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.

Cooperative 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 stuntng 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.

<table>
<thead>
<tr>
<th>Molybdenum poisoning</th>
<th>Parasites</th>
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<tbody>
<tr>
<td>Scouring</td>
<td>Scouring</td>
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<tr>
<td>Emaciation</td>
<td>Emaciation</td>
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<tr>
<td>Marked discoloraion of</td>
<td>Roughening but no discoloration of coat</td>
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<tr>
<td>hair</td>
<td>Variation in severity and numbers affected</td>
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<tr>
<td>Uniformity of severity</td>
<td>Condition persists on moving to dry pasture</td>
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<td>and numbers affected</td>
<td>Dry supplements do not prevent the condition</td>
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<td>Recovery when moved to dry pasture</td>
<td>Minute amounts of copper do not prevent the condition</td>
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<td>Excessive molybdenum in feces</td>
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<tr>
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<td>Excessive parasite eggs in feces</td>
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</tbody>
</table>

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. Alfalfa area 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 from 10 to 500 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 why molybdenum poisoning is rare in California.
MOLYBDENUM
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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 Califor-
nia, the total molybdenum content of the
soil is as great as in some of these af-
ected 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 pre-
vent 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 cut
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 seed 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 sub-
stance. 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 dan-
ger 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 promi-

nent 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 rough-
age 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 fore-
going symptoms appear. If negative, have
feces of affected animals tested for molyb-
denum.

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TRUCK CROPS
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Ladino clover or irrigated pastures re-
quire 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, suc-
cessful 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 require-
ments 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

When seeds are planted on beds during
dry seasons, it is necessary to germi-
nate 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 unnecessary 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.

L. D. Doneen is Associate Irrigation Agro-
nomist in the Experiment Station, Davis.

For additional information concerning irriga-
tion and water requirements of crops consult
your local farm advisor.

NEW PUBLICATIONS

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Tracy I. Storer. Ext. Cir. 142, April, 1948.
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COMMERCIAL HEAD LETTUCE ECO-
NOMIC STATUS 1947, by Sidney Hoos
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1948. (18 pages.)

DEHYDRATING FREESTONE
PEACHES, by E. M. Mrak and R. L.
Perry. Cir. 381, April, 1948. (11 pages.)

SULFUR-HOUSE OPERATION, by H.
J. Phaff and E. M. Mrak. Cir. 382, April,
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Mrak and R. L. Perry. Cir. 383, April,
1948. (11 pages.)

PORTABLE CLEANERS FOR SEED
GRAIN, by George B. Alcorn, P. C. Berry-
man, and R. R. Parks. Ext. Cir. 141,
March, 1948. (20 pages.)

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Gifts to the University of California for research by the College of Agriculture accepted in March, 1948

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CALIFORNIA AGRICULTURE, MAY, 1948