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Prussic Acid (Cyanide) in Forages

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Prussic acid poisoning in cattle has been recognized for many years. Prussic acid is hydrogen cyanide. Some cultivated forages in addition to Johnsongrass and some woody plants can accumulate cyanide. In the plant, cyanide exists as part of a parent compound that is not toxic. The toxin is released when the integrity of plant tissue structure is disrupted. Problems develop when the quantity consumed overrides the capacity of the animal's systems to metabolize and detoxify the cyanide.

Factors affecting prussic acid levels in fresh and harvested forages

In the plant, cyanide exists as part of a parent compound called a cyanogenic glycoside which is not toxic. Physical damage to the leaves of the plant allows the parent compound to mix with enzymes that cleave chemical bonds and release the cyanide. Cutting, crushing, trampling, wilting, freezing, cause damage and release cyanide. Chewing and microbial enzymes in the rumen also release cyanide from plant tissues. After release, the cyanide transforms to a gaseous state and dissipates for the damaged tissue. Because of this transformation, cyanide levels will dissipate in forages that are damaged in the field (i.e. hail damage) or are cut, wilted and/or cured for harvest.

Plant factors Forage sorghum, grain sorghum, sudangrass, and sorghum*sudangrass are common forage crops that contain cyanogenic glycosides. Johnsongrass is a common species in fields and pastures that also contains the glycosides.

The concentration of cyanogenic glycosides and the potential for cyanide poisoning is highest in the young tillers rather older leaves and stems. Concentrations are typically highest in young, actively growing leaf material, such as new growth early in the growing season, regrowth following cutting or grazing, new tillers that develop following moisture stress and drought, and new tillers that sprout following a non-killing frost or freeze.

Weather and climate factors during the growing season The cyanogenic glycosides that contain cyanide can accumulate in the plants during periods of stress or retarded growth. Dry soil conditions, cloudy overcast days, and cool ambient temperatures may lead to accumulation. Drought-stressed plants accumulate cyanide which can remain in the plant if there is opportunity for the plant to continue growth after the stress.

Freezing does not increase the amount of cyanogenic glycosides in plants. However, freezing disrupts tissue integrity and releases cyanide from the glycosides in the same manner as any other physical damage (mastication, cutting, crimping).

Following a stress period, several days of good growing conditions are necessary before the cyanogenic glycoside levels and potential for toxicity can decline.

Management factors Higher soil nitrogen levels tends to increase cyanide potential. Poor availability of other soil nutrients such as sulfur, phosphorus and potassium can retard plant metabolism and growth and increase cyanide potential.

Unlike nitrates, another potentially toxic compound in some forages, cyanide concentrations will dissipate when forages are cut and properly cured for hay. Forages that are ensiled can also have lower cyanide potential especially if some wilting is allowed prior to ensiling. HOWEVER, if the forage has a high cyanide concentration before cutting, or forages are not cured properly, hazardous concentrations of cyanide can remain in the harvested forage.

Analyzing concentrations

Cyanide levels in forages can be analyzed in a laboratory. However, there are a few considerations.

First, because the cyanide is volatile and cyanide concentrations will dissipate over time, care must be taken to handle the forage samples properly after collection and expedite delivery to the laboratory. Take an insulated cooler with ice or cold packs into the field when collecting the samples. When a sample is collected, place in a plastic bag and close the bag. Place the bag in the cooler on the ice or cold packs. Proceed directly to the laboratory. If the samples cannot be delivered to a laboratory after collection, remove them from the cooler and place them in a freezer until they can be delivered the next day. It is recommended to call the laboratory for specific guidance.

Second, cyanide analysis is not as precise as other procedures and results can be misleading. Because of this, if an analysis indicates there are critical concentrations in the forage, a second analysis at the same laboratory or a different laboratory may be appropriate. Cyanide levels exceeding 200 ppm on a wet basis or 500 ppm on a dry basis are commonly considered potentially toxic. Because of the difficulties with cyanide analysis, some laboratories do not report concentrations but instead prefer to report a "risk" scale (i.e. 1 safe to 4 high potential for toxicity).