



Avoiding Prussic Acid (cyanide) and Nitrate Poisoning in Drought Stressed Sorghum in Livestock (Slight Revision – Aug 2022)

Sorghum Checkoff Director of Agronomy Brent Bean, Ph.D.

Both nitrate and prussic acid poisoning can occur when cattle are grazed or fed drought stressed hay or silage. It is important to understand how and when each accumulates in sorghum plants and how to avoid lethal doses to the animals.

Nitrate vs. Prussic Acid

Conditions	Nitrate	Prussic Acid
Plant parts affected	Stalks (not found in leaves at high concentrations)	Young growth, new growth
Types of plants	All plants including sorghum, corn, millet and weeds	Sorghum, sudangrass, johnsongrass
Grazing problems	Primarily when animals eat lower stalk, but can be in upper stalk in drought stressed sorghum that produced little grain	Occur early in grazing period (plants less than 24 inches in height) or anytime new growth is present following a drought
Death occurs	4 hours of consumption	Within minutes
Effect of haying	None , the concentration stays the same as it was prior to haying	Dissipates when properly cured

Prussic Acid

- Also called hydrogen cyanide
- As-fed forage containing 200 ppm is considered toxic. Should be safe at levels less than 100 ppm.
- Dry forage is considered mostly safe at <500 ppm, potentially toxic at 500 to 1,000 ppm, and > 1,000 ppm very dangerous to cattle.
- Produced when dhurrin, which occurs naturally in the cells of sorghum leaves are ruptured from drought, freeze or even mechanical injury, combines with enzymes outside the cells and forms prussic acid.
- Dhurrin concentrations are especially high in young plants and the new leaves of drought stressed sorghum following a rain.
- Prussic acid poisoning is **much more likely when grazing than when feeding hay or silage.**
 - The prussic acid will form a gas, so after a short period of time it will escape to the air from the leaf tissue.
 - In freshly cut hay the prussic acid will usually dissipate in 72 hours as the hay dries in the field. However, hay should be retested before feeding.

- By the time sorghum has ensiled properly it is seldom a problem to feed. However, to be safe, test the silage prior to feeding.
- Risk of prussic acid poisoning from grazing can be reduced by feeding grain prior to the release onto sorghum. Cattle will eat less sorghum giving them time to acclimate to elevated prussic acid levels.
- After a hard freeze in the fall, wait five days before grazing to allow the prussic acid to dissipate.
- Testing for prussic acid:
 - Sample different areas of the field (low spots, high spots, dry spots, short spots, etc)
 - Collect 10-12 stalks (with leaves) per sampling sites
 - Keep cool! Get to the lab immediately.
 - If test results are high, test again in a few days.

Nitrate

- Nitrate poisoning occurs when cattle consume more nitrates than they can assimilate, or convert to protein.
- Nitrate accumulates in plants when poor growth conditions prevent nitrate from being used by the plant for new growth or grain production.
 - Drought
 - Long periods of cloudy weather
 - Cold temperatures
 - Mechanical damage
- Normally nitrate is incorporated into the grain during grain fill. When little grain is present due to drought, nitrates accumulate in the stalk of the plant. Nitrate levels are especially high in the lower portion of the stalk.
- Managing sorghum forage potentially high nitrate:
 - Grazing
 - Test drought stressed fields for nitrate prior to grazing (see below).
 - Avoid grazing lower stalks on risky fields. A leafy sorghum field poses less risk since cattle will first eat the leaves.
 - Generally nitrate levels will drop significantly 3 to 5 days after a good rain as the plant initiates new growth.
 - Haying
 - Test drought stressed fields for nitrate prior to grazing (see below).
 - Nitrate levels WILL NOT drop overtime in hay. If nitrate levels are high at the time of harvest, they will remain high in the hay.
 - Best to harvest in the afternoon rather than in the morning when nitrate levels are typically at their highest.
 - Raise the cutter bar since nitrate levels are at their highest in the lower portion of the stalks.
 - Silage

- Know the level of nitrate in the forage prior to ensiling.
- Raise the harvesting height to avoid the high levels of nitrate in the lower portion of the stalk.
- During the ensilage process, nitrate levels will drop, potentially 20 to as much as 50 percent. Test silage before feeding.

For more information see the Oklahoma State listed below under other resources. This is an excellent publication on nitrate levels in forage and how to avoid toxicity in livestock.

Interpreting Forage Nitrate Tests

Lab 1 Nitrate (NO ³) ppm	Lab 2 Nitrate Nitrogen (NO ³ -N) ppm	Comments
0 – 3,000	0 - 690	Generally safe for all cattle
3,000 – 5,000	690 – 1,150	Generally safe for non-pregnant cattle. Low risk of early term abortions. Dairy cattle ration should be less than 2500 ppm.
5,000 – 10,000	1,150 – 2,300	Some risk to all cattle. May cause late term abortions and weak newborn calves. May decrease milk production
> 10,000	> 2,300	Potentially toxic to all cattle

Sampling a field for nitrate testing:

- Sample different areas of the field
 - Low spots, high spots, dry spots, short spots, etc.
- Collect 10-12 stalks (with leaves) per sampling site
- Stalks are what are important to sample, do not collect roots
- Consider testing lower 18 inches of stalk and compare to the upper portion
- Do not need to keep cool

Other Resources

[Prussic Acid Poisoning - Kansas State University](#)

[Cyanide Poisoning - University of Nebraska](#)

[Nitrate Poisoning - Kansas State University](#)

[Nitrate Toxicity in Livestock - Oklahoma State](#)

[Nitrate and Prussic Acid Poisoning - Texas AgriLife](#)

AMS Approved