

Cyanide and Nitrate in Forage

In Texas, we utilize sorghum forages heavily for both grazing and hay. Sorghum forages include:

- johnsongrass
- haygrazer
- sudan x sorghum
- milo stubble

Livestock producers can quickly lose valuable animals if they fail to carefully monitor these forages' growing conditions that can cause elevated cyanide and/or nitrate levels. To assist producers with recognizing hazardous forages, the Texas A&M Veterinary Medical Diagnostic Laboratory offers expertise to aid in determining potential toxicity.

Conditions for Cyanide Toxicity

Sorghum forages have the capacity to produce the cyanogenic glycoside in the leaves of the grass, any time the plant is stressed:

- rapid growth – may have an almost blue cast to the green
- drought – may have ribbon-like leaves with wavy edges
- frost/hard freeze – look to see whether the entire plants were affected

Whenever the cyanogenic glycoside is present and grass cells are damaged, it gets broken down to release cyanide i.e. hydrogen cyanide (HCN), prussic acid. When the grass dies, either standing in the field or when cut for hay, its cells break down and digest the cyanogenic glycoside, releasing free cyanide into the atmosphere – this is why the hay needs to dry in the field until it's golden rather than green before it is baled. When it gets frozen, the grass dies very quickly and ice crystals break the cells and release cyanide into the air. If the haygrazer or johnsongrass patch is standing-dry, there should be no cyanide potential. However, there is still the potential for regrowth at the base. When plants with high cyanogenic glycoside concentration gets into a cow's rumen, the rumen microbes actively start breaking down the grass. This process releases free cyanide, which gets trapped in the rumen and crosses into the blood, poisoning the animal. Cyanide poisoning occurs quickly – animals are usually dead in about 30 minutes. They have no lasting effects if they survive.

Note that the submission guidelines are different for standing forage and baled hay. Submission guidelines are also different for cyanide and nitrate testing.



Testing for Cyanide

Standing forage

- 10 – 12 stalks from throughout the fenced area/pasture
- Place leaves in paper or plastic bag (no glass jar)
- **Ship overnight.**
 - If hand-carrying, deliver by 3 p.m. for same day results.
- If sample is shipped, expect results the evening of the day received.
- If it's been frozen and it's standing-dry, cyanide is gone.
- Be aware for potential regrowth at the base.
- If standing forage is positive for cyanide, it can either be left to continue growing or cut for hay and allowed to cure in the sun properly before baling.

Baled hay

- Obtain a glass jar with deep threads i.e. a canning jar or mayo jar, not a pickle jar.
- Obtain a hay probe and drill.
- Cyanide in the bale is free and very small. It will quickly escape through anything other than glass.
- Drill one probe and immediately transfer it to jar and screw shut
- Each jar can be one sample or samples from the same bale can be divided in up to 4 jars and combined for testing.
- Results are available the same day the sample is received.
- If baled hay is positive for cyanide, let the bale cure for at least 30 days, then unroll the bale and air it out for several hours before allowing cattle access.

Conditions for Nitrate Toxicity

Sorghum forages also have a tendency to concentrate nitrate from the soil and take it into the plant for later use as it grows. This typically occurs in fertilized fields, but can also occur in soils with high nitrogen levels due to other factors. Key things to consider about nitrate include:

- highest concentration is in the lower stalk
- decreases as the plant grows (converted into proteins)
- does not go away in hay
- must be below 1.0 % to be safe
 - May be used up to 1.50 % if supplemental feed is provided at 1 lb/hd/day for every 0.10 % over 1.00 %

Nitrate poisoning is also fast, but not as fast as cyanide poisoning. The microbes in the rumen convert nitrate to nitrite, which crosses into the bloodstream and binds hemoglobin so it can't carry oxygen.

Ruminants are either dead or fine within 4 hours. Cows that survive nitrate poisoning may later shed a dead fetus, because fetal hemoglobin binds nitrite more tightly than adult hemoglobin.

Again, note that the submission guidelines are different for standing forage and for baled hay, and are different for cyanide and nitrate testing.

Testing for Nitrate in Hay or Forage

Standing forage

- 10 – 12 stalks from throughout fenced area/pasture. Cut about 3" above ground.
- Cut the lowest 10-12" of the stalk for each and combine as one sample
- Wrap in paper (plastic if you must, no glass jar)
- Ship by 2 day delivery or overnight (timing not as critical)
- At the lab, sample is dried overnight and ground finely, then tested.
- Results available the day after the sample arrives.

Baled hay

- Best representative sampling by coring the bales
- Can combine as many cores as you want into one sample
- Place each sample in a paper or plastic bag (no glass jar)
- Ship by 2 day delivery or overnight
- Results available the day after the sample arrives.
- Grab sample from inside bale is less good, combine samples from several to one

Note that both types of poisoning are dependent on the actions of rumen microbes. Cattle, goats, and sheep are susceptible, but horses are not affected this way by these forages.