Nitrate Poisoning

What is Nitrate Poisoning?

Although its incidence is low, nitrate poisoning can occur in a wide range of fodder crops including forage crop and pastures. Plants absorb nitrogen from soil in the form of nitrate, which is quickly converted into amino acids. This conversion process requires energy from sunlight, water and favourable weather conditions, particularly temperature. When plants are stressed, this conversion process is interrupted and nitrate will begin to accumulate in the plant. In general, the highest levels of nitrate will be in the lower one third of the stem.

Symptoms of Nitrate Poisoning

A typical symptom of stock suffering nitrate poisoning is an increase in respiration rate, which may progress to severe gasping, convulsions and death. The blood changes to a chocolate brown colour but within several hours, after death, will change again to a dark red colour.

Factors influencing nitrate levels

Note: nitrate accumulation in plants generally occurs when several of the following occur together:

1. The crop is grown on fertile soil containing high levels of nitrogen

2. Drought, frost or any significant stress factor temporarily stops plant growth

3. Plants have their leaves removed or killed (i.e. grazing or severe hailstorm) while the stems and roots remain active

4. The growth of highly fertilised (particularly N) crops is suddenly halted due to an adverse weather change (e.g. cold and overcast weather).

Recommended grazing management

Stock can breakdown nitrate however there is a harmful by-product produced. In the process of turning nitrate into beneficial ammonia, ruminants produce the intermediate product, nitrate. This is usually no problem but when stock ingest nitrate faster than it can be broken down into ammonia, nitrate will form in the rumen. When this nitrate is absorbed into the bloodstream it reduces oxygen carrying capacity of the blood.

The tolerance of stock to nitrate does vary. Stressed animals, such as those that have been without feed, are sick, pregnant or lactating will be less tolerant to nitrate. Even mid-range levels of nitrate can be too high for them.

Treating affected stock

Affected stock need immediate treatment by a veterinary officer and success will depend upon how soon treatment can be given. Avoid handling or moving stock to minimise their oxygen needs.

What level of nitrate is dangerous?

orage suspected of containing high levels of nitrate should be tested prior to feeding. Nitrate can be expressed in two different ways – Nitrate nitrogen (NO_3 N) and Nitrate (NO_3-).

Table: Potentially toxic levels

	% of dry mattter	ppm of dry matter
Nitrate nitrogen (NO_3N)	Over 0.21	2,100
Nitrate (NO_3-)	Over 0.93	9,300

CAUTION - NITRATES CAN BE CUMULATIVE

The level of nitrate that causes toxicity in ruminants varies depending on rate of intake, diet, acclimation to nitrate and nutritional status. As a rule, forage containing less than 5,000 ppm NO_3 on a dry matter basis is safe. Forage containing 5,000 to 10,000 ppm NO_3 is considered potentially toxic when provided as the only feed. Forage containing over 10,000ppm NO_3 is considered dangerous but often can be fed safely after proper dilution with other feeds.

One thing to consider is that the effects of feed and water levels are additive. Consider both in avoiding or assessing nitrate problems. Common causes of high nitrate levels in water include shallow bores contaminated with surface water, water containing animal wastes, and surface runoff from heavy rain after fertilization with ammonium nitrate. Water containing more than 200ppm NO_3 is potentially toxic, especially when feed also contains an excessive level. You can use these formulas to convert nitrate to a common basis.

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Preventing nitrate poisoning

• Never turn hungry animals into possibly high nitrate forages. During drought, producers sometimes "turn onto" temporary forages to help animals in poor condition. The combination of poor body condition, high nitrate levels in the forage and high consumption can be deadly.

• Turning one old cow into a paddock to observe is not an effective test for nitrates, because cattle tend to bite the tops of plants first, where the concentration is lowest. As cattle are forced to eat the lower plant parts, poisoning could occur later when it is not suspected.

• Test hay before feeding if you suspect that it is high in nitrate. Nitrate levels remain constant in hay.

• If hay is high in nitrate, feed carefully with an energy supplement or in combination with low protein forages, or other hay low in nitrates.

• Never feed high-nitrate hay.

• Ensile forages high in nitrate. When hay is properly fermented, nitrate levels are reduced by 40 to 60 per cent. However, be careful in enclosed areas. High-nitrate forages can produce nitrogen dioxide (silo gas), which is very poisonous to humans.

• Irrigation or rain renews plant growth, which will lower nitrate levels (however, this could lead to prussic acid poisoning in sorghums

• Green chopping is the most dangerous feeding method. Cattle can adapt to higher than normal levels of nitrates if the increase occurs slowly. Healthy animals are less likely to develop problems than weak or sickly. Also, if enough carbohydrates are supplied, the digestive system can convert the nitrogen into ammonia or proteins faster, making it less likely that dangerous levels of nitrite accumulate.

TO CALCULATE DIFFERENT NITRATE FORMULATIONS

Potassium nitrate	Nitrate	Nitrate nitrogen
= Nitrate x 1.6 = Nitrate nitrogen x 7.0	= Potassium nitrate x 0.6 = Nitrate nitrogen x 4.4	= Potassium nitrate x 0.14 = Nitrate x 0.23

COMPARISONS OF NITRATE AND PRUSSIC ACID

	Nitrate	Prussic Acid
Plant parts affected	Older Lower Leaves	Young growth or new regrowth
Grazing problems	Occur when animals eat lower plant parts	Occurs early in the grazing period
Death occurs	Usually within 4 hours of consumption	Within minutes of consumption
Affect of haying on concentration	None – concentration is stable	Dissipates when cured or placed in a silage pit

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