

MANAGING NITRATE CONTAMINATED FEEDS

High levels of nitrates in forages can occur whenever the normal growth of plants is disrupted by hail, drought, spray drift or frost. The percentage of animals affected by acute nitrate poisoning in Manitoba is usually low. However, when death losses do occur, they occur suddenly and can be devastating. High levels of nitrates need not be a problem as long as the feeding program is managed correctly.

Plants normally take up nitrates in the water solution via root uptake and convert them into non-toxic non-structural carbohydrates in the form of plant sugars that are stored in the leaves. This process occurs in the daylight hours during normal plant growth. Nitrates can accumulate or build up in the plant when something arrests or prevents normal plant growth; this can be a frost, spray drift, or an onset of drought.

Factors That Influence Nitrate Accumulation

Forage Type

Nitrates accumulate more in some plants than in others. Cereal crops and weeds are more likely to accumulate nitrates than legumes and grasses. While it has been known to happen, a very small percentage of legume and grass hays will contain appreciable amounts of nitrates.

Level of Fertilization

High levels of soil nitrates as a result of nitrogen fertilization, manure application, legume plowdown or summerfallow can result in high levels of nitrates in forage. For example, redroot pigweed from a hog run was found to contain well over 3% nitrates, seven times that contained by the same weed harvested in an adjoining field.

Stage of Forage Development

Early cut forages (boot to milk stages) commonly contain higher nitrate levels than the same forage when almost mature (dough stage).

Light Intensity and Temperature

Poor light intensity (shade) and high temperatures lead to high nitrate levels in plants. Nitrates accumulate during the night and dissipate rapidly on bright sunny days with moderate temperatures.

Frost Damaged Crops

Nitrate levels will be highest just before sunrise. If an early frost comes, it usually occurs just before sunrise, when the nitrate content of the plant is at its peak. Any surviving leaves will likely be shaded by the frost damaged leaves above so the potential for nitrate reduction is limited.

Hail Damaged Crops

Immediately after a hailstorm, the nitrate content can be expected to be quite low because hailstorms usually occur after a hot, bright, sunny day. However, nitrates can then accumulate overnight and would remain high because the loss of leaves decreases the potential for nitrate conversion to protein. The degree of leaf loss determines the extent to which nitrate levels will decrease.

Drought

If conditions improve and the plant starts actively growing, some of the accumulated nitrates may be used up in a few days. This usually occurs only in the top leaves which are exposed to sunlight. The bottom leaves, which are shaded, may still contain high levels of nitrates.

Will Nitrates Decrease After Harvesting?

If hay in the windrow remains damp for several days or is rained on, nitrate levels will decrease. Hay dried quickly will lose very little nitrate. Nitrate concentration in hay bales does not change appreciably over time. Ensiling can result in a 40-60% reduction in nitrate level.

Other sources of nitrates

Nitrates can also accumulate in water sources, such as when livestock have direct access to surface water (dugouts), or when water wells are situated close to a manure source. Cattle could then be consuming nitrates both in their feed and water causing a higher dosing rate.

What happens to nitrates that are consumed?

Under normal conditions, cattle convert the nitrates in forage to nitrite. This is then converted to ammonia and used by rumen microbes to make protein. The problem arises when nitrate converts to nitrite faster than nitrite converts to ammonia. When this occurs, nitrite accumulates and is absorbed into the bloodstream where it binds to hemoglobin thus reducing the oxygen

Symptoms of Poisoning

Symptoms of lethal nitrate poisoning include labored breathing, frothing at the mouth, rapid pulse, weakness, diarrhea, frequent urination, incoordination and convulsions. Death may occur in three to four hours. Post-mortem examination reveals dark, chocolate-colored blood. Methylene blue is the treatment for nitrate poisoning.

Sublethal doses may result in loss of appetite, lowered milk production, slow growth and abortions.

Other things to consider

Avoid feeding high nitrate feeds to sick, hungry, pregnant or lactating animals. These animals have a lower tolerance level to the nitrate than compared to healthy cattle. Make sure all animals have access to plenty of clean drinking water as this will help dilute the nitrate in the animal's body. To effectively dilute high nitrate feeds you must have a feed test done. Once you know how much is in the feed you can dilute it to the safe level of 0.5% nitrate (NO₃, on a dry matter basis).

Table 1.

% Nitrate, DM basis	Effect on Animal
0 - 0.3	Virtually safe
0.3 - 0.6	Moderately safe in most situations, if animals are stressed limit to 50% of the ration

0.6 - 0.9	Potentially toxic to cattle, do not use as sole feed source
0.9 and up	Dangerous to cattle, often causes death

Animals will need to be adapted slowly to feeds containing higher nitrates. After a period of adaptation (one to two weeks) the animal's tolerance level to nitrates increases and higher levels can be fed. However, if the animals are off high-nitrate feeds for a few days they will need to be re-adapted to the problem feed if it is to be fed again.

As previously mentioned, the low and high nitrate feeds need to be blended together to decrease the toxicity. This does not mean putting out one bale of low and one bale of high nitrate hay on a free choice basis. Animals may eat the high nitrate feed solely which could cause toxicity. Feeding supplemental grain (2 to 5 lbs/head/day) with high nitrate forages can assist with the dilution of the nitrate level. As well the energy provided by the grain helps the rumen microorganisms convert the nitrite into ammonia which can then be excreted via the urine and feces.

Balancing rations is important when feeding high nitrate feeds since the nitrate level can increase the animal's requirements of vitamin A. If the ration requires supplemental protein avoid using non-protein nitrogen (NPN) such as urea since this can make the situation worse.

Different labs will express the nitrate levels in various ways. Below is a conversion table (Table 2) to determine the level of nitrates in your forage.

Table 2. Conversion table to convert lab results to nitrate

Unit	Chemical Designation	To convert to nitrate multiply by
Nitrate	NO ₃	1.0
Nitrate-nitrogen	NO ₃ -N	4.4
Potassium nitrate	KNO ₃	0.6
Sodium nitrate	NaNO ₃	0.7

For more information contact the ARD/MASC Service Centre at **1-844-769-6224** or email:

ARD@gov.mb.ca