

Testing Forages and Hay for Hydrogen Cyanide (Prussic Acid) Potential

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In some situations, there may be a desire to test forages or hay for hydrogen cyanide or prussic acid potential. Hydrogen cyanide (HCN) or hydrogen cyanide potential are more appropriate terms and will be used throughout this document. Free hydrogen cyanide is not routinely found in the plant. Instead, the plant contains one or more cyanogenic glycosides that can be converted to hydrogen cyanide by enzymes in the plant or enzymes in the rumen of cattle, which is why the term hydrogen cyanide potential is used.

There are several testing procedures being used by various labs, which may lead to results varying from lab to lab. To evaluate the full hydrogen cyanide potential, it is critical that the testing procedure includes a beta-glucosidase enzyme. The inclusion of this step is necessary because it allows for the most accurate measurement of hydrogen cyanide potential and more closely represents the conditions and changes that would occur within the rumen. Samples should be submitted to a lab that includes a beta-glucosidase enzyme and incorporates standard samples to ensure the test is consistent. ServiTech Laboratories (servitech.com) is the only commercial lab that we are aware of that currently includes both steps and is the lab our group has used to test research and producer samples.

Research conducted near Amarillo in 2021 (Bell and Banta, unpublished data) revealed both hydrogen cyanide potential and nitrates in pearl millet, corn, forage sorghum, and sudangrass samples grown in the same trial. Based on this research and other sampling, if forages are being tested for hydrogen cyanide potential it would be advisable to also test them for nitrates as well. The same sample can be used for both. Cost for hydrogen cyanide, nitrates, and dry matter analysis are currently running about \$43 per sample.

Interpreting results:

Results should be expressed and evaluated as mg/kg or ppm on a 100% dry matter basis (1 mg/kg = 1 ppm). Unfortunately, testing results can't guarantee that a forage will be safe to feed. There is limited research in cattle regarding toxic levels of hydrogen cyanide. Additionally, toxicity is a function of cyanogenic glycoside concentration in the forage, rate of forage consumption, and rate of hydrogen cyanide detoxification in the animal. Mammalian species including cattle and humans can detoxify some level of hydrogen cyanide. Toxicity becomes an issue when absorption of hydrogen cyanide exceeds the bodies' ability to detoxify it. Although testing cannot guarantee safety, knowing the level of hydrogen cyanide potential provides valuable information to make informed decisions regarding the risk level of a particular forage.

Collecting samples:

Hay samples: Use a hay probe to collect and composite samples from at least 8 to 10 representative bales from each cutting or lot of hay, just like would be done for other hay testing analysis. Mix the samples and place the composite sample in a quart sized plastic bag for shipping. Contrary to what has historically been thought, hydrogen cyanide potential can be an issue in some dry hay, even following a substantial post-harvest storage period. Research results from 4 experiments published by Dr. Stuart indicate that increased drying time, conditioning hay, or double conditioning hay did not lower hydrogen cyanide potential when compared with plant samples taken just prior to cutting.

Fresh forage samples: When collecting fresh forage samples, try to minimize bending or cutting of plant tissue until after the plants are dry. Plants should be cut approximately 2 to 4 inches above the ground and collected at random across the field. The number of plants to collect will vary by size. See below for size-dependent reference numbers of plants to collect. Generally, it would be desirable to collect enough sample to provide at least 100 grams of dry tissue for analysis.

- **Fresh plant samples** can be shipped overnight to the lab. Cut plants into 12 to 24 inch pieces so they will fit into a brown paper grocery bag (preferred) or trash bag. Place the bag in a cardboard box for shipping. Cut samples into as few pieces as possible. Samples absolutely should not be frozen and should not be placed on ice. Placing samples on ice could cause tissue freezing and cell rupture resulting in lower hydrogen cyanide values.
- Alternatively, **samples can be dried or partially dried prior to shipping**. Partially drying samples by placing them in the sun for a few days works well in many situations. It reduces shipping weight and allows for samples to be shipped with lower cost options compared to overnight shipping. If samples are dried, they can be cut or bent to help with shipping.

Amount of fresh forage sample to collect:

- Plants less than 12 inches tall: Collect about 40 to 60 plants.
- Plants 18 to 30 inches tall: Collect about 15 to 20 plants.
- Plants over 30 inches tall: Collect about 6 to 10 plants.

For additional questions about sampling please contact Dr. Jason Banta, jpbanta@ag.tamu.edu, or one of the other authors of this publication.

Note: This document reflects the current information and understanding of hydrogen cyanide potential in forages, testing, and risks to cattle and other livestock. However, there is still much to learn about these topics and additional research and technology advancements may change scientific understanding and recommendations in the future.