	13	66.5	12	63.9
Conception[a]	15	78.5	12	79.2	11	73.8	10	76.1
Pregnancy data:								
No. cows bred	15		14		13		12	
No. pregnant Oct.	15		11		10		8	
Avg. services per conception	1.27		1.36		1.30		1.62	

Calf wt. gain data:

Time period	No. calves	Avg. daily gain (lb.)	No. calves	Avg. daily gain (lb.)	No. calves	Avg. daily gain (lb.)	No. calves	Avg. daily gain (lb.)
Calving to 5/12	57	1.60	--	--	--	--	--	--
5/12 - 6/15	16	1.64	14	1.56	14	1.68	13	1.35
6/15 - 7/29	16	1.89	14	1.71	14	1.61	13	1.86
7/29 - 8/30	16	1.85	14	2.19	14	1.91	13	1.89
5/12 - 8/30	16	1.80	14	1.80	14	1.72	13	1.71

[a]Postbreeding cycle > 30 days duration.

Table 3. Vegetation production by major plant species 1958-1967. (Data supplied by Dr. W. R. Houston).

	Production in lb. per acre, air-dry basis					
Year	Western wheatgrass	Blue grama	Total perennial grasses	Forbs and annuals	Total	Crop year[a] precipitation (inches)
1958	163	240	501	9	520	10.79
1959	144	51	249	25	281	10.42
1960	88	53	196	35	235	8.88
1961	26	25	89	94	183	7.10
1962	101	76	244	490	735	14.80
1963	306	296	880	404	1288	13.90
1964	179	290	684	43	738	10.09
1965	638	234	1056	45	1181	14.24
1966	250	93	458	30	524	10.49
1967	710	230	1102	101	1213	14.12

[a]September of prior year through July 31 of year shown.

Grass moisture samples and the weight changes of the cows during the various weigh periods showed extremely interesting results. These figures are summarized in table 4. The most striking figure is the -2.97 lb. daily weight loss per cow from calving until May 12. Following calving, cows were placed on range containing an abundance of grass remaining from the previous year. However, observation indicated cows preferred the new green growth which contained an average of 73.7% (range 65.3-82.1%) moisture. Thus, a paradoxical situation existed: lactating cows covered large distances to find green grass and when it was consumed there was little nutritive value because of its high moisture content.

Table 4. Grass moisture content and weight changes of cows on range forage.

		Cow weight data		
Date grass sample obtained	Grass moisture content (%)	Time period	No. cows	Wt. change per cow (lb./day)
April 21	82.1	Calving to May 12	57	- 2.97
May 5	65.3			
May 19	43.2	May 12 to June 15	30	+ 1.28
June 16	49.2			
July 22	45.3	June 15 to July 29	16	+ 0.84

As the study continued, cows gained weight and continued to do so throughout the remainder of the study. This was undoubtedly a reflection of an increase in available range forage containing a higher percentage of dry matter (table 4).

Another important point can be seen by studying the calf weight gains during the period from calving to May 12 (table 2). The average weight gain during this period was 1.60 lb. per day. Thus, even though the cows were losing weight rapidly it does not appear milk flow was drastically curtailed as evidenced by reasonably good calf weight gains. This indicates that milk was being produced at the expense of body tissue stores of the dam.

Since this study was conducted during a year of high forage production, the weight loss from calving to May 12 did not result in a detrimental effect on reproduction. But remember this was during a year of high range forage production. This study has indicated the importance of having adequate range forage to produce and maintain weight gains in lactating cows. It also indicates that the period following calving could become a critical nutritional period if subsequent forage production was not ample to produce weight gains prior to and during breeding.

Summary

A study has been conducted to determine the effects of supplemental grain feeding on reproductive performance of lactating beef cows. The study revealed that when abundant range forage is available reproductive performance is at or near optimum and grain feeding under these conditions is not needed. Results indicate early spring forage contains a high moisture percentage and that the period following calving could become a critical nutritional period if subsequent forage production was not ample to produce weight gains prior to and during breeding. Suggestive evidence shows even though cows are on a low nutritional intake, milk production will continue at the expense of the body tissue stores of the cow.

SOME CAUSES OF CALF LOSSES

by
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Calf losses at or shortly after birth become a major economic loss of agricultural income, considering the national average death loss is approximately 5%. There are approximately 1,400,000 beef cows in Montana. The following figures show the income lost in Montana resulting from a 5% calf loss:

Total beef cows	=	1,400,000 cows
90% conception	=	1,260,000 calves
5% calf loss	=	63,000 calves
Assumed value of calf at weaning	=	$100/calf
Total value of calves lost	=	$6,300,000

This report will discuss some of the major causes of calf losses at the U. S. Range Livestock Experiment Station from 1956-1967.

Calf Losses (1956-1961)

An extensive study and analysis has been conducted on the calves lost during the period 1956-1961. A total of 143 calves were lost from 3049 parturitions (4.7%) during this period. Of the 143 calves lost, 124 were lost at birth and 19 were lost during the first 30 days after birth. Losses are summarized in table 1.

Over all years studied, calf losses from 3-year-old, first-calf heifers (9.5%) were significantly greater than from 4-year-old (4.3%) and 5 to 10-year-old (2.4%) dam groupings. The loss difference between the 4-year-old and 5 to 10-year-old dam groupings was not significant.

Seventy-five male and 49 female calves were lost at calving. The average birth weight of the male calves lost at birth was 75.8 lb. compared to the average weight of female calves lost being 58.4 lb. The average birth weight of all Station calves born during this period was 80.5 lb. for male calves and 75.4 lb. for female calves.

A total of 61 anatomically normal calves were lost from 3-year-old, first-calf heifers. Of these, 36 were unassisted and 25 were assisted at birth.

Table 1. Number of parturitions and loss percentages within year and age of dam groupings.

Year	Age (years) of dam groups: 3 — No. calves born	3 — % calf loss	4 — No. calves born	4 — % calf loss	5-10 — No. calves born	5-10 — % calf loss	Within year Total	Within year Avg. %
1956	147	10.2	93	2.2	339	2.1	579	4.1
1957	146	8.9	124	7.3	296	3.0	566	5.5
1958	122	10.7	106	5.7	234	3.0	462	5.6
1959	156	9.0	105	1.0	239	2.1	500	4.0
1960	131	9.9	123	3.2	210	2.4	464	4.7
1961	117	8.6	105	5.7	256	1.6	478	4.2
Total within age group	819		656		1574		3049[a]	
Average loss %		9.5*		4.3		2.4		4.7[b]

[a]Total number parturitions.
[b]Percent of all calves lost at birth and during first 30-day postnatal period.
*P<.05 between 3 and 4-year-old and 3 and 5-10-year-old dams.

At autopsy, the calves' lungs were removed and classified as functional or nonfunctional. Lungs that floated when placed in a container of water were classified as functional which indicated calves had taken at least one breath. Those that did not float were classified as nonfunctional indicating the calves had not taken a breath. Functional status of the lungs were classified in 89 calves lost at birth (table 2). Sixteen male and 9 female calves lost at birth had functional lungs and 41 male and 23 female calves had nonfunctional lungs. These 89 calves were anatomically normal with 64 (72%) having nonfunctional lungs and 25 (28%) having functional lungs. Calves with functional lungs cannot be called "stillborn".

Table 2. Lung status of normal calves (1956-1961).

	Functional	Nonfunctional
Male	16	41
Female	9	23
	25 (28%)	64 (72%)

Autopsy Findings (1956-1961, 1963-1967)

Table 3 summarizes the autopsy findings over the 11-year period in calves lost at birth and during the first 30 days after birth. The year 1962 was omitted in the summary because no autopsies were conducted. During this 11-year period 6863 calves were born with 355 (5.2%) being lost at birth and during the first 30 days after birth.

Table 3. Classification of autopsy findings in calves lost at birth or during the first 30 days after calving (1956-1961, 1963-1967).

Lost at birth	Autopsy classification	Number calves lost
Anatomically normal		
	Difficult birth	137[a]
	Drowned in placental fluid	17[a]
	Unknown	29
Anatomically abnormal		
	Skeletal abnormalities	24
	Visceral abnormalities	42
	Premature	6
Calf losses during first 30 days after birth		
	Disease	22[a]
	Injuries at or after birth	15[a]
	Exposure	14[a]
	Hairballs in stomach	11
	Starvation	7[a]
	Abnormalities	5
	Spastic	4
	Unknown	22

[a]Calf losses that could be classified as preventable.

Of the total number lost, 255 calves (71.8%) were lost at birth compared to 100 calves (28.2%) being lost during the first 30 days after birth. The largest single loss of calves was due to delayed and difficult parturition. This classification represented 137 calves lost or 53.7% of the calves lost at birth. Eighty-one calves (22.8%) were classified as abnormal and these abnormalities either directly or indirectly contributed to death. If we classify as preventable, calf losses that could have been avoided if assistance had been given at the proper time, 154 or 43.4% of the losses at birth could have been prevented. Proper care after calving could have saved 58 calves (16.3%) lost and these losses can also be classified as preventable.

More than one-half of the calves lost were unassisted. A large percent of the losses were attributable to delayed or difficult parturition. These data indicate many calf losses can be prevented by closer observation of the cows at calving and providing assistance when needed at time of calving.

Calving Difficulty (1966-1967)

Calving difficulty for 1966 and 1967 has been summarized in table 4. Calves were scored for either an assisted or unassisted birth and normal or abnormal presentation at birth. The 2 years involved 1574 births with 246 (15.6%) requiring assistance. There were 201 (12.8%) normal presentations receiving assistance and 45 (2.8%) abnormal presentations assisted.

Table 4. Calving difficulty during 1966 and 1967 calving seasons.

Age of cow	1966 Total number births	1966 Normal births assisted No.	%	1966 Abnormal births assisted[a] No.	%	1967 Total number births	1967 Normal births assisted No.	%	1967 Abnormal births assisted[a] No.	%	2-year total Number births	2-year total Number assisted No.	%
4-years & older	387	8	2.1	5	1.3	465	4	0.9	10	2.2	852	27	3.2
Heifer 3-years	186[b]	18	9.7	7	3.8	158[c]	25	15.8	10	6.3	344	60	17.4
Heifer 2-years	91[d]	22	24.2	5	5.5	287[e]	124	43.2	8	2.8	378	159	42.1
Total	664	48		17		910	153		28		1574	246	
Average % Assisted			7.2		2.6			16.8		3.1			15.6

[a]Includes backward or breech calves, leg back, head back, etc.
[b]Average calf birth weight 73 lb.
[c]Average calf birth weight 78 lb.
[d]Average calf birth weight 69 lb.
[e]Average calf birth weight 71 lb.

The 2-year-old heifers gave birth to the lightest calves, but required the greatest frequency of assistance at parturition. One hundred fifty-nine (42.1%) 2-year-old heifers required assistance at birth. Sixty (17.4%) and 27 (3.2%) of the 3-year-old heifers and mature cows, respectively, required assistance at birth. Of the 27 mature cows receiving assistance at birth, 15 had abnormal presentations.

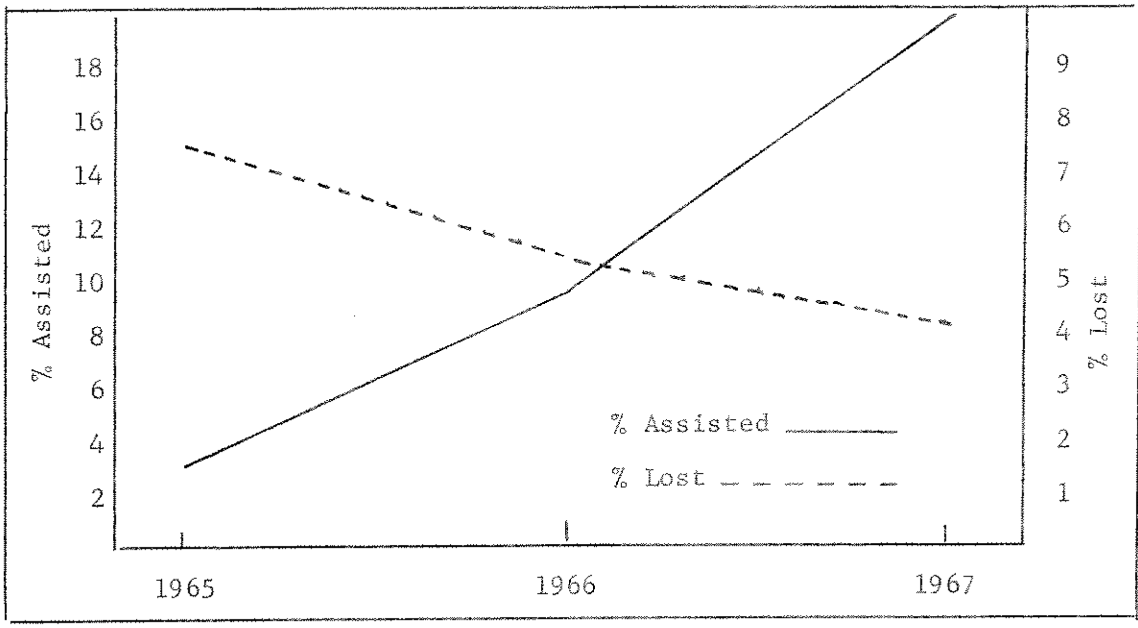

Figure 1. Calf losses at birth and assists at birth.

In figure 1 the percentage of calves lost is plotted as a dotted line and the percentage of cows receiving assistance is plotted as a solid line. This covers the years 1965-1967. Figure 1 indicates calf losses were reduced by increasing the frequency of assistance for difficult births. In 1965 only 3.0% of the cows and heifers were assisted with a 7.4% calf loss. In 1967 19.9% of the cows and heifers were assisted with a 4.1% calf loss. This is a marked decrease in calf losses with a much larger percentage of cows and heifers receiving assistance. The largest reduction in percent of loss occurred in the 2 and 3-year-old heifers. This was accomplished with 24-hour observation of first-calf heifers including adequate equipment and facilities for assisting difficult births.

Summary

A study was conducted at the U. S. Range Livestock Experiment Station to determine the major causes of calf losses and possible methods of reducing calf losses. More male calves were lost at birth and during the first 30-day period after birth than female calves. Male calves lost averaged heavier at birth than female calves lost. Two-year-old and 3-year-old first-calf heifers had a significantly higher loss of calves than cows 4 years of age and older even though birth weights of their calves were lighter. The largest single loss-cause was delayed and difficult birth. The calving difficulty data indicate that more assistance of cows having difficult parturitions should reduce calf losses. The data indicate improved management procedures can reduce calf losses.

INTERSEEDING FOR RANGE IMPROVEMENT IN THE NORTHERN GREAT PLAINS

by

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Range interseeding has shown promise of substantially increasing productivity and the proportion of desirable forage species on depleted ranges. Where ranges are to receive deferment from grazing for range improvement, interseeding may considerably reduce the time required and increase the amount of improvement.

During the drought of the 1930's contour furrowing of rangeland was widely used to hold rainfall, reduce soil blowing, and prevent deposition of sediment on lower areas. The accompanying destruction of native vegetation led to the development of seeding attachments to the furrowing machines and contour furrowing became interseeding. Since the early 1950's the practice has become more widespread (Becker and others, 1956; Hervey, 1960; Schumaker, 1964).

Several local manufacturers in the Great Plains have produced interseeding attachments for use on tool bars. Most differences between existing machines are due to the type and brand of equipment parts used. Some machines are capable of handling a variety of smooth and fluffy seeds, and some have added equipment for applying fertilizers with the seed. Some of the available machines lack strength and durability for Dense Clay and rocky soils.

Since 1964 the Agricultural Research Service and the Bureau of Land Management have cooperated in development of an interseeding machine suited to the rough topography and clayey soils common to the region. Another objective was to study adaptability and limitations of the interseeding operation.

Methods

The interseeder constructed in 1964 has undergone several modifications. The first change was rebuilding with stronger materials. Later a brush guard was added to protect the seeder unit and a trip mechanism added to reduce damage on rocky sites. Recently, the gauge wheels were changed to sealed bearing type.

Two types of bottoms have been tested, an 18-inch sweep blade with 2 sod slicers added on the top edge about 2 inches high and 7 inches apart and a 22-inch, commercial middlebuster bottom. The sweep blade constructs a narrower furrow than the middlebuster bottom but undercuts the sod to the same width. It does not turn the sod strip over or create the rough surface of the middlebuster.

In the fall of 1965, a series of plots were established near Ismay, Montana. The 18-inch sweep blade was used. Ten species and treatment plots were assigned at random to each of 3 replicates on a mixed Pan Spot-Clayey site. Plot size was

60 x 60 feet. In both the spring and fall of 1966 many of the treatments were repeated using the 22-inch middlebuster bottom. Sweet clover was broadcast by hand over one block of plots in March 1967.

In August 1967, forage production was determined for selected treatments. All species plots were rated for stand establishment in June and late July of 1966 and in June and September of 1967.

Precipitation near Ismay was substantially below normal during the spring of 1966 and during late summer and fall. During spring and early summer of 1967, precipitation was approximately 50% above average.

Results

The most rapid and significant vegetational changes from the interseeding operation occurred between the strips from native vegetation already present. An average increase of 17% in production of perennial grasses was found on the plots interseeded in the fall of 1965, but only about 2% of this was from the seeded grasses (table 1). The greatest response was from the machine treatment alone with no seeding. Here, western wheatgrass, a key species in the northern plains, increased 650%. Blue grama and other perennial grasses decreased about 55 and 20%, respectively. For all treatments applied in the fall of 1965, the average increase in production of western wheatgrass was about 360%.

On the treatments applied in the spring of 1966, production of western wheatgrass increased between 66 and 485%. Total production of perennial grasses ranged from a loss of 15% to an increase of 30%. On the most recent treatment, machine only in the fall of 1966, a 6% loss in total production of perennial grasses was found. However, even in this short interval, production of western wheatgrass increased 165%.

Over all treatments, regardless of application date, production of blue grama, a low-producing, sod grass, was reduced 30 to 45%. On all treatments, except the seeding of Rambler alfalfa, reductions in other perennial grasses, such as buffalo grass, red threeawn, and tumblegrass, of 25 to 70% were observed. Production of annual species greatly increased on all treatments. They were able to take advantage of soil disturbance, and will decline as perennial grasses re-establish. The chief species in this group were common sunflower and Russian thistle.

Both western wheatgrass and the native green needlegrass were substantially taller and remained green nearly two months longer on treated plots in 1967.

Several of the species seeded in the fall of 1965 and the spring of 1966 were rated at 30-40% of a full stand during 1966 (table 2). In late July many of the legumes were rapidly drying, and heavy grasshopper damage was found. By June 1967, several of the early grass seedings and nearly all of the legume seedings were seriously reduced. Most of these losses occurred during late summer and fall of 1966.

The damaging effect of weather or grasshoppers or both on alfalfa during the summer of 1966 is shown by the high stand ratings in 1967 for the fall 1966 seeding of Orenberg alfalfa as compared to the near complete disappearance of the spring 1966 seeding. Only 3 of the 22 seedings made in the fall of 1965 and spring of 1966 were not considered failures in September 1967. These were the fall 1965 seedings of thickspike wheatgrass and the spring 1966 seeding of the native white prairie clover. All seedings of browse species were failures regardless of seeding date.

Conclusions and Summary

Successful use of the interseeding machine on about 300 acres of rangeland in the fall of 1967 with little damage indicates that development of the machine is completed.

The vegetational results of this study point out that, where western wheatgrass is present, contour furrowing is the most valuable part of the interseeding operation. The variable but generally poor results obtained from seeding both adapted, native and introduced species indicate that the seeding operation may be of questionable value. It is possible that under more favorable weather or reduced grasshopper infestation the seedings would have been more successful.

The results of this study as well as the successes and failures of other field trials in northern and eastern Montana and in the central plains provide tentative guides to adaptability and limitations of the interseeding practice. These are summarized as follows:

Range Site. Experience in central and eastern Montana indicates that best results from interseeding have been obtained on Silty sites with good results on Sandy, Clayey, and Pan Spot sites, and poor results on Sand and Dense Clay sites. In Nebraska best success has been on Sand and Sandy range sites with that on Silty sites not far behind. Success has been limited on Clayey and Dense Clay sites (Schumaker, 1964).

Slope. In Montana the practice has been successfully applied on slopes up to 10%. However, caution is needed on the steeper slopes with care given to staying on the contour and the furrows interrupted at short intervals to avoid erosion.

Range Condition. Interseeding may be used on sandy ranges regardless of range condition where it is necessary to avoid soil blowing and wind erosion from soil bared in large blocks by a complete revegetating operation of plowing, discing, and seeding.

The practice has been most successful in Montana where a remnant of desirable species such as western wheatgrass, thickspike wheatgrass, or needle-and-thread are present. Ryerson and others (1966) suggested that interseeding be done on ranges in no lower than high poor condition.

Plant Control. Interseeding has stimulated growth of fringed sagewort whenever it was present on the site. If this undesirable species is present in more than minor quantities, it should be controlled with herbicide before interseeding a legume.

Furrow Type and Spacing. The furrow should be no more than 2-3 inches deep to undercut the rootcrown of the common blue grama sod. Width of furrow or undercutting of sod should be a minimum of 18 inches in Montana to 14 inches in Nebraska. Spacing depends on width of the furrow. For 18 to 22-inch furrows, spacing should be a minimum of 54 inches. To date little difference is apparent in vegetation response to either sweep blade or middlebuster bottoms.

Seed Placement. The seeding attachment should be equipped with depth bands permitting a maximum seeding depth of 3/4 inch. A packer wheel is desirable for soil firming in Sandy or Silty soils. Drag chains are necessary if the seed is not covered.

Species for Seeding. Seed of native, adapted forage species are available for most range sites of the northern plains. To avoid management problems the climax native species for the site are suggested. The addition of a small amount of legume seed, usually the spreading-type alfalfas, is recommended for all range sites. Recent studies in the northern plains (Campbell, 1961; Rumbaugh and Thorn, 1965) have demonstrated the value of alfalfa in range seedings.

Size of Area. Small areas of 10-30 acres may be interseeded in larger areas as a means of obtaining better livestock distribution due to the usually higher palatability of herbage on the interseeded area. However, interseeding entire pastures is the most common. This improves management alternatives and allows use of existing fences for deferment.

Cost. Experience to date indicates an application cost per acre of $3 to $5 with lower costs on large areas of level, silty to sandy soils and higher costs on small areas of rough topography or rocky soils. Deferment and cost of seed at 4-6 pounds per acre would be in addition to the application cost.

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Table 1. Forage production (air-dry) in 1967 for selected interseeding treatments near Ismay, Montana.

Date of application, treatment and species	Seeded spp.	Western wheat.	Blue grama	Other per. grasses	Total per. grasses	Sweet clover	Other ann.& forbs	Fringed sagewort	Total
					Pounds per Acre				
Control	--	130	689	85	907	--	4	--	911
Fall 1965									
Machine only	--	980	307	66	1355	--	41	64	1458
Green needle-grass	21	619	327	55	1024	--	166	--	1191
Thickspike (Havre)	30	350	574	64	1018	--	100	85	1206
Thickspike (Ekalaka)	13	448	322	62	845	--	79	--	924
Spring 1966									
Machine only	--	216	510	49	775	--	132	--	909
Prairie clover	23	760	350	43	1174	6	79	--	1259
Rambler alfalfa	19	730	260	173	1182	2	41	--	1223
Fall 1966									
Machine only	--	344	482	23	849	49	205	21	1127

Table 2. Species, season and year seeded, and stand ratings in percent in 1966 and 1967.

Species and interseeding date		Percent stand rating			
		Jun 1966	Jul 1966	Jun 1967	Sep 1967
Bluebunch wheatgrass[1/]	F '65[2/]	45	60	8	5
Green needlegrass	F '65	15	20	13	8
Indian ricegrass	F '65	5	T	T	0
Prairie sandreed	F '65	0	30	0	T
Thickspike wheatgrass (Ekalaka source)	F '65	10	45	10	10
" (Havre source)	F '65	15	43	11	20
Western wheatgrass	F '65	0	T	3	T
Sainfoin	F '65	T	10	6	3
Gardner saltbush	F '65	0	0	0	0
Thickspike wheatgrass (Ekalaka source)	S '66	0	0	T	1
" (Havre source)	S '66	0	T	1	T
Western wheatgrass	S '66	0	0	1	4
Western wheatgrass + N[3/]	S '66	0	0	0	0
Orenberg alfalfa	S '66	75	43	2	T
Rambler alfalfa	S '66	90	40	17	T
Sainfoin	S '66	T	T	2	3
Teton alfalfa	S '66	75	T	3	1
White prairie clover	S '66	40	80	42	25
Yellow flower alfalfa	S '66	100	47	5	2
Fourwing saltbush	S '66	0	0	0	0
Gardner saltbush	S '66	0	0	0	0
Gardner saltbush + N	S '66	0	0	0	0
Nuttall saltbush	S '66	0	0	0	0
Winterfat	S '66	0	0	0	0
Western wheatgrass + N	F '66			0	T
Orenberg alfalfa	F '66			35	45
Fourwing saltbush	F '66			0	0
Gardner saltbush + N	F '66			0	0
Winterfat	F '66			0	0
Sweet clover	S '67			22	25

1/ Botanical names of plants mentioned are shown in: Booth, W. E. 1950. Flora of Montana, Part I, Conifers and Monocots. Part II, Dicotyledons. Res. Found. Mont. St. Coll., Bozeman.

2/ F = fall seeding, S = spring seeding.

3/ 15 pounds per acre ammonium nitrate placed with seed.