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UCD VET VIEWS
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Nitrate Toxicity

Nitrate toxicity affects grazing cattle in California every year and drought conditions increase the chance of this problem affecting your herd. This month we will try to answer some of the common questions regarding this potential problem.

What does nitrate toxicity look like in cattle?

Acute poisoning occurs within 30 minutes to 4 hours after ingestion of plants or water high in nitrates. Thus, the problem occurs very quickly and often the cattle are observed to be normal one day and dead the next day. A very early sign is salivation followed by frequent urination. Soon after, the cattle exhibit difficult breathing, increased respiratory rate, and dark brown or "chocolate" colored blood and mucous membranes. The animals then become weak, reluctant to move, and have convulsions before they die. It is common to simply find some of the cattle dead. If pregnant cattle receive a dose that is not quite deadly, they may abort soon after recovering.

What causes the problem?

High levels of nitrates (or nitrites) in the feed or water are the cause of nitrate toxicity. These compounds are converted to nitrites in the rumen of cattle and the nitrites are absorbed across the rumen wall and into the blood stream. The nitrite in the blood reacts with hemoglobin to form a compound (methemoglobin) that can no longer carry oxygen to the cells of the body. Thus the cattle simply cannot deliver oxygen to their vital organs—brain, heart, etc. As you can imagine, death quickly follows a lethal dose.

Where do the nitrates come from?

Nitrates can be high in water sources when this water collects runoff from fertilizers, decaying organic matter, animal wastes or other sources of nitrogen. The nitrates are generally higher after periods of excess runoff—spring snow melt, irrigation runoff after fertilization, or heavy rains. Occasionally, deep, drilled wells can also have high levels of nitrates. Certain weeds are high in nitrates, such as pigweed, lamb's quarters, Johnson grass, nightshade, Russian thistle, and Canadian thistle—all of which occur commonly in California. Additionally, almost any crop can have high nitrate levels; however, Sudan grass hay and oat hay are more likely to have levels of nitrates that are potentially toxic.

How do I know if nitrate toxicity is the problem?

If your cattle die acutely and there has been a recent change in feeding practices—feeding high-risk hay (oat hay, Sudan grass hay, etc), change in water supply, moving from one field to another—you should suspect nitrate toxicity as a problem. There are a number of other common causes of acute death in cattle, such as Redwater, Anaplasmosis, and other toxicities that must be considered. Your veterinarian, working with the California Animal Health and Food Safety Laboratory can perform tests on the dead cattle to determine the cause of death. For nitrate toxicity, samples from the eye of the dead cattle can be very useful to diagnose nitrate problems. Also, rumen samples, feed samples, and water samples are usually analyzed. The diagnosis is not an easy one and if you don't pin it down after the first round of dead cattle, more problems will follow.

How do I treat affected cattle?

There is an antidote for nitrate toxicity. The most common treatment is methylene blue. This is a chemical that restores the hemoglobin so it can carry oxygen again. It is administered intravenously by your veterinarian and must be done very soon after the cattle are affected. This must usually be done within an hour or so of when the cattle first become ill.

How do I prevent nitrate toxicity?

First of all, make sure the cattle are not exposed to weeds that contain high levels of nitrates—pigweed, lamb's quarters, Johnson grass, nightshade, or thistles—in high numbers. Cattle will not eat these weeds in any amount unless forced to by lack of quality forage. Be sure high-risk water is not available to the cattle. If surface water or well water is thought to be a risk, have it tested before allowing cattle access. Thoroughly test any high-risk hays—Sudan grass hay, oat hay—particularly if it has been stressed by drought, high rates of nitrogen fertilization, or frost before harvesting, before feeding.

What levels of nitrates should I be concerned about?

The concentration of nitrates and nitrites is commonly expressed in a variety of different terms. Before making any decisions consult with your veterinarian to make certain of the units of measure and any appropriate conversion. The nitrate concentration can vary tremendously within a stack of hay. When testing hay, be sure to sample at least 40 bales of hay from different parts of the stack. Below is a list of water and forage concentrations of nitrates and associated risks.

Water—ppm (parts per million) Nitrate (NO₃)

0-44	Not harmful
45-132	Slight possibility of harm
133-220	Risky over long period of time
221-660	Some losses expected
661-880	Increased losses expected
880 and above	Heavy, acute losses

Feed—Nitrate Nitrogen (NO₃-N) Content

0.0-0.1%	Safe under all conditions
0.1-0.15%	Safe for cattle EXCEPT pregnant cows
0.15-0.4%	Increasing level of risk, limit amount to keep total diet below 0.15% of Nitrate Nitrogen
Over 0.4%	Do not feed

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