B-174

minerals

FOR BEEF CATTLE

TEXAS A&M UNIVERSITY
TEXAS AGRICULTURAL EXTENSION SERVICE
J. E. Hutchison, Director, College Station, Texas

In Brief....

1. Supply granulated **Salt:**
   a. Free choice in mineral feeder for all cattle (except in those areas along the coast where cattle do not lick salt).

2. Supply **Phosphorus** through:
   a. Pasture fertilization—good only when a grazing crop is growing.
   b. Two parts by weight of steamed bonemeal and one part salt in mineral box.
   c. Soluble phosphate compounds by hand in controlled drinking water.
   d. Monosodium phosphate by automatic dispenser in controlled drinking water.

3. Minerals are not "cure-alls," yet are essential along with proteins, carbohydrates, fats and vitamins.

4. Mineral requirements vary with age, sex and purpose of cattle as shown in Table 1. The calcium and phosphorus content varies in feeds as shown in Table 2.

5. Supply **Calcium** through pulverized limestone or oystershell flour in the ration for fattening weaned calves.

6. Research in Texas indicates no beneficial results from feeding "trace minerals". Trace minerals usually are present in adequate amount in natural feedstuffs.

7. Using feeds in mixtures which increase consumption of minerals by cattle are of doubtful merit. Examine the feed tag and calculate the cost of available phosphorus (P).

MINERALS FOR BEEF CATTLE

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BEEF CATTLE NEED MINERALS. The ones most likely to be needed are sodium, chlorine, phosphorus and calcium. Small amounts of sulfur, iodine, copper, cobalt, magnesium, potassium, iron, manganese, zinc, molybdenum and selenium are required and are spoken of as "trace" minerals.

Trace minerals are supplied in sufficient amounts from natural forage, water and balanced rations. Sodium and chlorine are supplied by feeding common salt. Phosphorus and calcium frequently require special attention and are treated in more detail.

TABLE 1. Recommended daily dry feed, calcium and phosphorus allowances for beef cattle*

Class of Cattle	Weight lb.	Daily feed lb.	Calcium Ca oz.	Phosphorus P oz.
Wintering weaned calves	400	11	.56	.42
	500	13	.56	.42
	600	15	.56	.42
Wintering yearlings	600	16	.56	.42
	700	17	.56	.42
	800	18	.56	.42
Wintering bred heifers	700	20	.63	.56
	800	20	.63	.56
	900	18	.56	.53
Wintering mature bred cows	800	22	.78	.63
	900	20	.63	.56
	1000	18	.56	.53
	1100	18	.56	.53
	1200	18	.56	.53
Cows nursing calves	900–1100	28	1.06	.85
Bulls, growth and maintenance	600	16	.85	.63
	800	18	.81	.63
	1000	22	.78	.63
	1200	24	.74	.63
	1400	26	.71	.63
	1600	26	.63	.63
Fattening calves finished as short yearlings	400	12	.71	.53
	500	14	.71	.56
	600	16	.71	.60
	700	18	.71	.63
	800	20	.71	.63
Fattening yearlings	600	18	.71	.60
	700	21	.71	.63
	800	22	.71	.67
	900	24	.71	.71
	1000	26	.71	.71
Fattening two-year olds	800	24	.71	.71
	900	26	.71	.71
	1000	27	.71	.71
	1100	29	.71	.71

*Reprinted in part from TAES Bulletin 461 Revised.

Generally, green grazing supplies all needed minerals, but dry grazing may not supply sufficient phosphorus, the most deficient mineral. Minerals available to cattle through grazing vary according to the minerals in the soil and stage of plant growth.

Mineral requirements vary with the age, sex and purpose of cattle. Table 1 shows the daily requirement for calcium, phosphorus and also dry feed.

Some feeds, Table 2, are naturally high in these minerals and when they are being fed in sufficient amounts little to no mineral supplements are necessary.

Mineral supplement consumption fluctuates directly with nature and management. It may vary according to seasonal grazing conditions or stages of grass growth. Consumption may vary also by changing mineral supplements or according to the palatability of the supplement. Cattle mineral requirements, Table 1, remain fairly constant for their weights and supplements are needed during certain periods to balance their ration.

For simplicity this publication refers to mineral nutrients, mineral compounds or elements as "minerals."

SUPPLYING SALT

On some Texas grazing areas cattle require no supplemental salt because forage or drinking water may have adequate amounts of sodium and chlorine. In most areas cattle should have access to salt, preferably granular, at all times. The average cow consumes about 26 pounds of supplemental salt per year.

SOIL PHOSPHORUS

Figure 1 shows the phosphorus situation in Texas soils. This mineral is adequate only in the green growth stage of grasses. On soils low in phosphorus, the green grass will be more deficient than on soils medium to high in phosphorus. Seasonal changes influence this natural source; therefore, management practices should insure against a deficiency.

TABLE 2. Calcium and phosphorus composition of certain feeds.

Feeds	Calcium		Phosphorus	
	Percent	Oz. per lb.	Percent	Oz. per lb.
Alfalfa hay	1.04	.16	.21	.03
Bonemeal, special steamed	28.70	4.60	13.90	2.22
Bonemeal, steamed	30.00	4.80	13.90	2.22
Cottonseed meal—41% Protein	.20	.03	1.11	.17
Defluorinated superphosphate	28.30	4.50	12.30	1.96
Dicalcium phosphate	26.50	4.20	20.50	3.28
Disodium phosphate (crystalline)	.00	.00	8.60	1.37
Johnsongrass, dried, bloom	.58	.09	.21	.03
Limestone	38.30	6.10	.00	.00
Meat and Bone Scraps—50% Protein	9.65	1.5	4.81	.76
Monocalcium phosphate	16.00	2.50	24.00	3.84
Monosodium phosphate (anhydrous)	.00	.00	25.00	4.00
Oystershell flour	36.90	5.90	.00	.00
Peanut meal—41% Protein	.17	.03	.44	.07
Sorghum hay	.46	.07	.14	.02
Soybean oil meal	.26	.04	.61	.09
Spent bone black	22.00	3.50	13.10	2.09
Tankage—60% Protein	5.88	.94	3.14	.50

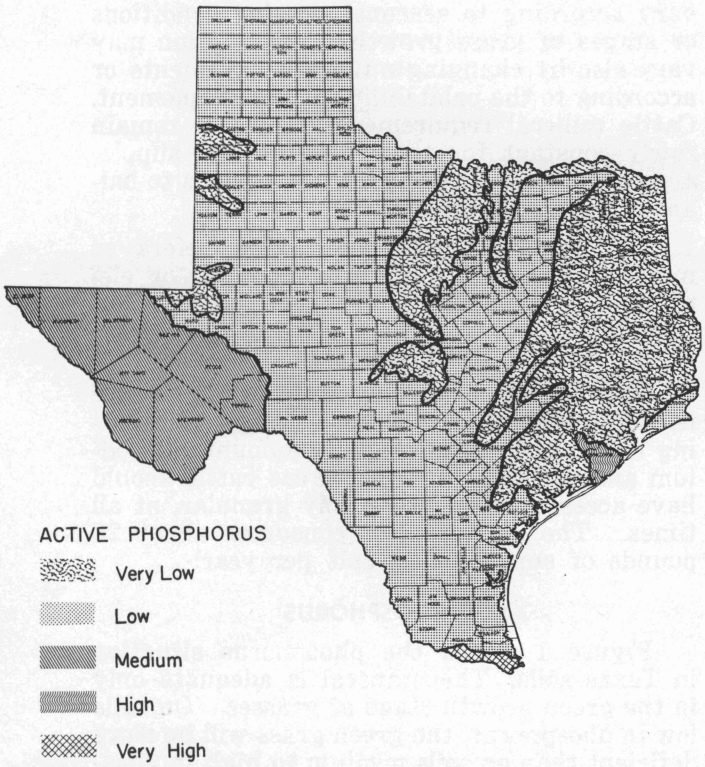

Fig. 1. Active phosphorus in Texas soils. Taken from Tex. Agr. Exp. Sta. Bulletin 549.

Phosphorus Deficiency Symptoms

The cow in Figure 2 shows the effects of a phosphorus deficiency known as "creeps."

Behind that "creepy" condition lies a series of contributing factors: Deficiency of phosphorus in the soil results in a deficiency of phosphorus in the grasses. This leads to a phosphorus deficiency in the animal.

An early symptom of phosphorus deficiency in cattle is depraved appetite indicated by chewing bones, sticks, boards, stones and dead animal materials. The depraved appetite may result in a secondary disease characterized by paralytic symptoms. It is called "loin disease" and is caused by toxins produced by microorganisms of the botulinus type commonly found in dead animal material.

Phosphorus deficiency causes loss of appetite and weight, decline in milk production, poor calf crop and failure to breed. With prolonged phosphorus deficiency, cows become lame and stiff at the joints or "creepy."

Cows fed phosphorus supplements on pastures deficient in phosphorus may average as much as 200 pounds heavier than cows not fed the supplements. Calves may weigh 50 to 70 pounds more at weaning age. Feeding phosphorus supplements can increase the calf crop as much as 30 percent. Cows with adequate phosphorus breed earlier after calving.

When and Where Deficiencies Occur

Phosphorus deficiency may occur at times in all sections of Texas. In some sections the deficiency always exists. Where the soils are most deficient in phosphorus, the deficiency worsens when the forage matures or when cold or drouth stops forage growth. Year-round use of phosphorus supplements will increase production in such areas.

In regions where rainfall is less than 30 inches a year, the young growing grasses usually are rich in phosphorus. Since the phosphorus content diminishes with maturity, the dry and mature grasses are very low in the mineral and do not contain enough phosphorus for cattle of any age. Therefore, a phosphorus supplement should be made available at certain times of the year. However, the deficiency in such areas seldom become serious because cattlemen usually feed concentrates containing phosphorus during the winter. Cottonseed cake and cottonseed long have been known as good feeds for "creepy" cows. However, a free choice phosphorus supplement supplied in late summer and fall would be good insurance.

SUPPLYING PHOSPHORUS

Practical methods of supplying phosphorus to range cattle include: (1) soluble phosphorus

in the drinking water, (2) phosphorus supplements in mineral feeders and (3) fertilizing pastures with superphosphate.

In one 5-year experiment with breeding cows on a deep, sandy soil in the 20 to 25-inch rainfall belt, all three methods were used. Over the 5-year period good results were obtained by the use of disodium phosphate in the controlled stock water. Results from a surface application of 400 pounds per acre of 20 percent superphosphate were good, except that the plants could not draw phosphorus from the soil during drouth. Supplying steamed bonemeal in self-feeders increased production over that from native pasture without supplements.

Phosphates in Water

Where it is possible to control the water supply of cattle, such as from wells, adding phosphorus to the water may be the most satisfactory method of correcting phosphorus deficiency. This is especially true during periods of prolonged drouth. The materials may be added to the water troughs by hand, but an automatic dispenser, Figure 3, adds the desired amount of phosphate solution to a given amount of water. It can be used with almost any type of controlled water system.

The phosphorus compounds recommended for use in stock water are disodium phosphate (crystalline or anhydrous) and monosodium phosphate (anhydrous).

Stock Solution for Automatic Dispenser

The automatic dispensing machine requires the use of a stock solution. This solution should contain 2½ pounds of monosodium phosphate per gallon of water or 100 pounds to 40 gallons water. Disodium phosphate tends to clog the machine and should not be used.

Hand Method of Supplying Phosphorus in Water

Soluble phosphate compounds may be added to the drinking water by hand. Any of the following products are recommended except in earthen tanks or ponds:

Disodium phosphate (crystalline)—20 pounds per 1,000 gallons water

Disodium phosphate (anhydrous)—10 pounds per 1,000 gallons water

Monosodium phosphate (anhydrous)—8 pounds per 1,000 gallons water.

Phosphorus requirements and water consumption vary in different regions, but recommendations for general use call for ¼ ounce of phosphorus per 8 gallons of water or ¼ ounce per head daily. This is the proportion used most successfully in the 5-year experiment mentioned.

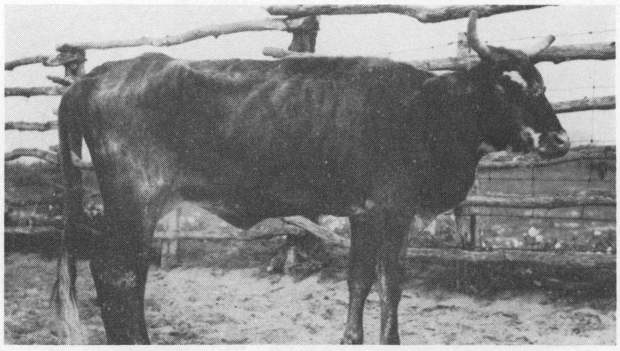

Fig. 2. This cow shows the effects of a phosphorus deficiency.

Phosphorus Supplements Free Choice In Mineral Feeders

Sheltered mineral feeders, Figure 4, lessen waste because they protect expensive mineral supplements from wind and rain. Several designs are available. The weathervane type is satisfactory if kept level and treated with rust preventive material. The feeding trough should be 12 to 18 inches from the ground to permit calves free access to the mineral. The feeding box could be divided so that salt only may be supplied in one compartment and other minerals in the other. This is favored during periods when there is little need for additional phosphorus, assuming that cattle consume phosphorus as needed.

A mixture of one part salt and two parts steamed bonemeal by weight is recommended widely for self-feeding on pasture in the highly phosphorus deficient areas. Half and half mixes probably are used most under borderline conditions. In highly saline areas, as in sections of the Gulf Coast, the bonemeal is supplied without salt. Spent bone black is used often instead of bonemeal and in the same manner, since both products contain near equal amounts of phosphorus. In general, phosphorus supplements of mineral origin, such as defluorinated superphosphate, dicalcium phos-

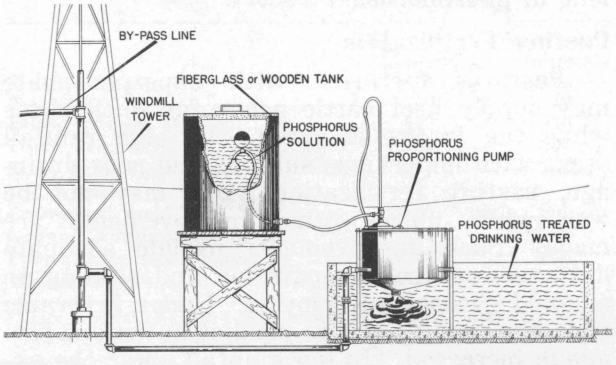

Fig. 3. An automatic dispenser which can be used with almost any type of controlled water system.

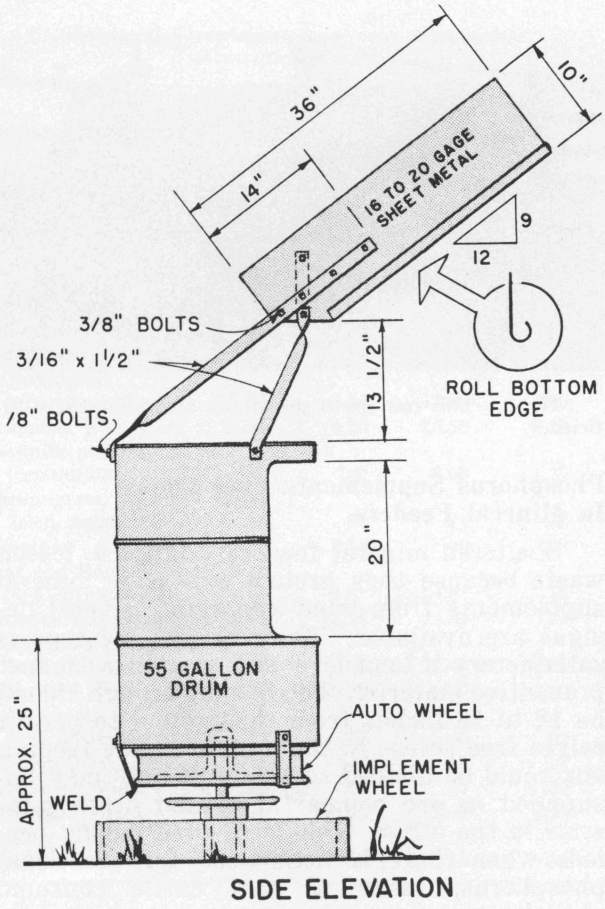

Fig. 4. Mineral feeders prevent waste. Order Blueprint No. 356 or weathervane type, No. 5844.

phate and disodium phosphate (crystalline), are not palatable. Cattle will not eat enough of these to prevent phosphorus deficiency if self-fed. They may be mixed with other materials such as cottonseed meal to increase consumption. Two pounds of 41 percent cottonseed meal or cake supply about 9 grams of phosphorus, or as much as is contained in 3 ounces of bonemeal. This is slightly more than the minimum daily supplemental needs of phosphorus for cattle on pastures markedly deficient in phosphorus.

Pasture Fertilization

Pastures fertilized with superphosphate may supply beef cattle needs for phosphorus while the forage is green. In high rainfall areas with impervious subsoils and poor drainage, pasture fertilization alone may not be worthwhile unless other improvements are made. Such improvements include adequate drainage, seedbed preparation and seeding to adapted grasses and clovers. Under favorable moisture conditions, the yield of nutritious forage is increased. In low rainfall areas the expense of pasture fertilization may not be justified.

When Phosphorus Supplements Are Needed

Late summer, fall and winter are the critical periods in all areas. Phosphorus supplements are recommended daily in all phosphorus deficient areas.

Cattle consume little or no phosphorus supplement, except seasonally, where the soil has adequate phosphorus or if the cattle are being fed as much as 2 pounds daily of 41 percent protein supplement. However, most cattlemen prefer to have a phosphorus supplement available at all times.

SUPPLYING CALCIUM

Pasturage and forage in most parts of Texas contain enough calcium, Figure 5. Rations of grains and grass hays, however, do not contain enough calcium for the growth and fattening of weaned calves, and rickets may develop in barn-reared young calves.

Pulverized limestone and oystershell or finely ground limestone containing 92 to 98 percent calcium carbonate are the common calcium supplements. Lumber yard lime is not recommended for use as a calcium supplement since it may not be completely slaked.

Legume hays, such as alfalfa, clover or peanut, are high in calcium compared with grass hays, such as Johnsongrass or other sorghums. When cattle are fattened on grain and grass hays, it is advisable to feed about 1/10 pound of limestone flour or pulverized oystershell per head daily as a calcium supplement. This should be mixed with the ground grain and protein supplement. Fattening rations providing 3 to 4 pounds of alfalfa hay per head daily for yearling or older cattle need not be supplemented. Calves should get the supplement even with the alfalfa, since they have a high calcium requirement for growth and because they have a limited capacity for hay. Steamed bonemeal contains enough calcium to supply herd requirements.

TRACE MINERALS

Only small amounts of trace minerals are required. Those which have been recognized as essential are sulfur, iodine, copper and cobalt. Others believed to be essential for beef cattle are magnesium, potassium, iron, manganese, zinc, molybdenum and selenium.

Trace minerals have been widely discussed and publicized. They may or may not be deficient in feeds consumed by beef cattle. Certain areas of the world are deficient in certain trace minerals. A few such areas have been identified in the United States, but so far none in Texas. Deficiencies possibly could exist where high rates of commercial fertilizers have been applied on irrigated land. Under these

conditions the trace minerals may have been depleted by successive removal of high tonnages of forage. Some soils may have become eroded so badly that certain trace minerals have been lost.

Feeding trace mineral mixtures has not proved profitable nor beneficial where research has been conducted in Texas.

The East Texas Pasture Investigations Station at Lufkin, Texas, force fed five groups of Hereferd heifers copper, cobalt, iron and bonemeal in comparison with a check group receiving only salt as a lick. Copper, cobalt and iron were administered by a daily drench. The bonemeal was fed with a spoon. All had salt as a lick and the treatments were for 1 year. Gain favored the copper solution group over the controls by 42 pounds per head. The treatments were continued on the same cattle after calving. There was no difference in weight among the groups when the calves were weaned. However, when the same treatments were applied to the calves through the first winter after weaning, the calves receiving copper had gained 24 pounds more per head.

The group receiving bonemeal raised more calves and an analysis of the pasture forage indicated a deficiency of phosphorus.

Trace minerals fed to calves in feedlot at College Station for 100 days, Table 3, did not prove beneficial.

Trace Mineral Deficiency Symptoms and Treatment

Sulfur

Amino acids containing sulfur are required by the animal body. Sulfur may be supplied in cattle rations in organic or inorganic form. When rations contain urea to partially supply the protein needs of cattle either methionine or inorganic sulfur supplements, such as sulfate or flowers of sulfur, may prove beneficial. Some studies, however, have shown no benefit from adding supplemental sulfur to practical rations containing as much as 40 percent of the nitrogen in the form of urea, presumably due to adequate supplies of sulfur already in the ration.

Iodine

Iodine requirements have been established for dairy cattle but not for beef cattle. Salt containing stabilized iodine (0.0076 percent iodine) will prevent symptoms of deficiency. Iodine deficiency usually results in the production of dead or weak goitrous calves. Texas' feedstuffs apparently contain sufficient iodine.

Copper

Copper deficiency is an area problem. Symptoms include depraved appetite, loss of condition, stunted growth, rough hair coat and anemia. Diarrhea may vary from intermittent to severe. Estrus is suppressed. Young calves may have straight pasterns and stand forward on their toes. Animals may suddenly fall dead after little or no struggle. Deficiencies have occurred in beef calves kept on nurse cows long after the normal weaning age. Copper deficiency can be prevented by adding 0.25 to 0.5 percent copper sulfate to salt and fed free-choice.

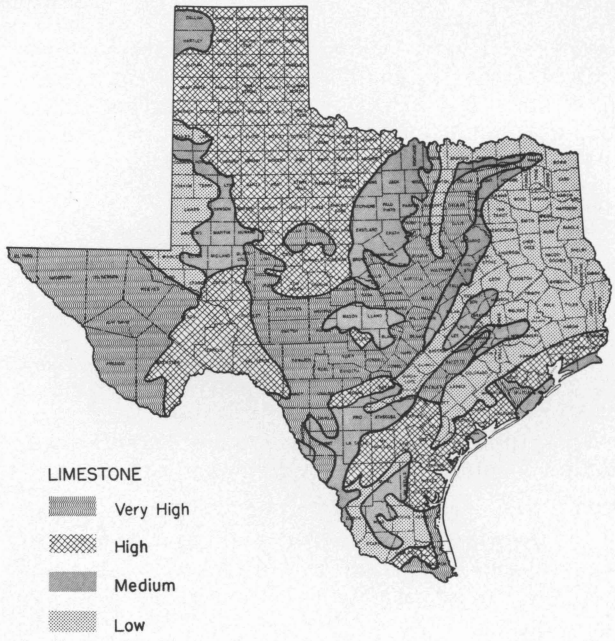

Fig. 5. Limestone in Texas soils. Data from Tex. Agr. Exp. Sta. Bulletin 549.

Cobalt

Cobalt requirements of beef cattle are .07 to .10 milligram per 100 pounds body weight (approximately 0.03 to 0.05 milligram per pound of feed). Most cobalt deficiency symptoms are general in nature, characterized by loss of appetite, weakness, emaciation and

Table 3. Effects of trace minerals on performance of Hereford steer calves fed poor-quality prairie hay for a 100-day period

	Controls	Trace minerals[1]
No. steers	10	10
Initial weight, lb.	443	445
Final weight, lb.	558	557
Daily gain, lb.	1.15	1.12
Ration		
Cottonseed meal, lb.	2.00	2.00
Ground sorghum grain, lb.	3.89	3.89
Poor-quality prairie hay, lb.	8.12	8.06
Mineral mixture, lb.[2]	0.15	0.10

[1]Trace mineral mixture — 20% manganese sulfate, 40% iron sulfate, 0.933% cobalt carbonate, 2% copper sulfate and 0.589% zinc carbonate — was added at a level of 0.5% of the concentrate.
[2]50% steamed bonemeal and 50% salt fed free choice to both groups.

eventual death. Cobalt administration in deficient animals brings about rapid recovery. A vitamin B_{12} injection also relieves cobalt deficiency but is not a practical method of meeting the requirement. No cobalt deficient areas have been found in Texas.

Magnesium

The magnesium requirement for beef cattle has not been determined.

Potassium

Requirements for potassium are not established. Since forages commonly fed to cattle contain much more potassium than sodium, it seems unlikely that a deficiency would occur under most practical conditions.

Iron

Iron requirements for beef cattle are unknown, but levels in common feeds used are believed to be ample.

Manganese

Manganese requirements of beef cattle appear to be met with as little as 2.7 to 4.5 milligrams per pound in the air-dry ration. Since many roughages contain 22.5 to 67.5 milligrams of manganese per pound on an air-dry basis and grains other than corn contain 6.75 to 22.5 milligrams per pound, it is unlikely that beef cattle rations need supplementing with manganese.

Zinc

Requirements for zinc have not been established for beef cattle, but needs demonstrated in swine and small laboratory animals indicate that it probably is essential. A deficiency, however, is unlikely since most forages contain from 4.5 to 45 milligrams per pound, which would supply liberal amounts in comparison to the requirements of other animals.

Molybdenum

Research indicates that molybdenum is an essential mineral nutrient, being an integral part of important enzyme systems of the body. The requirement of beef cattle is unknown but probably is extremely low, since as little as 10 to 20 parts per million in forages result in toxic symptoms. Toxic levels interfere with copper metabolism, which results in typical copper deficiency symptoms.

Selenium

A selenium deficiency has not been demonstrated in beef cattle, but selenium toxicity occurs in some areas on the Northern Great Plains of the United States. Symptoms are loss of appetite, loss of hair from the tail, sloughing of hoofs, lameness and eventual death. No practical method of treatment is known other than removal of animals from affected areas.

COMPLETE MINERAL MIXTURES

Numerous mineral mixtures are available in various forms. Producers should examine feed tags for the phosphorus, calcium and salt content of the product to be fed. The mixture should contain at least 6.0 percent phosphorus (P). Cost consideration should be based on the percentage of available phosphorus (P) since calcium (Ca) and salt (Na Cl) are much cheaper than phosphorus. The general practice of adding feeds to mineral mixtures to stimulate more mineral consumption is of doubtful merit. This is a form of force feeding and cattle should not be forced to consume more than normal requirements. The average cow consumes annually free choice about 33 pounds of steamed bonemeal and 26 pounds of salt.

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SUGGESTED READING

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