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CYANIDE POISONING

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Cyanide, prussic acid and hydrocyanic acid are all terms describing the same toxic substance. It is one of the most rapidly acting toxins that affect mammals. Cyanide is a lethal ingredient that has been used in rodent and vermin killers.

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Understanding Cyanide Poisoning

A number of common plants may accumulate large quantities of cyanogenic compounds. Sorghums and related species readily accumulate these compounds. These cyanogenic compounds are in epidermal cells (outer tissue) of the plant, while the enzymes that enable cyanide production are in the mesophyll cells (leaf tissue).

Any event that causes the plant cell to rupture, allowing the cyanogenic compound and the enzyme to combine, will produce cyanide. Plant cells can be ruptured by cutting, wilting, freezing, drought, crushing, trampling, chewing or chopping.

Once plants containing cyanide have been consumed, the toxin rapidly enters the blood stream and is transported throughout the body of the animal. Cyanide inhibits oxygen utilization by the cells in the animal's body. In essence, the animal suffocates.

Ruminant animals (cattle and sheep) are more susceptible to cyanide poisoning than nonruminant animals because the ruminal microorganisms have enzymes that will release cyanide in the animal's digestive tract.

Clinical Signs

Cyanide is a potent, rapidly acting poison. Signs of cyanide poisoning can occur within 15 to 20 minutes to a few hours after animals consume the toxic forage. Animals often are found dead.

Clinical signs, when noticed, occur in rapid succession. Excitement, rapid pulse and generalized muscle tremors occur initially, followed by rapid and labored breathing, staggering and collapse. Signs also may include salivation (drooling), lacrimation (runny eyes), and voiding of urine and feces. The mucous membranes are usually bright pink, and the blood will be a characteristic bright cherry red.

Diagnosis

When livestock losses occur and cyanide poisoning is suspected:

- Contact your veterinarian.
- Send the suspect forage to the diagnostic laboratory for analysis. Do not send grains, stomach contents or blood samples.
- Change forages or remove animals from suspected pastures until results of the analysis are returned.

Treatment

The treatment for cyanide poisoning consists of re-establishing oxygen transport at the cellular level. Your veterinarian is the only qualified individual to institute this treatment.

Sodium nitrite is injected intravenously to convert hemoglobin to methemoglobin, which reacts with cyanide from the cyanide-cytochrome complex to form cyanmethemoglobin. A simultaneous injection of sodium thiosulfate provides sulfur to convert cyanmethemoglogin to the less toxic thiocyanate, which is excreted in the urine. The remaining methemoglobin is converted by other enzymes to hemoglobin, which then is available to transport oxygen normally.

Caution: Clinical signs of cyanide poisoning and nitrate poisoning are quite similar. Be certain nitrates are not a problem before administering sodium nitrite. An injection of sodium nitrite into an animal already suffering from nitrate poisoning would be disastrous.

The blood of animals affected with nitrate poisoning will be chocolate brown, compared with the cherry red of blood from prussic acid poisoning.

Sodium thiosulfate, alone, is also an effective antidotal therapy for cyanide poisoning.

Forages

Cyanide poisoning most often is associated with sorghums and sudangrass. However, a number of other plants can be cyanogenic. **A list of these plants is found in Table 1.**

Table 1. Plants With Cyanogenic Potential

Apple	Forage sorghums	Shattercane
Apricot	Grain sorghums	Sorghum-sudangrass hybrids
Arrow Grass	Hydrangea	Sudangrass hybrids
Birdsfoot trefoil	Indiangrass	Velvet grass
Cherry	Johnsongrass	Vetch seed
Chokecherry	Lima bean	White Clover
Elderberry	Peach	
Flax	Poison suckleya	

Leaves usually produce two to 25 times more cyanide than do stems in forage grasses; seeds contain no cyanide. Young, upper leaves have more cyanide than lower leaves. New shoots often contain high concentrations of cyanide. New shoots produced after frost can be especially hazardous.

Cyanide content appears to be higher in plants grown in soils high in nitrogen and low in phosphorus. When fertilizing forage ground, use split nitrogen (N) applications when the total amount exceeds 60 pounds of N per acre to decrease the risk of cyanide toxicity.

Herbicides such as 2,4-D can increase cyanide concentrations in forage for several weeks after application. Plan grazing rotations accordingly.

Drought increases the chance for high levels of cyanide in plants. This may be because the plants have not been able to mature and contain mostly leaves, which have a higher in cyanide content. In general, any stress condition that retards plant growth can result in higher than normal levels of cyanide.

Frost or freezing causes plant cells to rupture, allowing cyanide to be released. If the potential for poisoning is great before freezing (high concentrations of cyanide-containing compounds are present), then the danger of poisoning is even greater while the plant is frozen and for several days following a frost.

Do not graze frosted summer annuals until the regrowth of shoots is 15 to 18 inches tall, or until several days after the entire plant and shoots are killed by a subsequent frost.

Forage Analysis

Cyanide analysis estimates the “potential” of the plant to cause poisoning. During the forage analysis, the plant cells are broken, allowing the cyanogenic compound to mix with the plant enzymes that release the cyanide. The toxin then is measured. **Table 2 provides some guidelines for evaluating forages for cyanide toxicity.**

Table 2. Cyanide (HCN) Content of Forages

As-fed Basis (Moisture Content Unknown)	Cyanide Content (Dry-matter Basis)	Comments
< 200 ppm	< 600 ppm	This feed should not cause cyanide poisoning.
200 to 600 ppm	600 to 1800 ppm	This feed is potentially toxic; it should be fed at a restricted rate.
> 600 ppm	> 1,800 ppm	This feed is potentially very toxic. Drying, ensiling, or allowing it to mature should reduce the cyanide content. Retest before feeding.

Prevention

Plant Species

The plants most commonly associated with cyanide poisoning are sudangrass, Johnsongrass, sorghums and sorghum-sudangrass hybrids. Grain sorghums are potentially more toxic than forage sorghums or sudangrass. Indiangrass and chokecherry also can cause cyanide poisoning. Hybrid pearl millet and foxtail millet generally have very low levels of cyanide.

Plant Age and Condition

Young, rapidly growing plants generally have high levels of cyanide. Higher concentrations of cyanide are found in young leaves than in old leaves or stems. New forage growth following drought or frost is dangerously high in cyanide.

Plants grown in soils high in nitrogen but low in phosphorus and potassium tend to have high cyanide concentrations.

Drought and Frost

Cyanide poisoning commonly is associated with plant regrowth following a drought-ending rain or the first autumn frost. Wait at least seven days after a killing frost before grazing to allow cyanide to dissipate.

Feeding

Most livestock losses occur when hungry or stressed animals graze young sorghum growth. Do not graze new growth or regrowth in sorghum or sorghum-sudan pastures. Feeding grain or hay before turning animals into pasture may reduce the rapid intake of forage and, thus, the amount of cyanide consumed. Animals do not develop immunity to cyanide, but they can detoxify low levels of cyanide.

Harvest Technique

Fresh forages have higher concentrations of cyanide than silages or hay. However, if the forage had extremely high concentrations of cyanide before cutting or if the hay was not properly cured, dangerous levels of cyanide can remain. If you have any doubts about the level of cyanide in a forage, get suspect hays and silages analyzed before feeding.

Guidelines

Cattle are more susceptible to cyanide poisoning than sheep. Horses also can be affected.

Keep the following guidelines in mind when feeding forages such as sorghum and sorghum-sudan hybrids:

- ✓ Never graze sorghum less than 18 inches in height.
- ✓ Feed hungry cattle before allowing them to graze forages that may contain high levels of cyanide.
- ✓ Do not allow animals to graze troublesome plants after a light frost or after rain has ended a summer drought. Wait several days after a killing frost before grazing.
- ✓ Chop or ensile plants high in cyanide to reduce toxin levels.
- ✓ Analyze suspect forage samples before feeding.

If you have questions
concerning submitting samples
to a laboratory for analysis,
you can contact the
North Dakota State University
Veterinary Diagnostic Laboratory
at 701-231-8307.

This publication was authored by Charlie Stoltenow and Greg Lardy, 2012.

For more information on this and other topics, see www.ag.ndsu.edu

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