

Cyanide and nitrate poisoning from sorghum crops



Cyanide (sometimes called prussic acid) and nitrate can be present in various amounts in grain and forage sorghums. In hot and dry conditions, such as drought, these plants become stressed, causing them to accumulate these toxins. Fatalities can occur when ruminants graze sorghum crops or are fed sorghum hays containing excess levels of cyanide and or nitrate toxins.

By observing a few simple rules for using sorghum crops as fodder, you can prevent significant losses.

This guide contains information on cyanide poisoning, as well as nitrate poisoning in livestock. It gives advice on how you can prevent, diagnose and manage these poisonings. It also has information on how best to use sorghum as fodder.

Cyanide poisoning from sorghum

Animals, especially ruminants, can suffer cyanide poisoning from eating plants that contain high levels of cyanogenic glycosides.

All sorghums can accumulate cyanogenic glycosides and have the potential to poison stock, but some are safer than others.

Inside the animal's rumen the plant cyanogenic glycoside is hydrolysed to release hydrogen cyanide. Cyanide prevents the release of oxygen from the red blood cells, starving the tissues of oxygen.

Risk during the lifecycle of the crop

Cyanide-producing potential is present during any stage of the crop's lifecycle. The risk is higher when growing plants are stressed by:

- wilting
- crushing
- droughts
- frosts
- trampling
- hail damage
- insect damage (grasshoppers and caterpillars).

Therefore, stressed regrowth is considered the most dangerous—take care at this stage to avoid poisoning.

The lowest risk of cyanide accumulation is when plants are flowering and seeding.

Safe levels of cyanide for cattle and sheep

There is a wide difference in cyanide accumulation in different plant varieties, for example, grain sorghums, and the sweet sorghum and delayed-flowering varieties, tend to have

much higher cyanide levels than other varieties. *Sorghum alnum* and Johnson grass (*Sorghum halepense*) are the most dangerous, while silk sorghum is generally one of the safest.

The cyanide concentration of plants is measured as mg/kg or ppm (parts per million) of hydrogen cyanide on a dry weight basis. Some common sorghum varieties have relatively high cyanide concentrations of between 400–900mg/kg.

Many factors can lead to cyanide poisoning in cattle. For this reason it's difficult to apply a threshold for safe grazing to all circumstances. However, as a general rule-of-thumb cyanide levels above 600mg/kg are a risk to grazing stock but levels down to 200mg/kg can still be a threat to very hungry animals.

Hay made from hazardous sorghum forage will remain hazardous. Ensiling such material can decrease its cyanide potential, but actual levels in the end product should be checked before feeding it.

Signs of cyanide poisoning in livestock

Signs of cyanide poisoning in animals include:

- rapid laboured breathing
- frothing at the mouth
- mucous membranes that are bright red in colour
- muscle weakness or twitching
- convulsing
- staggering
- unconsciousness
- death

Animals eating large amounts of toxic feed will die within 5–15 minutes of developing clinical signs of poisoning. Affected animals rarely survive more than 1–2 hours after consuming lethal quantities.

Diagnosis and treatment of cyanide poisoning

If you find a sick or dead animal, promptly remove all stock from the sorghum crop and seek advice from your veterinarian. A post-mortem examination will help identify the exact cause of death in your animal. Your veterinarian will collect the appropriate samples and submit these for laboratory testing.

Nitrate poisoning in sorghum

Nitrate can accumulate in many weed, crop and pasture plants. Plants accumulate nitrate when soil nitrate is high but conditions are not favourable for normal plant growth, which would normally allow the nitrate to be converted to plant protein.

Nitrate in plants is converted to nitrite by bacteria present in the animal's rumen. The excess nitrate and nitrite is absorbed through the rumen wall into the bloodstream. Nitrite changes the normal red haemoglobin in blood cells to brown methaemoglobin that cannot carry oxygen. If more than 75% of haemoglobin is converted this prevents the blood from carrying enough oxygen, starving the tissues of oxygen, causing the animal to die.

Plants that accumulate nitrate

Nitrate can accumulate in many weed, crop and pasture plants. Forage sorghum, grain sorghum, sudan grass, sudan grass hybrids and pearl millet are well recognised nitrate accumulators.

Factors that influence nitrate build-up

Nitrate build-up in plants depends on many factors but generally occurs where soil nitrate is high and the plants are not able to convert the nitrate to protein (reduced photosynthesis).

High soil nitrate concentration can be due to:

- nitrogen fertiliser application
- high manure deposition
- fallowing
- drought

Nitrate build-up in plants can occur during:

- drought and rain post drought
- cloudy weather
- cold weather
- wilting
- herbicide application
- insect or fungal damage

Most nitrate in plants is concentrated in stems and stalks. Toxic amounts of nitrate will persist in hay.

Safe levels of nitrate for cattle and sheep

The nitrate concentration of plants is generally measured as per cent (%w/w) nitrate, expressed as potassium nitrate (KNO₃) equivalent on a dry weight basis. The nitrate content of sorghum crops in Queensland has been recorded as high as 6.4% KNO₃. Sorghum hay in Queensland has reached levels of 12% KNO₃.

Plants are regarded as hazardous to ruminants if they contain 1.5% or greater KNO₃. Animals may become acclimatised to concentrations up to 3%, but any sudden increase in feed intake or the addition of supplements containing monensin can lead to poisoning.

Signs of nitrate poisoning

Signs of nitrate poisoning in livestock are very similar to that of cyanide poisoning and include:

- increased heart rate
- rapid laboured breathing
- muscle weakness or tremors
- blue-grey or brown* mucous membranes
- frothing at the mouth
- abortion
- staggering gait
- unconsciousness
- death

*When nitrite oxidises haemoglobin the blood colour changes to chocolate-brown (the colour of methaemoglobin). This discoloration fades with time and is generally not observed in an animal that has been dead for several hours.

Diagnosis and treatment of nitrate poisoning in animals

If you find a sick or dead animal, promptly remove all stock from the suspected feed source and seek advice from your veterinarian.

A post-mortem examination will help identify the exact cause of death in your animal. Your veterinarian will collect the appropriate samples and submit these for laboratory testing.

Adapting animals to higher nitrate levels

Animals can adapt to higher (but not toxic) nitrate levels, if introduced slowly. This allows time for bacterial populations in their rumen to change. The extra bacteria help the animal break down the nitrite.

Monensin supplementation can increase deaths from nitrate-nitrite poisoning because it breaks down nitrate, contributing to the build of toxic nitrite.

Testing plants for cyanide and nitrate

Producers can have plants tested for levels of cyanide and/or nitrate by a commercial agricultural laboratory. The Biosecurity Sciences Laboratory also conducts testing as part of a veterinary investigation of a significant disease incident, or by prior arrangement.

If you suspect cyanide or nitrate poisoning contact your veterinarian or Biosecurity Queensland (<https://www.daf.qld.gov.au/contact/customer-service-centre>) for advice on laboratory diagnosis.

Sending plant samples for testing

Plant samples should be collected and packaged appropriately so they reach the laboratory as quickly as possible and without damage.

For fresh plant samples, dig up and wrap the root ball in wet newspaper.

Paper wrapping should be used to package either fresh plant or hay samples—do not submit in plastic bags as this can lead to falsely low results.

Rules for using sorghum crops for fodder

The following guidelines for using sorghum crops as fodder can help reduce the risk of cyanide and nitrate poisoning:

- avoid grazing stressed plants or when regrowth is sprouting
- delay grazing until plants are more than 45cm high for short varieties and 75cm high for tall varieties. Flowering plants or grain are less likely to poison stock
- do not graze hungry stock. Animals are most likely to be poisoned if they eat large amounts in a short time
- watch your stock closely in the first hour and monitor at least twice a day for the first few days
- supplement stock with sulphur-containing licks or blocks or molasses (which is naturally rich in sulphur). Sorghums are low in sulphur and sulphur helps the liver to detoxify cyanide
- test crops for cyanide and/or nitrate levels before using as fodder if in doubt about its safety
- do not use crops that are unsafe to graze to make hay. Ensiling hazardous sorghum will reduce the cyanide content but the end product should be tested before use. ■■