



TECHNICAL NOTE

NITRATE-NITROGEN IN PASTURE & STOCK FEEDS

High concentrations of Nitrate-Nitrogen (Nitrate-N) in forage may cause death of livestock due to “nitrate poisoning”. Susceptible classes of stock include cattle, deer, goats and sheep. Dairy cows are considered to be the class of stock that is most at risk.

Factors that influence the Nitrate-N levels in plants

Nitrogen is an essential nutrient for the growth of plants. It is absorbed from the soil as nitrate-N, which then moves via the sap stream to the growing points for protein synthesis. During periods of rapid plant growth, uptake of nitrogen from the soil is correspondingly rapid. However, if the environmental conditions change forcing a reduction in the rate of plant growth, nitrate-N will temporarily accumulate – and may reach a toxic level. Nitrate-N levels gradually reduce as plant growth continues, especially in warm sunny conditions.

Plants such as annual ryegrass, perennial ryegrass, oats, sorghum and brassica have high nitrate-N levels when they are physiologically immature. Weeds such as amaranthus growing in forage crops may also have high levels.

Generally, the nitrate-N levels are higher in stem or stalks compare to leaf tissue.

High Risk Conditions

- A cold or cloudy weather change following a period of good growing conditions
- Annual ryegrass or “new grass” grazed in early spring or autumn
- Grazing lush plant growth after a drought has broken. This is due to nitrate accumulation in soil during drought conditions
- Nitrogen fertiliser applied at heavy rates
- Feeding young, immature forage crops.

Symptoms of Acute Nitrate Poisoning

The nitrate component of pasture or feeds is absorbed very quickly into the bloodstream of ruminant animals. When the level of dietary nitrate is high, some of the absorbed nitrate is converted to nitrite, which reduces the ability of the blood (haemoglobin) to carry oxygen. “Poisoning” is actually a form of suffocation (anoxia).

Animals breathe quickly in an effort to absorb more oxygen - they become unsteady and stagger due to lack of oxygen to the brain, Cows may salivate or froth at the mouth, start gasping for breath and then go down and may die quickly. Blood from dead animals is usually a “chocolate-brown” colour.

Some animals are more susceptible than others e.g. cows in poor condition or otherwise stressed may have less tolerance to nitrate-N in the feed.

Test results and reporting units

Analytical results may be reported as either “Nitrate-nitrogen” or “Nitrate” as a proportion of the plant tissue dry matter. These are simply ways of reporting the same information. Toxicity risk progressively increases where the Nitrate-N level is greater than 2200 mg/kg (or ppm), or 1% Nitrate.

Table 1 describes some recommendations that might be followed if feeding high nitrate-N forages is unavoidable. Further management practices are described below.

Nitrate-Nitrogen		Nitrate (ion) %	Recommendations
mg/kg (or ppm)	%		
<1000	<.1	0.0 - 0.44	Safe to feed under all conditions
1000 - 1500	0.1 - 0.15	0.44 - 0.66	Safe to feed to non-pregnant animals
1500 - 2000	0.15 – 0.2	0.66 – 0.88	Safely fed if limited to 50% of the total DM ration
2000 - 3500	0.2 – 0.35	0.88 – 1.54	Feeds should be limited to 35-40% of the total DM ration. Feeds over 2000ppm nitrate-N (0.2%) should not be fed to pregnant animals.
3500 - 4000	0.35 – 0.40	1.54 – 1.76	Feeds should be limited to 25% of total DM in the ration. Do not feed to pregnant animals.
>4000	>0.4	Over 1.76	DO NOT FEED. Feeds containing these levels are potentially toxic.

Table 1: Nitrate levels in forages for cattle (Adapted from: Cornell University)

Management Practices

- A laboratory analysis is recommended if any of the “risk’ factors exist. Hill Laboratories can provide accurate results one working day after receiving the forage sample at the laboratory
- Following guidelines as above, introduce stock gradually to any potentially at risk feed e.g. on-off grazing of brassicas
- Avoid putting hungry cows straight onto new pasture or greenfeed – feed some bulky roughage prior
- Allow crops and new pasture to mature before feeding
- Have water supply analysed to check nitrate levels
- Ensiling (1-3 months fermentation) will allow conversion of nitrate to ammonia and may reduce nitrate levels, although the level of reduction is variable. Haymaking does not reduce the nitrate level of the forage. Testing of the ensiled forage for nitrate-N is recommended before feeding.

References

1. Fleming, P.H., 2003. *Farm Technical Manual, Farm Management group, Lincoln University. P B-56*
2. Langer, R.M.H., 1990. *Pastures: their ecology and Management p 296*
3. *Pasture and Forage Plants for New Zealand, 2003. Grassland Research and Practice series No.8 p75*
4. Cullum, A. 2006. *Nitrate Poisoning. Intelact: Lifting Productivity*
5. Sniffen, C.J. and L.E Chase. 1981. *Nitrates in Dairy Rations, Department of Animal Science, Cornell University.*

Contact Details

For further information about the above test please contact an Agriculture client service manager.