THE USE OF EARLY WINTER GAINS IN THE SELECTION OF HIGH YEARLY GAINING STEERS

by

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B.S., Kansas State University, 1956

A THESIS

submitted in partial fulfillment of the

requirements for the degree

MASTER OF SCIENCE

Department of Animal Husbandry

KANSAS STATE UNIVERSITY
Manhattan, Kansas

1961

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INTRODUCTION

Numerous factors are considered in selecting animals for grazing or feeding purposes. One of the most common factors, is the grade of the animal. Cattle feeders usually purchase animals according to visual observation, selecting a type of animal they think will make the greatest economic return while on feed.

Fully as important as the grade of the animal, but at present more difficult to determine is the gaining ability of the individual. Some research indicates that it may be possible from certain observations to predict future gains of cattle.

The objective of this study was to evaluate growth of the individual soon after weaning as an indicator of future performance.

Many growers of cattle purchase calves in the fall planning to feed them for a year on harvested roughage and grass before selling them as stockers or feeders. Efficiency of production could be improved if a method could be developed to evaluate accurately and early in the feeding period the gaining ability of each animal.

Some studies have indicated that high gaining steers could be selected with some degree of accuracy if weight for age was known. Unfortunately this information is not available on most calves purchased by the feeder.

REVIEW OF LITERATURE

In reviewing the literature in this field, Hankins and Titus (1939) determined that the growth of an animal was most commonly measured by the increase in liveweight, although at times an increase in height, length, girth, or some other characteristic may be used. Factors which influenced

growth were inheritance, relative completeness of diet, and rate of feed consumption. They determined that growth may be readily restricted by limiting the feed consumption of an animal, but it was impossible to stimulate growth by nutritional means beyond the animals inherited growth capacity. Gains made by young growing animals were composed largely of protein and water, while that of mature animals, or nearly mature consisted mostly of fat. Because of the gradual change, it generally was not possible to fix any definite point where growth ceased and fattening began.

Weight gains by time period for Hereford cattle on the semi-desert ranges of New Mexico were reported by Koger and Knox (1951). They reported that growth rate of steers on the range was positively correlated with their gain in the feedlot. In general, winter and summer gains were positively correlated when the animals were grown under range conditions. During periods in which animals were subjected to variable external influences, such as milk supply from the dam or a low plain of nutrition, growth showed a low or in some instances a negative correlation with growth in other periods.

According to Kincaid et al. (1945 , winter feeding levels effected summer gains. An increase of 80 pounds of winter gain decreased summer gain by .58 pounds per head daily and on this basis, annual gains were increased by .42 pounds per animal daily for each pound gained during the winter. The data from this study indicated that no significant difference occurred in gain between yearling and two year old steers.

A positive correlation r = 0.42, was obtained by Sheets (1924) with two year old steers between winter gain and yearly gain when fattened on grass. Steers that had an advantage of 100 pounds of gain at the end of the wintering period had only a 62 pound advantage after 54 days on grass and 41 pounds after

136 days on grass. Steers which lost weight or made low gains during the winter made the greatest summer gain, r = -0.57.

Since differences in weight due to winter feeding are gradually minimized, but not wholly overcome, during the summer season of fattening on grass, it is important that cattle to be marketed early should gain considerably more weight during the winter than if they are to be marketed later.

In a study with 959 Hereford steers, Ruby et al. (1948) reported that calves with a larger initial weight, remained heavier through the winter in the dry lot and the summer grazing period than calves with a lighter initial weight. A positive correlation, r = 0.23 was obtained between initial weight going into the drylot and the total winter gain. Variation in total gain was small, low winter gaining steers tended to make up for the low winter gains by making greater gains during the summer grazing period. As winter gain increased by one pound per head daily, summer gain decreased by .22 pounds per head daily when lot means were compared.

A positive correlation was reported by Kidwell (1954) between gains made by steers during two successive winters, but a significant negative correlation was noted between the winter and summer gains of the animals.

A study by Urick et al. (1957) concluded that steers selected for high gaining ability in either the first or second winters should show a definite advantage in the succeeding wintering period in gaining ability. Winter gains were correlated with gains on the summer range, r = 0.45, P>.05, selection in one environment should result in appreciable gains in other environments.

Weight gains by time periods for 356 steer calves were reported by McIlvain, et al. (1956). The data indicated that steers which made the largest gains during the first 45 days of the wintering period also made the

largest yearly gains. In using this as a basis for selection, accuracy in selection was not greatly increased by using longer wintering periods as a basis for selection. They concluded that steers wintered on different planes of nutrition tend to equalize in weight the following summer. Steers which make low winter gains due to lack of nutrients usually make more summer gain, but less yearly gain than well wintered steers.

Similar results were reported by Smith et al. (1951) and (1952) and Holland et al. (1957) and (1958) in that low winter gaining steers tend to make larger summer gains, but do not equal yearly gains made by the larger winter gaining steers. Their findings also indicated that lighter weight steer calves at weaning time tend to make larger gains than heavier steer calves.

There are two opposing influences in the relationship of gains made at different periods of growth by animals. Individuals that reach a large mature size must necessarily have a high growth rate throughout all or most of their growth period. Likewise, the smaller individuals of a population do not usually gain extremely fast at any period, or else they would not end up in the small size group. This influence tends to result in growth at different periods showing an automatic positive correlation. In animals where mature size is similar, the greater the amount of growth which is realized by a given age the less the amount which is left to attain later. This tends to give a negative relationship between growth made at different periods and would be in most evidence where the environment to which the different animals are subjected is held uniform.

The amount of flesh, non-fatty tissue, gained per unit of time by an animal varied at different ages of its growth period, according to Brody (1921)

and Lush (1930). They reported that the animal made its most rapid gain during life from birth to five months of age, from five to fifteen months the daily rate of gain declined and the last large growth cycle, where maximum gain occurred was at 20 months of age.

In reviewing literature, Knapp et al. (1941) noted that Ponticario found a high correlation between weights of animals at 6, 12, and 18 months of age. He proposed that animals be evaluated on their weight at 12 months of age in the early maturing breeds and 18 months in the late maturing breeds.

McIlvain et al. (1956) concluded that the weight of the calf at weaning time was not an indicator of subsequent gains of the individual. Lightweight calves representing a smaller monetary investment, made essentially the same gains during the year after weaning as steers weighing 150 pounds more at weaning time.

No correlation was found by Kidwell (1954) between weaning weight and future gains of the animal, since a large part of the weaning weight of a calf was due to the dams maternal ability.

Knapp et al. (1941) found no correlation between weaning weight and gain in the feedlot or between daily gain before weaning and daily gain in the feedlot.

A significant correlation was obtained by Pierce et al. (1954) between birth weight of a calf and gain in the feedlot. Heavier calves at birth had a tendency to retain their advantage throughout the feeding test. Gain per day during the suckling period and weight of calf at the beginning of the test were not correlated with gain during the test period.

The appearance of the steer calf was not a reliable indicator of what might be expected of its feedlot performance or carcass quality, according

to Lush (1932). Steers of many shapes gained well, and steers which gained the same were of many different shapes.

Knox and Koger (1946), Lush (1932) and Hultz (1927) reported that rangy calves made more rapid and economical gains than very low set calves, and that calves on a fattening ration during their sixth to twelfth month of age changed type. They noted that there were more low set calves that became rangy than rangy calves that became lowset.

A high correlation was reported by Black and Knapp (1938) between length of body and rate and efficiency of gain, but height at the withers with weight being constant was the best measure of performance.

Large type steer calves gained faster and were heavier at weaning time and made larger and more economical gains in the feedlot for Woodward et al. (1942) than small type calves.

In a study of performance in Hereford cattle, Stanley and McCall (1945) reported that height at the withers, length of body and depth of chest were highly correlated with rate of gain. Average daily gains of upstanding calves were greater than daily gains of the lower set calves. The accepted general appearance of the calf was not a reliable indicator of its capacity to grow and efficiency of gain.

In comparing compact, intermediate, and rangy steer calves, Knox and Koger (1946) noted that the rangy steer calves had a significantly greater initial weight and made a larger gain than the compact or intermediate type steer. Growth prior to feeding age was found to be positively correlated with feed lot gain.

According to Lush (1932) and Black and Knapp (1938) maximum gains are associated with a long body, large paunch and girth, but a small flank girth and narrow at the loin.

Steers sired by large type bulls tend to gain more than those sired by medium or small size bulls, according to Weber et al. (1951). This advantage was more pronounced during the wintering and grazing phase than during the full feeding phase. It was noted that medium size cattle tend to combine the gaining ability of the large cattle and the finishing ability of the small cattle without sacrificing efficiency of gain.

Feeder grade and shade of color are two factors considered by cattlemen when purchasing steer calves for pasturing. According to Holland et al. (1957) and (1958) no correlation was found between feeder score or color score and summer gain on grass.

Feeder grade at the beginning of the feeding period tended to be negatively correlated or independent of subsequent gains, according to Durham and Knox (1953). Gains during the fattening period were found to be associated with subsequent slaughter grade. A correlation of $r = -0.10$ was noted between feeder calf grade and yearling gain and $r = -0.02$ between feeder calf grade and feedlot gain. However, a correlation of 0.17, $P > .05$ was found between yearling gain and feedlot gain.

Effects of feeder grade on winter, summer and yearly gains were studied by McIlvain et al. (1956). The difference in gain between the different feeder grades was very small.

In a study of 2,073 feeder cattle Hankins and Burk (1938) reported there was little or no relationship, $r = 0.09$, between feeder grade and subsequent gains of steers, however there was a fairly high correlation between feeder grade and the number of days required to reach a certain slaughter grade.

Some environmental factors which probably influence gains are feed

consumption, temperature, and feeding and management practices.

A negative correlation was reported by Knapp and Clark (1951) between previous environment and gains in the feedlot, r = -0.30. It was believed that the negative correlation may have been due to the relatively poor conditions of environment before weaning or that a negative correlation may have existed between milk production and gain.

Koger and Knox (1951) noted that when environment was constant for animals, there was a positive relationship between gains made at different periods. This relationship could be obscured or even reversed by variable environmental conditions.

Stockmen have recognized the existence of animals that respond readily to feed and others that do not. It has been found that there is a difference in breeding ability of sires to transmit efficiency of gain to their progeny.

A high correlation was reported by Winters and McMahon (1933) between rate of gain and feed efficiency. They noted in their study that at the end of the first 28 days in a feeding trial that the most efficient steers could be determined with accuracy for the entire trial.

A comparison of efficiency can only be made between animals of equal size, according to Knapp and Baker (1943), and that in a time constant population where animals are not of the same size, selection should be made on rate of gain rather than observed gross efficiency.

Knapp et al. (1941) obtained the best feed efficiency from small calves, since the heavier calves required more feed for maintainence thus lowering efficiency.

A statistical study of rate and efficiency of gains was made by Black and Knapp (1936) from data obtained from the Bureau of Animal Industry. They

noted that although there was a high correlation between rate and efficiency of gain before weaning, there was little or no correlation for rate and efficiency of gain during the fattening period.

In studying genetic and environmental correlations, Knapp and Clark (1947) reported that gains made by steers during the first part of a 260 day feeding period were due largely to environment, while environmental and genotypic effects were equal during the middle portion of the feeding period. During the last part of the feeding period, gains were due largely to heredity. From this, they concluded that heredity played the most important part in determining the gains of calves in the feedlot.

A moderate fattening ration was sufficient to identify animals with a superior gaining ability, according to Urick et al. (1957). Winter gains as calves were highly correlated genetically with winter gains as yearlings, $r = 0.45$, with the first winter in the dry lot, and $r = 0.87$ with the second winter in the drylot. They concluded as did Romo and Blackwell (1954), and Kidwell (1954), that genes which control growth at one period of time probably are the same genes which influence growth at a later period.

In order to be profitable, beef cattle must have the inherent ability to grow and gain rapidly. The most satisfactory method of studying rate of gain was under controlled conditions of the feedlot. Reported estimates of heritability have been inconsistent.

Heritability of gain was reported as 54 percent by Warwick and Cartwright (1954).

In reviewing literature on heritability of gain, Urick et al. (1957) reported that most estimates range from 0 to 99 percent, with many estimates approaching 60 percent. They determined from their studies with 205 head of

steers that heritability for rate of gain for the first winter was 34 percent, second summer on grass 43 percent, and for the second winter on a fattening ration the estimate was .09 percent. They concluded that the low .09 heritability was due to the steers having obtained most of their growth by this time.

Shelby et al. (1955) and Knapp and Clark (1951) reported 60 percent as being the average heritability estimate for feedlot gain. They concluded that selection for most characteristics should be based on the individual's record, rather than from visual observation.

EXPERIMENTAL METHODS AND MATERIALS

The material for this study was obtained by reviewing the cattle experimental work at the Kansas Station over the past ten years and selecting data most suitable for analyzing, in regard to effect of early gain on future performance. It was decided to use data from experiments conducted during the years 1950, 52, 53, 55, and 1957, where four methods of winter management were involved; wintering on dry bluestem pasture, wintering in the dry lot, and wintering in the dry lot with an addition of two and four pounds of grain per head daily to the groups respectively. Following the winter period all animals were grazed on bluestem pasture.

The Hereford steer calves used in these experiments were obtained during the latter part of October off the ranges of Texas and New Mexico, except in 1955 when they came from Medicine Lodge, Kansas. Upon arriving at the experiment station the calves were kept in dry lot for four to six weeks to be weaned, readjusted to feed and environment, and to be treated for any shipping diseases that may have occurred.

For the five year period, twenty lots of steer calves, a total of 205 head were selected for this study. The calves were assigned to their original treatment on the basis of weight.

The wintering phase of the experiment was approximately 155 days in length, running from the latter part of November till the first of May, at which time all the animals were removed to pasture and grazed under the same conditions, until the first of October.

Salt and water were supplied free choice to the animals at all times.

Each animal was individually weighed at the beginning, and end, and every 28 to 30 days throughout the experiments.

Simple correlation coefficients were used to determine the relationship between gain during the first 30 day period and (1) gain during the first 60 days of the feeding period, (2) gain during the total winter feeding period, (3) gain during the summer grazing period and (4) yearly gain. The gain during the first 60 days of the wintering period was correlated with total winter gain and summer and yearly gain. Winter gain was correlated with summer and yearly gain, while summer gain was correlated with yearly gain. All the simple correlations were made on an intra-year, intra-lot basis to reduce environmental and management error, (see appendix).

A test of homogenity, Snedecor (1957) was applied to the correlations on an intra treatment, inter year basis to determine if correlations for all lots were from the same population. All the within treatment lots appeared to be homogenious indicating they were from the same population, as a result, the discussion of results in this paper was conducted on an inter-year, intra treatment basis.

Experiment I

Eight lots, or a total of 77 steer calves which were grazed on winter bluestem pasture were included in Experiment I. After arriving at the experiment station and being in the dry lot for a preliminary feeding period of four to six weeks, the calves were placed on bluestem pasture the latter part of November, and remained under this type of winter management for 155 days or until the first of May, when supplemental feeding was stopped due to the availability of new grass. In addition to the dry bluestem grass which was the main source of roughage for these calves during the winter, two pounds of protein supplement, either soybean or cottonseed pellets, were fed per head daily. During period when snow covered the ground, prairie hay was fed free choice in addition to the protein supplement.

The mean weight of the steer calves at the beginning of the experiment was 453 pounds, Table 1, some 40 to 50 pounds heavier than any of the other groups of calves used in this study. The 40 to 50 pound advantage was due primarily to 30 calves being used in the experiment in 1955 that had an average initial weight of 518 pounds, however their average yearly gain was similar to the average of the entire group.

Results and Discussion, Experiment I

Inter year correlations as reported in Table 3, show a significant positive correlation $P > .01$, between gain during the first 30 day period, the first 60 day gain period, and yearly gain, thus indicating that gains made early in the winter feeding period give a good indication of what may be expected of the animal throughout the year. The correlation of $r = .63$ between total winter gain and yearly gain was similar to correlations reported

by Ruby et al. (1948), r = .670 and Sheets (1924 r = .430. Correlation between the different winter period gains and total summer gain showed a positive non-significant relationship, indicating that higher gaining individuals during the winter feeding period may be the high gaining individuals during the summer grazing period. These findings agree with McIlvain and Savage (1950), who reported that steers which made the most gain during the winter under range conditions also made the greatest summer gains under range conditions. Similar results were reported by Koger and Knox (1951) in that a positive correlation existed between winter and summer gains when the animals were wintered on the range.

Table 2 shows the increased yearly gain obtained by removing various percentages of low gaining steers from the herd at various time intervals. Selection based on the first 30 day or 60 day winter gain period were as reliable as selection based on a 120 day winter gain period.

Experiment II

Eight groups or a total of 95 steer calves were used in this experiment over a five year period. They were wintered in dry lot and then grazed on bluestem pasture during the summer. The winter ration, per head daily, consisted of 28 pounds of silage and one pound of protein supplement or 10 to 12 pounds of prairie hay and one pound of protein supplement, varying from year to year.

The mean weight of the calves at the start of the winter feeding program was 420 pounds. As shown in Table 1 and 4, these steers gained 35 pounds more during the winter than those in Experiment I which were wintered on bluestem pasture, this increase may have been due to the calves being of

Table 1. Experiment I, Inter year means, standard deviations and coefficients of variation of the weights and gains.*

Variable	Mean Weight Pounds	Standard Deviation Pounds	Coefficient of Variation
Initial Weight	453	58.0	.12
Spring Weight	550	53.6	.09
Final Weight	819	69.0	.08
Winter Gain	97	38.0	.39
Summer Gain	269	36.7	.13
Total Gain	366	52.2	.14

Table 2. Experiment I, Average increase in yearlong gains per steer through selection at different rates and time periods during the wintering period.*

		Time Periods of Selection at:			
		30 days Lbs.	60 days Lbs.	90 days Lbs.	120 days Lbs.
Percent of Highest Gaining Steers Retained in Herd	25	33	47	40	59
	50	24	24	24	28
	66	17	21	12	13
	75	18	15	11	11
	85	9	9	5	8

*Steers winter and summer grazed on bluestem pasture.

Table 3. Experiment I, Inter year period correlations of gain.[1]

Variable	No. of Days	Mean Daily Gain	Standard Deviation	Simple Correlations X_1	X_2	X_3	X_4	X_5
X_1 Gain first 30 days of winter feeding	30	.54	.43		.62**	.55**	.15	.42**
X_2 Gain first 60 days of winter feeding	60	.44	.34			.73**	.02	.37**
X_3 Total winter gain	155	.65	.27				.12	.63**
X_4 Total summer gain	146	1.70	.21					.84**
X_5 Total yearly gain	301	1.17	.17					

**For significance P.01 = .35

*For significance P.05 = .27

[1]Steers wintered on bluestem pasture and then summer grazed on bluestem pasture.

lighter weight, difference in environment or breeding, or other factors but was probably due largely to the difference in winter management. These steers made lower summer gains and yearlong gains than the steers wintered on pasture.

Results and Discussion, Experiment II

As in Experiment I, inter year correlations, Table 6, show a significant positive correlation ($P \geq .01$) between the first 30 day gain period, the 60 day winter gain period and total yearly gain. These correlations indicate that steers which gain exceptionally well during the early wintering periods may be expected to have higher yearly gains than steers which gain less during the winter. Average summer gain was not significant $r = -.231$, but indicates a negative trend, Table 6, with total winter gain, indicating under this system of winter feeding that steers which make the larger winter gains will not necessarily make the largest summer gains. The correlation $r = -.23$ between total winter gain and summer gain corresponded very closely with work reported by Holland et al. (1957) $r = -.20$, Ruby et al. (1948) $r = -.28$, and Kidwell (1954) $r = -.20$.

The first 60 day winter gain period appeared to give a good indication of the animal's potential gaining ability for the entire year. The correlation of $r = .50$ between the first 60 days of wintering gain and yearly gain was given further assurance from data in Table 5 which indicated that no practical increase in yearly gain may be obtained by selecting animals for gaining ability after a longer test period.

Table 4. Experiment II, Inter year means, standard deviations and coefficients of variation of the weights and gains.*

Variable	Mean Weight Pounds	Standard Deviation Pounds	Coefficient of Variation
Initial Weight	402	55.5	.13
Spring Weight	534	80.4	.15
Final Weight	750	90.4	.12
Winter Gain	132	39.5	.29
Summer Gain	216	48.0	.22
Total Gain	348	58.8	.16

Table 5. Experiment II, Average increase in yearlong gains per steer through selection at different rates and time periods during the wintering period.*

		Time Periods of Selection at:			
		30 days Lbs.	60 days Lbs.	90 days Lbs.	120 days Lbs.
Percent of Highest Gaining Steers Retained in Herd	25	30	40	41	39
	50	25	30	33	29
	66	14	21	21	21
	75	9	16	16	19
	85	3	9	10	14

*Steers wintered in the dry lot without grain and then summer grazed on bluestem pasture.

Table 6. Experiment II, Inter year period correlations of gain.[1]

Variable	No. of Days	Mean Daily Gain	Standard Deviation	Simple Correlations X_1	X_2	X_3	X_4	X_5
X_1 Gain first 30 days of winter feeding	30	1.16	.66		.78**	.54**	.00	.41**
X_2 Gain first 60 days of winter feeding	60	1.00	.43			.72**	-.13	.50**
X_3 Total winter gain	155	.89	.27				-.23	.59**
X_4 Total summer gain	146	1.27	.32					.46**
X_5 Total Yearly gain	301	1.08	.21					

**For Significance P.01 = .30

*For Significance P.05 = .23.

[1]Steers wintered in the dry lot without grain and then summer grazed on bluestem pasture.

Experiment III

Experiment III consisted of 20 steer calves, ten in each of two years, which were wintered in drylot on 10 to 12 pounds of prairie hay, two pounds of grain and one pound of protein supplement per steer daily. The steers were grazed on bluestem pasture during the summer months. The mean weight of the calves at the beginning of the experiment was 411 pounds. As in the other groups, the wintering phase began the last of November and continued until the first of May. This group of calves outgained those in Experiment I by 76 pounds and Experiment II by 41 pounds during the winter, but exceeded yearly gain by only 13 pounds of those in Experiment I and 31 pounds by those in Experiment II.

Results and Discussion, Experiment III

No significant correlations were obtained between the gains made during the 30 and 60 day winter gain periods and yearly gain, as shown in Table 9, indicating that it would be difficult to select the high yearly gaining individuals during the wintering period with any degree of accuracy under the conditions of this test. This was further noted in Table 8, which shows that when selecting more than 50 percent of the individuals for gaining ability at different dates it was difficult to increase yearly gain by selecting individuals on the basis of early winter gains. The correlation $r = -.54$ ($P > .01$) between total winter gain and summer gain indicated that the higher gaining steers during the winter made less gain during the summer when wintered on a moderate plane of nutrition.

Table 7. Experiment III, Inter year means, standard deviations and coefficients of variation of the weights and gains.*

Variable	Mean Weight Pounds	Standard Deviation Pounds	Coefficient of Variation
Initial Weight	411	36.1	.08
Spring Weight	584	62.4	.10
Final Weight	790	63.1	.08
Winter Gain	173	38.8	.22
Summer Gain	206	38.2	.18
Total Gain	379	43.7	.11

Table 8. Experiment III, Average increase in yearlong gains per steer through selection at different rates and time periods during the wintering period.*

		Time Periods of Selection at:			
		30 days Lbs.	60 days Lbs.	90 days Lbs.	120 days Lbs.
Percent of Highest Gaining Steers Retained in Herd	25	41	48	48	42
	50	2.8	15.5	17.2	11.2
	66	-4.0	6.0	11.3	11.3
	75	-3.0	-3.0	-2.0	2.0
	85	-4.0	3.0	-1.0	2.0

*Steers wintered in the dry lot on roughage and two pounds of grain per steer daily and then summer grazed on bluestem pasture.

Table 9. Experiment III, Inter year period correlations of gains.[1]

Variable	No. of Days	Mean Daily Gain	Standard Deviation	Simple Correlations X_1	X_2	X_3	X_4	X_5
X_1 Gain first 30 days of winter feeding	30	1.34	.60		.70**	.36	-.09	.23
X_2 Gain first 60 days of winter feeding	60	1.25	.31			.76**	-.34	.41
X_3 Total winter gain	155	1.17	.24				-.54*	.41
X_4 Total summer gain	146	1.38	.27					.54*
X_5 Total yearly gain	301	1.28	.12					

**For significance P.01 = .62

*For significance P.05 = .50

[1]Steers wintered in the dry lot on roughage and two pounds of grain per steer daily and then summer grazed on bluestem pasture.

Experiment IV

A total of 20 steer calves, in groups of ten each during a two year period were used in this study. The winter ration for these animals in drylot consisted of 10 to 12 pounds of prairie hay, four pounds of grain and one pound of protein supplement per steer daily. This ration was fed from the last of November until the first of May when the steers were removed to bluestem pasture. The initial weight of the calves was 412 pounds. A 45 pound increase in winter gain per head was obtained over those in Experiment III indicating that the higher grain ration probably fattened these animals to a greater degree, and was a factor in the smaller summer gain. Steers in Experiment IV outgained those in Experiment III by 27 pounds for the year, this increase was probably due to the greater winter gain.

Results and Discussion, Experiment IV

As in Experiment III no significant correlation was observed between any of the winter period gains and yearly gain, as shown by Table 12, indicating that it would be difficult to select the high yearly gaining individuals on the basis of gain during the winter feeding period. Data from Table 11 suggest that one must cull over 50 percent of the animals before any appreciable yearly increase in weight gain could be obtained and this would have to be on a longer gain period than 30 days.

A significant negative correlation $r = -.66$ ($P > .01$) was obtained between winter gain and summer gain, Table 12, indicating that the more gain that is made during the winter the less gain an animal will make during the summer grazing period. Neither total winter nor total summer gain was significantly correlated with yearly gain indicating that neither the

Table 10. Experiment IV, Inter year means, standard deviations and coefficients of variation of the weights and gains.*

Variable	Mean Weight Pounds	Standard Deviation Pounds	Coefficient of Variation
Initial Weight	412	35.1	.08
Spring Weight	630	84.6	.13
Final Weight	818	84.4	.10
Winter Gain	218	55.9	.25
Summer Gain	188	41.0	.21
Total Gain	406	61.9	.15

Table 11. Experiment IV, Average increase in yearlong gains per steer through selection at different rates and time periods during the wintering period.*

		Time Periods of Selection at:			
		30 days Lbs.	60 days Lbs.	90 days Lbs.	120 days Lbs.
Percent of Highest Gaining Steers Retained in Herd	25	-11.0	30.0	22.0	29.0
	50	-20.0	23.0	8.0	16.0
	66	-19.0	8.0	8.0	8.0
	75	-15.0	7.0	7.0	7.0
	85	- 7.0	-1.0	7.0	8.0

*Steers wintered in the dry lot on roughage and four pounds of grain per steer daily and then summer grazed on bluestem pasture.

Table 12. Experiment IV, Inter year period correlations of gains.[1]

Variable	No. of Days	Mean Daily Gain	Standard Deviation	Simple Correlations X_1	X_2	X_3	X_4	X_5
X_1 Gain first 30 days of winter feeding	30	1.69	.57		.72**	.65**	-.57*	.03
X_2 Gain first 60 days of winter feeding	60	1.57	.32			.87**	-.62*	.25
X_3 Total winter gain	155	1.45	.27				-.66*	.35
X_4 Total summer gain	146	1.26	.28					.40
X_5 Total yearly gain	301	1.35	.15					

**For significance P.01 = .62

*For significance P.05 = .50

[1]Steers wintered in the dry lot on roughage and four pounds of grain per steer daily and then summer grazed on bluestem pasture.

wintering nor grazing period may be used as a basis for selection for high gaining individuals.

GENERAL DISCUSSION

The objective of this study was to evaluate early growth of steer calves after weaning as an indicator of future performance. Although different methods of winter management were involved in this study of the relationship of gains made by stocker steer calves at different time periods of the year, it was not the purpose of this study to determine which method of management was most satisfactory.

A difference of 35 pounds in winter gain was obtained between the calves in Experiment I and II, with the larger gains produced by the calves in the dry lot. Cause for this variation was probably the difference in winter feed and management, but could have been due to many factors.

Calves wintered on bluestem pasture, Experiment I, outgained the calves in Experiment II, wintered in the dry lot, by 53 pounds during the summer and 18 pounds throughout the year.

Among steers wintered on bluestem pasture, steers which made the largest winter gain showed a positive but non-significant correlation with summer gain. These results were similar to those reported by McIlvain and Savage (1950) and Koger and Knox (1951), who conducted similar studies in which they studied weight gains of steers, by time periods, on a winter range management type of operation.

Steers wintered in dry lot on roughage and no grain, Experiment II, showed a negative and non-significant correlation of winter and summer gain. This indicated that the higher winter gaining steers wintered in dry lot and fed

harvested roughage and no grain made smaller summer gains while grazing. This was also found to be the case by Kidwell (1954), who wintered calves in dry lot on a hay ration. This trend appeared to become more pronounced as the winter gain increased as reported in Experiments III and IV.

It appeared that under either of these two types of winter management, Experiment I and II, steers which made the greatest yearly gains could be selected within 60 days after being put on their winter ration. High gaining calves wintered on bluestem pasture tend to be recognized a little sooner than calves wintered in the dry lot. In Table 3, although both correlations of 30 and 60 day winter period gains on bluestem pasture were highly correlated with yearly gain, the first 30 day feeding period correlation of r = .42 was higher than that of r = .37, the 60 day winter period correlation. By culling 25 percent of the lower gaining individuals, Table 2, after the first 30 days on winter bluestem pasture, the gain of the entire herd may be increased by 18 pounds per animal, while if culled at 60 days the individual animal increases in gain in the herd would be 15 pounds, culling 15 percent of the individuals would give only a small increase in yearly gain.

Calves wintered in dry lot on roughage and no grain tend to give an indication of their yearly gaining ability by the time they have been on feed for 60 days. Although both correlations were highly significant, the 60 day winter gain period gave a higher correlation r = .50 than the 30 day gain correlation of r = .41. This observation is further based on data in Table 5, which indicated that when culling any percentage of the herd, gain per animal for the entire year could not be increased appreciably by extending the gain test period beyond 60 days.

In Experiments III and IV when grain was included in the winter ration,

it was impossible to determine the high yearly gaining individuals from early winter feeding tests, however only a small number of animals were involved.

No significant correlations were obtained between any of the winter gain periods and yearly gain in Experiment III when the calves were wintered in dry lot on roughage and fed two pounds of grain per head daily. A significant negative correlation r = -.54 ($P > .05$) was obtained between total winter and total summer gain, thus higher winter gaining steers would make less summer gain than low winter gaining steers. In Table 8, where 25 percent or less of the individuals were culled for low gains, no increase in individual animal gains were obtained on a yearly basis if selected during any winter gain period. From those data it appeared that the high yearly gaining steers when fed grain in addition to roughage were slow in being identified, thus not indicating their gaining potential at an early date.

A similar situation existed in Experiment IV where the steers received four pounds of grain per animal daily in addition to the regular roughage ration. A significant negative correlation ($P > .05$) existed between the 30 day, 60 day and total winter gain period and total summer daily gain. Thus those steers could be identified during the first 30 day winter gaining period which would make the least amount of summer gain. No significant correlation was noted between yearly gain and gain during any other gain period thus indicating that no accurate selection for yearly high gaining individuals could be obtained by selecting during the early winter period. Culling any percent of the herd, for low gainers, Table 9, after 30 days of feeding, would actually decrease steer gains from 7 to 20 pounds depending on the rate of culling. Thus it appeared that the higher yearly gaining

steers were slow in indicating their yearly gaining ability.

It appears that a stockman may be able to obtain an early post weaning indication of an animal's gaining ability within 60 days after the beginning of the feeding period. To do this however, a non-grain roughage type ration must be fed, which would be practical for cattle that are to be wintered and grazed a full season on grass.

When grain was added to the ration, it was observed that the larger yearly gaining steers were slower in being identified, thus making early selection impossible.

SUMMARY

The purpose of this study was to investigate the possibility of using early winter gains, the first 30 or 60 day winter gains as a basis for selecting steer calves that would gain the most throughout the year. In analyzing the data, it appears that this may be done with considerable accuracy under the different types of winter management practiced in the Osage and Flinthill grazing regions, where calves are wintered on an all roughage ration.

Steer calves wintered under range or pasture conditions, utilizing bluestem grass as the main source of roughage tend to be identified as being high or low yearly gaining individuals within the first 30 to 60 days of winter feeding. The animals which gain well during the early part of the winter may also be expected to make larger summer and yearly gains.

Steers wintered in dry lot utilizing hay or silage as roughage with no grain added to the ration, tend to be identified as being high or low yearly gaining individuals within 60 days after the winter feeding tests have begun.

However, it must be noted that the smaller gaining calves during the winter under this type of winter feeding tend to make more summer gain than the larger winter gaining calves, but make less yearlong gains than the larger winter gaining individuals.

By adding two or four pounds of grain to the roughage ration of steer calves in the dry lot, the selection of the high yearly gaining individuals becomes difficult due to the fact that the higher yearly gaining individuals tend to be slow in being identified during the first 30 to 60 day wintering period. Calves under this type of management tend to produce nearly equal amounts of winter and summer gain. This may be caused by the added effect of having grain in the ration thus covering up any difference in the gaining ability of young growing animals.

Generally it may be concluded that the high yearly gaining calves may be selected with accuracy within 60 days after the beginning of the winter feeding period if grain is not added to the wintering roughage ration.

ACKNOWLEDGMENT

The author wishes to express his sincere thanks to Professor Ed F. Smith, major instructor, for his assistance and supervision in conducting the study and in preparation of the manuscript.

The author is also grateful to other members of the Animal Husbandry staff for their advice and assistance. Thanks are also given to Dr. H. C. Fryer of the Statistics Department for assistance in analysis of the statistical data. Appreciation is also expressed to the authors wife Louise, for her assistance and encouragement throughout the study.

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APPENDIX

Experiment I, wintered on pasture, intra year, intra lot correlations.

Year	Lot No.	No. of animals	First 30 days winter x First 60 days winter	First 30 days winter x Total winter	First 30 days winter x Total summer	First 30 days winter x Total yearly	First 60 days winter x Total winter	First 60 days winter x Total summer	First 60 days winter x Total yearly	Total winter x Total summer	Total winter x Total yearly	Total summer x Total yearly
1950	1	10	.697	.543	-.168	.248	.822	.006	.660	-.306	.524	.651
1952	2	10	.562	.835	.489	.769	.323	-.035	.136	.373	.789	.864
1953	3	9	-.217	-.005	.670	.601	.686	-.029	.270	-.011	.450	.834
1953	4	9	.904	.766	.241	.650	.903	.269	.751	.367	.867	.782
1953	5	9	-.265	.583	-.580	-.083	.223	-.340	-.127	-.285	.513	.676
1955	6	10	.851	.155	.417	.339	.340	.540	.503	.707	.873	.962
1955	7	10	.728	.554	-.440	-.124	.916	-.586	-.152	-.405	.061	.858
1955	8	10	.802	.728	.432	.643	.936	.316	.650	.346	.705	.910
Experiment II, winter dry lot (no grain) intra year, intra lot correlations												
1950	1	8	.914	.292	.017	.482	.441	-.058	.597	-.812	.261	.350
1950	2	9	.421	.554	-.455	-.001	.635	-.493	.041	-.514	.354	.620
1952	3	10	.584	.281	-.151	.167	.686	-.095	.555	-.081	.832	.485
1952	4	10	.928	.695	.189	.741	.882	.042	.837	-.137	.849	.406
1953	5	9	.779	.677	.204	.586	.817	.339	.772	.175	.754	.775
1955	6	10	.858	.739	-.383	.580	.690	-.300	.592	-.638	.678	.133
1957	7	25	.771	.616	-.153	.325	.795	-.279	.379	-.283	.539	.420
1957	8	14	.831	.315	.115	.472	.587	.109	.356	.357	.379	.510

Experiment III, wintered dry lot (2 pounds grain) intra year, intra lot correlations.

Year	Lot No.	No. of Animals	First 30 days winter x First 60 days winter	First 30 days winter x Total winter	First 30 days winter x Total summer	First 30 days winter x Total yearly	First 60 days winter x Total winter	First 60 days winter x Total summer	First 60 days winter x Total yearly	Total winter x Total summer	Total winter x Total yearly	Total summer x Total yearly
1950	1	10	.784	.417	-.386	-.011	.781	-.677	.047	-.777	.201	.461
1952	2	10	.637	.337	.225	.448	.772	.121	.702	-.198	.617	.649
Experiment IV, wintered dry lot (4 pounds grain)												
1950	1	10	.848	.785	-.664	.075	.775	-.662	.061	-.613	.369	.509
1952	2	10	.561	.506	-.518	-.009	.939	-.612	.474	-.751	.369	.335

THE USE OF EARLY WINTER GAINS IN THE SELECTION OF HIGH YEARLY GAINING STEERS

by

WILLIAM MILLER DICKSON

B.S., Kansas State University, 1956

AN ABSTRACT OF A THESIS

submitted in partial fulfillment of the

requirements for the degree

MASTER OF SCIENCE

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1961

Selecting animals that have a high gaining ability is one of the more important factors to consider in selecting animals for grazing and feeding purposes. With this in mind a study of the relationship of gains made by time periods after weaning as related to future gaining ability was made.

Four experiments were conducted in which four different types of winter management were used. In Experiment I, eight lots of steer calves consisting of 77 head were wintered on bluestem pasture. In Experiment II eight lots of steer calves consisting of 95 head were wintered in dry lot with no grain added to the winter roughage ration. Two lots of steer calves involving 20 head were wintered in dry lot with two pounds of grain per head daily added to the roughage ration in Experiment III. Four pounds of grain per head daily was added to the roughage ration in the fourth experiment, which included 20 calves divided into two lots.

In all the experiments the calves were grazed on bluestem pasture during the summer months.

Simple correlations were used in all experiments to determine the relationship of gains made by the steer calves during the early wintering period with summer and yearly gain.

In summarizing the results, it appeared that the high yearly gaining steers may be selected with accuracy within the first 60 days of winter feeding, if wintered on bluestem grass or in dry lot on a non-grain ration. Highly significant correlations were obtained between the first 30 and 60 day winter period gains and total winter and yearly gains. This indicated that the high gaining steers during the first 60 days of winter feeding may be expected to make the largest yearly gains.

Selecting high gaining steers during the early part of the winter feeding

period when they have been fed either two or four pounds of grain per head daily in addition to roughage and protein supplement appeared more difficult. The higher yearly gaining individuals appeared to be slow in being identified, under this higher plane of nutrition. No significant correlations were obtained between the early winter period gains and winter gain or yearly gain.