Brief Summary—New Info. on Prussic Acid in Sorghums

"Penn State" hay sampler & brace for sampling hay bales 24" deep.

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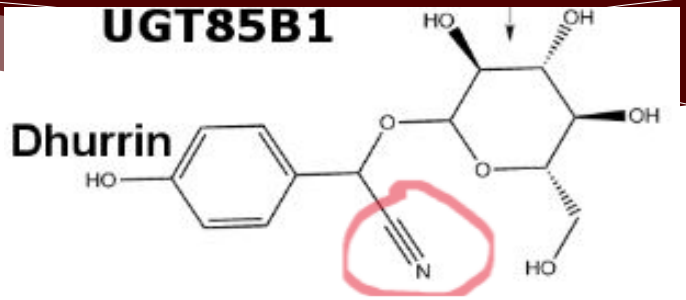
Poison Potential in Sorghums

- Prussic acid (HCN)—new information
  - Purdue Univ., Kansas State
  - Anticipate revisions in management—cattle consume the compounds that create prussic acid regardless of a frost, freeze, or drought. So, is this the issue we have always thought?
  - Advice for now: play it safe. Prussic acid does occasionally kill livestock. We may be less sure now about the circumstances.

Heavily frosted sorghum/sudan on top of canopy. But much green/live tissue remains inside canopy. Until a complete killing freeze occurs prussic acid potential will remain (and resets the clock for a ~7-day grazing restriction after each new freeze). (Photo credit: Laura Taylor, Dallam/Hartley Extension)

Poison Problems in Sorghums



Dhurrin, the common parent molecule of prussic acid, or HCN, in sorghums.

- Prussic acid—another name for Hydrogen Cyanide (HCN)
  - Frost/freeze in the Fall (the most common concern)
  - Droughty conditions in the summer
  - Young sorghums being grazed too soon when early dhurrin levels are more concentrated. (This is why seed companies say not to graze sorghums until at least 24" tall. Prussic acid potential is high. Delayed grazing is not due to poor regrowth or pulling plants out of the ground.)
  - Fresh regrowth in late fall (e.g., after grain sorghum is harvested and cattle are turned in to graze stalks)
  - Free prussic acid/HCN will normally dissipate adequately in properly cured hay. But KSU & Purdue research shows significant levels of dhurrin may remain in the sorghum hence there is ongoing potential for several months or more. (Enzymic activity in the rumen can release a new round of prussic acid.)

Where to Test for Prussic Acid?

- Servi-Tech, Amarillo, Texas
  - http://servitech.com/locations
- Not Texas A&M Soil/Water/Forage Lab, Not Texas Veterinary Medical Diagnostic Lab
  - No prussic acid test offered.
- Servi-Tech includes necessary step (adds a βeta-glucosidase enzyme) to release HCN from dhurrin to the free toxic form for proper measurement.
  - This indicates the **potential** prussic acid in the forage
- Many labs now just indicate the presence of prussic acid rather than assign it a numerical value.

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Grower/Livestock Producer Guide

- Managing the Prussic Acid Hazard in Sorghums (K-State Research & Extension, MF-3607, June 2022), https://bookstore.ksre.ksu.edu/pubs/managing-the-prussic-acid-hazard-in-sorghum_MF3607.pdf

- I will use this guide, not the current Texas A&M AgriLife Extension guide, until it is updated
  (Dr. Calvin Trostle)

K-STATE Research and Extension

Managing the Prussic Acid Hazard in Sorghum

Forage sorghum, sorghum-sudangrass and sudangrass are important forage crops throughout the United States. Sorghum forage has many important traits including high drought tolerance, less need for fertilizer, lower production cost as compared to corn, and a variety of usable forms (hay, silage, green chop, and pasture).

While sorghum is a valuable forage crop, sorghum species can produce prussic acid, which can be toxic to livestock. Prussic acid, also known as hydrogen cyanide (HCN), can cause acute toxicity and death. Hydrogen cyanide interacts with cellular respiration and leads to the body's inability to use oxygen for respiration to do work. Symptoms include shortness of breath and convulsions. Death can occur within minutes after the onset of symptoms, if toxic sorghum is consumed in large enough quantities. Concentrations (on a dry matter basis) between 500 and 750 ppm HCN can be toxic, and should be fed with another source of feed, while concentrations higher than 750 ppm are very dangerous to livestock and should not be fed (Cope 2021).

Potential of HCN toxicity (HCN potential) is directly related to dhurrin content, which is the precursor to HCN. Dhurrin likely serves as an insect deterrent by facilitating the release of HCN. Dhurrin is broken down through cell disruption, such as chewing or freezing, which causes rapid HCN release. Figure 1 illustrates the steps

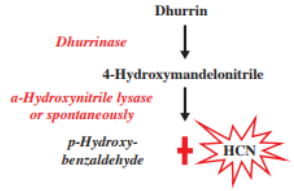

Figure 1. The pathway of dhurrin conversion to HCN. The enzymes that result in the breakdown of dhurrin are italicized.

Characteristics Affecting Dhurrin Content and HCN Potential

Dhurrin content, and therefore HCN potential, can vary due to species, variety within a species, growth stage, plant tissue type, and different abiotic (nonbiological) stresses.

Species/Varieties. Dhurrin content in sudangrass is about 40 percent less than in most other sorghums. As a group, the sorghum-sudangrass hybrids have more HCN potential than sudangrass and forage sorghum has more HCN potential than sorghum-sudangrass and sudangrass. Sorghum-sudangrass hybrids have been developed to contain less dhurrin. As a precaution, for plant hybrids known to be lower in HCN potential, talk with seed supplier.

Johnsongrass, shattercane and sorghum have high HCN potential, and may be hazardous when found in pastures and fence rows.

Plant Age. Sorghum age has a

decreases as the plant ages to minimal or negligible amounts by maturity (Halkier and Moller 1989; Nielsen et al. 2016). Older plants, however, can increase HCN potential as a result of environmental factors, as described below. Delay grazing until the plants have reached a height of 18 to 24 inches to avoid HCN toxicity under good growing conditions.

Tissue Type. The vegetative portion of all sorghums can contain dhurrin. HCN potential varies within a single sorghum plant depending on the plant tissue. Leaves generally contain larger amounts of dhurrin in comparison to stems and roots (Gleadow et al. 2016). Tillers, commonly called shoots, can contain a large amount of dhurrin, too. Examine fields for the presence of young tillers on more mature sorghum plants. Tillers growing off the main shoot of a young sorghum plant are shown in Figure 2.

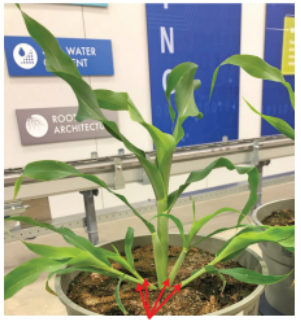

Figure 2. Four tillers growing off the main

“Dhurrin-free” Sorghums

- Purdue Univ., Texas Tech, others show the pathway that produces dhurrin is disabled.
- No prussic acid / no prussic acid potential (not just reduced prussic acid)—animal grazing preference.
- First company on the market: S&W Seed (SWSU4804PF) and their Sorghum Partners seed brand (SP4408PF). Limited sorghum/sudan seed, 2025. BMR version available in 2026. Other companies licensed for 2026?
  - Texas A&M Univ. is working on a dhurrin-free sorghum genetic from a different source. Commercial release projected for 2029/2030.

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Purdue Univ. Grazing (Sheep)

- Preferential feeding of the Experimental dhurrin-free hybrid.

Further research also confirms with dairy cattle.
And rabbits like it, too.

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Implications: Prussic Acid-Free Sorghums

- Early season: Though concerns about prussic acid in young sorghums are gone, it is still likely favorable to wait until ~24" tall to begin grazing to ensure regrowth potential is not hurt.
- Summer drought: Sorghums where growth is stalled but then regrow with rain—any new growth/regrowth would be immediately safe to graze (no delay due to prussic acid concerns).
- Fall initial frost/freeze (and repeated freezes): Cattle grazing on prussic acid-free sorghums need not be removed from the field. (When this normally occurs, repeated heavy frost/freeze can release a new round of prussic acid further down in the canopy. You might have to keep the cattle off until the non-PF crop is completely dead.) Cattle removal may require expensive supplemental feeding.

Implications: Prussic Acid-Free Sorghums

- Possible *future* grain sorghum hybrids with prussic acid-free trait: Though this is not currently available (and the PF trait has no value for grain production)…
  - Farmers could graze a prussic acid-free sorghum immediately after grain harvest. Some of the forage may still be green.
  - Re-tillering around the base of the plant (and also any growth from the upper stalk that leads to "sucker" heads) could be freely grazed. This is an issue with non-PF sorghum/stalks when there is still favorable conditions for growth. Sorghum is "bi-annual", that is, it could grow for two years. Once grain development is complete, the stalk remains alive and will tiller. Normally, this tender regrowth is a prussic acid concern. It would not be with a PF grain sorghum.