

Prussic Acid Poisoning in Livestock



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Prussic Acid Poisoning

It was discovered in the early 1900s that under certain conditions sorghums are capable of releasing hydrocyanic acid (HCN or prussic acid), which makes them potentially dangerous for grazing. In the plant HCN is attached to a larger molecule, a cyanogenic glucoside called dhurrin. Dhurrin itself is harmless as it is simply a compound consisting of a sugar and a non-sugar molecule. However, a two-step enzymatic process results in two hydrolysis products with the final one being HCN. Generally, for this process to occur the plant has to be damaged as the glucosides and degradative enzymes are compartmentally separated within the plant cells. This damage may occur through the chewing action of an animal, a hard freeze where cell walls are ruptured, or through mechanical action such as that caused by a swather and its crimpers. Once ingested by an animal the HCN is released in the rumen and readily absorbed into the bloodstream. HCN does not prevent oxygen from being transported by hemoglobin, but does prevent the body cells from receiving oxygen. The site of this inhibition is believed to be the cellular electron transport system where cyanide (CN) blocks the utilization of oxygen. Thus, the animal dies from asphyxiation at the cellular level. Animals affected by prussic acid poisoning exhibit a characteristic bright red blood just prior to and during death.

Plant Factors in HCN Accumulation

Several points of agreement among agronomists, animal scientists, and veterinarians on HCN accumulation in sorghum plants include:

1. Young plants contain more HCN per unit weight than do older plants.
2. Any stress condition such as drought or freeze damage will increase HCN amounts.
3. There is more HCN in the leaves than in stems—the

topmost (younger) leaves contain more HCN than do the lower leaves.

4. HCN tends to become diluted in older plants, but top-most leaves may still contain dangerous amounts.
5. Sun-curing of hay will reduce HCN, especially if the hay is crimped. Dhurrin will be hydrolyzed and HCN evaporates in gaseous form.
6. Dryland sorghum tends to be higher in HCN potential than does irrigated sorghum due to stress.
7. High nitrogen rates, regardless of phosphorous level, will increase HCN potential.
8. Imbalance of nitrogen and phosphorous in the soil increases HCN potential.
9. HCN potential in sorghum plants is genetically controlled and varies among sorghum types (Table 1). Several enzymes are involved in production of amino acids with many genes being involved.

Table 1. Generalizing ranking of sorghum types in their potential HCN accumulations

<i>Sorghum Types</i>	<i>HCN Potential</i>
Piper Sudangrass	Low
Sudangrass X Sudangrass Hybrids	Fairly Low
Sorgo-Sudangrass Hybrids	Intermediate
Sorghum-Sudangrass Hybrids	High
Sorgos (Varieties)	Intermediate to High
Grain Types (Varieties and Hybrids)	High to Very High
Johnsongrass	Generally High
Sorghum Alnum (Columbus Grass)	Generally High

Commercial hybrids which are relatively low in prussic acid potential exist while others are being developed, but such hybrids are not advertised as "safe" because of the multitude of uncontrollable factors involved. *One can never be absolutely certain that a field of sorghum is safe to graze.*

Management Practices

Taking a proactive approach to managing for HCN poisoning is preferable to waiting for it to "just happen." The following management techniques will help prevent losses related to HCN.

1. Do not turn in hungry cattle. Feed some hay first then turn in cattle in late afternoon.
2. Prevent selective grazing of **lush young** regrowth by using rotation grazing.

3. Allow plants to reach at least 18 to 24 inches in height before grazing is allowed. This permits some dilution of the HCN.
4. Do not graze after frost until all plants are field cured. It is necessary to make sure you have had a killing frost because sorghum plants will initiate tillering with a light frost. The tillers will be exceptionally high in HCN. It is recommended that at least 7 days (one week) be allowed after a killing frost.
5. If environmental conditions in your area are such that HCN poisoning is a consistent problem, check with your seed dealer about varieties or hybrids that would have a low HCN accumulation potential.
6. Take a soil sample from the area to be planted. Do not apply excessive nitrogen fertilizer. Keep soil phosphorus, and pH at an appropriate level for producing sorghum, see OSU Fact Sheet No. 2225, "OSU Soil Test Calibrations." Soil sampling is essential in managing for HCN.
7. When turning cattle into a field with possible HCN problems, the following is recommended:
 - Turn in only a few cattle at first and see how they do.
 - Ask your local veterinarian to be present in case of problems.

Laboratory Analysis for Prussic Acid

The Oklahoma Animal Disease Diagnostic Laboratory will test forage samples for prussic acid. A common problem associated with testing for prussic acid is the volatilization (i.e. loss as a gas) of prussic acid as the sample dries. If prussic acid has been lost from a sample prior to analysis, the test result can be misleading. In order to prevent volatilization, call the laboratory for special instructions on how to properly submit samples. General guidelines for interpreting results from a prussic acid test are provided in Table 2.

Table 2. Generalized interpretation for forage prussic acid (HCN) test

<i>ppm HCN (dry matter basis)</i>	<i>Interpretation</i>
0-250	Very low - safe to graze.
250-500	Low - safe to graze.
500-750	Medium - doubtful to graze.
750-1000	High - dangerous to graze.
>1000	Very high - very dangerous to graze

Treatment for Prussic Acid Poisoning

Due to the acute nature of this toxicity, for treatment to be successful, it must be done immediately when symptoms are observed. Also, due to the fact that the oxygen transport system of blood is compromised, death by suffocation will occur, sometimes within minutes of observing symptoms especially if the animal becomes excited or exerted.

The toxicity may be distinguished by the bright red color of the venous blood. The treatment recommended is sodium thiosulfate. This product is not readily available either commercially or over the counter for sale to producers. Therefore, you should make plans with your veterinarian to have some material on hand in case of an emergency. The product is difficult to find and may have to be compounded by the practitioner. A well thought out and preplanned emergency plan with your veterinarian could save thousands of dollars in losses if an emergency should occur.

Summary

There are no totally reliable quick test methods of determining the amount (ppm) of prussic acid that may have accumulated in sorghum plants. Livestock producers should be cautious about grazing plants that have been subjected to stress. Danger can be reduced by planting a variety or hybrid that is low in prussic acid potential and by using preventative management practices.

The environmental scenarios that enhance prussic acid accumulation are similar to those of nitrate toxicity. For information regarding the factors involved in nitrate toxicity refer to OSU Fact Sheet No. 2903, "Nitrate Toxicity in Livestock."

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