Effect of Molybdenum

on livestock in permanent pastures

H. S. Cameron and H. Goss

The development of permanent pasture in certain areas of the state has been accompanied by a somewhat obscure disease affecting the young stock grazing on pastures, "up to the hocks in feed, but starving to death." Based on investigational work in England on a comparable condition there is a probability that the element molybdenum may be an important factor in causing the disease.

Coöperative investigation between the plant and animal group in the Experiment Station are underway, and tend to support the belief. Although the manner by which molybdenum is involved is far from clear, certain observations from field stations warrant a preliminary report on procedures the livestock operator can adopt when the condition is suspected.

Symptoms

In molybdenum poisoning the first symptoms resemble those encountered in animals heavily parasitized with stomach or intestinal worms.

There is excessive scouring and fairly rapid emaciation. Scouring often is a result of a change from dry to succulent feed, but usually disappears when the animals become accustomed to the feed.

The first consideration should be the possibility that the condition is due to worms. This can be verified by a laboratory examination of the feces for parasite eggs. A few such eggs are likely to be found in all animals; a large number, however, indicates that the condition is caused by parasites.

Treatment with phenothiazine will alleviate the disease if parasites are responsible; if molybdenum is responsible, the drug will have no effect, and the animal will become progressively worse.

Another method of differentiating molybdenum poisoning from parasitism is the number of animals affected. In the latter, only a percentage in the pasture are affected and there is a great variation in severity, while in the former all the young stock show the condition uniformly.

A characteristic sign of molybdenum poisoning is the marked change in coat color. In the case of red and white cattle, the red becomes almost a tan and the white, a light tan; in severe instances the red and white are indistinguishable.

In the Holstein, black tends to become gray. The discoloration is first apparent around the eyes. Removal of the affected animals to dry pasture is often followed by recovery, although permanent stunting may be the end result.

Following the elimination of parasitism as a cause of the condition, the feces may be tested for molybdenum. Testing of this material is probably one of the best indications of the molybdenum intake of the animal.

Comparison of molybdenum poisoning and parasitism.

Molybdenum poisoning Ruminants only	Parasites All livestock
Scouring	Scouring
Emaciation	Emaciation
Marked discoloration of hair	Roughening but no discoloration of coat
Uniformity of severity and numbers affected	Variation in severity and numbers affected
Recovery when moved to dry pasture	Condition persists on moving to dry pasture
Dry supplements tend to prevent the condition	Dry supplements do not prevent the condition
Minute amounts of copper prevent the condition	Minute amounts of copper do not prevent the condition
Does not respond to phenothiazine	Responds to phenothiazine
Excessive molybdenum in feces	Excessive parasite eggs in feces

Animals Affected

Young growing cattle are the most susceptible of all domestic livestock. Sucking calves have been observed in the advanced stages while the cows remain in a thrifty condition. Sheep have been reported affected in England. So far they have not been reported as being involved in outbreaks in California.

Apparently only ruminants are susceptible. Massive doses of molybdenum have been administered to horses experimentally over a period of eight weeks without effect. Swine are not affected.

Sources of Molybdenum

Many analyses have been made of different species of plants taken from pastures where the cattle showed symptoms of distress. Almost without exception the results have shown that the legume plants contain very much more molybdenum than normally. This is particularly true of ladino clover, bur clover, birdsfoot, trefoil, and several species of melilotus.

Alfalfa from these areas also contains abnormal amounts of molybdenum, but not to such great extent as the other legumes. However, alfalfa pastures have produced severe scouring of cattle in several instances.

Generally speaking, dry hay from a high molybdenum area is less likely to cause scouring than green succulent pastures, but cured alfalfa hay from certain localities has caused severe symptoms of molybdenum poisoning in several cases.

There is some indication that by storage the toxicity of affected alfalfa hay tends to decrease. This is in harmony with the results obtained in England.

The English workers reported that with the coming of frost the affected pastures gave much less trouble than did the growth earlier in the season. They also found that drying the plants lowered the solubility of molybdenum which they contain.

Ordinarily, plants growing on normal soil do not contain more than a very few parts per million of molybdenum, usually less than five parts per million. In contrast, most legumes grown on the affected areas are found to contain from 20 to as much as 100 or more parts per million molybdenum.

On the other hand, nonlegumes growing alongside the legumes usually contain not more than 10 to 12 parts per million and in some instances considerably less. It is only where conditions are extremely severe that toxic amounts of molybdenum have been found in the nonleguminous pasture plants. Alfilarea also absorb but little molybdenum and the same is true of various weeds.

Despite the high molybdenum content of legumes, the soil in which they were grown has been found to contain only a very low amount of total molybdenum. In this respect the conditions in California differ sharply from those found in England.

Samples of soil taken from certain affected ranches in the San Joaquin Valley were found to contain only 1.5 to three parts per million of total molybdenum.

In other cases where cattle were severely affected the soil contains four to 10 parts per million molybdenum. On the other hand, the molybdenum content of the affected soils in England was found to range from about 20 to as much as 100 parts per million. However, the English workers made the important observation that it is not the total amount of molybdenum in the soil that is important, rather it is the conditions that affect the availability of molybdenum that determine whether or not excessive amounts will be absorbed by plants.

They found that plants absorb abnormal molybdenum only on slightly alkaline soil—that is, soil containing lime.

A surprisingly high percentage of the total molybdenum of the California soils is soluble in water. It is therefore readily available for absorption by plants.

This is probably an important reason

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why so much molybdenum is taken up by the plants growing in the affected areas. Ordinarily, molybdenum is one of the most insoluble constituents of the soil. In certain unaffected localities in California, the total molybdenum content of the soil is fully as great as in some of these affected areas, but it is extremely insoluble.

It would appear from observations in the affected areas that new pastures are likely to be more toxic than those that have been in existence for several years. No satisfactory explanation is available for this.

It has been quite well established that providing hay in the pastures will prevent the disease. As the season progresses the animals will consume more hay, and in September are likely to be using three times the amount they would take in May. A group of heifers supplemented with oat hay in an affected pasture did not develop symptoms, whereas comparable animals on pasture alone showed symptoms of molybdenum poisoning.

The addition of copper in the form of bluestone to the feed or water has been advocated as a preventive. The work in England, and in California, supports this.

There is nothing new in the giving of copper to livestock, although it was not considered as an antidote for a toxic substance. It really was placed in water troughs to destroy growth of algae that were considered harmful. This may be the source of the belief in the beneficial action of copper, whereas in reality it was counteracting molybdenum.

Copper sulfate may be administered preferably in the drinking water, but may also be given in the feed. Care should be exercised as to the amount consumed. The substance is poisonous if too much is given. Only a small amount is necessary to counteract molybdenum.

The animal does not need more than one gram per day—one ounce equals thirty grams—and since that is well below the toxic dose there should be little danger of poisoning.

Copper need be given only during the summer when pasture growth is luxuriant.

The mode of action of copper is not clear, but according to work in Australia an excess of molybdenum interferes with copper utilization.

An excess of copper over an extended period may result in a chronic copper poisoning that may end fatally. A prominent symptom of copper poisoning is red colored urine produced by the breaking down of red cells and resultant passage of hemoglobin into the urine.

1. When possible provide dry roughage for stock on permanent pastures in areas where molybdenum poisoning has been shown to exist.

2. If dry roughage is insufficient to prevent the condition, use bluestone in the water or feed during the summer months at a dose not to exceed one gram per day per animal.

3. Check for parasites when the foregoing symptoms appear. If negative, have feces of affected animals tested for molybdenum.

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TRUCK CROPS

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Ladino clover or irrigated pastures require water over a long growing period and the average requirement is generally considered to be 4½ to five acre-feet. On extremely heavy soils or shallow hardpan soils which prevent deep percolation, successful pastures have been maintained using only three acre-feet.

Many of these shallow-rooted crops are short-seasoned and when grown on heavy soil or hardpan land, the water requirements may be relatively low—usually around an acre-foot of water per acre—if the soil is moist at time of planting. The bush bean is a good example of this crop type.

When seeds are planted on beds during dry seasons, it is necessary to germinate them by irrigation.

This requires large quantities of water and in some cases, two or more acre-feet have been applied to sprout crops such as lettuce. This is several times the quantity of water necessary to grow the crop after seedling stage.

Water can be saved by keeping the beds low, as far as practicable, so that it will be unecessary to maintain water in the furrows for long periods to wet the surface.

Planting the seeds close to the edge of the bed will place the seed nearer the water and germination will require less subbing.

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For additional information concerning irrigation and water requirements of crops consult your local farm advisor.

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