



University of Arizona

COLLEGE OF AGRICULTURE
AGRICULTURAL EXPERIMENT STATION

A STUDY OF PERFORMANCE IN HEREFORD CATTLE

- I. Progeny Testing of Hereford Sires
- II. Type as an Indicator of Performance

By

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A STUDY OF PERFORMANCE IN HEREFORD CATTLE

BY E. B. STANLEY AND RALPH McCALL*

INTRODUCTION

The existence of wide individual differences in feed utilization and growth capacity among beef animals is a familiar fact. These are believed to be heritable qualities, and the hope is entertained that it is possible to develop superior lines of beef-producing cattle. The involved and time-consuming procedure of testing production has hampered any extensive adoption of this practice.

The study herein reported was made to determine whether marked differences exist in the efficiency of beef production from calves sired by different bulls, and to obtain useful information if possible in measuring performance in Hereford cattle. Livestock shows will continue indefinitely as the "testing ground" of the purebred breeder. It is the intention in a study of this nature to supplement attainment in body shape with an evaluation of growth rate and feed utilization which together should constitute a dependable gauge of production.

PREVIOUS INVESTIGATIONS

The need for a measure of performance in beef cattle was recognized at an early date. Robert Bakewell and other early beef cattle breeders obtained a rather accurate measure of efficiency of their production, but little controlled work of this nature has been done until recent years.

Sheets (10) reported one of the earliest studies on measures of performance in beef cattle. He proposed that a sire be tested by (a) the efficiency of meat production, as measured by pounds of cold carcass produced per 100 pounds of digestible nutrients consumed, and (b) carcass quality.

Winters and McMahon (12) suggested a measure of weight at one year of age and a score on type and thickness of flesh, for evaluating breeding animals.

Black and Knapp (1) concluded that the test period used in measuring beef cattle performance be limited to a weight-constant period of 500 to 900 pounds in live weight; also that the final evaluation be based on efficiency of gain during this period and on carcass grade. They found a high correlation between rate and efficiency of gain. Knapp and coworkers (5) reported that daily gain and efficiency of gain were not highly correlated in a time-

*The helpful assistance of Fred Gremmel and C. L. Bell, resigned, in planning and conducting this study is gladly acknowledged. Ralph McCall resigned, January, 1945.

constant population. In later work, Knapp and Baker (7) reported that daily gain may be used with a high degree of accuracy to predict efficiency of gain of animals fed through a comparable weight range, but that much of the accuracy might be lost when wide variations exist between individuals in initial and final weights.

According to Knapp *et al.* (6) approximately 80 per cent of the differences in carcass grade could be accounted for by differences in initial weight and total gain while on feed.

Woodward and coworkers (13) reported that large-type calves were heavier at weaning time than small-type calves and made larger and more economical feed-lot gains. In their study, little difference existed between types in dressing percentage and carcass grade.

Hultz (4) found that very rangy calves made more rapid gains than very low-set calves, and that calves on a fattening ration during their sixth to twelfth months of age changed type. There were more low-set calves that became rangy than of very rangy calves that became low set in this test.

In a study with fifty head of steers of beef, dual-purpose, and dairy breeding, Black, Knapp, and Cook (2) discovered that steers considered low set from the standpoint of weight had a significant advantage over tall steers in amount and efficiency of gain, dressing percentage, and carcass grade. Length of body showed significant negative correlations with all the above points.

I. PROGENY TESTING OF HEREFORD SIRES

MATERIALS AND METHODS

Seventy-five young grade Hereford cows were divided into three lots of twenty-five head each and allotted to three breeding pastures in May, 1940. The three groups were divided as uniformly as possible by means of individual scores. The Hereford bulls used were quite different in their breeding.¹ Each bull was bred to the same group of cows each year in order to determine whether the relationship between sire groups and full brothers could be maintained. The pastures were of equal carrying capacity located in good range country, predominantly grama and curly mesquite grass. Calf weights were taken at birth and again at weaning time.

The steer calves were individually fed from as near a weight range of 400 to 800 pounds as possible in order to eliminate the variations in initial weight. Each steer was individually fed in a woven wire lot 35 feet long and 5 feet wide. Water was available

¹Domino 5th 2566169 is by Domino Prince 2206494 and out of Miss Domino 4th 2073151; A. Stanway Star 2609619 is by WHR Domino Stanway 44th 2198705 and out of WHR Vega Domino 4th 2275373; Mischief B. (a pure-bred but unregistered bull) is by Mischief 248th 2260498 and out of Bonnie Mischief 79th 2265797.

at all times. Each calf was fed according to its appetite in order to judge capacity for feed consumption.

Feeder grades were determined by the Animal Husbandry staff. At the conclusion of the test all steers were slaughtered at the same packing plant, and carcass grades were determined by a government grader.

Statistical procedure described by Snedecor (11) was used in the analysis of variance and correlation.

1941-42

During this first year of individual feeding, some changes in feeding procedure became necessary in order that each steer should respond to the limit of his capacity. Because of this situation and the small size of the Mischief B. group (most of the calves by this sire dropped in 1941 were heifers), the results of the first year's study reported in Table 1 were considered questionable as a measure of the capabilities of the three sires.

TABLE 1.—FEED-LOT AND CARCASS PERFORMANCE OF STEER CALVES BY THREE SIRES FED IN 1941-42
—SINGLE STEER BASIS

	Domino 5th	A. Stanway Star	Mischief B.
Number of steers	9	10	4
Age beginning of exp. (days) ..	234.7	254.2	261.5
Average steer days	196.0	197.0	196.0
Initial weight (lb.)	477.2	473.5	453.3
Final weight (lb.)	835.6	790.1	788.3
Average gain (lb.)	358.4	316.6	335.0
Daily gain (lb.)	1.83	1.61	1.71
Daily feed per steer (lb.)			
Hegari silage	9.54	9.20	8.51
Barley	6.12	5.68	5.38
Cottonseed meal	1.40	1.41	1.41
Beet pulp ^a	0.12	0.13	0.12
Alfalfa hay	3.90	3.65	3.52
T. D. N.	9.77	9.25	8.80
T. D. N. per 100 lb. gain (lb.).....	534.4	578.6	515.0
Gain per 100 lb. T. D. N. (lb.).....	18.84	17.44	19.49
Feed cost per 100 lb. gain ^b	\$10.25	\$11.08	\$9.91
Grades ^c			
Feeder grade	11.92	10.30	8.97
Carcass grade	16.67	16.60	17.50
Other slaughter data			
Dressing per cent	58.05	59.73	58.17
Lb. cold carcass per 100 lb. T. D. N.....	24.34	24.85	25.52

^aStarted feeding beet pulp on May 1, 1942.

^bFeed prices per ton were as follows: hegari silage, \$4.00; alfalfa hay, \$14.00; beet pulp, \$36.00; barley, \$36.00; salt, \$25.00.

^cNumerical scores have the following values: fancy selected and prime, 2 to 6; choice, 8 to 12; good, 14 to 18; medium and commercial, 20 to 24.

The calves by Domino 5th and A. Stanway Star were about the same in initial weight but were larger than those by Mischief B. In relation to age at the beginning of the test, the Domino 5th calves had an advantage in size, especially when compared to the Mischief B. group. Initial weights were large this year because of especially good range conditions.

Slightly greater gains were made by the Domino 5th calves, the lowest group in feeder grade. The Mischief B. group excelled both in feeder grade and in gain per 100 pounds T.D.N. consumed.

Carcass grades were generally low this year, because most of the calves were lacking in finish. A rather definite advantage in dressing percentage was registered by the A. Stanway Star calves, but the Mischief B. sired calves yielded more weight of cold carcass per 100 pounds T.D.N. consumed.

1942-43

Gains were considerably higher this second year of the study (Table 2). Sire group differences in gain were not large, but the Mischief B. calves made the largest gains, and those by Domino 5th were smallest. None of these differences were significant. As in the previous year, the Mischief B. calves made the most ef-

TABLE 2. — FEED-LOT AND CARCASS PERFORMANCE OF STEER CALVES BY THREE SIRES FED IN 1942-43 — SINGLE STEER BASIS

	Domino 5th	A. Stanway Star	Mischief B,
Number of steers.....	10	11	8
Age beginning of exp. (days)	246.8	251.2	271.0
Average steer days.....	177.0	169.3	165.0
Initial weight (lb.).....	445.3	440.9	437.7
Final weight (lb.).....	839.2	826.5	822.9
Average gain (lb.).....	393.9	385.6	385.2
Daily gain (lb.).....	2.23	2.28	2.33
Daily feed per steer (lb.)			
Hegari silage.....	14.41	16.08	14.48
Barley.....	6.33	6.64	6.50
Cottonseed meal.....	0.83	0.73	0.71
Alfalfa hay.....	3.34	3.24	3.66
T. D. N.....	10.09	10.54	10.31
T. D. N. per 100 lb. gain (lb.)	453.4	461.4	441.8
Gain per 100 lb. T. D. N. (lb.).....	22.09	21.78	22.65
Feed cost per 100 lb. gain*	\$8.25	\$8.31	\$8.00
Grades ^b			
Feeder grade.....	17.98	12.80	12.83
Carcass grade.....	10.80	10.18	10.00
Other slaughter data			
Dressing per cent.....	58.73	59.87	57.94
Lb. cold carcass per 100 lb. T. D. N.	26.91	26.77	27.66

*Feed prices per ton were as follows: hegari silage, \$4.00; barley, \$36.00; alfalfa hay, \$14.00; salt, \$25.00.

^bNumerical scores have the following values: fancy selected and prime, 2 to 6; choice, 8 to 12; good, 14 to 18; medium and commercial, 20 to 24.

ficient gains, but the spread between sire groups in this respect was not appreciable: although the average initial age of this group was greater, the calves were not as large as the Domino 5th and A. Stanway Star calves.

The steer calves sired by Domino 5th rated lower in feeder grade this year, compared to the other two groups, than in the previous year. However, little difference was evident in the carcass grades, and the entire group was well finished. Feed consumption was generally higher than in the previous year.

For the second time the A. Stanway Star group excelled in carcass yield, but the Mischief B. calves because of their more efficient gains produced more pounds of cold carcass per 100 pounds of T.D.N.

1943-44

The calves by Mischief B. maintained their superiority in efficiency of gain and repeated the performance of the previous year in making the most gain (Table 3). None of these differences were significant. They also consumed more feed than the other two sire groups. For the first time the Mischief B. calves were the

TABLE 3. — FEED-LOT AND CARCASS PERFORMANCE OF STEER CALVES BY THREE SIRES FED IN 1943-44 — SINGLE STEER BASIS

	Domino 5th	A. Stanway Star	Mischief B.
Number of steers	10	12	6
Age beginning of exp. (days)	284.4	278.6	274.8
Average steer days	176.5	174.2	170.3
Initial weight (lb.)	408.4	412.0	400.2
Final weight (lb.)	776.2	765.3	781.3
Average gain (lb.)	367.8	353.3	381.1
Daily gain (lb.)	2.08	2.03	2.24
Daily feed per steer (lb.)			
Hegari silage	10.14	10.07	10.97
Barley ^a	6.81	6.92	7.42
Cottonseed meal	0.97	0.98	0.97
Alfalfa hay	3.10	3.00	3.15
T. D. N.	9.84	9.87	10.52
T. D. N. per 100 lb. gain (lb.)	475.6	491.5	473.1
Gain per 100 lb. T. D. N. (lb.)	21.12	20.52	21.23
Feed cost per 100 lb. gain ^b	\$9.58	\$9.98	\$9.56
Grades ^c			
Feeder grade	14.41	13.04	13.03
Carcass grade	13.29	12.90	12.33
Other slaughter data			
Dressing per cent.	59.06	59.09	58.53
Lb. cold carcass per 100 lb. T. D. N.	25.35	25.25	24.49

^aConsisted of approximately half barley and half wheat.

^bFeed prices per ton were as follows: hegari silage, \$4.00; barley and wheat mixed, \$40.00; alfalfa hay, \$14.00; salt, \$25.00.

^cNumerical scores have the following values: fancy selected and prime, 2 to 6; choice, 8 to 12; good, 14 to 18; medium and commercial, 20 to 24.

youngest group at the beginning of the feeding period, and they weighed practically the same as the other two groups.

The relationship between sire groups in feeder grades and carcass grades was similar to that of the previous year with the exception that the Domino 5th sired calves were rated closer to the other two groups as feeders. Because of relatively late calving dates and dry weather during the early summer, initial weights were lighter this year. Some of the steers were not as well finished as would have been desirable when it became necessary to close the experiment in late June because of hot weather. Carcass grades were lower than the second year of the study, but only two steers graded below good.

The Mischief B. calves rated lowest in carcass yield. Although these calves made a more economical gain, the A. Stanway Star and Domino 5th calves for the first time produced slightly more pounds of cold carcass per 100 pounds of T.D.N.

THREE-YEAR SUMMARY

The Mischief B. calves rated highest for the three-year period in the amount and economy of gain, feeder and carcass grade, and

TABLE 4. — FEED-LOT AND CARCASS PERFORMANCE OF STEER CALVES BY THREE SIRES — THREE-YEAR AVERAGE, SINGLE STEER BASIS

	Domino 5th	A. Stanway Star	Mischief B.
Number of steers	9.7	11	6
Age beginning of exp. (days).....	256.0	262.1	270.2
Average steer days	182.7	179.5	173.7
Initial weight (lb.)	442.5	440.3	428.7
Final weight (lb.)	816.4	793.2	801.4
Average gain (lb.)	373.9	352.9	372.7
Daily gain (lb.)	2.05	1.97	2.15
Daily feed per steer (lb.)			
Hegari silage	11.36	11.67	11.83
Barley ^a	6.42	6.42	6.52
Cottonseed meal	1.07	1.04	0.97
Alfalfa hay	3.45	3.29	3.46
T. D. N.	9.90	9.88	10.00
T. D. N. per 100 lb. gain (lb.).....	486.2	507.9	468.5
Gain per 100 lb. T. D. N. (lb.).....	20.75	20.01	21.48
Feed cost per 100 lb. gain ^b	\$9.30	\$9.70	\$8.95
Grades ^c			
Feeder grade	14.87	12.13	12.04
Carcass grade	13.48	13.12	12.44
Other slaughter data			
Dressing per cent	58.63	59.54	58.19
Lb. cold carcass per 100 lb. T. D. N.....	25.55	25.63	26.10

^a1943-44 consisted of approximately half barley and half wheat.

^bFeed prices per ton were as follows: hegari silage, \$4.00; barley, \$36.00; alfalfa hay, \$14.00; salt, \$25.00.

^cNumerical scores have the following values: fancy selected and prime, 2 to 6; choice, 8 to 12; good, 14 to 18; medium and commercial, 20 to 24.

in pounds of cold carcass per 100 pounds T.D.N. (Table 4). These calves consumed slightly more feed than did the other groups. They were excelled by A. Stanway Star and Domino 5th calves only in carcass yield and initial weight.

Differences between sire groups in amount of gain were not significant. The advantage of the Mischief B. calves in efficiency of gain was significant only when compared with the A. Stanway Star group (Table 5).

Although the calves by Mischief B. were older at the beginning of the experimental period, they were not fed so long as the other two groups; therefore, there was little difference between sire groups in age at time of slaughter. There was likewise little difference in final weight; the slight advantage in this respect was with the Domino 5th calves.

STATISTICAL COMPARISONS

Body measurements with daily gain

The Domino 5th calves were taller, longer, slightly deeper, and wider at the thurls but were narrower in forerib than those by A. Stanway Star and Mischief B. (Table 6). The differences in measurement were less than the appearance of the steers in the three groups indicated.

Highly significant positive correlations with daily gain were obtained for circumference of cannon, length of body, width at the thurls, height at withers, and fullness at the stifle when measurements were not corrected for size. Weaning weight and daily gain were also highly correlated.

In order to test the assumption that the significant correlations indicated above were influenced by size of the animal, the measurements were divided by height at withers to eliminate the effect of size. The modified correlation of circumference of cannon and length of body with daily gain barely showed significance. Height at withers corrected for weaning weight and correlated with daily gain yielded a highly significant negative correlation. The tallest steers gained the most, as was evidenced by the positive correlation of uncorrected height at withers with daily gain; but when the effect of size was eliminated the low-set steers had a definite advantage in daily gain. Lush (8) reported length of body and height at withers, the two most important points of several studied in their association with daily gain.

The small negative correlation for corrected depth of chest and daily gain indicated that the steers measuring shallow bodied in relation to their height slightly outgained the deeper-bodied steers. According to Lush (8), the fastest gaining steers and those which produced the highest grading carcasses averaged shallow chested but large in heart girth.

TABLE 5. — ANALYSIS OF VARIANCE OF AMOUNT AND ECONOMY OF GAINS OF STEER PROGENY BY THREE HEREFORD Sires — MEAN SQUARES ONLY

Source of variation	Degrees of freedom	Daily gains				Gain per 100 lb. T.D.N. consumed
		Three years		1942-43 1943-44		
		Three sires	A. Stanway Star Mischief B.	Three sires	A. Stanway Star Mischief B.	
Sires	2	.179	.357	.106	13.005	3.780
Error	80-57	.113	.126	.074	4.584	2.496

*Significant P is less than .05.

TABLE 6. — BODY MEASUREMENTS OF STEERS BY THREE HEREFORD Sires AND THEIR CORRELATION WITH DAILY GAIN

	Body measurements (inches)			Correlation† with daily gain		Corrected measurements correlated with daily gain‡	
	Domino 5th	A. Stanway Star	Mischief B.	Between steers by same sire	Total population	Between steers by same sire	Total population
				Between steers by same sire	Total population	Between steers by same sire	Total population
Circumference of cannon....	6.34	6.37	6.37	+ .427*	+ .437*	+ .257	+ .298†
Length of body.....	22.46	21.28	21.65	+ .439*	+ .401*	+ .302†	+ .286†
Width at thurls.....	13.00	12.85	12.82	+ .470*	+ .445*	+ .229	+ .241
Depth of chest.....	19.72	19.56	19.26	+ .263	+ .199	+ .172	+ .203
Height of withers.....	38.52	38.04	37.60	+ .420*	+ .377*	+ .384*	+ .343*
Fullness of stifle.....	30.81	30.96	30.32	+ .406*	+ .366*	+ .201	+ .179
Width of forerib.....	11.04	11.23	11.54	+ .054	+ .083		

*Significant P is less than .01.

†Significant P is less than .05.

‡Body measurements corrected by dividing by height at withers. Height at withers corrected by dividing by weaning weight. Correlations based on fifty-seven steers with exception of width of forerib, which is based on twenty-eight steers.

Other comparisons

Next to the highest correlation obtained was between gain per 100 pounds T.D.N. consumed and daily gain, which means that the fastest gaining steers were also the most efficient in utilization of feed. This is in accordance with other studies (5, 7, 12). The heaviest steers at weaning time were the fastest gaining (Table 7), but there was little association between condition at the beginning of the test and gain.

The highest correlation obtained was between net return and daily gain (one year only). The amount of gain was a very important indication of profit from the feeding operation.

TABLE 7. — OTHER CORRELATIONS WITH PROGENY OF THREE HEREFORD SIRES

	Correlation coefficient	
	Between steers by same sire	Total population
Gain per 100 lb. T.D.N. consumed and daily gain	+ .779*	+ .783*
Weaning weight and daily gain	+ .400*	+ .354*
Initial condition and daily gain	+ .066	+ .087
Net return and daily gain	+ .821*	+ .830*
Feeder grade and daily gain	- .104	- .042
Feeder grade and carcass grade	- .050	+ .020
Cannon circumference and dressing percentage	- .083	- .102
Corrected cannon circ. and carcass grade†	+ .397*	+ .423*
Corrected width at thurls and carcass grade†	+ .244	+ .255
Corrected fullness at stifle and carcass grade†	+ .278†	+ .274†
Corrected height at withers and carcass grade†	+ .408*	+ .377*
Corrected width of forerib and carcass grade†	+ .071	+ .110

*Significant P is less than .01.

†Significant P is less than .05.

‡Body measurements corrected by dividing by height at withers. Height at withers corrected by dividing by weaning weight.

Correlations based on fifty-seven steers with exception of net return and daily gain which is based on twenty-eight steers.

There was practically no correlation of feeder grade with either daily gain or carcass grade. These associations were complicated because of the variation between steers in length of time on feed and the declining gain toward the end of the study. Carcass grades were significantly higher for the low-set, heavy-boned calves measuring largest at the stifle. The proportion of edible meat from these carcasses was not determined. It is probable that this value will decline as the amount of bone becomes very large. Low-set steers yielded significantly higher grading carcasses than tall steers when height was corrected for weaning weight. The correlation between width at thurls and carcass grade was hardly significant.

DISCUSSION OF RESULTS

Each of the three sires was bred to the same group of females each year, making it possible to observe the uniformity of performance of full brothers. Data on this point are not available for cows that had heifer calves in all but one of the three years, or were not settled some years. Table 8 contains a record of the daily gain in two or three successive seasons made by steer calves having the same sire and dam, together with the average of each sire group for comparison. This table shows little uniformity in amount of gain of these full brothers, when compared to the sire-group average for each year. The reason for these differences is not clear, but undoubtedly the genetic variation among full brothers is one of the major causes.

TABLE 8 — AVERAGE DAILY GAIN OF STEER CALVES BY THE SAME SIRE AND DAM

Dam	1941-42	1942-43	1943-44
Domino 5th			
3	2.01	2.20	
6	1.84	2.09	1.91
7	2.02	2.63	
14		2.07	1.54
50		2.06	1.80
65	1.69	2.39	
70	2.32	2.21	2.20
Group average	1.83	2.23	2.08
A. Stanway Star			
19	1.92	1.97	2.19
25	1.90	2.31	
32	1.21	2.54	2.43
34		2.15	1.33
42		2.49	2.35
47	1.47		1.90
76	1.55		1.85
78	1.55		2.37
Group average	1.61	2.28	2.03
Mischief B.			
57		2.52	2.26
58		2.49	2.57
Group average		2.33	2.24

Table 9 shows a lack of similarity in the economy of gains of full brothers. The question then arises: What is the value of a progeny test in view of the lack of uniformity in performance of the progeny of a sire? This study is not extensive enough to answer this question fully but emphasizes the importance of numbers of animals in making sire comparisons. Previous investigations (6) have indicated that eight animals is the smallest number

TABLE 9. — THE AMOUNT OF GAIN PER 100 POUNDS T D N CONSUMED OF STEER CALVES BY SAME SIRE AND DAM*

Dam	1941-42	1942-43	1943-44
Domino 5th			
3	21.88	23.03	
6	19.25	21.90	19.49
7	19.54	23.59	
14		21.01	19.41
50		22.12	20.78
65	16.60	22.68	
70	20.32	21.19	21.28
Group average	18.84	22.09	21.12
A. Stanway Star			
19	20.16	19.85	23.34
25	19.10	20.02	
32	15.17	22.65	21.87
34		22.52	17.95
42		23.30	22.38
47	16.11		21.25
76	16.75		18.46
78	16.45		23.91
Group average	17.44	21.78	20.52
Mischief B.			
57		23.36	21.95
58		21.59	22.97
Group average		22.65	21.23

for a satisfactory test of a sire, and these studies suggest at least eight animals should be used.

The appearance of the steer calves as feeders was not a reliable indication of what might be expected of their feed-lot performance or carcass quality. A similar conclusion was made by Lush (8) following a study with 241 steers. In spite of this fact, these data suggest that steers rating above average from the standpoint of size, thickness of body, low setness, and size of cannon are also likely to rate above average in feed-lot gain, carcass quality, and final return.

These studies bear out the observation that slaughter condition is by far the most important factor in determining the carcass grades of a group of well-bred Hereford steers, especially at the light weights at which these steers were slaughtered. A similar conclusion was made by Hankins and Burk (3) in a study involving 2,073 cattle in which they observed that the lightweight calves of the several feeder grades showed striking similarity in carcass grades until about 450 pounds gain was made. They also reported that the average choice lightweight feeder required about 400 pounds feed-lot gain to produce a choice carcass, while feeders of similar weight, grading good, required about 320 pounds to pro-

duce a carcass grade of good. With more condition, body conformation and quality should become more evident.

II. TYPE AS AN INDICATOR OF PERFORMANCE

MATERIALS AND METHODS

In order to stimulate interest in the improvement of Arizona range cattle, from eight to ten groups of steer calves from different ranches containing ten head per group were fed each year in this study for a period of six years. The calves were received at the University Farm in December, after which they were carried on a growing ration until show time in February. They were in most cases close to one year old at the beginning of the fattening period shortly following the Tucson show. The fattening period ranged from 120 days in 1934-35 to 87 days in 1940-41. Each year the ration was the same for all groups and consisted of hegari silage, barley or hegari grain, cottonseed meal, and alfalfa hay. All groups received as much feed as they would consume without waste.

GROUP RATINGS

In Table 10, a record has been made of the ratings of each pen on feeder grade, initial weight, daily gain, economy of gain,

TABLE 10. —RELATION OF FEEDER GRADE TO AMOUNT AND COST OF GAIN, INITIAL WEIGHT, AND CARCASS VALUE — RATING

Feeder grade ^a	Initial weight ^b	Daily gain ^c	Economy of gain ^d	Carcass value per 100 lb. ^e	Gross return to packer ^f
1934-35					
1	10	4	1	5	8
2	3	8	5	2	2
3	2	1	3	2	1
4	1	3	5	6	4
5	6	8	9	9	7
6	8	2	2	1	3
7	8	6	4	4	5
8	7	7	5	10	10
9	4	5	5	8	9
10	5	8	10	7	6
1935-36					
Lightweights (519 to 498 lb.)					
1	3	3	2	1	1
2	2	1	1	2	2
3	4	4	4	4	4
4	1	2	3	3	3

1935-36
Heavyweights (684 to 552 lb.)

1	1	2	4	3	2
2	3	3	3	4	3
3	4	3	2	5	5
4	2	5	5	1	1
5	5	1	1	2	4

1936-37
Lightweights (609 to 511 lb.)

1	2	5	4	1	1
2	1	4	5	2	2
3	4	2	2	3	3
4	3	3	3	5	5
5	5	1	1	4	4

1936-37
Heavyweights (681 to 619 lb.)

1	4	1	1	2	2
2	5	4	3	4	4
3	1	3	4	1	1
4	2	5	5	5	3
5	3	2	2	3	5

1937-38

1	8	3	2	4	7
2	7	1	1	2	3
3	6	2	3	7	6
4	5	5	4	6	8
5	2	8	7	8	4
6	4	6	6	3	2
7	1	4	5	5	5
8	3	7	8	1	1

1938-39

1	4	10	10	1	1
2	3	6	7	6	3
3	8	3	3	3	5
4	6	4	4	2	6
5	10	2	1	8	10
6	2	7	9	9	8
7	7	8	5	3	7
8	1	5	6	10	9
9	5	9	8	3	2
10	9	1	2	7	4

1940-41

1	3	8	8	1	4
2	2	5	3	4	6
3	8	3	2	6	5
4	4	7	6	3	2
5	1	1	7	2	3
6	5	4	4	4	1
7	6	1	1	7	8
8	7	6	5	8	7

*For footnotes see next page.

*Rated by judge at Tucson Livestock Show.

	1934-35		1935-36		1936-37		1937-38	1938-39	1940-41
	Lightwt.	Heavywt.	Lightwt.	Heavywt.	Lightwt.	Heavywt.			
¹ Range 588 to 479 lb.	519 to 498 lb.	684 to 552 lb.	609 to 511 lb.	681 to 619 lb.	660 to 494 lb.	690 to 450 lb.	673 to 560 lb.		
² Range 2.71 to 2.38 lb. (120 days)	2.84 to 2.37 lb.	2.84 to 2.52 lb.	2.39 to 2.14 lb.	2.38 to 2.07 lb.	2.62 to 2.14 lb.	2.68 to 2.26 lb.	2.34 to 1.80 lb.		
³ Range \$6.60 to \$7.62 (100 lb. gain)	\$5.48 to \$6.35	\$5.34 to \$6.57	\$8.40 to \$9.84	\$9.20 to \$10.58	\$6.30 to \$8.12	\$5.81 to \$7.88	\$8.51 to \$9.97		
⁴ Range \$17.35 to \$16.56 (100 lb.)	\$16.10 to \$15.23	\$15.97 to \$15.58	\$18.26 to \$17.87	\$18.31 to \$17.84	\$17.64 to \$17.33	\$17.10 to \$16.48	\$18.39 to \$17.80		
⁵ Range \$7.16 to \$2.09 (per steer)	\$9.26 to \$5.43	\$13.07 to \$9.07	\$7.04 to \$2.87	\$7.13 to \$3.68	\$9.30 to \$5.48	\$4.57 to -\$3.89	\$.09 to -\$3.67		

carcass value per 100 pounds, and gross return to the packer above the cost of the fat steer. The maximum range in each factor is indicated at the end of the table. A number one rating signifies the highest grading feeder, the heaviest initial weight, the largest daily gain, the lowest feed cost per 100 pounds gain, the highest carcass value per 100 pounds, and the largest gross return to the packer.

Gains were uniformly high, ranging from a minimum of 1.80 pounds per day for one lot in 1940-41 to a maximum of 2.84 pounds daily for one lot fed in 1935-36. The feed requirement per 100 pounds gain was in most cases similar to that proposed by Morrison (9). There was considerably more variation between groups in return to the packer than in any of the other ratings.

As might be expected, no group maintained top rank in the several ratings. The greatest similarity was between daily gain and economy of gain, as evidenced by a correlation coefficient of .860, reported in Table 11. A very similar correlation was obtained in the progeny study. The next highest correlation was between feeder rating and carcass value. The rating as feeders was not a very good indication of the amount of gain. Had the feeding period been longer, it is probable there would have been a closer agreement in the ratings for daily gain and carcass value. Contrary to the finding of the progeny test, there was no similarity between the ratings for daily gain and initial weight. Variations in initial condition may have influenced this comparison.

TABLE 11. — CORRELATION OF FEEDER RATING OF PENS OF STEER CALVES WITH SOME FEED-LOT AND CARCASS RATINGS*

Rating	Correlation in total population
Feeder rating and daily gain	+.196
Feeder rating and economy of gain.....	+.291†
Feeder rating and carcass value per 100 lb.	+.390‡
Feeder rating and gross return to packer.....	+.369‡
Daily gain and economy of gain.....	+.860‡
Daily gain and gross return to packer.....	+.062
Daily gain and carcass value per 100 lb. .	+.151
Daily gain and initial weight.....	-.062

*Includes fifty-five pens of steers, totaling 575 head.

†Significant P is less than .05.

‡Significant P is less than .01.

Low-set steers produced considerably higher grading carcasses than those considered upstanding in the steer type study reported in Table 12. A similar result was obtained in the progeny test. These low-set steers gained more than those classified as medium in this respect, but the upstanding steers had a definite lead in daily gain. This shows a lack of consistency of this factor in its effect on daily gain. The effect of feeder grade on daily gain and carcass grade was similar to that of type, except there was less variation in daily gain between feeder grades than between types.

Choice condition as feeders resulted in slightly higher grading carcasses, but at the expense of daily gain.

Size of bone was more closely associated with carcass grade than with daily gain, but the relation was in neither case as close as that observed in the progeny study, reported in Tables 6 and 7. Steers judged as wide bodied produced carcasses considerably superior to narrow-bodied steers and also gained faster. However, in one year actual measurements taken at the thurls and corrected for size of steers showed no correlation with either rate of gain or carcass grade. Quiet steers registered an advantage over wild steers both in daily gain and carcass grade.

Three divisions of hair color were made—light, medium, and dark. The light red steers in the type study shown in Table 12 made larger gains and yielded higher grading carcasses. No such relationship was found in the steers of the progeny test, as the correlation of hair color with daily gain in this study was almost zero, and the steers having the darker colored hair graded

TABLE 12. — THE RELATION OF SEVERAL FACTORS TO DAILY GAIN AND CARCASS GRADE IN STEER TYPE STUDY

	Daily gain	Carcass grade *	Number of steers
Type			
Low-set	2.49	5.60	110
Medium	2.37	5.03	183
Upstanding	2.64	4.56	96
Feeder grade			
Choice	2.42	5.63	112
Good	2.40	4.97	194
Medium	2.45	4.53	83
Feeder condition			
Choice	2.34	5.47	118
Good	2.46	4.95	191
Medium	2.44	4.88	80
Size of bone			
Large	2.40	5.17	18
Medium	2.40	5.07	148
Small	2.38	4.32	123
Body width			
Wide	2.49	5.74	106
Medium	2.39	5.02	213
Narrow	2.40	4.23	70
Disposition			
Quiet	2.45	5.50	206
Medium	2.39	4.77	138
Wild	2.34	4.07	45
Color			
Light	2.53	5.14	43
Medium	2.38	4.72	185
Dark	2.35	4.62	61

*Larger numbers indicate superior grade.

significantly higher in the carcass. The opinion is held by some that steers possessing light colored hair do a little better in the feed lot and carry more finish at the conclusion of a feeding period. The results reported above show a tendency in that direction but also illustrate the point that steers of certain lines of breeding that would rate as dark colored may be equal or superior in daily gain and carcass grade to a specific group of light colored steers.

DISCUSSION OF RESULTS

Tables 10 and 11 demonstrate the lack of agreement between the judges' impressions of a group of feeder steers and the ability of those steers to make large and economical gains. The same was true in the progeny test. The judges' feeder appraisal was more in agreement with carcass value in the type test than in the progeny study.

In the type test, low-set steers slightly outgained medium steers but were excelled in gains by steers classified upstanding. Possibly had height been corrected for weight as in the progeny test, the low-set steers in the type study would have rated higher in daily gain.

Both tests show a very high correlation between amount and economy of gain. This relationship was very high in the type test, even though there was considerable variation in initial weight. According to Knapp and Baker (7) a higher correlation may be expected between amount of gain and efficiency of gain when the steers are fed through a standard weight range.

SUMMARY AND CONCLUSION

1. In a feed-lot test of the steer-calf progeny of three Hereford sires over a three-year period, the group by Mischief B. was superior to those by A. Stanway Star and Domino 5th in amount of gain, economy of gain, pounds of cold carcass per 100 pounds gain, as well as in feeder grade and carcass grade. In most cases, the differences were not large enough to be significant.
2. The steer calves by Domino 5th were the heaviest at the conclusion of the test, and those by A. Stanway Star ranked first in carcass yield.
3. There was little uniformity in the feed-lot records of steers by the same sire and dam. The same was true when full brothers' records were compared to the average of that sire group for the year. Apparently one of the major causes of these variations is the difference in the genetic make-up of the full brothers.
4. Evaluation of a sire on the basis of the performance of less than eight of his progeny should not be attempted, and ten or twelve progeny would allow a more reliable appraisal.

5. In both the progeny study and the type test, there was a very high correlation between amount of gain and its feed cost. Breeders can accurately judge the progeny of a sire by taking weight records over a period of ad libitum feeding. Knowledge of the feed consumption is not required.
6. The appearance of feeder steer calves was not a reliable indication of their capacity for growth and efficiency of gain. The initial appraisal was a better indication of carcass grade than of rate of gain.
7. When corrected for height at the withers, correlations of length of body and cannon circumference with daily gain were significant. A significant negative correlation was observed between height at withers, corrected for weaning weight and daily gain, indicating greater gain from steers weighing heavy in relation to height.
8. Other significant correlations with daily gain are: weaning weight (progeny study only) and net return.
9. Significant positive correlations with carcass grade are: corrected cannon circumference, corrected fullness at stifle, corrected height at withers. Feeder rating and carcass value per 100 pounds were significantly correlated in the type test, but the correlation of feeder grade and carcass grade was not significant in the progeny study.
10. In view of the fact that the appearance of a steer is not a dependable criterion of its growth rate and gain efficiency, an effort should be made to acquire a maximum of those feeder qualities associated with carcass quality, such as thickness of body, weight for height, quality, size of bone, and quiet disposition. Light colored hair and weight for age may also be associated with rapid growth in feeder cattle.
11. Body conformation of the feeder was a better indication of its carcass grade than of its feed-lot performance.
12. The amount of condition rather than conformation was more indicative of ultimate carcass grade, particularly with lightweight cattle.

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