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Systems of Producing Fat Yearlings for South Dakota

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SYSTEMS OF PRODUCING FAT YEARLINGS FOR SOUTH DAKOTA

By

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This is to certify that, in accordance with the requirements of South Dakota State College for the Master of Science Degree, William C. McCone has presented to this committee three bound copies of an acceptable thesis, done in the major field; and has satisfactorily passed a two-hour oral examination on the thesis, the major field, Animal Husbandry, and the minor field, Agricultural Economics

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INTRODUCTION

About twelve billion pounds of dressed beef and veal were produced in the United States in 1947 through the conversion of grassland crops into meat by cattle and these cattle lead all classes of American livestock in the consumption of grass and grassland crops. Grass usually represents the principal and cheapest feed for beef cattle. They utilize about one third of the permanent pastures and three fourths of the range areas. Pastures may be regarded as a costly source of feed only on highly productive farm lands, but their use in rotation with cultivated crops on such land is certain to continue and be expanded as a sound practice.

In recent years 23 per cent of South Dakota's gross farm income came from cattle. A great percentage of these cattle were marketed as fat yearlings. As of January 1, 1949 South Dakota farms were carrying 2,556,000 head of cattle which is 2 per cent higher than in 1948 and is a 23 per cent increase in numbers over the 1938-1947 average.

Many cattle feeders in eastern South Dakota have varying amounts and types of roughages available which they wish to utilize by the best method possible. The experiment reported in this paper was designed to study the efficiency of various South Dakota roughages and grasses in rations for wintering

calves and fattening them on grass as yearlings. The profitableness of limited winter feeding and then utilizing maximum amounts of grass to produce fat yearlings has been shown at other experiment stations, but up to the time of the present study this method had not been tested under South Dakota conditions, using feeds produced in South Dakota.

This study was made on two types of pasture suitable to South Dakota to measure their ability for producing beef on a per acre basis. The results obtained may be beneficial in planning a pasture and crop rotation system which will result in greater overall farm production for this area. Many producers are following the practice of fattening cattle on pasture so a study of various methods of using the feeds available on most South Dakota farms should be of practical importance.

REVIEW OF LITERATURE

Conclusions of various workers have not always agreed on the best method of producing fat yearlings for market. Ensminger et al (1947) state that steer calves, wintered on a full feed of roughage plus a limited amount of grain so as to make an average daily gain of 1.0 to 1.7 pounds, are desirable animals to be grain fed on pasture the following season. When supplemented with grain, the grass-alfalfa pastures produced considerably more pounds of beef per acre than the pure grass species (smooth brome and crested wheat grass). They state that whether or not it will be profitable to feed grain on pasture will depend upon the price of grain, the premium paid for cattle of higher finish and grade, the season in which cattle are to be marketed, and the area and quality of pasture.

According to data by Guilbert et al (1944), it appears advantageous to use grain in liberal amounts to supplement range for beef cattle and thereby materially lessen the amount of grain which otherwise would be required for finishing in the dry lot. This supplemental feed at an early date results in a saving of feed and cost as well as in a better finished carcass.

Livesay (1940) arrived at results differing from those of Guilbert and concluded that to finish steers in the dry lot after no supplemental feeding on pasture or to finish on pasture supplemented with grain made very little difference in the amount

of grain required. He also found that dressing percentages and carcass grades were similar for cattle finished in dry lot, on pasture with grain supplement, and on pasture with grain added only at the finishing stage.

Taylor and Hobbs (1943) found that larger net financial returns have resulted from pasture alone than from grain supplemented pasture despite the lower gains made on pasture alone.

According to Stephens (1948), lots which made the lowest winter gains made the greatest gains on grass during the summer but when yearling steers were full fed following early summer grazing, those on the high level of wintering proved most profitable.

Bull et al (1941) found that carcasses from cattle full fed on pasture were equal in palatability and finish to carcasses from cattle full fed in dry lot, but the carcasses graded lower because of the presence of yellow fat.

Black (1939) states that, generally speaking, fattening cattle on grass requires only about one half the quantity of grain or other concentrates that strictly dry lot cattle required. The practice of supplementing the grass with grain for production of grass-grain finished steers is well suited to areas where the bulk of the farm land is in grass with a limited acreage devoted to grain production.

Three years of experimentation by Black, Warner, and Wilson (1931) in the Appalachian region in West Virginia showed

rather conclusively that feeding of grain (corn and cottonseed meal) was advisable for fattening steers on grass as the gains of the steers were increased 37 per cent and the selling price more than 10 per cent. These increases in steer gain and sale price were sufficient to more than offset the additional expense incurred over that for strictly grass cattle. However, it should be taken into consideration that buying and selling prices of the cattle may have a more direct bearing on the profits than feed costs, and accordingly the feeding of grain to cattle on pasture may not necessarily be done at a profit. Grain increased the dressing percentage and produced fatter, more attractive, saleable carcasses.

These experiments were followed immediately with another series to study the relative values of different methods of feeding the supplements. The results for the three-year period showed that the sale value of steers fed grain throughout the grazing season of 135 days was increased $1.13 per hundred weight over those fed strictly grass but only 8 cents over the sale value of similar steers fed grain during the last 79 days of grazing period. This fact indicates that the feeding of grain supplement to steers on grass during the first half of grazing season, provided grazing conditions are good, is not necessary for best results. The results also indicate that the practice of feeding a limited grain ration during the last half of the grazing period is to be preferred to the feeding of a

liberal ration of grain and hay in the dry lot for a short period immediately following the summer grazing season. The results of these experiments in the blue grass region of West Virginia should be applicable to all blue grass regions and to many other sections having improved pastures.

Experiments by Black and Clark (1938) in southwest South Dakota, in which steers were fed grain on native summer pasture, showed the same results as in the West Virginia experiment. There was no significant advantage in feeding supplement throughout the grazing season as compared to feeding only during the last half of the season.

Danger of losses due to bloat in pasturing legumes were controlled by Ensminger et al (1944). This was accomplished by providing a full feed of hay or other dry roughage to cattle before they were put on legume pasture and thus preventing them from filling too rapidly on the green material. Cattle remained on legume pasture continuously when possible but if it became necessary to take the cattle off legume pasture for a short period, they were again filled with roughages before returning to pasture. Mixtures which contained approximately half grasses and half legumes were used. Water and salt were kept available at all times.

WINTER PHASE

Experimental Procedure

The experiment being reported divided itself naturally into two phases, namely a winter phase and a summer phase. The two phases will be discussed separately, with the winter phase being discussed first.

Forty eight calves, thirty two steers and sixteen heifers, were used in each of three years of the experiments. These were spring calves which were purchased late in the fall. Four lots, composed of eight steers and four heifers each, were fed during the winter phase. Random selection, within sexes, was used in making up the lots and type and condition ratings were then taken on each individual calf. Single-day weights were used in starting and completing the experiment and the cattle were weighed at every twenty-eight day interval during the trial.

Roughages in the form of alfalfa hay, brome hay, and corn silage, which are common feeds in this area, were used to compare their values as a winter feed for calves to be finished on pasture the following summer. The calves were wintered on rations which were designed to produce a daily gain somewhere between a pound and a quarter and a pound and a half. The full fed check lot, lot I, was the only group of cattle which received soybean oilmeal as a source of protein supplement. The rations

of the remaining three lots were balanced by adding alfalfa hay as a source of protein.

Winter daily rations fed per head for the four lots were as follows:

Lot I

1. Shelled corn full fed
2. Corn silage full fed
3. Soybean oilmeal (enough to balance ration)
4. Alfalfa hay 5 pounds

Lot II

1. Shelled corn 3 pounds
2. Corn silage full fed
3. Alfalfa hay 5 pounds

Lot III

1. Shelled corn 3 pounds
2. Brome hay full fed
3. Alfalfa hay 5 pounds

Lot IV

1. Shelled corn 3 pounds
2. Alfalfa hay full fed

Each lot received salt, bonemeal, and limestone free choice. Water heated by use of electric tank heaters was kept available for the cattle at all times during the winter phase. Twice-daily feeds, at morning and evening, were offered the cattle.

Analysis of Data

The three winter feeding trials were not carried out over equal periods as untimely snowstorms in the fall of 1946 and 1947 made it impossible to move the calves and get them started on feed at the desired time. As the winter feeding phase ended at approximately the same time each year this meant that the feeding periods were 125, 146, and 165 days for 1947, 1948, and 1949, respectively. Forty-eight calves were started on the experiment each year but in the winter of 1948 two calves died. These death losses could not be attributed to any factor directly concerned in this experiment.

Tables I, II, and III show winter feeding results for the years 1947, 1948, and 1949, respectively. In terms of daily gain the results for the three years were fairly consistent with lot I, full fed corn, making the greatest gains each year. This was followed by lot II, full fed corn silage, with daily gains approximately half a pound less than those of lot I. The gains in lot IV, full fed alfalfa hay, were the same as those for lot II in 1947 and 1948 but were somewhat lower in 1949. In the first two years lot IV outgained lot III, full fed brome hay, but in 1949 lot III made the larger gain. This might indicate that the relative quality of the hay for the various years differed somewhat and had an effect on the gains that were made. It may be noted that with the exception of lot IV for

1949 all lots made greater gains in 1948 than in 1947 and again greater gains in 1949 than in 1948. This may be directly related to the fact that the length of the feeding period increased from year to year and quality of feeds may have had a direct bearing.

In calculating feed prices, the average price in effect for the various feeds during the period of the experiment each year was used. According to these prices, corn silage, lot II, produced one hundred pounds of beef at less cost each year than did the brome, lot III, and alfalfa hay, lot IV. These trials showed that corn silage was worth 50 per cent of alfalfa hay for its ability to produce gain. Price spreads were greater than 50 per cent thus the silage lot produced gains at less cost.

Table 1.

Data of Winter Feeding Phase From January 21 to May 26, 1947

Lot No.	I	II	III	IV
	Alfalfa Hay, Corn Silage, Corn Full Fed, Soybean Oil-meal	Alfalfa Hay, Corn Silage Full Fed, 3 lbs. Corn	Alfalfa Hay, Brome Hay Full Fed, 3 lbs. Corn	Alfalfa Hay Full Fed, 3 lbs. Corn
1. No. animals in lot	12	12	12	12
2. No. days total phase	125	125	125	125
3. Av. wt. per animal (lbs.)				
Initial	486	485	488	488
Final	712	648	607	652
4. Total gain	226	163	119	165
5. Daily gain	1.81	1.30	0.96	1.32
6. Av. daily ration (lbs.)				
Shelled corn	9.30	3.00	3.00	3.00
Soybean oilmeal	0.58	----	----	----
Alfalfa hay	5.00	5.00	5.00	16.80
Corn silage	8.70	20.55	----	----
Brome hay	----	----	11.50	----
Salt	0.03	0.04	0.03	0.03
Bonemeal	0.03	0.03	0.03	0.03
Limestone	0.02	0.02	0.01	0.01
7. Feed per cwt. gain (lbs.)				
Shelled corn	512.0	229.8	313.8	226.7
Soybean oilmeal	32.1	----	----	----
Alfalfa hay	276.1	383.0	523.0	1270.8
Corn silage	480.7	1574.6	----	----
Brome hay	----	----	1204.7	----
Salt	1.8	2.4	3.0	2.2
Bonemeal	0.8	1.0	1.1	0.9
Limestone	1.6	1.9	2.6	1.8
8. Feed cost per cwt. gain ($)	16.69	12.44	18.82	15.52
9. Financial results per animal				
Cost per cwt. in feed lot	16.00	16.00	16.00	16.00
Initial cost	77.76	77.60	78.08	78.08
Feed cost	37.77	20.30	22.49	25.67
Total cost	115.53	97.90	100.57	103.75
Necessary selling price per cwt.	16.22	15.11	16.56	15.91

FEED PRICES FOR 1947

	Per lb.		Per lb.
Shelled corn, $1.30 per bu.	0.0232	Corn silage, $5.00 per ton	0.0025
Soybean oilmeal, $82. per ton	0.041	Gr. limestone, $1.30 per cwt.	0.013
Alfalfa hay, $16. per ton	0.008	Bonemeal, $4.40 per cwt.	0.044
Brome hay, $12. per ton	0.006	Salt, $1.50 per cwt.	0.015

Table 2.

Data of Winter Feeding Phase From January 2 to May 27, 1948

Lot No.	I	II	III	IV
	Alfalfa Hay, Corn Silage, Corn Full Fed, Soybean Oil-meal	Alfalfa Hay, Corn Silage Full Fed, 3 lbs. Corn	Alfalfa Hay, Brome Hay Full Fed, 3 lbs. Corn	Alfalfa Hay Full Fed, 3 lbs. Corn
1. No. animals in lot	11	11	12	12
2. No. days total phase	146	146	146	146
3. Av. wt. per animal (lbs.)				
Initial	438	438	438	438
Final	740	653	630	653
4. Total gain	302	215	192	215
5. Daily gain	2.05	1.48	1.32	1.47
6. Av. daily ration (lbs.)				
Shelled corn	11.34	3.00	3.00	3.00
Soybean oilmeal	0.39	----	----	----
Alfalfa hay	5.00	5.00	5.00	16.13
Corn silage	5.40	17.75	----	----
Brome hay	----	----	9.36	----
Salt	0.03	0.04	0.03	0.03
Bonemeal	0.01	0.01	0.02	0.02
Limestone	0.01	0.01	0.01	0.02
7. Feed per cwt. gain (lbs.)				
Shelled corn	553.6	202.3	228.1	204.2
Soybean oilmeal	19.2	----	----	----
Alfalfa hay	244.1	337.3	380.2	1097.7
Corn silage	263.8	1197.2	----	----
Brome hay	----	----	711.6	----
Salt	1.5	2.8	2.6	2.3
Bonemeal	0.6	0.8	1.3	1.2
Limestone	0.6	0.8	0.9	1.2
8. Feed cost per cwt. gain ($)	25.82	15.57	19.90	21.57
9. Financial result per animal				
Cost per cwt. in feed lot	24.00	24.00	24.00	24.00
Initial cost	105.12	105.12	105.12	105.12
Feed cost	77.98	33.48	38.21	46.38
Total cost	183.10	138.60	143.33	151.50
Necessary selling price Per cwt.	24.74	21.23	22.75	23.20

FEED PRICES FOR 1948

	Per lb.		Per lb.
Shelled corn, $2.12 per bu.	0.0379	Corn silage, $6. per ton	0.003
Soybean oilmeal, $98. per ton	0.049	Gr. limestone, $1. per cwt.	0.010
Alfalfa hay, $26. per ton	0.0125	Bonemeal, $4.75 per cwt.	0.0475
Brome hay, $18. per ton	0.009	Salt, $1.45 per cwt.	0.0145

Table 3.

Data of Winter Feeding Phase From December 11 to May 25, 1949

Lot No.	I	II	III	IV
	Alfalfa Hay, Corn Silage, Corn Full Fed, Soybean Oil-meal	Alfalfa Hay, Corn Silage Full Fed, 3 lbs. Corn	Alfalfa Hay, Brome Hay Full Fed, 3 lbs. Corn	Alfalfa Hay Full Fed, 3 lbs. Corn
1. No. animals in lot	12	12	12	12
2. No. days total phase	165	165	165	165
3. Av. wt. per animal (lbs.)				
Initial	409	410	411	409
Final	757	670	650	633
4. Total gain	348	260	239	224
5. Daily gain	2.11	1.57	1.45	1.36
6. Av. daily ration (lbs.)				
Shelled corn	9.57	3.00	3.00	3.00
Soybean oilmeal	0.30	----	----	----
Alfalfa hay	5.00	5.00	5.00	14.21
Corn silage	5.98	18.38	----	----
Brome hay	----	----	8.80	----
Salt	0.02	0.02	0.02	0.02
Bonemeal	0.02	0.02	0.02	0.02
Limestone	0.02	0.02	0.02	0.02
7. Feed per cwt. gain (lbs.)				
Shelled corn	453.2	190.9	207.1	221.2
Soybean oilmeal	14.1	----	----	----
Alfalfa hay	236.7	318.1	345.2	1047.6
Corn silage	283.1	1169.6	----	----
Brome hay	----	----	607.6	----
Salt	0.7	1.0	1.0	1.1
Bonemeal	0.7	1.0	1.0	1.1
Limestone	0.7	1.0	1.0	1.1
8. Feed cost per cwt gain ($)	13.19	11.05	13.65	16.54
9. Financial result per animal				
Cost per cwt. in feed lot	24.50	24.50	24.50	24.50
Initial cost	100.20	100.45	100.70	100.20
Feed cost	45.90	28.74	32.62	37.05
Total cost	146.10	129.18	133.32	137.25
Necessary selling price per cwt.	19.30	19.28	20.51	21.68

FEED PRICES FOR 1949

	Per lb.		Per lb.
Shelled corn, $1.12 per bu.	0.020	Corn silage, $6 per ton	0.003
Soybean oilmeal, $72. per ton	0.036	Gr. Limestone, $1 per cwt.	0.010
Alfalfa hay, $23 per ton	0.0115	Bonemeal, $4.50 per cwt.	0.045
Brome hay, $18 per ton	0.009	Salt, $1.25 per cwt.	0.0125

To present the data of the three years winter phase in condensed form, table 4 shows the resulting averages. Limited fed lots II, III, and IV made approximate per head total gains of 200 pounds in comparison to about 300 pounds total gain in the full fed lot I.

The limited fed lots required an average of 225 pounds of corn to produce one hundred pounds of beef in comparison to 506 pounds of corn needed per hundred pounds gain in the full fed lot.

Table 4.

Three Years Average Data of Winter Feeding Beef Calves

Lot No.	I	II	III	IV
	Alfalfa Hay, Corn Silage, Corn Full Fed, Soybean Oilmeal	Alfalfa Hay, Corn Silage Full Fed, 3 lbs.Corn	Alfalfa Hay, Brome Hay Full Fed, 3 lbs. Corn	Alfalfa Hay Full Fed, 3 lbs. Corn
1. No. animals in lot	12	12	12	12
2. No. days total phase	145	145	145	145
3. Av. wt. per animal (lbs.)				
Initial	444	444	446	445
Final	736	657	629	646
4. Total gain	292	213	183	201
5. Daily gain	1.99	1.45	1.24	1.38
6. Feed per cwt. gain (lbs.)				
Shelled corn	506.3	207.7	249.7	217.4
Soybean oilmeal	21.8	-----	-----	-----
Alfalfa hay	252.3	346.1	416.1	1138.7
Corn silage	342.6	1313.8	-----	-----
Brome hay	-----	-----	841.3	-----

In a statistical analysis (Snedecor, 1946) of daily gains for the three years winter phases of the four lots, there was a highly significant difference between rations and a difference in gains between years at the 5 per cent level (Table 5). Differences in gains between years may have been due to the unequal length of feeding periods. These differences occurred when gains of full fed dry lots were analyzed with gains in the limited lots. In the two cases where steers were lost during the trial, an average of gains produced from the remaining cattle was used to fill in for an analysis of equal numbers in lots. In this discussion the word "significant" or the single asterisk (*) has been used to indicate a difference that would occur by chance in no more than 5 per cent or no less than 1 per cent of the time. "Highly significant", indicated by the double asterisk (**), has been used to indicate a difference that would occur by chance in less than 1 per cent of similar trials.

Table 5. Analysis of Variance of Gains in Winter Phase of Four Lots and Three Years Work.

Source of Variance	D/F	Sum of Squares	Mean Square	F
Total	141	23.058		
Between Rations	3	11.791	3.930	36.288**
Between Years	2	2.236	1.118	10.323*
Rations X Years	6	.650	.108	1.688
Error	130	8.380	.064	

When gains of the three limited fed lots were analyzed (Table 6) there was no significant difference between rations and no significant difference between gains made the three different years.

Table 6. Analysis of Variance of Gains in Winter Phase of Three Lots Limited Fed.

Source of Variance	D/F	Sum of Squares	Mean Square	F
Total	106	10.117		
Between Rations	2	.917	.458	2.830
Between Years	2	1.648	.824	5.087
Rations X Years	4	.648	.162	2.314
Error	98	6.905	.070	

Conclusions

Calves in the three lots which were wintered on a grain-limited feeding level appeared to possess sufficient condition but were not considered too fat to turn on grass in the spring. Although the calves of these three lots, II, III, and IV did not show the high degree of finish as did the full fed lot I, they were in a desirable, thrifty condition. Gains obtained in wintering calves in this experiment show that available roughages in the form of alfalfa hay, brome hay, or corn silage may be used to produce low cost gains. The quality of the roughage is more important than the type of roughage as shown by varied results in different years this trial was carried. Average daily gains of from one pound to one and one half pounds resulted from calves being fed three pounds of corn per head daily plus all the roughage they would consume.

With the exception of lot III in 1947, all of the limited fed cattle could have been sold at a profit in the spring if they had been sold for the purchase price per hundred pounds. Under these conditions profits may be assured even though sufficient spring pastures may not be available.

SUMMER PHASE

Experimental Procedure

Although the summer phase of this experiment is a continuation of the winter phase, it will be discussed separately as the cattle from the three limited fed lots were relotted and the rations were changed in starting the summer phase. The full fed dry lot I continued with no change in cattle and constituents of the ration as this lot was a check used in comparing grass fed cattle and dry lot fed cattle. Four new lots (V, VI, VII and VIII) of six steers and three heifers each were formed from cattle used in lots II, III, and IV of the winter phase. Random selection, within sexes, was used in making up the summer lots, each summer lot composed of one heifer and two steers from each of the three winter lots. Single-day weights were used in starting and completing the experiment and the cattle were weighed at every twenty-eight day interval during the trial with the exception of a seventy day weight.

The summer phase of this experiment was started at the time when pastures had made sufficient growth so that cattle readily could get a fill. Native grass, which was chiefly Kentucky blue grass, and brome and alfalfa pastures were used. Tests were made on both types of pastures to measure the value of feeding corn throughout the summer phase versus pasturing for 70 days then adding corn and protein supplement to the ration until the

cattle were marketed. No protein supplement was added to any of the pasture rations until after the initial 70 days.

Summer phase daily rations per head for the five lots were as follows:

Lot I

1. Shelled corn full fed
2. Soybean oilmeal
3. Alfalfa hay 5 pounds
4. Salt, bonemeal, and limestone free choice

Lot V

1. Native grass pasture (chiefly Kentucky bluegrass)
2. Cracked shelled corn and soybean oilmeal added after first ten weeks on pasture

Lot VI

1. Brome and alfalfa pasture
2. Cracked shelled corn and soybean oilmeal added after first ten weeks on pasture

Lot VII

1. Brome and alfalfa pasture
2. Cracked shelled corn
3. Soybean oilmeal added after first ten weeks on pasture

Lot VIII

1. Native grass pasture (chiefly Kentucky bluegrass)
2. Cracked shelled corn
3. Soybean oilmeal added after first ten weeks on pasture

Lots V, VI, VII, and VIII received salt free choice on pasture. Water was available at all times for all five lots. Two daily feeds were continued at morning and evening for the dry Lot I and the remaining lots were fed on pasture one, daily, morning feed.

As a preventive measure to guard against bloating on brome and alfalfa pastures, the cattle placed on these pastures were provided with a good fill of dry roughage before being turned on pasture. Brome hay was fed on the brome and alfalfa pasture during the early part of the summer phase in an effort to keep cattle from grazing too much alfalfa.

The various lots were marketed according to the time needed to accomplish relatively equal finish and weight. The objective was to market lots when steers averaged not less than 925 pounds and heifers not less than 875 pounds.

Cattle in each lot were weighed individually on leaving the experiment station and individual weights were taken at the direct buying point so that shrinkage in transit could be calculated. Individuals were graded on foot by a packing company buyer who also gave individual prices on cattle sold. Carcass data including cold carcass weights, government grade, and color of eye muscle were obtained on the second day after the cattle were killed.

Analysis of Data

In 1947 the cattle were turned on the four pasture lots on May 26 and in 1948 grazing started on May 27. At this time there was considerable growth of pastures and cattle readily could get a fill. Climatic conditions were favorable toward producing ample pasture for the cattle during the complete grazing trials. Lots VII and VIII, which received corn with pasture the complete grazing season, reached sufficient weight and finish to be marketed about October 8 of each year. Lots V and VI, which were grazed for 70 days and then had corn added to the ration, were sent to market about November 3 of each year.

Tables 7 and 8 give data on the summer phase of 1947 and 1948. Each year daily gains in lots VII and VIII, which were fed corn with pasture the complete season, were greater than in the dry lot. Greatest daily gains, 2.36 and 2.60 pounds as compared to dry lot daily gains of 2.17 and 2.00 pounds, resulted in lot VII each year on brome and alfalfa pasture and a full feed of corn. Lot VIII, which was on native pasture and received a full feed of corn throughout the summer phase, made average daily gains of 2.18 and 2.31 for the respective years. Lot V, on native grass for 70 days then fed to market weight, made the smallest gains each year with only 1.76 and 1.97 pounds daily gains as compared to 1.90 and 2.06 pounds daily gain in lot VI on brome and alfalfa pasture then late fed.

Corn consumed per hundred pounds gain during the summer period was highest in the dry lot with 760.9 pounds required in 1947 and 707.0 pounds in 1948. Lot V on native pasture, then late fed corn, required 429.7 pounds and 395.6 pounds of corn to produce one hundred pounds of gain the two respective years. Corn requirements for lot VI, on brome and alfalfa then late fed, were 377.5 and 375.6. Lot VII which received a full feed of corn the entire phase plus brome and alfalfa pasture consumed 529.0 pounds and 589.4 pounds of corn per hundred pounds gain. Lot VIII on native pasture plus a full feed of corn required 572.1 pounds and 672.7 pounds of corn the two respective years.

The dry lot cattle reached suitable weight and finish to be marketed four weeks before the pasture-plus corn fed cattle. Eight weeks after the dry lot cattle were sold the late fed cattle on pasture were sent to market.

Carcasses of the cattle fed on pasture did not grade as high as indicated by their live, market grade. Seldom were any of the pasture cattle carcasses good enough to grade choice. The greatest percentage graded good with a few grading commercial. The most important single factor reducing the carcass grade on the pasture fed cattle was the yellow color of the fat. In addition the pasture fed carcasses were not as evenly and thickly covered as the dry lot carcasses, and the inside rib showed lack of high finish. The carcasses were not as firm from the pasture cattle

as from the dry lot fed cattle and a relatively small amount of marbling was found in the eye muscle, which in many cases was soft and darker than that of the full fed lot.

The experiment station was located approximately sixty miles from the market, and average shrink was calculated by difference in weight when cattle were loaded on the truck and when sold at the market. These average shrinkages in most cases were very close to twenty five pounds with the one exception of lot VIII, in 1948, which showed a shrinkage of only eight and six tenths pounds. There is no direct evidence available to show why this group of cattle should shrink such a small amount in relation to shrinkage of comparable lots.

Table 7.

Data on Summer Feeding Phase for 1947

Lot No.	I	V	VI	VII	VIII
	Dry Lot, Alfalfa Hay, Corn Full Fed, Soybean Oilmeal	Native Grass for 71 Days Then Fed 94 Days	Brome Alfalfa 71 Days Then Fed 85 Days	Brome Alfalfa and Full Fed 142 Days	Native Grass and Full Fed 142 Days
No. animals in lot	12	8	9	9	9
No. days total phase	104	165	156	142	142
Av. initial weight (lbs.)	712	632	644	632	634
Av. final weight	938	951	940	967	944
Total gain per animal	226	319	296	335	310
Av. daily gain	2.17	1.76	1.90	2.36	2.18
Av. daily ration (lbs.)					
Corn	16.54	7.54	7.07	12.48	12.48
Soybean oilmeal	1.21	0.96	0.88	0.79	0.79
Salt	0.06	0.05	0.06	0.05	0.05
Silage	0.64	----	----	----	----
Alfalfa hay	5.00	----	----	----	----
Brome hay	----	----	0.56	0.59	----
Feed per cwt. gain (lbs.)					
Corn	760.4	429.7	372.5	529.0	572.1
Soybean oilmeal	55.6	54.6	46.2	33.7	36.4
Salt	2.7	3.1	3.1	2.1	2.3
Alfalfa hay	229.9	-----	-----	-----	-----
Silage	29.5	-----	-----	-----	-----
Brome hay	-----	-----	23.8	30.5	-----
Acres pasture per cwt. gain	-----	0.35	0.19	0.13	0.29
Feed cost per cwt. gain ($)	31.57	19.53	16.88	21.45	23.48
Cost per head to summer phase ($)	115.53	100.11	101.94	100.11	100.38
Feed cost per head (summer) ($)	71.41	56.73	45.56	68.31	68.31
Pasture charge per head ($)	-----	5.56	4.44	3.56	4.44
Av. marketing costs ($)	3.93	3.89	3.86	3.92	3.87
Total costs ($)	190.87	166.29	155.80	175.90	177.00
Av. selling price ($)	31.07	26.08	27.00	28.17	28.38
Carcass grade	9AA	5A	8A	4AA	3AA
	3A	3B	1B	5A	6A
Selling price per head ($)	286.39	241.73	247.05	265.07	261.28
Profit per head ($)	95.52	75.44	91.25	89.17	84.28
Av. shrink (lbs.)	16.8	24.2	25.4	26.1	23.2
Av. dressing per cent	58.0	56.4	56.6	58.1	58.5

Table 8.

Data on Summer Feeding Phase for 1948

Lot No.	I	V	VI	VII	VIII
	Dry Lot, Alfalfa Hay, Corn Full Fed, Soybean Oilmeal	Native Grass 70 Days Then Fed 90 Days	Brome Alfalfa 70 Days Then Fed 90 Days	Brome Alfalfa and Full Fed 129 Days	Native Grass and Full Fed 129 Days
No. animals in lot	10	9	9	9	8
No. days total phase	109	160	160	129	129
Av. initial weight (lbs.)	740	650	641	639	651
Av. final weight	959	965	970	974	948
Total gain per animal	219	315	329	335	297
Av. daily gain	2.00	1.97	2.06	2.60	2.31
Av. daily ration (lbs.)					
Corn	14.12	7.78	7.76	15.31	15.51
Soybean oilmeal	1.00	0.67	0.67	0.43	0.46
Salt	0.08	0.06	0.08	0.08	0.10
Alfalfa hay	5.02	----	----	----	----
Brome hay	----	----	0.55	0.23	----
Feed per cwt. gain (lbs.)					
Corn	707.0	395.6	377.1	589.4	672.7
Soybean oilmeal	50.3	34.0	32.5	16.7	19.8
Salt	4.0	2.8	4.0	3.0	4.2
Alfalfa hay	251.5	----	----	----	----
Brome hay	----	----	26.7	8.7	----
Acres pasture per cwt. gain	----	0.35	0.17	0.13	0.30
Feed cost per cwt. gain ($)	27.93	14.28	13.87	19.81	22.56
Cost per head to summer phase ($)	183.09	145.48	143.71	143.50	145.60
Feed cost per head (summer)($)	61.08	44.91	45.62	66.38	67.10
Pasture charge per head ($)	----	5.56	4.44	3.56	4.44
Av. marketing cost ($)	2.64	2.70	2.70	2.68	2.68
Total costs ($)	246.81	198.65	196.47	216.12	219.82
Av. selling price ($)	35.47	28.76	28.50	33.77	33.66
Carcass grade	9AA 1A	7A 2B	1AA 7A 1B	2AA 7A	8A
Selling price per head ($)	332.03	270.02	267.88	321.73	316.23
Profit per head ($)	85.22	71.37	71.41	105.61	96.41
Av. shrink (lbs.)	22.7	25.8	29.8	21.7	8.6
Av. dressing per cent	58.75	58.16	58.32	58.75	58.68

In a statistical analysis of daily gains of the four pasture lots for 1947 and 1948, there was a highly significant difference between rations (Table 9). This difference might be expected as gains of the two lots receiving a full feed of corn on pasture were analyzed with the two lots which were grazed for seventy days and then had a full feed of corn added. A significant difference at the 5 per cent level was shown on daily gains between years.

Table 9. Analysis of Variance of Gains in Summer Phase for Four Lots Pasture Fed.

Source of Variance	D/F	Sum of Squares	Mean Square	F
Total	69	9.777		
Between Rations	3	3.562	1.187	56.294**
Between Years	1	.405	.405	19.201*
Rations X Years	3	.063	.021	-----
Error	62	5.747	.093	

In a statistical analysis of the carcass data there was no significant difference in carcass grades from cattle on the four grass lots (Table 10). No differences were found between the two years grades of carcasses. There was a significant difference at the 5 per cent level due to an interaction of rations and years.

Table 10. Analysis of Variance of Carcass Grades on Four Lots of Cattle Grass Fed.

Source of Variance	D/F	Sum of Squares	Mean Square	F
Total	69	151.320		
Between Rations	3	41.153	13.718	3.326
Between Years	1	4.014	4.014	-----
Rations X Years	3	12.373	4.124	2.813*
Error	62	93.780	1.466	

When carcass grades of cattle from the dry lot were analyzed with the four grass lots (Table 11), there was a significant difference

at the 5 per cent level in comparing carcasses from all five lots. This difference is explainable by the fact that the dry lot carcasses were superior to those of the grass fed cattle. There was a significant difference at the 5 per cent level due to an interaction of rations and years.

Table 11. Analysis of Variance of Carcass Grades on Five Lots. Dry Lot Analyzed with Four Grass Fed Lots.

Source of Variance	D/F	Sum of Squares	Mean Square	F
Total	91	292.96		
Between Rations	4	151.168	37.792	7.917*
Between Years	1	.668	.668	-----
Rations X Years	4	19.094	4.774	3.208*
Error	82	122.030	1.488	

Conclusions

The first year greatest profits per head resulted from cattle fed in the dry lot, whereas, the second year greatest profits resulted from cattle going on brome and alfalfa pasture plus a full feed of corn. This was due largely to the fact that corn was relatively much higher in price the second year, and the total feed cost for dry lot cattle was unduly high. The cattle which were marketed with the lowest cost of feed per hundred pounds of gain were not always the most profitable due to great differences in selling price per hundred pounds. Whether cattle should be grained immediately upon going on pasture or pastured without grain for a period while pastures are lush, will be partially controlled by beef price trends. Weakened price trends in the fall or in the month of October caused less profits per head on cattle which made greatest use of pastures even though their gains were made at less cost.

Condition of pastures during the two years summarized was above normal. It may be expected that benefits resulting from pasturing in this experiment are greater than will result in years when pastures are limited due to climatic conditions. In two lots a full seventy day period without grain resulted in satisfactory gains as pastures received enough rainfall for continual growth. In years when pastures are dry and growth is retarded during July, it would be necessary to supplement pasture

with grain in order to maintain sufficient gains to produce finished cattle before winter.

Data on the acres of pasture needed to produce one hundred pounds of beef showed almost identical results for the two years. Cattle on native pasture for seventy days without grain required .35 acres to produce one hundred pounds gain while cattle on brome and alfalfa for seventy days without grain required .18 acres of pasture to produce one hundred pounds gain. This gives brome and alfalfa pasture a value of twice that of native pasture under the conditions pertaining to this experiment.

SUMMARY AND CONCLUSIONS

COMBINED WINTER AND SUMMER PHASE

The results of three years winter feeding trials with Hereford steer and heifer calves are presented. Four winter lots were divided in such a way as to compare the values of feeding roughages such as corn silage, brome hay, and alfalfa hay in maximum amounts to produce moderate gains with minimum grain costs. A fourth full fed lot was added as a check with which limited and later pasture fed lots could be compared. Under conditions of this experiment it was found that steer and heifer calves weighing approximately 450 pounds in the fall of the year, wintered on a full feed of roughage plus a limited amount of grain so as to make an average daily gain of 1.0 to 1.5, are desirable cattle for grain feeding on pasture the following season.

Corn silage, brome hay, or alfalfa hay may make up the bulk of the winter ration which is to be supplemented daily with approximately 3 pounds of corn per head. Price and quality of these winter feeds will be a deciding factor as to selection of a most profitable winter ration.

Five summer lots were divided in such a way as to compare dry lot feeding, brome and alfalfa pasture plus a full feed of corn, native grass pasture plus a full feed of corn, brome and alfalfa pasture for seventy days then a full feed of corn added,

and native grass pasture for seventy days then a full feed of corn added.

Under conditions which prevailed during this experiment it was possible to produce approximately five hundred pounds of beef with thirty bushels of corn plus liberal amounts of winter roughage and summer pasture. The full fed dry lot required fifty seven bushels of corn to produce an equal gain. Although the higher selling dry lot cattle graded above the pasture fed cattle in live weight and carcass grade, nearly twice as much corn was needed to feed them out in comparison to limited winter fed then summer grazed cattle. This may be a factor to consider for producers who have a limited supply of corn and an abundant supply of winter roughage and summer pasture.

Satisfactory average per head daily gains ranging from 1.76 to 2.60 pounds resulted from cattle fed on pasture. Native grass pasture, which was chiefly Kentucky blue grass, was shown to have a value of 50 per cent that of brome and alfalfa pasture when computing acres required to produce one hundred pounds of beef.

Although no complete record of labor required was kept during this trial, it does seem logical that the pastured lots had an advantage in this respect. Time spent in feeding once a day on pasture was less than in feeding twice a day to the dry lot. No labor was needed for cleaning and bedding of sheds and feed lots on the pastured cattle. Values of pastures and legumes in soil conservation and rotation were not measured but surely are

advantages in a program of feeding cattle on grass.

It appears that when there is a great spread in prices per hundred pounds between choice dry lot cattle and good pasture fed cattle, highest profits are likely to be in the dry lot, although, if grain prices are relatively high and price spreads between good and choice cattle are small, it may be expected that the greatest profits will be from cattle that have made the most of utilizing roughages and pastures. Trends of market prices of beef and grain are factors to consider before making a decision on a feeding and management practice for fattening cattle.

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