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# *Supplements for Fattening*

*Two- and Three-year-old*

## *Steers on Grass*

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# *The Story in Brief*

**The research reported herein was undertaken to find answers to these questions:**

1. Does it pay to feed mature steers being fattened on grass?
2. If so, is it necessary to use a high-protein feed? Or would equally good results be obtained with only a mineral supplement, or with an energy feed such as corn?

As the work progressed, it became apparent that the answer to Question 1 might be different after the grass begins to mature than it is in the early part of the growing season when grass is lush. Therefore research was started looking toward the answer to another question:

3. When should the feeding supplement be started?

Answers to these questions were sought in a series of trials during the spring and summer grazing seasons of the years 1943 to 1948, inclusive, using a total of 728 steers.

## **Results of the trials indicate that:**

1. It is desirable to feed steers fattening on grass, partly because they gain a little more, but principally because they sell for enough more per hundredweight to show a profit above cost of the feed.

2. (a) No mineral supplement is needed with the native grass ("bluestem") pastures of northeastern Oklahoma.

- (b) An energy feed (ground shelled corn) produced slightly less gain than a high-protein feed (43 percent cottonseed cake), but the corn steers averaged enough higher in selling price to return a slightly greater profit.

3. Feeding a concentrate throughout the grazing season gave slightly larger daily gains, but the profit per steer and dressing percentage were slightly in favor of the steers which received cake only after July 1.

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# *Supplements for Fattening*

## *Two- and Three-year-old Steers on Grass*

By A. E. DARLOW, W. D. CAMPBELL, V. G. HELLER, J. C. HILLIER, R. W. MacVICAR,  
O. B. ROSS, D. F. STEPHENS, and BRUCE R. TAYLOR.<sup>1</sup>

The northeastern section of Oklahoma, where the long grasses of the Bluestem type predominate, has become famous as an area where mature steers are fattened and go direct to the killer market as grass-fat steers. Although thin, mature steers make phenomenal gains on this grass during the early summer months, many producers believe the steers do not put on sufficient finish to meet the demands for cattle of this general type. Therefore it has been a practice in this section to feed such steers some high-protein supplement in addition to the grass.

During the early years of this practice, there was no question concerning the supplement to be fed: Cottonseed cake was available, it gave satisfactory results, and in most instances was just as cheap or cheaper than corn.

In more recent years, it has become apparent that there is too little protein available to properly balance rations for livestock and to efficiently use all of the carbonaceous roughages and grains available. This was particularly noticeable during World War II. Naturally, these questions arose:

Does it pay to feed mature steers on grass?

If it does, should they be fed a high protein feed or would a feed relatively low in protein give equally good results?

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<sup>1</sup> Respectively: Head, Department of Animal Husbandry; Technician, Beef Cattle; Research chemist, and formerly Head of Department of Agricultural Chemistry Research; Associate Animal Husbandman, Meats; Head, Department of Agricultural Chemistry Research; formerly Animal Husbandman, Nutrition; formerly Assistant Animal Husbandman, and now Superintendent, Ft. Reno Experiment Station; formerly Animal Husbandman. Others associated with the work for brief periods include H. M. Briggs, J. A. Hoefler, and Charles S. Hobbs.

Therefore the tests reported in this bulletin were undertaken to determine:

1. The advisability of feeding high-protein supplements to mature steers on grass.
2. Whether added gain that might be realized by feeding such supplements was due to the protein, the energy, or the minerals contained in the feed.

As the tests progressed, it was found that during the spring and early summer months, when the grass was lush, steers made practically as good gains on grass alone as they did when given a supplement. This raised another set of questions:

Does it pay to feed a supplement when plenty of good grass is available?

If not, when should the feeding of supplement be started?

These questions were given attention in the later years of the series of tests reported herein.

## **How the Tests Were Made**

The work reported in this bulletin was conducted at the Experiment Station's Experimental Range Unit on the Lake Carl Blackwell Area west of Stillwater, during the years 1943 to 1948, inclusive.

Most of the Experimental Range Unit consists of meadows and pastures where the predominant grasses are little bluestem, big bluestem, switch and Indian grass. There are, however, areas where there is considerable buffalo and grama grass. There also are areas that had previously been plowed; and on these the grass is a lower type than is found in the undisturbed meadows and pastures.

All cattle used in the tests were two- and three-year-old, high-grade Hereford steers. They were all wintered on the experimental range unit except for the steers used in the 1943 trial, which were bought in the spring and moved to the pasture.

The cottonseed cake and corn was fed once each day in the morning in bunks. The salt and mineral mixtures were fed free-choice. The number of steers used varied from 22 head per pasture one year to a high of 33 head per pasture. It was felt that there was ample grass available in all grazing seasons.

Calcium and phosphorus determinations were made on blood samples to provide information on how the animals utilized each of these mineral elements. Blood samples were obtained by intravenous puncture from 10 representative steers of each lot at the beginning and end of each trial. Inorganic phosphorus in the blood plasma was determined by the method of Youngberg and Youngberg. Calcium was determined by the method of Clark and Collip. AOAC methods were used in the analysis of feed.

During the last two years of the studies reported, the steers were rotated among the pastures each 28 days to eliminate possible variations among lots due to differences in the pastures.

Grass analyses by months are reported in Table I for the 1943 and 1944 grazing seasons. These are representative of seasonal changes during the years covered by the trials.

Grass analyses for other years, feed analyses, additional blood analyses, and other detailed information may be found in the annual progress reports of this work.<sup>1</sup>

## **The Rations Compared**

Five different ration combinations were used in the course of the six years. All included bluestem grass and salt (free-choice), the comparison being on the supplement fed with this basal ration. The supplement fed and the years during which they were fed, were:

Lot 1. No supplement. 1943 to 1948.

Lot 2. A mineral mixture. 1943 to 1945. The mineral mixture in 1943 was one-half salt and one-half bone meal. In 1944 and 1945, it was equal parts of salt, ground limestone, and bone meal.

Lot 3: 43 percent cottonseed cake. 1943 to 1948.

Lot 4: Ground shelled corn. 1943 to 1948.

Lot 5: No supplement to about July 1, and 43 percent cottonseed cake thereafter. 1946 to 1948.

<sup>1</sup> See, for the years indicated: 1943, Mimeo. Cir. M-102, pp. 1-5; 1944, Mimeo. Cir. M-136, pp. 9-12; 1945, Bul. B-296, pp. 28-34; 1946, Misl. Pub. MP-11, pp. 30-34; 1947, Misl. Pub. MP-13, pp. 10-13; and 1948, Misl. Pub. MP-15, pp. 15-18. Lot numbers as used in these annual reports are the same as used in this final summary report, except that in the annual reports "Lot 2" designates the mineral steers in 1943 to 1945 and also the "caked after July 1" group in 1946 to 1948. In this bulletin, "Lot 5" is used to designate the latter group.

In Lots 3 and 4 during the first three years (1943 to 1945),  $\frac{1}{2}$  pound per head daily of a commercial molasses feed was added to the cottonseed cake and corn to help induce the steers to come to feed.

## Results

### Mineral Supplement vs. Concentrate Feed

Results for the first three years are averaged in Table II. They show there was no benefit from mineral supplement. Gains and profits were almost equal in the straight-grass and grass-mineral lots (Lots 1 and 2, respectively). The blood analyses in Table III show that the straight-grass steers obtained adequate amounts of calcium and phosphorus. Values of plasma calcium and phosphorus for all lots were within the range considered normal, and differences among the lots were not statistically significant.

Profits were slightly higher on the corn and cottonseed cake lots (Lots 3 and 4, respectively) than on either the straight-grass or the grass-mineral lots, due more to the higher selling price than to the additional gain.

The slight difference in favor of cottonseed cake as compared to corn apparently was due to the additional protein rather than to the higher calcium and phosphorus content of the cottonseed meal.

### Composition of Grass

TABLE I.—Chemical Composition of Grasses in Experimental Pastures; by Months, Grazing Seasons 1943 and 1944.

(Percent; dry basis)

Date of sampling	Moisture	Ash	Crude protein	Ether extract	Crude fiber	Nitrogen-free extract	Calcium	Phosphorus
<b>1943<sup>1</sup></b>								
May 1	53.52	7.63	14.86	3.38	14.67	59.44	.3174	.2094
June 1	61.23	7.57	8.37	2.97	32.52	48.52	.406	.123
July 1	64.7	6.59	6.69	2.27	33.09	51.32	.321	.111
August 1	56.97	7.38	5.44	3.13	30.94	53.10	.407	.091
<b>1944<sup>2</sup></b>								
May 1	78.36	8.79	16.42	3.42	32.00	37.39	.419	.312
June 1	62.90	6.18	8.33	3.28	30.63	51.58	.263	.110
July 1	70.12	5.93	5.88	2.44	30.75	55.01	.361	.099
August 1	56.80	6.58	5.60	2.90	28.99	55.52	.365	.079

<sup>1</sup> Composite sample of predominant species.

<sup>2</sup> Big bluestem only.



The grass alone provided enough calcium and phosphorus (as shown by comparison of Lots 1 and 2), and the corn and cottonseed cake supplied approximately equal amounts of energy.

### Mineral Supplement vs. Concentrates

TABLE II.—Comparison of Mineral Supplement with Concentrate Feeds (Ground Shelled Corn and Cottonseed Cake); 1943, 1944, and 1945

(Average grazing period, 116 days)

	Lot 1 No supplement	Lot 2 Mineral <sup>1</sup>	Lot 3 Ground shelled corn	Lot 4 Cottonseed cake
<b>Total number of steers</b>	83	83	83	83
<b>Average weights per steer (lbs.)</b>				
Initial	737	733	736	736
Final	985	975	1016	1037
Total gain	248	242	280	301
Daily gain	2.14	2.09	2.41	2.59
<b>Average daily ration (lbs.)</b>				
Ground shelled corn			4.39	
Cottonseed cake				4.39
Molasses feed			.49	.49
Mineral		.025		
Salt	.065	.045	.054	.058
Bluestem grass	ad lib.	ad lib.	ad lib.	ad lib.
<b>Cost of feed per steer (dollars)</b>				
Bluestem grass	8.67	8.67	8.67	8.67
Ground shelled corn			11.20	
Cottonseed cake				12.88
Molasses feed			1.68	1.68
Mineral		.05		
Salt	.05	.03	.04	.04
Total feed cost	8.72	8.75	21.59	23.27
<b>Cost of steer (\$12.88 per cwt.)</b>	94.93	94.41	94.80	94.80
<b>Total cost (feed plus steer)</b>	103.65	103.16	116.39	118.07
<b>Return (dollars)</b>				
Selling price per cwt.	11.75	11.83	12.72	12.83
Selling price per steer	107.09	106.69	121.49	123.34
Return per steer	3.44	3.53	5.10	5.15
<b>Marketing data</b>				
Percent shrink	7.47	7.50	6.00	7.38
Dressing percentage	54.5	55.5	56.8	57.5

<sup>1</sup> Bone meal was fed the first year, bone meal and ground limestone the second year, and a 1-1-1 mineral mix the third year. Figure given is an average of the total minerals fed.

#### AVERAGE FEED PRICES

Cottonseed cake	\$50.66/ton	Salt	\$13.00/ton
Corn	1.23/bu.	Limestone	14.00/ton
Molasses	59.00/ton	Steamed bone meal	67.00/ton

### Supplement All Season vs. Part of Season

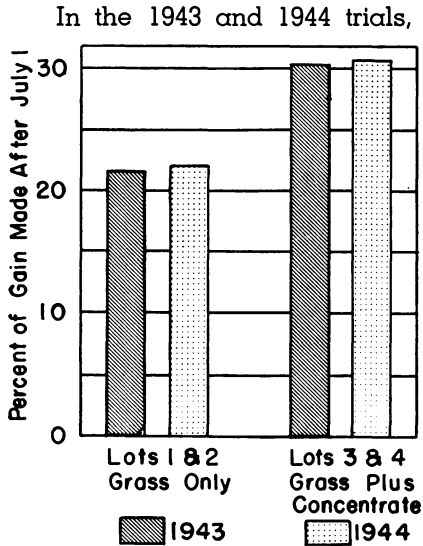


FIGURE 1.—Gains of straight-grass cattle fall off sharply after about July 1, when grass begins to mature. Early season gains are about equal. This data led to trials comparing lots fed protein supplement all season with those fed protein supplement only from about July 1 onward.

It is well known that the percentage of protein in grasses falls off rapidly after the plants have passed their period of most rapid

### Mineral Levels of Blood

TABLE III.—Plasma Calcium and Phosphorus Content of Blood from Experimental Steers; 1944<sup>1</sup>.

(Mg. per 100 ml. of plasma)

	Calcium			Phosphorus		
	Initial	Final	Change	Initial	Final	Change
Lot 1 No supplement	11.80	11.34	-.46	5.31	4.74	-.57
Lot 2 Mineral	12.03	12.40	+.37	5.62	5.07	-.55
Lot 3 Gr. shelled corn	11.75	12.25	+.50	5.18	5.34	+.16
Lot 4 Cottonseed cake	11.66	12.16	+.50	5.30	5.74	+.44

<sup>1</sup> Values obtained in 1944 are typical of those obtained in the other two years.

## Gains by Months

TABLE IV.—Average Weight Gains Per Head, by Months; Grazing Seasons 1943 and 1944.

Period (all dates inclusive)	Gain per steer (Pounds)					Percent of total gain (average of all lots)
	Lot 1 No supple- ment	Lot 2 Mineral	Lot 3 Ground shelled corn	Lot 4 Cottonseed cake	Average	
<b>1943</b>						
April (last 13 days)	57	62	72	70	65	20.3
May	99	96	95	113	101	31.5
June	69	78	73	61	70	21.9
Total April 18 to June 30	225	236	240	244	236	73.7
Percent of total gain	76.8	79.7	67.0	72.8	73.7	
July	33	33	66	48	45	14.1
August (24 days)	35	27	52	43	39	12.2
Total April 18 to August 24	293	296	358	335	320	100.0
<b>1944</b>						
April 27 to May 31	145	122	148	128	136	53.3
June	43	61	42	64	52	20.4
Total April 27 to June 30	188	183	190	192	188	73.7
Percent of total gain	81.0	75.9	70.4	69.1	73.7	
July	45	53	62	64	56	22.3
August (13 days)	-1	5	18	22	11	4.0
Total April 27 to August 13	232	241	270	278	255	100.0

growth.<sup>1</sup> (Table I shows the drop in protein percentage of the grass in the experimental pastures in the 1943 and 1944 seasons.) This fact, plus the similarity in gains up to July 1, raised this question:

"Would it pay to start the steers on straight grass, and begin feeding supplement only after the grass has passed its period of most rapid growth?"

The trials were revised in 1946 to seek an answer to that question. Lot 2 was discontinued and Lot 5 added. The cattle in Lot 5

<sup>1</sup> See, for example, U.S.D.A. Tech. Bul. 943, *Nutritional Qualities of Range Forage Plants in Relation to Grazing with Beef Cattle on the Southern Plains Experimental Range*, by D. A. Savage and V. G. Heller; and Okla. Agri. Exp. Sta. Bul. B-333, *Winter Pasture for More Feed and Better Feed at Lower Cost*, by Hi W. Staten and V. G. Heller. Numerous examples are found in the annual Feeders' Day Reports of the Oklahoma Station, cited in the footnote on page 7.

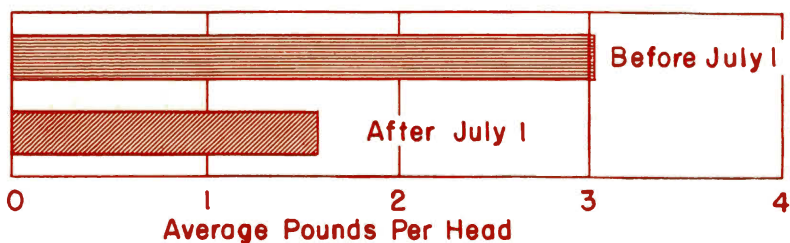


FIGURE 2.—Average pounds gain per head per day during 1943 and 1944 grazing seasons. Before July 1, the steers' average gain was 3.05 pounds; after July 1, 1.53. (Data from Table IV.)

were handled the same as Lot 1 (straight grass) up to the early part of July, but after that date received the same amount of cottonseed cake as the steers in Lot 4. This comparison was continued through the 1947 and 1948 seasons. The results are shown in Table V.

The Lot 5 steers gained considerably more than did the Lot 1 steers that were on straight grass throughout the season. The gains in Lot 5 approached those made by the steers fed either corn or cottonseed cake throughout the grazing period (Lots 3 and 4). However, the Lot 5 steers sold for less than either the cottonseed cake or corn lots, which is a reflection of the apparent condition of the cattle when they went to market.

Profits on the steers supplemented from July onward were just as great as for the steers getting cottonseed cake throughout the grazing period.

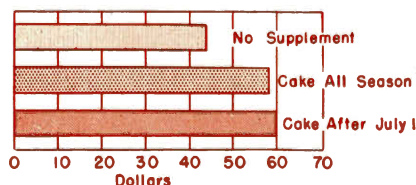


FIGURE 3.—Return per steer in comparison of supplement all season with supplement after July 1. (Data from Table V.)

The average dressing percentages of Lots 3, 4 and 5 indicate that the steers fed cottonseed cake after July were as fat as those fed throughout the entire grazing period.

It is possible that the benefit from late supplementation would be even more apparent if the steers had been carried into late August or September, because the protein content of the grass continues to decrease as the season advances.

#### Ground Shelled Corn vs. Cottonseed Cake

The 1946 to 1948 trials also included further comparison of ground shelled corn and cottonseed cake; that is, Lots 3 and 4 were

continued without change in ration throughout the six years from 1943 to 1948. Results are averaged in Table VI. (Results for 1943 to 1945 are also shown in Table II, and those for 1946 to 1948 in Table V.)

### Supplement After July 1

TABLE V.—Comparison of Supplement All Season with Supplement After July 1<sup>1</sup>; 1946, 1947, and 1948.

(Average grazing period, 109 days)

	Lot 1 No supplement	Lot 3 Ground shelled corn	Lot 4 Cottonseed cake	Lot 5 Cottonseed cake after July 1 <sup>1</sup>
<b>Total number of steers</b>	99	99	99	99
<b>Average weights per steer (lbs.)</b>				
Initial	882	881	882	882
Final	1119	1155	1162	1148
Total gain	237	274	280	266
Daily gain	2.17	2.51	2.57	2.44
<b>Average daily ration (lbs.)</b>				
Ground shelled corn		3.40		
Cottonseed cake			3.41	3.33
Salt	.06	.07	.06	.06
Bluestem grass	ad lib.	ad lib.	ad lib.	ad lib.
<b>Cost of feed per steer (dollars)</b>				
Bluestem grass	12.33	12.33	12.33	12.33
Ground shelled corn		13.30		
Cottonseed cake			15.80	5.66
Salt	.05	.06	.05	.05
Total feed cost	12.38	25.69	25.18	18.60
<b>Cost of steer (\$20.67 per cwt.)</b>	182.31	182.10	182.31	182.31
<b>Total cost (feed plus steer)</b>	194.69	207.79	210.49	200.91
<b>Returns (dollars)</b>				
Selling price per cwt.	23.17	25.50	25.17	24.17
Selling price per steer (shrunk)	239.67	272.05	269.52	260.88
Return per steer	44.98	64.26	59.03	59.97
<b>Marketing data</b>				
Percent shrink	7.56	7.63	7.85	5.98
Dressing percentage	56.7	57.9	57.5	57.7

<sup>1</sup> Feeding of cottonseed cake was started in Lot 5 on July 8 in 1946 and July 1 in the other two years. The intention was to begin supplementation at the time the grass was beginning to mature.

#### AVERAGE FEED PRICES

Cottonseed cake	-----	\$88.00/ton
Corn	-----	3.59/cwt.
Salt	-----	15.80/ton

## Cottonseed Cake vs. Corn

TABLE VI.—Comparison of Cottonseed Cake and Ground Corn as a Supplement; 1943 to 1948, Inclusive.

(Average grazing period, 112 days)

	Lot 1 No supplement	Lot 3 Ground shelled corn	Lot 4 Cottonseed cake
<b>Total number of steers</b>	182	182	182
<b>Average weights per steer (lbs.)</b>			
Initial	810	808	809
Final	1052	1086	1100
Total gain	242	278	291
Daily gain	2.16	2.48	2.60
<b>Average daily ration (lbs.)</b>			
Ground shelled corn		3.90	
Cottonseed cake			3.90
Molasses feed <sup>1</sup>		.25	.25
Salt	.06	.06	.06
Bluestem grass	ad lib.	ad lib.	ad lib.
<b>Cost of feed per steer (dollars)</b>			
Bluestem grass	10.50	10.50	10.50
Ground shelled corn		12.67	
Cottonseed cake			14.81
Molasses feed		.88	.88
Salt	.05	.05	.05
Total feed cost	10.55	24.10	26.24
<b>Cost of steer (\$16.78 per cwt.)</b>	135.92	135.58	135.75
<b>Total cost (feed plus steer)</b>	146.47	159.68	161.99
<b>Returns (dollars)</b>			
Selling price per cwt.	17.46	19.11	19.00
Selling price per steer (less shrink)	169.87	193.38	193.10
Return per steer	23.40	33.70	31.11
<b>Marketing data</b>			
Percent shrink	7.52	6.82	7.61
Dressing percentage	55.6	57.4	57.5

<sup>1</sup> Molasses feed was fed the first three years only.

### AVERAGE FEED PRICES

Cottonseed cake .....	\$67.83 per ton
Corn .....	2.90 per cwt.
Molasses Feed .....	59.00 per ton
Salt .....	13.75 per ton

TABLE VII.—Summary; 1943 to 1945, and 1946 to 1948.

Supplement	Average daily gain (lbs. per head)		Return per steer (dollars)		Dressing percentage	
	1943-5	1946-8	1943-5	1946-8	1943-5	1946-8
None	2.14	2.17	3.44	44.98	54.5	56.7
Mineral <sup>1</sup>	2.09	—	3.53	—	55.5	—
Ground shelled corn	2.41	2.51	5.10	64.26	56.8	57.9
Cottonseed cake (43%)	2.59	2.57	5.15	59.03	57.5	57.5
None to July 1; cottonseed cake thereafter	—	2.44	—	59.97	—	57.7

<sup>1</sup> In 1943, equal parts of salt and bone meal; 1944, equal parts ground limestone and bone meal; and 1945, equal parts salt, ground limestone, and bone meal.

As an average of the six years, the cottonseed cake steers slightly outgained the corn lots (0.12 pound per head per day). The steers receiving corn outgained the straight grass steers about a third of a pound per head per day.

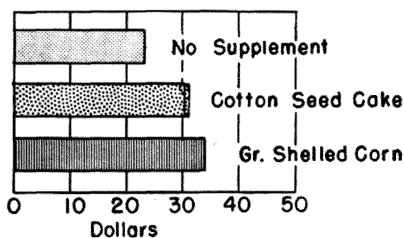


FIGURE 4.—Return per steer in comparison of cottonseed cake and ground corn as a supplement. (Data from Table VI.)

The difference in gain between the grass steers and those fed concentrate was mostly during the latter part of the season, just as was the case in 1943 and 1944.

The additional gain made by the corn and cottonseed cake lots was not enough to pay for the feed. However, the concentrate-fed steers sold at a price enough higher to make the feeding profitable; and the dressing percentages indicate that these steers were enough fatter for the difference to show on the killing floor.

## Summary

A total of 728 two- and three-year-old Hereford steers were used over a period of six years in comparing straight-grass cattle with those receiving mineral, energy, and protein supplements. The experimental pastures were predominantly long grasses of the bluestem type, but also included some short grasses and some areas of previously plowed land carrying grasses of a lower type. Essential elements from the results are shown in Table VII. Chemical analyses of blood plasma, made at the beginning and end of each trial, showed values for calcium and phosphorus in all lots to be within the range considered normal.

