

# **Drought and the Risk of Nitrate Toxicity in Forages**

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All forage contain nitrates, it only becomes a problem when there is excessive accumulation. Nitrate can accumulate in any forage species given the combination of high available soil N and cool temperatures, drought, or other stress that slows plant growth. Using urea or other ammonium forms of N as fertilizer will not solve the problem, as they are quickly converted to nitrate in the soil. With moderate to high levels of N fertilization, nitrate levels peak in grass forage about 2 to 3.5 weeks following N application. This peak is more pronounced and more persistent, as the rate of N fertilization increases. Under normal weather conditions, nitrate levels decline rapidly after peaking, but plant stress conditions may prevent this decline.

## **Drought causes nitrate buildup**

Drought slows or prevents nitrate from being converted to amino acids and proteins in the plant, and can result in buildup of high levels of nitrate which can be maintained in the plant indefinitely. Nitrate toxicity is much more likely in grasses, as they are more likely to receive N fertilization. Nitrate toxicity is more likely in drought-stressed corn or sorghums that are grazed or harvested as forage. Weeds are much more likely to be higher in nitrates than crop species, so weedy fields are of more concern.

## **Silage is safer**

Green-chopped forage carries the highest risk of nitrate toxicity. Nitrate is stable in dried forage, so dry hay can remain high in nitrate. Proper silage fermentation reduces nitrates by one-half or more, and minimizes risk from nitrate toxicity. Poor fermentation, however, may not reduce nitrates. As with most all anti-quality compounds in forages, one potential solution to the problem is dilution of the toxic forage with other feeds in the diet. Most nitrate problems can be solved by replacing one half of the high nitrate forage in the diet with another feed source.

## **Nitrate testing**

There are tests available for nitrates in forages that can be used on-farm, including quick field tests for a qualitative analysis. One of the more recently developed quantitative tests was designed to eliminate use of hazardous chemicals present in older versions of these tests (Nitrate Elimination Company, Tel.: 1-888-NITRATE, email: [sales@nitrate.com](mailto:sales@nitrate.com)). A 5-pack of nitrate tests costs about \$30, and can be performed by non-skilled users in about 30 minutes.

No single level of nitrate is toxic under all conditions, but general guidelines are available. Analyses from commercial labs may be reported as nitrates, or as nitrate-N. A forage nitrate concentration up to 0.44% (4400 ppm nitrate or 1000 ppm nitrate-N) is safe to feed as the sole forage source in the diet. This is conservative, some guidelines list 0.66% nitrate as the cut-off. Non-pregnant cattle can tolerate up to 0.88% nitrate in forage, but concentrations exceeding 0.9% nitrate are potentially lethal. Nitrate in forage is less toxic than nitrate that might be directly injected from other sources, such as direct injection of fertilizers.

## **Signs of nitrate poisoning**

Excess nitrate in the animal is absorbed into the bloodstream. Rapid or noisy breathing, salivation, muscle tremors, weakness, diarrhea, and frequent urination are all symptoms of nitrate toxicity. Severe nitrate poisoning may cause death within a few hours after symptoms appear. Pregnant animals are much more susceptible to nitrate poisoning than non-pregnant animals. Forage with a nitrate concentration exceeding 1.5% should not be fed, even as a smaller portion of the diet. If nitrate poisoning is suspected, immediately switch animals to another forage source. Animals with moderate nitrate poisoning can be successfully treated with a methylene blue solution intravenously.

## **Things to consider if high nitrates are suspected:**

1. Delay harvest until drought has been over for a week or two.
2. Raise the cutter bar for harvest. Lower stem typically has the highest nitrate concentrations.
3. Consider making silage instead of hay or green chop.
4. Have suspected forage tested to determine whether it is necessary to dilute the forage or completely avoid feeding it.
5. Dilute high nitrate forages with a low nitrate feed source.
6. Feed a balanced ration, cattle should have access to nitrate-free water at all times.
7. Adapt cattle slowly to forage with elevated levels of nitrate. Feed forage several times a day if possible, rather than one feeding.
8. Avoid feeding green chop, particularly green chop that has heated or kept overnight. Nitrites are formed with heating and are much more toxic than nitrates.
9. Don't overstock pastures with high nitrate forages. Heavy grazing results in consumption of lower canopy, higher nitrate fractions.
10. Feed cows before turning them out into a suspected high nitrate pasture. Cattle will adapt to higher levels of nitrate over time, if concentrations do not exceed 0.9% (9000 ppm) nitrate.
11. Observe cattle frequently if pasture is suspected to be high in nitrates.
12. Remove animals from forage source if symptoms occur, and call a veterinarian.