



Nitrate Toxicity in Forages

by

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Introduction

During certain years on Central Coast ranges, epidemics of nitrate toxicity occur in cattle. Losses usually occur in the late winter or spring and have been in the form of treatment costs, weight losses, delayed use of pasture and deaths.

What Causes Nitrate Accumulation in Plants?

Almost anything that interferes with normal growth can result in higher nitrate concentration in the plant. Outbreaks of poisoning are often noticed on ranges in the eastern section of San Luis Obispo County when sudden flushes of young weedy growth occur. Drought or cloudiness can also increase nitrate accumulation in plants.

Plants probably take up more nitrogen in the form of nitrate than in any other form. During normal growth these nitrates are rapidly converted to plant protein. Unusual growth conditions may interrupt this conversion while the uptake of nitrate continues. This causes a build-up of nitrate in the plant tissue, especially in the stems. Nitrogen fertilization can aggravate this situation.

Nitrates are normally present in practically all plants. Species vary, however, in the amount of nitrates which they accumulate. Some species which have been reported as nitrate accumulators are oats, corn, sudan, wheat, turnips, filaree and numerous

weeds such as fiddleneck (amsinkia), milk thistle, Russian thistle and several species of the mustard family.

How Does Nitrate Affect Animals?

Nitrate toxicity is most common in ruminants, particularly cattle, although horses may also be affected. In the digestive tract, microorganisms or enzymes reduce the nitrate (NO_3) to nitrite (NO_2) which is absorbed into the bloodstream. Here it reacts with the hemoglobin forming methemoglobin. Unlike hemoglobin, methemoglobin has little or no oxygen-carrying capacity. Thus, as the blood loses its ability to transport oxygen from the lungs to the body tissue, the animal suffers asphyxiation.

Symptoms of nitrate poisoning include a staggering gait, muscular tremors, blue coloration of mucous membranes, bloat, rapid and labored breathing and collapse. Animals may appear relatively normal until forced to move about. The blood is typically brown or chocolate colored.

How Much Nitrate is Dangerous?

Nitrate toxicity in ruminants involves at least two factors -- the concentration of nitrate in the forage and the total quantity consumed at any one time. According to New York research, sudden death is possible if the total ration of the animal contains nitrate equal to 2 to 5 percent of the dry matter. The Missouri Experiment Station reports

that nitrate (NO_3) levels of 0.6 percent on a dry matter basis and above can cause milk production loss and that levels of 1.5 percent and more in the total ration can be expected to cause death.

How Can I Field-test for Nitrate?

Plants can be tested for toxic levels of nitrate as follows:

Dissolve 0.5 gm (500 mg.) of diphenylamine in 20 cc of water and add concentrated sulfuric acid to bring the volume to 100 cc. For a half-strength solution, add together equal parts of the above mixture and 80 percent sulfuric acid. Cool and store in a brown bottle.

To test suspected forage, add one drop of the half-strength solution to the cut surface of the plant (stem joints are a good place). If the color ranges from green to blue, the result is positive for nitrate. This green to blue reaction indicates 2 percent nitrate, a dangerous level. Remember, different parts of the plant will contain different levels of nitrate. A large percentage of the nitrate is stored in the stems. Some corresponding plant samples should be sent to a commercial laboratory to check the accuracy of field tests.

What Can Be Done About High Nitrate?

If nitrate accumulation in a pasture causes toxicity to livestock, the forage should be changed if possible. Move the animals to another field or feed hay in drylot until the nitrate content decreases in the problem pasture. If the cattle cannot be moved, the toxic forage may be diluted by feeding hay in self-feeders. Usually the problem will diminish when weather conditions change and plant growth lower in nitrates has been added.

If weeds are the nitrate accumulators causing the problem, it should be possible to reduce them with improved grazing and range management practices. By rotating annual grazing patterns among fields so that heavy grazing does not occur in the same field every year during the seedsetting season, the nonweedy plants will be given a better chance to compete. Heavy grazing early in the growing season, however, can reduce weedy growth. Reseeding can increase the percentage of desirable forage species in some cases.

Treatment

Methylene blue can be injected into poisoned animals. Contact a veterinarian.

Conclusions

Nitrate toxicity in range cattle has a long history in San Luis Obispo County. It occurs during the late winter and early spring and is most common east of the Santa Lucia mountains. Sudden flushes of young weedy growth and interrupted growth due to drought or cloudiness can increase the nitrate content of forages. Moving cattle off the toxic feed until the nitrate level returns to normal, supplementing with hay, reducing weeds and treating sick animals with methylene blue will lower losses.