Bulletin No. B-470 June, 1956

Feeding Trace Minerals To Beef Cattle in Oklahoma

By
A. B. Nelson, Robert Totusek
L. S. Pope, W. D. Gallup, and
R. W. MacVicar

OKLAHOMA A&M COLLEGE
DIVISION OF AGRICULTURE
SCIENCE SERVING AGRICULTURE
EXPERIMENT STATION

CONTENTS

Feeding Trace Minerals to Beef Cattle in Oklahoma

A. B. Nelson, Robert Totusek, L. S. Pope, W. D. Gallup and R. W. MacVicar[1]

Thirteen mineral elements are recognized as essential to the animal body. Mineral deficiency disorders develop when these elements are not provided in the feed in adequate amounts. Seven minerals are required in relatively large amounts. They are calcium, phosphorus, sodium, potassium, chlorine, magnesium, and sulfur. The minerals, iron, copper, cobalt, iodine, manganese, and zinc, are required in small amounts and are called trace minerals. The latter usually are adequately provided in practical rations fed under most farm conditions. However, deficiencies have been reported in feed crops produced in certain areas of the United States.

In order to determine the value of feeding trace mineral mixtures to range beef cattle, tests have been conducted in three areas of Oklahoma by the Oklahoma Agricultural Experiment Station. The results of tests conducted in the period 1949-1955 are summarized in this bulletin. The experimental areas were as follows: Experiment I, Lake Carl Blackwell Experimental Range Area, near Stillwater in the north central part of the state; Experiment II, Range Cattle Minerals Station, near Wilburton in the southeastern area; and Experiment III, Ft. Reno Experiment Station, near El Reno in the central part of the state.

Experiment I. Lake Carl Blackwell Experimental Range Area, Stillwater

Procedure

In the fall each year of 1953 and 1954, 2- and 3-year-old grade Hereford stocker cows were divided into two lots. A different group of cows was used each year. Both Lots 1 and 2 were fed approximately 2 pounds of pelleted cottonseed meal per head daily as a winter supplement to the native pasture grass. The pellets were fed every other day in a trough. Most of the two-year-old heifers had produced a calf

[1] Respectively: Associate Animal Husbandman, Nutrition; Assistant Animal Husbandman; Associate Animal Husbandman; Research Chemist; Head, Department of Agricultural Chemistry. Others associated with the work included J. D. Blucker, A. E. Darlow, B. Davis, M. E. Gibson, P. E. Loggins, J. A. Nance, O. B. Ross, D. F. Stephens, J. C. Street, V. A. Swader.

the preceding spring; however, they were not rebred until January of the winter they were on this experiment. Both lots had access to a mineral mixture of two parts salt and one part steamed bonemeal. The cows of Lot 2 were fed trace minerals, in addition. The trace mineral mixture was mixed with a small amount of cottonseed meal and spread over the remainder of the protein supplement. The trace minerals were added in such amounts that the cows consumed approximately 10.0 mg iron, 1.0 mg copper, 0.2 mg cobalt, 0.2 mg iodine, and 50.0 mg manganese per 100 pounds of bodyweight.

The cattle were weighed at approximately monthly intervals throughout the winter. The tests were terminated in late March of each year and winter weight gain was used as the measure of the value of the mineral additions.

Results

The feeding of a trace mineral mixture during the winter had no apparent value in these tests with stocker cows. A long-time feeding experiment might give different results than those obtained in these short wintering tests.

The average winter gain of cows is given in Table I. The gains of both groups were essentially the same. The cows fed pelleted cottonseed meal as a supplement to dry grass gained an average of 18 pounds per head during the experimental period. Those fed a trace mineral mixture with the cottonseed meal supplement gained an average of 14 pounds. The cost of the trace minerals was $0.60 per cow for the season.

Table I.—Value of Trace Minerals for Wintering Stocker Cows at the Lake Carl Blackwell Range Area, Two-Year Average.

Comparisons	Lot 1 No trace minerals	Lot 2 Trace minerals
Total number of cows	46	48
Average weight per cow (lb.)		
Initial[1]	720	722
Final	738	736
Gain	18	14
Cost of trace minerals ($)	---	0.60

[1] The tests were conducted 12-15-53 to 3-18-54 and 10-20-54 to 3-24-55. Different lots of cows were used each year.

Experiment II. Range Cattle Minerals Station, Wilburton

Part 1. Feeding Trials with Beef Heifers

Procedure

In the fall of 1949, 20 weanling heifer calves were equally divided into two lots. The heifers in both lots were fed prairie hay, free-choice, 1.25 pounds corn gluten meal, salt, and sufficient dicalcium phosphate to provide a daily intake of 2.5 grams of phosphorus per 100 pounds of bodyweight (about ½ ounce of dicalcium phosphate per animal per day). In addition, the heifers of Lot 2 were fed trace minerals. For each gram of potassium iodide in the mineral mixture there was 115 grams ferric sulfate, 27 grams ferric oxide, 3 grams cobalt sulfate, 592 grams manganese sulfate, and 15 grams copper sulfate ($5H_20$). A small quantity of sodium thiosulfate and sodium carbonate was included to prevent the loss of iodine. These minerals were fed at approximately the same rate as was fed in Experiment I near Stillwater. During the winter months, this mineral mixture was fed in a trough with the corn gluten meal. During the summer season, when the heifers were on the range, the minerals were mixed with salt in sufficient amounts to maintain approximately the same trace mineral intake as during the winter.

As the experiment progressed, it was observed that the heifers fed the trace mineral mixture were making the smaller gains. Chemical analysis of the native grass and hay showed that it had an unusually high content of manganese. To test the possibility that the manganese provided in the grass and hay plus that provided in the mineral mixture interfered with growth, another experiment was started in the fall of 1950.

In the 1950 experiment, a second group of weanling heifer calves was divided into two lots designated as Lots 3 and 4. The heifers of Lot 3 were fed the same ration as was fed Lot 1 in 1949 (no trace minerals) and Lot 4 was fed the same ration plus the trace mineral mixture without manganese. In this test the heifers were fed approximately 20 mg of copper and 200 mg of iron. This was approximately four times the estimated normal requirement. The 20 yearling heifers which were used in the 1949-50 experiment as calves were redivided into two lots. The yearling heifers of Lot 5 were fed the same ration as the calves of Lot 3 (no trace minerals), and those of Lot 6 were fed the same ration as the calves of Lot 4 (trace minerals without manganese). Blood samples were obtained at intervals throughout the year for chemical determinations, including plasma phosphorus, plasma protein, and hemoglobin.

Results

Growth data are summarized in Table II.

The heifer calves in Lot 1 gained 72 pounds during the winter of 1949-50, while those of Lot 2, fed the trace minerals, gained 56 pounds. The heifers fed the trace minerals had longer hair coats and appeared less thrifty than those of Lot 1. During the summer period, the heifers of Lot 1 gained 148 pounds while those of Lot 2 gained 166 pounds. Consequently, the total yearly gain per animal was about the same for each lot, 220 and 222 pounds for Lots 1 and 2, respectively. No differences in thriftiness and general appearance were apparent at the end of the summer period.

In the 1950-51 experiment the trend of results was reversed. The weanling heifer calves fed the trace mineral mixture without manganese, Lot 4, gained 13 pounds more (80 vs. 67 pounds) during the winter, 3 pounds more (201 vs. 198 pounds) during the summer, or a total of 16 pounds more (281 vs. 265 pounds) during the year than the heifers not fed the trace minerals, Lot 3. These differences were not considered significant. The two groups of heifers were similar in appearance. The yearling heifers of Lot 5, however, gained 9 pounds more during the winter, 13 pounds more during the summer, or a total of 22 pounds more during the year than the yearling heifers of Lot 6 fed additional trace minerals. Again, the differences in gain were not considered significant. During 1950-51 there were only small, in-

Table II.—Effect of Feeding Trace Minerals on Gains of Heifers in Southeastern Oklahoma, Wilburton. (Weight and gain in pounds)

	Weanling heifers 1949-50		Weanling heifers 1950-51		Yearling heifers 1950-51	
Comparisons	Lot 1 No trace mineral	Lot 2 Trace mineral	Lot 3 No trace mineral	Lot 4 Trace mineral[1]	Lot 5 No trace mineral	Lot 6 Trace mineral[1]
Number of animals	10	10	10	9[2]	10	10
Weight, beginning of period	352	352	362	362	560	560
Weight, end of winter period	424	408	429	442	605	596
Gain during winter period	72	56	67	80	45	36
Weight, end of summer period	572	574	627	643	849	827
Gain during summer period	148	166	198	201	244	231
Total gain for year	220	222	265	281	289	267

[1] Manganese not included.
[2] One calf removed from the experiment because of coccidiosis.

consistent differences between lots of calves in hemoglobin and plasma phosphorus values. (See Appendix Table I). Plasma phosphorus values were slightly higher for the yearling heifers fed the trace mineral supplements while the hemoglobin values were practically the same.

Part 2. Feeding Trials with Beef Cows

The performance of beef cattle in the experimental herd near Wilburton, was below normal from 1947 to 1951 as measured by percentage calf crop, weaning weight of calves, and growth of heifers after weaning. Supplemental phosphorus feeding greatly improved the growth rate of weanling heifers but only slightly improved the reproductive performance of cows. One of the suggestions regarding the possible causes of reproductive failures was a deficiency of trace minerals. The feeding of trace mineral mixtures had little apparent affect on the growth rate of weanling and yearling heifers from 1949 to 1951 (see Part 1, Experiment II), but trace minerals had not been fed to reproducing cows prior to 1951.

To determine the value of feeding trace minerals to beef cows in Southeastern Oklahoma, the following experiment was started at Wilburton in the fall of 1951.

Procedure

These trials originally consisted of 40 head of 2-year-old grade Hereford heifers which were divided into 2 groups of 20 head each. Both groups had access to native tall-grass pasture yearlong and received no other roughage at any time. Cattle were rotated among the pastures at regular intervals to minimize pasture differences. During the winter, all cows were fed an average of 2.5 pounds of cottonseed cake per head daily. An adequate intake of supplemental phosphorus was insured at all times. During the first 2 years, bonemeal was fed by pouring it over the cottonseed cake during the winter and monsodium phosphate was force-fed in drinking water during the summer. Salt was fed free-choice. During the third and fourth year, a high intake of phosphorus was encouraged by adding cottonseed meal to a mineral mixture of 2 parts bonemeal and 1 part salt.

Lot 1 received no supplemental trace minerals. Lot 2 was fed the trace minerals iron, copper, iodine, and cobalt at levels to supply approximately 100 mg iron, 10 mg copper, 2 mg iodine, and 2 mg cobalt per cow daily. The trace minerals were fed during the first two years by pouring them over the cottonseed cake in winter and by mixing them with the salt in summer, and during the third and fourth years by adding them to the mineral mixture.

Cows were pasture bred to purebred Hereford bulls from May 1 to September 1. Most of the calves were dropped in February and March; calves were weaned in October of each year. Cows and calves were weighed at approximately 6-week intervals, and one-half of the cows in each lot were bled several times each year for the determination of blood plasma phosphorus, hemoglobin, and red blood cells.

Results

Weight changes and productivity of the cows are shown in Table III. These results are a summary of four consecutive years.

Trace minerals had little apparent influence on the weight of cows. The average weights of cows in the control and trace mineral groups did not differ greatly during the 4 years of the experiment, and the average winter losses, summer gains, and yearly gains were very similar. No differences in appearance of the cows were noted at any time. Blood plasma phosphorus, hemoglobin and red blood cell values were similar and apparently not influenced by trace mineral feeding.

Feeding supplemental trace minerals likewise had little apparent influence on the productivity of the cows. Cows that were fed sup-

Table III.—Effect of Feeding Trace Minerals on Weight and Performance of cows at Wilburton (Southeastern Oklahoma) over a period of 4 years, 1951-1955.

	Lot 1 No trace minerals	Lot 2 Trace minerals
Total number of cows	74[1]	80
Average weight per cow (lb.)		
Initial 10-31-51	807	810
4-11-52	723	764
11-7-52	899	927
4-10-53	838	859
11-12-53	1016	1050
4-14-54	889	901
11-9-54	951	972
4-20-55	869	916
Final 11-16-55	1103	1118
Average weight gain or loss		
Winter	—88	—80
Summer	162	157
Yearly	74	77
Production of cows		
Av. birth weight of calves (lb.)[2]	72	71
No. of calves weaned	70	72
Av. weaning weight of calves (lb.)[3]	442	444

[1] One cow died at calving time the first year and one cow killed by lightning the third year.
[2] Corrected for sex by adding 5 pounds to the birth weight of each heifer.
[3] Corrected for age by adjusting all calves to a standard age of 210 days, and for sex by adding 25 pounds to the age corrected weight of each heifer.

plemental trace minerals weaned slightly fewer calves than cows that did not receive trace minerals (90 percent compared to 95 percent average calf crop.) However, this difference was small and was probably not caused by the experimental treatments, since several of the calf deaths were due to pinkeye and losses at castration and dehorning. The average birth weights and weaning weights of the calves with and without trace minerals for the 4 years were almost identical.

Experiment III. Fort Reno Experiment Station, El Reno

Procedure

Three wintering trials were conducted with yearling and two-year-old steers to determine the value of adding trace minerals to three different protein supplements. This study was part of a larger experiment in which cottonseed, soybean, and soybean-sesame meals were compared as supplements for wintering big steers on native grass. The calcium and phosphorus content of the three supplements was equalized by additions of steamed bone meal and ground limestone.

In each of three years a different group of steers was started on experiment in early November. They were allotted after an overnight shrink in drylot. Two-year-old Hereford steers were used in the first (1950-51) and third (1952-53) trials and yearlings in the second trial (1951-52). They were each allowed 8 to 10 acres of native grass pasture in which buffalo, side oats grama, and blue grama were the predominant species. The lots were rotated among the pastures at approximately monthly intervals to reduce the effect of pasture differences. The trials ended in early March of each year, and final weights were obtained after an overnight shrink in drylot. The steers were then appraised as feeder cattle by a committee from the Oklahoma City Livestock market.

In each of three trials, the steers were fed, salt, free choice, in addition to the following supplements:

Lot 1. Cottonseed meal and ground limestone.

Lot 2. Same as Lot 1 plus trace minerals.

Lot 3. Soybean meal and steamed bone meal.

Lot 4. Same as Lot 3 plus trace minerals.

In the first trial (winter of 1950-51) two additional lots were included:

Lot 5. Soybean meal (2 parts), sesame meal (one part) and steamed bone meal.

Lot 6. Same as Lot 5 plus trace minerals.

The protein supplement was fed every other day. In different years the amount varied from 1.5 to 3.0 pounds per head daily, depending on the age of the cattle and the condition of the pastures. The amount was also adjusted to provide approximately the same supplemental protein to all lots of cattle within each trial.

The trace mineral mixture* was a commercial product. In the first two trials, the minerals were weighed separately and poured over the protein supplements in sheltered feed bunks. In the last trial, they were mixed with the protein supplements, in a large vertical mixer. It was estimated that 0.86 grams of trace mineral mixture which was fed per steer daily, supplied 2.8 mg cobalt, 63 mg manganese, 2 mg zinc, 6.6 mg copper, and 127 mg of iron.

Results

The average results obtained are summarized in Table IV. The winter gains of steers fed either cottonseed meal or soybean meal with and without trace minerals were essentially the same. In the single comparison where the soybean-sesame meal mixture was fed, the addition of trace minerals showed some advantage in promoting daily gains, although there was much variation in response. In only two out of seven possible comparisons did the addition of the trace mineral mixture increase winter gains of steers in this experiment. The trace minerals did not increase the bloom or thriftiness of the cattle, as judged by their appraised market value as feeder cattle, except in the first trial with the soybean-sesame meal supplement.

These tests were conducted in an area where there was no previous history of a trace mineral deficiency. The area had never been farmed, although it had been rather heavily grazed for several years previous to the test. Results obtained at this location are possibly not applicable to areas that have been under cultivation for some time, or to areas where the soil is eroded and of low fertility.

Summary

Tests were conducted in three areas of Oklahoma to study the value of adding trace minerals to the rations of range beef cattle. When the cattle were provided an adequate amount of roughage (prairie hay or native grass pastures), properly supplemented with protein, phosphorus, and salt, the feeding of supplemental trace minerals was of no apparent benefit.

---

* Trace mineral mixture was supplied by the Calcium Carbonate Company, Chicago, Ill.

Table IV.—Effect of Adding Trace Minerals to Protein and Mineral Supplements for Wintering Steers on Native Grass at Ft. Reno (131 days)[1].

Comparisons	Cottonseed meal and ground limestone		Soybean meal and bone meal		Soybean-sesame meal and bone meal	
	Lot 1	Lot 2 (Trace minerals)	Lot 3	Lot 4 (Trace minerals)	Lot 5	Lot 6 (Trace minerals)
Total number of steers	58	57[2]	58	58	20	20
Average weight per steer (lb.)						
Initial, November 9	889	889	889	889	948	948
Final, March 20	910	904	905	908	936	957
Total gain or loss	21	15	16	19	—12	9
Appraised values as feeders ($)	28.08	28.08	28.08	28.08	32.50	33.75

1 Average of three separate trials for Lots 1, 2, 3, and 4; single trial for Lots 5 and 6.

2 One steer removed from Lot 2 because of sickness; data for that steer not included.

Appendix Table I.—Phosphorus and Hemoglobin Values[1] of Blood from Yearling and Weanling Heifers (1950-51).

Date	10-23-50	12-20-50	1-30-51	3-15-51	4-24-51	6-11-51	7-26-51	9-18-51	10-23-51	Year Ave.
Lot 3 — Weanling heifers not fed trace minerals										
Phosphorus	6.29	7.01	7.31	7.08	7.84	5.42	4.19	7.29	6.02	6.49
Hemoglobin	10.6	10.3	10.2	9.8	9.8	10.0	11.4	10.7	10.3	10.2
Lot 4 — Weanling heifers fed trace mineral mixture										
Phosphorus	6.06	6.42	6.41	6.98	7.28	5.76	4.12	4.99	5.47	6.03
Hemoglobin	10.1	10.5	10.3	10.4	10.4	10.0	11.1	11.7	10.9	10.6
Lot 5 — Yearling heifers not fed trace minerals										
Phosphorus	5.04	5.75	6.37	5.74	6.61	4.65	4.57	4.51	3.89	5.23
Hemoglobin	11.4	10.7	10.9	10.2	10.0	10.8	13.6	12.5	11.8	11.3
Lot 6 — Yearling heifers fed trace mineral mixture										
Phosphorus	5.54	6.51	6.38	7.22	7.13	5.85	5.10	5.12	4.68	5.95
Hemoglobin	10.6	10.6	11.5	11.0	11.0	11.3	13.2	12.4	11.8	11.5

[1] Phosphorus (inorganic) in mg per 100 ml of plasma; hemoglobin in gm per 100 ml of blood.

6-55—4½M.