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NITRATE POISONING OF LIVESTOCK

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SOURCES OF NITRATE

Sources of nitrate poisoning for livestock include crop plants, weeds, water and fertilizers. The most frequent source involves crop plants.

Plants

The majority of nitrate poisoning cases in North Dakota have involved drought stressed oats, corn and barley.

The concentration of nitrate in plants is highest in stems, less in leaves and least in fruits and grains. Levels are usually elevated prior to flowering and rapidly drop off after pollination.

The abnormal accumulation of nitrate in plants is influenced by various factors. Table 1 lists common plants known to accumulate nitrate if conditions, as indicated below, are right:

- Moisture conditions. Drought and plant stresses are associated with increased levels of nitrate in plants.
- Soil conditions and type. Soils high in nitrate (or ammonia) readily supply nitrate to plants; acidity, low molybdenum, sulfur or phosphorus deficiencies and low temperatures are known to increase nitrate uptake by plants.

Water

Water may be a source of toxic levels of nitrate for livestock. Water may become contaminated by fertilizer, animal wastes and decaying organic matter. Shallow wells with poor casing are susceptible to contamination; deep wells and ponds have occasionally become contaminated.

Table 1. Common plants known to accumulate nitrate.

Crops	Weeds
Alfalfa	Canada thistle
Barley	Dock
Corn	Jimsonweed
Flax	Johnson grass
Oats	Kochia
Rape	Lambsquarter
Rye	Nightshade
Soybean	Pigweed
Sudangrass	Russian thistle
Sugarbeets	Smartweed
Sweetclover	Wild sunflower
Wheat	

Fertilizer

Acute nitrate toxicity may be produced if livestock consume nitrate fertilizer. Care should be taken to avoid grazing immediately after spreading fertilizer. "Head lands," where the fertilizer spreader turns, or areas where filling and spilling take place may have excessive quantities of nitrate freely available to livestock. Fertilizer sacks should be safely discarded.

EFFECTS OF NITRATE ON LIVESTOCK

Nitrate in plants is not toxic to livestock until converted to nitrite. This conversion - nitrate to nitrite - occurs in the animal's digestive tract.

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Cattle and sheep are more susceptible to poisoning because microorganisms in their rumen favor this conversion to nitrite.

Nitrite absorbed into the blood converts hemoglobin to methemoglobin. Methemoglobin has no oxygen carrying capacity. The severity of poisoning depends on the level of methemoglobin in the blood.

SYMPTOMS OF POISONING

Clinical signs of nitrate poisoning are related to lack of oxygen in the blood. Acute poisoning usually occurs within a half hour to four hours after consuming toxic levels of nitrate in feed or water. Symptoms are of rapid onset and include:

- bluish/dark mucosal membranes because blood is dark brown (lacks oxygen)
- rapid/difficult breathing
- noisy breathing, as if in pain
- extremely rapid pulse; 150 + /min.
- salivation, bloat, tremors
- weakness, inability to rise, coma, death

Pregnant females which survive nitrate poisoning may abort due to lack of oxygen to the fetus.

Post-morten examination reveals dark, "chocolate-colored" blood. Clotting is normal.

DIAGNOSIS

Diagnosis of nitrate poisoning is based on clinical signs and circumstantial evidence of nitrate ingestion.

Laboratory confirmation of nitrate poisoning requires chemical analysis of feedstuffs and water available to animals immediately before onset of signs. Chemical analysis of rumen contents for nitrate is not reliable. Results of chemical analysis are interpreted according to guidelines in Table 2.

Treatment

Treatment of nitrate poisoning is specific and involves intravenous administration of methylene blue. The most commonly available formulation is a 4 percent aqueous solution; it is administered at the rate of 2 mg methylene blue per pound of body weight. It may need to be repeated. Commercial preparations intended for treatment of prussic acid only should not be used to treat nitrate poisoning. Mineral oil given via a stomach tube will counteract the caustic action of nitrate fertilizer and speed up its elimination from the digestive tract.

Prevention

Prevention of nitrate poisoning is best achieved by controlling type and quantity of forage offered to livestock. **Avoid forages with potentially toxic levels of nitrate or at least dilute them with feeds low in nitrate.** When in doubt, have feeds and forages analyzed for nitrate **before grazing or feeding them.**

Guidelines to interpret results of laboratory assays for nitrate in forage and water samples are summarized in Table 2. These guidelines apply to livestock only.

Part of information contained in this circular has been abstracted from CLINICAL AND DIAGNOSTIC VETERINARY TOXICOLOGY, pp. 460-467, by G.D. Osweiler, T.L. Carson, W.B. Buck and G.A. Van Gelder, 3rd. Ed. (1985), Kendall/Hunt Publishing Co., Dubuque, Iowa.

Table 2. Interpretation of laboratory results.

	Level of Nitrate			
	KNO_3	NO_3-N	NO_3	Recommendations for use in livestock
FORAGE	0-1%	0-0.15%	0-0.65%	Generally considered safe for livestock
	1-3%	0.15-0.45%	0.65-2%	CAUTION: Problems have occurred at this level. Mix, dilute, limit feed forages in this level
	>3%	>0.45%	>2%	DANGER DO NOT FEED. Potentially toxic.
WATER	0-720 ppm	0-100 ppm	0-400 ppm	Generally safe for livestock
	720-2100 ppm	100-300 ppm	440-1300 ppm	CAUTION. Possible problems. Consider additive effect with nitrate in feed.
	>2,100 ppm	>300 ppm	>1,300 ppm	DANGER. Could cause typical signs of nitrate poisoning.

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