



A comparison of progeny tests with sires tested on different cow herds and under different environmental conditions
by Ray R Woodward

A THESIS Submitted to the Graduate Committee in partial fulfillment of the requirements for the degree of Master of Science in Animal Industry
Montana State University
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Abstract:

This study was undertaken to analyze the results of one phase of record of performance work in beef cattle. Eleven Hereford sires, raised by the United States Range Livestock Experiment Station at Miles City, Montana, were bred to cows in the herd at that Station one year, and either the next year or soon thereafter were bred to cows in the North Montana Branch Station herd at Havre, Montana. Growth and feed lot records of the two steer progenies from the same sire were then available for comparison.

Four factors were considered in the comparison of the two records. They were birth weight, average daily gain from birth to weaning, average gain in the feed lot and efficiency of gain in the feed lot. Statistical analyses of the variation in weights and gains were made in each case.

There was a significant difference between stations in average daily gains from birth to weaning and efficiency of gain in the feed lot. Significant differences between sire groups occurred in each analysis. A significant sire X station interaction was observed in rate and efficiency of gain in the feed lot.

There was enough difference in the performance of the progeny from the same sire at the two stations to cast some doubt on the methods of testing. Recommendations were made to standardize the record of performance program to increase the accuracy of tests at different stations.

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WITH SIRES TESTED ON DIFFERENT COW HERDS AND
UNDER DIFFERENT ENVIRONMENTAL CONDITIONS

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RAY R. WOODWARD

A THESIS

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ABSTRACT

This study was undertaken to analyze the results of one phase of record of performance work in beef cattle. Eleven Hereford sires, raised by the United States Range Livestock Experiment Station at Miles City, Montana, were bred to cows in the herd at that Station one year, and either the next year or soon thereafter were bred to cows in the North Montana Branch Station herd at Havre, Montana. Growth and feed lot records of the two steer progenies from the same sire were then available for comparison.

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INTRODUCTION

Beef cattle, probably more than any other class of livestock, are selected for breeding purposes almost solely on show ring and visual appraisal standards. The selection of dairy cattle, for example, has long been based on the production record of the cow or the female progeny of a certain bull. Conformation is not over-looked in the selection of desirable dairy cattle, but emphasis is placed on the production record. In contrast, conformation is practically the only factor considered in the selection of beef cattle. The only other consideration is a possible attempt to maintain certain lines of breeding, in which case inbreeding may or may not be done. However, this practice is used only to maintain or improve certain characteristics in conformation that the breeder finds desirable.

While it is admitted that the show ring has brought about considerable improvement of beef cattle, it is evident that mere visual appraisal is not a sufficient measure of beef cattle performance. An important disadvantage of the show ring as a standard for selection is the practice of fattening cattle to the extreme in order to improve their appearance. When these cattle are then used on the range, the lowered level of feeding frequently results in temporary sterility and complete inability to make an adjustment to range conditions. This problem could be solved by discontinuing the practice of highly "fitting" animals for the show ring but it is doubtful that all breeders would be willing to accept this solution. For these reasons numerous investigators are attempting to develop other standards for the evaluation of this class of livestock.

The United States Range Livestock Experiment Station, at Miles City, Montana, in cooperation with the Montana Agricultural Experiment Station, inaugurated a program of record of performance for Hereford cattle in 1936. An attempt is being made to determine the rate of gain, efficiency of gain and carcass quality of the progeny of various Hereford sires. It is hoped that by this experiment a method will be evolved whereby beef sires and dams can be selected to produce rapid gaining and efficient calves. Obviously the present method of show ring selection is not comprehensive enough to permit proper evaluation of such economic characters.

At present the record of performance work is more or less in an exploratory stage. Experimental studies have shown that there are significant differences between the progeny of the various sires in ability to make rapid and economical gains as well as differences in the carcass quality of steers sired by various bulls that have been tested. The only data, so far as is known, resulting from testing the same sire on different cow herds and under different environmental conditions are included in this study.

REVIEW OF LITERATURE

A record of performance for beef cattle was probably first outlined by Sheets (10) and Winters and McMahon (11). The former suggested that efficiency of gain was one of the prime requisites in the selection of beef cattle. Winters and McMahon individually fed a group of steers for 196 days and determined that there was a high correlation between rate and efficiency of gain. This was confirmed by Black and Knapp (1). They further state that average daily gains from birth to weaning and from weaning to slaughter are negatively correlated. This shows that animals which grow at a greater rate while on milk tend to gain at a slower rate thereafter. They found no correlation between economy of gain from birth to weaning and economy of gain from weaning to slaughter.

Pontecorvo (9) found a high correlation between weights of beef and dual purpose animals at 6, 12 and 18 months of age. Thus a heavy weight at 6 months of age would indicate a heavy weight at 18 months of age.

Black and Knapp (2), in reviewing several methods of progeny testing, concluded that the greatest differences between progeny of various sires were evidenced during a feeding period in which the initial weights averaged 500 pounds and the final weights averaged 900 pounds.

Knapp et al. (5), in a study of beef and dual purpose cattle, concluded that only a minor portion of the variation in birth weight can be attributed to the genetic growth potentialities of the calf. Knapp and Black (4) further determined that differences in the progeny of sires could not be determined during the suckling period.

Knapp et al. (6), in summarizing some of the most comprehensive work on record of performance, state that the inherited differences between the progeny of various sires may be demonstrated by weaning weights, daily gain in the feed lot, efficiency of gain in the feed lot, dressing percentage and weights of heifers at 18 and 30 months of age. The latter point is in agreement with the work done by Pontecorvo (9). They further show that the score at weaning is of little value in predicting the future rate of efficiency of gain in the feed lot. This is concrete evidence that visual appraisal is not to be heavily relied upon as a basis for selection of beef cattle.

Knapp et al. (7), report that a feeding period of 168 days was found to be sufficient to indicate differences between sire groups in record of performance testing. They also state that eight individually fed steers from each sire are sufficient to give a good test of a sire's ability to transmit efficiency of feed utilization.

Clark et al. (3), in a comparison of bulls from three Hereford lines of breeding, found a difference of as much as 57 pounds in weaning weights, 50 pounds in feed lot gains and 103 pounds in the final weight out of the feed lot, between the steer progeny of the various sires.

Knapp and Baker (8), state that full feeding of steers in record of performance tests produced much more variable gains between sires than did limited feeding. They concluded that ad libitum feeding was the best method to show differences in ability to gain.

Experimental work reviewed in this study was conducted at the United States Range Livestock Experiment Station at Miles City, the North Montana Branch Station, at Havre, and the Montana Agricultural Experiment Station, at Bozeman, Montana. The steer progenies of 11 bulls were fed out at Miles City and Bozeman. The bulls were all purebred Herefords raised in the Miles City herd. The first winter after birth they were individually fed at Miles City and the following summer bred to a group of cows. Each bull was placed in a pasture with only the cows assigned to his herd. The steers from these matings were then individually fed at Miles City as calves to determine their record of performance. These bulls were then taken to Havre, generally as two-year-olds, and the same breeding procedure was followed at this station with the North Montana Branch Station herd of grade Herefords. The second steer progenies were then shipped to Bozeman and fed as calves. The records of the performance of these two progeny groups serve as the basis of comparison between the two tests.

Random selection was used both to determine the cows for the breeding herds and the steers used in the feeding trials. The breeding seasons averaged approximately 50 days.

All of the cows were wintered on the range together and were fed either a protein supplement or hay. Calving also took place on the range. The calves were weighed and ear-tagged as soon as they were dropped.

The calves were started on feed shortly after weaning. A preliminary trial of approximately two weeks preceded the regular trial for the purpose of allowing the calves to become accustomed to the ration and feed lot.

If possible eight steers were used from each sire group as according to Knapp et al. (7). The initial and final weights were the average of three successive weighings made at the beginning and end of the feeding trial. Intermediate weights were taken every 28 days.

In the procedures mentioned above the handling of the steers was quite similar at Bozeman and Miles City. The principal variables in methods of testing were the length of the feeding periods and the rations fed. Variables other than those in methods of feeding were the use of different cow herds, different environmental conditions and different years for testing.

The rations fed at Miles City and Bozeman are shown in Table I. Approximately the same feeds were offered in each test. The only instance in which a protein supplement was not included as a part of the concentrate in the ration was in 1940 at Miles City. Corn was used for the grain portion of the concentrate at Miles City and barley was fed at Bozeman. The roughage fed at both stations was alfalfa. The only exception occurred the last two years at Bozeman when native hay was fed. Salt and bonemeal were offered in all trials.

In Table II are given the registered names of the bulls with the year tested at each station. For the purpose of brevity, these bulls will be referred to by their number brands in this paper, as is commonly done in the stations participating in this testing program. For example, LLB Domino 2nd is known as Miles City 44 or M.C. 44.

These bulls are all of Domino breeding but represent two lines of the strain. About one-half of them are progeny from a line founded by Advance Domino 20th and Advance Domino 54th. The remainder represent a

Table I. Rations and Methods of Feeding

Station	Year	Concentrates	Hay	Methods of Feeding
Miles City	1940	1 part corn 1 part beet pulp	Alfalfa	Hay 3-5 lbs. Grain limited 281 days
Miles City	1941	6 parts corn 3 parts beet pulp 1 part wheat bran 1 part linseed oil meal	Alfalfa	Hay and grain fed ad libitum 265 days
Miles City	1942	6 parts corn 3 parts beet pulp 1 part wheat bran 1 part linseed oil meal	Alfalfa	Hay and grain fed ad libitum 252 days
Miles City	1943	6 parts corn 3 parts beet pulp 1 part wheat bran 1 part linseed oil meal 1/2 part alfalfa meal	Alfalfa	Hay and grain fed ad libitum 273 days
Miles City	1944	6 parts corn 3 parts beet pulp 1 part wheat bran 1 part linseed oil meal 1/2 part alfalfa meal	Alfalfa	Hay and grain fed ad libitum 259 days
Bozeman	1942	9 parts barley 9 parts beet pulp 2 parts linseed cake	Alfalfa	Hay and grain fed ad libitum 197 days
Bozeman	1943	9 parts barley 9 parts beet pulp 2 parts linseed cake	Alfalfa	Hay and grain fed ad libitum 252 days
Bozeman	1944	9 parts barley 9 parts beet pulp 2 parts linseed cake	Native hay	Hay and grain fed ad libitum 224 days
Bozeman	1945	9 parts barley 9 parts beet pulp 1 part linseed oil meal 1 part soybean oil meal 1/2 lb. alfalfa meal	Native hay	Hay and grain fed ad libitum 245 days

Table II. Registered Names of Bulls Tested and
Year Used at Miles City and Bozeman

Registered Name of bull	:	Brand	:	Year Tested at Miles City	:	Year Tested at Bozeman
Baron Domino		M.C. 13		1940		1942
Basil Domino		M.C. 16		1941		1942
Brian Domino		M.C. 20		1942		1944
Bourbon Domino		M.C. 21		1942		1944
Clayton Domino		M.C. 28		1942		1943
Baldwin Domino		M.C. 31		1942		1945
Baxter Domino		M.C. 32		1942		1944
ELB Domino 1st		M.C. 43		1944		1945
ELB Domino 2nd		M.C. 44		1943		1944
Baldwin Domino 2nd		M.C. 47		1944		1945
A-A Domino 2nd		M.C. 57		1944		1945

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line founded by Dandy Domino. The coefficient of inbreeding in all of the bulls is small and in some cases negligible.

DISCUSSION

The average birth weights of the steers included in the feeding trials at Miles City and Bozeman are given in Table III. It must be stated again that calves born and raised until weaning at the Havre station were subsequently fed out at Bozeman. M.C. 44 and M.C. 57 sired the calves with the heaviest birth weights, if both stations are considered. Calves by M.C. 44 weighed 89.9 pounds at birth at Miles City and 83.6 pounds at Havre. Almost exactly the same weights were registered by the M.C. 57 calves, but the heavier group was dropped at Havre.

The lightest calves were those from cows bred to M.C. 13. There was approximately 9.5 pounds difference in birth weights between the heaviest and lightest sire groups. The heaviest calves were from M.C. 44. The calves born at the Havre station averaged a little heavier than did those dropped at Miles City. Six of the eleven bulls tested sired calves at Havre that were heavier at birth than those they sired at Miles City. The remaining five bulls had heavier calves at Miles City.

Table III. Birth Weights in Pounds of Steers at Miles City and Bozeman

Sire:	M.C. 13	M.C. 16	M.C. 20	M.C. 21	M.C. 28	M.C. 31
Station:	M.C. 1/ B. 2/	M.C. B.	M.C. B.	M.C. B.	M.C. B.	M.C. B.
	75 90	90 81	72 74	75 102	72 78	80 77
	64 71	82 82	68 73	59 82	90 76	78 67
	63 70	81 78	81 76	75 84	81 84	79 72
	80 70	85 71	89 92	108 82	81 86	78 95
	87 75	79 80	79 91	83 86	97 85	95 82
	77 90	77 84	83 82	76 80	90 91	87 75
	74 81	75 61	87 90	75 96	85 93	75 90
	74 96	85 79	86 83	78 80	85 75	80 83
Avg.	74.3 80.4	81.8 77.0	80.6 82.6	78.6 86.5	85.1 83.5	81.5 80.1
Sire:	M.C. 32	M.C. 43	M.C. 44	M.C. 47	M.C. 57	
Station:	M.C. B.	M.C. B.	M.C. B.	M.C. B.	M.C. B.	
	85 90	80 98	92 91	82 72	80 72	
	81 79	79 75	88 74	75 80	91 107	
	75 87	80 82	79 86	83 87	53 87	
	81 82	69 83	87 86	70 81	82 90	
	74 82	95 85	89 82	81 72	93 87	
	76 86	84 75	98 81	66 78	98 85	
	79 76	83 80	94 76	79 91	89 85	
	84 70	81 72	92 94	84 95	83 99	
Avg.	79.4 81.5	81.4 81.3	89.9 83.8	77.5 82.0	83.6 89.0	

1/ Miles City 2/ Bozeman

Table IV. Analysis of Variance of Birth Weights of Steers
at Miles City and Bozeman - (Mean Squares Only)

Source of Variance	Degrees of Freedom	Mean Squares
Between Stations	1	72
Between sire groups	10	137.1*
Stations X Sires	10	81.5
Within sire groups	154	68.9

* P is less than .05

An analysis of variance of the birth weights at Miles City and Bozeman is shown in Table IV. The only significant difference obtained was between sire groups, in which P was less than .05. Knapp et al. (5) concluded that birth weight was primarily an expression of the size, weight, age and physiological constitution of the dam, and that only a minor part of the variation in birth weights was due to different potentialities for growth of the calves. The latter would be considered the effect of the sire. Therefore, the results of this analysis were about what could be expected, considering previous investigations, as only a barely significant difference between sire groups was obtained. There was not a significant difference in birth weights between stations, nor was there a sire X station interaction.

Table V includes the average daily gains from birth to weaning of all calves used in the feeding trials. As was expected, a greater station influence was evident in average daily gains than in birth weights. Calves from all but two of the sires made heavier gains from birth to weaning at Havre than they did at Miles City. Weaning weights at Havre have been consistently heavier than at Miles City since the Miles City

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Table V. Daily Gains in Pounds from Birth to Weaning of Steers
at Miles City and Bozeman

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1/ Miles City 2/ Bozeman

bulls have been used with both herds. The number of days between birth and weaning has averaged approximately the same at both stations. The difference in average daily gains can probably be attributed to more favorable conditions at Havre, including a more productive range, cooler temperatures during the summer and shorter distances to water on the range.

M. C. 28 sired the calves which averaged the heaviest gains from birth to weaning in these studies. His calves were outstanding at both Miles City and Havre, although calves from M. C. 57 gained faster at Havre. M. C. 13 sired the lowest gaining calves in the trials. His calves were also the lightest in birth weight.

In general the low gaining calves at Miles City were from sires that also had low gaining calves at Havre. The greatest difference in gains, between sire groups by the same bull, were in the M. C. 57 calves. They were only average at Miles City but were the top calves at Havre.

Table VI. Analysis of Variance of Average Daily Gains From Birth to Weaning at Miles City and Bozeman
(Mean Squares Only)

Source of Variance	Degree of Freedom	Mean Squares
Between stations	1	.25**
Between sire groups	10	.124**
Stations X sires	10	.034
Within sire groups	154	.047

** P is less than .01

The analysis of variance for average daily gain from birth to weaning is shown in Table VI. The results indicated a significant difference between sire groups and between stations. There was not a significant sire X station interaction. This meant that sires producing fast gaining

calves at one station tended to do likewise at the other station. Differences between sires were significant in spite of any effect of station.

These findings were in direct contrast to those of Knapp and Black (4), who state that an analysis of variance study showed that differences between the progeny of various sires cannot be demonstrated by rate of gain during the suckling period prior to weaning. They were working with fewer numbers than were included in this work and it is possible that an increased number of degrees of freedom would result in significant differences between sires which would not be apparent with fewer numbers.

Reference is now made to Bozeman and Miles City in the discussion on feed lot performance. As explained previously, this is because the feeding of the Havre steers was done at Bozeman.

The average daily gains of the steers in the feed lot are shown in Table VII. Variations in the performance of progeny from the same sire were quite pronounced. The greatest difference was in the gains of the M. C. 13 calves. His steers gained .51 pound more per day at Bozeman than at Miles City. There was also considerable spread in the average daily gains between sire groups, particularly at Bozeman, ranging from the highest gain of 2.30 pounds per day to the lowest gain of 1.59 pounds per day. The extremes were not so great at Miles City as the high gain at that station was 2.28 pounds per day and the low was 1.68 pounds per day.

When both stations are considered the M. C. 28 calves again made the heaviest gains. His progeny were high at Bozeman and second at Miles City. The progeny of M. C. 44, considered the best sire ever tested at Miles City, made only fair feed lot gains in Bozeman. On the same basis the

M. C. 47 calves averaged the poorest gains at both stations. They were the lowest gaining calves at Bozeman and second to the lowest in Miles City. M. C. 13 sired the lowest gaining calves at the latter station.

Table VII. Daily Gains in Pounds of Steers on Feed
at Miles City and Bozeman

Sire:	M.C. 13		M.C. 16		M.C. 20		M.C. 21		M.C. 28		M.C. 31	
Station:	M.C. 1/	B. 2/	M.C.	B.	M.C.	B.	M.C.	B.	M.C.	B.	M.C.	B.
	1.49	2.39	1.65	2.25	1.92	1.78	2.27	2.22	1.69	2.18	2.03	1.73
	1.71	2.14	1.73	2.12	2.02	1.87	1.79	2.15	2.27	2.13	1.78	1.47
	1.57	1.98	1.96	2.59	1.69	1.25	1.64	1.73	2.45	2.61	2.13	1.71
	1.73	2.02	1.80	2.00	2.01	1.87	2.30	1.95	1.83	2.31	2.04	1.69
	1.83	2.24	1.83	2.32	2.18	1.85	2.16	1.92	2.09	2.51	1.78	1.89
	1.74	2.31	1.88	2.21	2.23	2.02	1.88	1.97	2.19	2.37	1.95	1.67
	1.68	2.28	1.71	1.92	2.24	1.08	2.13	1.72	2.09	2.35	2.06	1.96
	1.68	2.16	1.80	2.34	2.19	1.68	1.95	2.04	2.09	1.98	2.06	1.76
	:	:	:	:	:	:	:	:	:	:	:	:
Avg.	1.68	2.19	1.80	2.22	2.06	1.68	2.01	1.96	2.09	2.30	1.98	1.73
	:	:	:	:	:	:	:	:	:	:	:	:
	:	:	:	:	:	:	:	:	:	:	:	:
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	:	:	:	:	:	:	:	:	:	:	:	:
Sire:	M.C. 32		M.C. 43		M.C. 44		M.C. 47		M.C. 57			
Station:	M.C.	B.	M.C.	B.	M.C.	B.	M.C.	B.	M.C.	B.		
	1.90	1.91	1.98	1.76	2.28	2.14	1.92	1.90	1.73	1.74		
	1.90	2.04	2.03	1.87	2.46	1.50	1.71	1.16	2.10	2.28		
	1.86	1.87	1.85	1.75	2.03	1.94	2.03	1.67	2.04	1.93		
	1.79	2.02	1.49	1.78	2.26	2.10	1.85	1.18	1.71	1.95		
	2.01	2.10	1.98	1.70	2.33	1.97	1.74	1.64	2.17	1.71		
	1.85	2.00	1.91	1.55	2.48	1.53	1.95	1.62	2.16	2.01		
	2.02	1.88	1.92	2.01	2.14	1.98	1.75	1.64	2.24	1.82		
	1.77	1.94	1.71	1.59	2.28	1.75	1.79	1.87	1.71	2.00		
	:	:	:	:	:	:	:	:	:	:		
Avg.	1.89	1.97	1.86	1.75	2.28	1.86	1.84	1.59	1.98	1.93		
	:	:	:	:	:	:	:	:	:	:		
	:	:	:	:	:	:	:	:	:	:		

1/ Miles City 2/ Bozeman

Table VIII. Analysis of Variance of Average Daily Gains
While on Feed at Miles City and Bozeman
(Mean Squares Only)

Source of Variance	Degree of Freedom	Mean Squares
Between stations	1	.0223
Between sire groups	11	.3460
Stations X sires	11	.4548**
Within sire groups	168	.0374**

** P is less than .01

Table VIII shows the results of the analysis of variance on average daily gains in the feed lot. This analysis contains data on an additional sire. The record of performance on this sire has not been used heretofore as his record at both stations was incomplete. Rather unusual results were obtained from this analysis. There were no significant differences in average daily gains between stations but there were significant differences between sire groups and there was a significant sire X station interaction. This meant that some sires tested high at Miles City and low at Bozeman while other sires were high at Bozeman and low at Miles City. The most plausible explanation of such results is that they were due to year effects, since the same sire was not used the same year at both stations.

In support of this contention the results of the tests on three sires can be cited. M.C. 43, M.C. 47 and M.C. 57 were all tested in 1944 at Miles City and in 1945 at Bozeman. Their relative ratings were the same at both stations. However, three other bulls were tested in 1942 at Miles City and in 1944 at Bozeman. The high testing bull in Bozeman was low in Miles City.

The efficiency of gain of the steers in the feed lot are given in table IX. About the same results occurred as were observed in the rate

Table IX. Efficiency of Gains in Pounds of Steers on Feed
at Miles City and Bozeman

Sire:	M.C. 13		M.C. 16		M.C. 20		M.C. 21		M.C. 28		M.C. 31	
Station:	M.C. 1	B. 2	M.C.	B.	M.C.	B.	M.C.	B.	M.C.	B.	M.C.	B.
	645.0	463.8	569.3	490.7	501.4	535.1	497.0	477.0	573.2	523.7	507.9	569.0
	553.0	524.3	604.3	521.1	520.3	482.6	508.5	486.0	520.9	531.1	478.2	631.7
	527.9	529.9	555.7	434.0	570.2	576.9	530.2	514.7	491.1	454.2	458.3	549.9
	587.9	481.2	603.8	522.7	579.1	498.6	541.8	479.0	557.3	513.7	481.9	564.4
	540.8	493.6	579.0	483.9	521.0	511.6	500.2	428.6	505.0	479.4	596.9	514.0
	526.3	483.3	516.9	500.9	467.1	470.3	500.5	456.2	498.9	505.4	490.2	542.3
	563.5	475.5	527.1	550.2	488.5	518.8	481.2	437.3	524.4	500.3	460.2	488.9
	563.5	484.5	512.3	471.0	499.9	508.9	538.8	406.0	524.4	515.5	486.8	514.4
	:	:	:	:	:	:	:	:	:	:	:	:
Avg.	563.5	492.0	558.6	496.8	518.4	512.9	511.7	460.6	524.4	502.9	495.1	546.8
	:	:	:	:	:	:	:	:	:	:	:	:
	:	:	:	:	:	:	:	:	:	:	:	:
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Sire:	M.C. 32		M.C. 43		M.C. 44		M.C. 47		M.C. 57			
Station:	M.C.	B.	M.C.	B.	M.C.	B.	M.C.	B.	M.C.	B.		
	498.1	536.6	548.2	549.1	527.7	449.2	517.6	499.1	588.4	541.7		
	536.8	478.0	483.0	503.9	514.7	570.0	590.6	742.8	541.0	454.9		
	529.4	531.9	565.6	555.4	539.1	530.0	530.9	562.8	540.3	496.2		
	519.8	482.2	575.7	544.3	512.9	471.8	530.8	757.7	568.5	486.8		
	503.9	479.6	545.0	561.7	536.7	505.3	556.4	532.0	528.5	563.8		
	519.4	489.8	601.9	577.5	464.5	492.3	543.4	586.0	497.9	512.3		
	516.3	455.5	552.2	481.4	511.7	445.3	514.2	554.6	513.4	514.1		
	523.1	412.6	548.4	554.1	533.3	499.6	522.1	520.9	551.8	480.9		
	:	:	:	:	:	:	:	:	:	:		
Avg.	518.4	483.2	552.5	540.9	517.6	495.4	538.3	594.5	541.2	506.3		
	:	:	:	:	:	:	:	:	:	:		
	:	:	:	:	:	:	:	:	:	:		

in the feed lot. Variation in performances of the same sire groups was pronounced between stations. One factor was different, since most of the sires had faster gaining calves at Miles City, but all except two of the sire groups proved to be more efficient in gain at Bozeman.

The most efficient calves, averaging the performance at both stations, were from M.C. 21. The least efficient were the progeny of M.C. 47.

When record of performance studies were first initiated the efficiency of gain of the progeny of a sire was considered to be of primary importance. However, further experience and study have shown that while efficiency of gain is one of the important factors in beef cattle selection, it has not been as important as rate of gain. This fact was established because of purely economic reasons. An efficient steer may not return the most profit. A low gaining steer, regardless of how efficient he may be in feed utilization, frequently does not return as great a margin between feed costs and selling price as does a high gaining steer that may be less efficient. Thus, the emphasis in record of performance studies has been shifted to rate of gain, although both points are considered.

Table X. Analysis of Variance of Efficiency of Gains
of Miles City and Bozeman - (Mean Squares Only)

Source of Variance	:	Degree of Freedom	:	Mean Squares
Between stations	:	1	:	15,587.13**
Between sire groups	:	10	:	7,571.86**
Stations X sires	:	10	:	6,815.93**
Within sire groups	:	154	:	1,512.03

** P is less than .01

Table X shows the results of an analysis of variance on efficiency of

gains in the feed lot at Miles City and Bozeman. Significant differences were found between sire groups and between stations. There was also a significant sire X station interaction. Practically the same results occurred in this analysis as were obtained when the average daily gains in the feed lot were analyzed. The exception was that there was no significant difference between stations in average daily gains, but there was a significant difference between stations in efficiency of gains.

The similarity in results between rate and efficiency of gain of the sire groups was to be expected. Winters and McMahon (11) and Blank and Knapp (1) both found a high correlation between rate and efficiency of gain in the feed lot. The latter reported a correlation of .88 between efficiency of gain and rate of gain from weaning to slaughter and a correlation of .89 between efficiency of gain and rate of gain from birth to slaughter.

It is evident from the preceding statistical analyses of the sire tests at Bozeman and Miles City that changes in the comparative ratings of some of the sires occurred. The results were not different enough to merit a complete revision of the present method of testing, but they do show the need for standardization of procedures in conducting record of performance. The reasons why the progeny of the same sire do not perform similarly in different tests still have to be determined. Some of the more probable reasons can be mentioned. There is no doubt that the feeder affects the feed lot performance of a group of steers. The elimination of this variable might be brought about by the use of self-feeders. Another factor, which is not subject to control, is weather. There is doubtlessly

some inherited difference in the ability of calves to withstand inclement weather. It is important to the success of the record of performance program that a method of testing be evolved that would assure an accurate appraisal of a sire regardless of where he is tested. Although there was some lack of agreement in results obtained at the two stations in this experiment a fairly high correlation was achieved. Further changes which might help to reduce the variables in these tests include the use of a standard ration, standard management and feeding procedures and the use of a feed lot where climatic changes would not be a major problem.

SUMMARY.

There were no significant differences in birth weights between calves sired at Miles City and calves sired at Havre, but there was a barely significant difference between sire groups.

Calves at the Havre station made significantly faster gains from birth to weaning than did the calves at the Miles City station. There was also a significant difference in average daily gains from birth to weaning between sire groups. Sires producing fast gaining calves at one station tended to do the same at the other station.

There were no significant differences between stations in average daily gains in the feed lot. There were significant differences between sire groups and there was a sire X station interaction. Hence some of the sire groups made fast gains at Havre and slow gains at Miles City. With other sire groups the reverse was true.

An analysis of the efficiency of gains in the feed lot showed that the steers fed at Bozeman made significantly more efficient gains than did the steers fed at Miles City. The remainder of the analysis showed results similar to those obtained from the study of rate of gain in the feed lot. There was a significant difference between sire groups and a sire X station interaction.

In order to achieve a higher correlation between tests at different stations, certain practices not included in these tests are recommended. These recommendations are not based on experimental evidence, but summarize what may have caused the lack of agreement in the records of progeny from the same sire.

They include -

1. The use of standard rations to be fed at all stations where tests are made.
2. The use of standard management and feeding procedures.
3. The use of self-feeders if practicable.
4. The use of an enclosed feed lot minimize the effect of temperature changes.

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