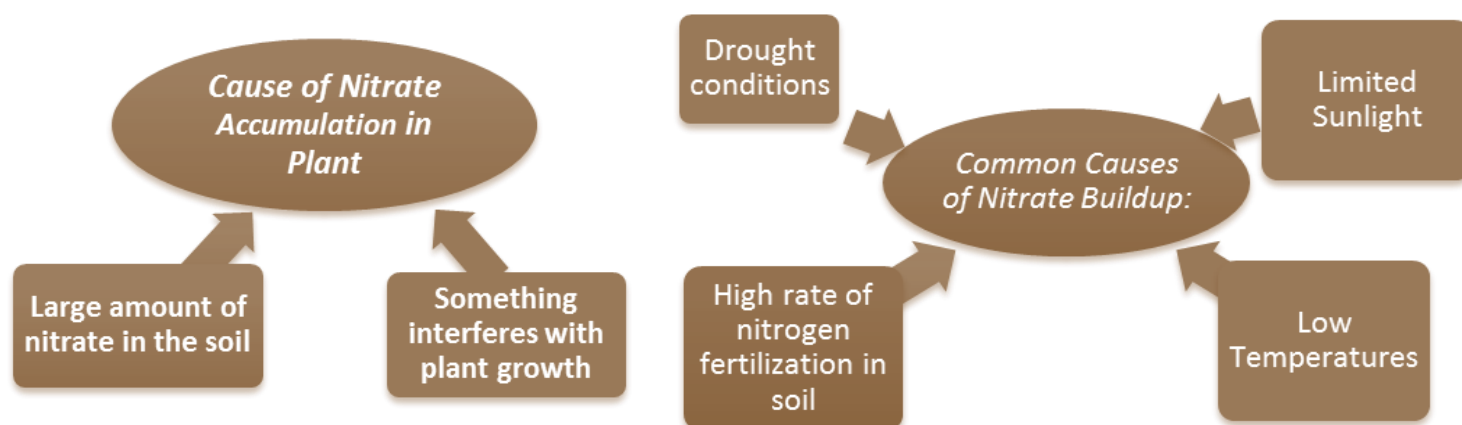


Ag Health News

LABORATORIES

Dietary Nitrate: Where Is The Risk?

Ag Health Labs receives many samples each year where the client is concerned about nitrate content. Many times, they have lost livestock and are trying to find a cause, or they suspect that there might be some nitrate accumulation in the forage. Questions will come up about nitrate poisoning; therefore, we thought a newsletter article might be helpful in explaining nitrate accumulation in plants and nitrate poisoning in cattle.



Plant Physiology

Normal Growing Conditions

- Plants absorb nitrate from the soil through their roots
- The plant converts nitrate to amino acids, proteins, and other nitrogenous compounds
- This primary site for this conversion is in 'green leaves'

Unfavorable Growing Conditions

- The conversion process of nitrates to other nitrogen compounds is slowed down
- Nitrates accumulate in the stalks and stem

Drought Conditions that cause nitrate accumulations in plants

- Drought that occurs during a period of heavy nitrate uptake by the plant (drought during or immediately after pollination is many times associated with high levels of nitrate accumulation)

Drought conditions that DO NOT cause high nitrate accumulation in plants

- Nitrate in dry soil surface is not available for uptake by plant (there has to be some moisture present for the plant to uptake nitrate from soil)

Milk Lab Friendly Reminder

Please do your best to get samples to the lab by 3pm. Milk sample received after **3pm** may not be plated the same day depending on milk lab volume.

Please fill milk tubes $\frac{3}{4}$ full. Do not fill to the top of the tube.

Ruminant Animal

- Plant nitrate is converted to proteins by rumen bacteria
- Nitrite is an intermediate product in the conversion that causes nitrate poisoning
- Nitrate toxicity occurs when a high nitrate level in feed overwhelm the animal's digestive tract
- This happens when the rate of nitrate conversion to nitrite is faster than rate of nitrite conversion to ammonia (which will be converted to amino acids and microbial protein)
- Nitrite accumulates and is absorbed into blood stream
- Nitrite reacts with the 'oxygen-carrying' hemoglobin and changes it to 'methemoglobin'
- Methemoglobin cannot carry oxygen and the animal suffocates.

Reducing the Risk of Nitrate Poisoning

- Wait to harvest after a known drought event. Once moisture is present, and the plant goes back to a normal physiological state, the nitrates that accumulate in the stalk and stem will start to convert to other nitrogenous compounds that are not toxic to the animal.
- Nitrates accumulate in the stalk. Therefore, leaving the bottom 1/2 to 1/3 of the stalk in the field by increasing the chop height, will reduce the nitrate level in the remaining forage that is harvested. The part of the plant with the highest nitrate concentration will not be fed.
- Ensilage the forage. The ensiling process will reduce nitrate accumulation by approximately 1/3. Wait at least 4 weeks after ensiling before feeding forages high in nitrate.
- Have the forage tested for nitrate concentration before feeding.
- Dilute high nitrate forages with low nitrate feeds to reduce the percentage of nitrate in the ration
- Drought stressed forages tend to be lower in energy content. The additional energy from feeding grain or other feeds high in energy along with the drought stressed forage will help the conversion of nitrate to ammonia by ruminal bacteria.
- Frequent intake (several times a day) of small amounts of high nitrate forage will increase the amount of high nitrate feeds that are tolerable by the ruminant without toxic effects.
- Introduce 'questionable feed' slowly over a period of time (1 to 2 weeks). This allows time for the rumen bacteria to adapt to the higher level of nitrate.
- Make sure the livestock are receiving a 'balanced ration' that provides all the nutrients necessary.
- Know the nitrate concentration of the water that livestock are consuming. High levels of nitrate in drinking water can become critical when feeds high in nitrate are fed.

Factors Influencing

Nitrate Toxicity or Safety

- Total dietary intake of nitrate
- Previous adaptation of the animal to high nitrate
- Feeding practices
- Nutritional quality of the ration
- General health of the animal
- Nitrate level in drinking water
- Type of livestock (cattle are more susceptible to nitrate poisoning than horses or sheep)

“Drought stressed forages tend to be lower in energy content...”

Standard Guide for Nitrate Levels in Forage Fed to Cattle

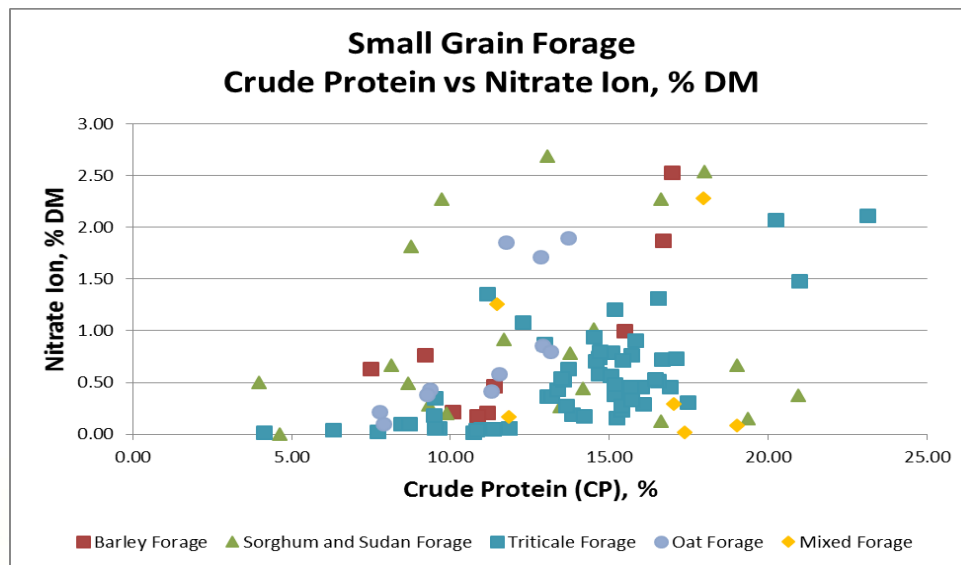
Nitrate Ion (NO ₃ ⁻) (dry matter basis) percent	Nitrate nitrogen (dry matter basis) ppm ¹	Comments
Less than 0.44	0-1,000	Safe to feed if adequate feed and water are available.
0.44-0.88	1,000-2,000	Generally safe when fed balanced rations. Best to limit it to half of the total dry ration for pregnant animals and also be sure water is low in nitrate.
0.88-1.50	2,000-4,000	Limit to 50 percent of total ration dry matter ² for all animals; may experience some symptoms, possibly death.
Greater than 1.50	Greater than 4,000	Potentially toxic-do not feed.

¹ppm=parts per million

²Total ration dry matter refers to total dry matter being consumed as forages and concentrates.

Feed Types

Grains, byproducts of grains, and legume (alfalfa) forage tend to be low in nitrate concentration. Grass and grain forages tend to accumulate nitrate under certain conditions. This graph of data, collected from Ag Health Labs, demonstrates that many small grain forages are prone to nitrate accumulation. The nitrate ions ranged from ~0 to 2.7%. This states that the nitrate accumulation, within a feed type, can vary greatly. This is primarily due to the amount of nitrate in the soil and the growing conditions of the plant. However, there are plants that tend to be nitrate accumulators, such as many of the small grain forages. If you suspect that your forages have been in a situation where there was a potential for nitrate to accumulate, you may want to have them tested.



References:

Undersander, D., Combs, D., Shaver, R., and Thomas, D. Nitrate Poisoning in Cattle, Sheep and Goats. University of Wisconsin-Madison and the Cooperative Extension Service.

Vough, L.R., Cassel, E.K. and Barao, S.M. Cause and Prevention of Nitrate Poisoning in Livestock. Maryland Cooperative Extension Fact Sheet 426. p 1-4.