

MEASURE AND MANAGE

Nitrates in Forages

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High Nitrate Levels in Forages

- Forage crops growing under mildly stressful conditions may exhibit increased quality. However, crops exposed to severe or prolonged periods of stress may become potentially hazardous to the health of the animals to which the crops are to be fed.
- Crops such as corn, sorghum, sudan grass, and other grass/legume forages, when exposed to abnormal growing conditions can accumulate high levels of nitrates in the plant.

Conditions which contribute to high nitrate levels are:

1. Cool, cloudy, dry weather inhibits protein formation
2. Frost damage - roots are still accumulating nitrates but the leaves are unable to metabolize it.
3. Drought conditions – nitrates move up in soil profile; dry conditions limit plant growth; potassium levels remain low
4. Hail – reduces leaf surface area and therefore the ability of plants to metabolize nitrates
5. Herbicide application – 2-4-D late in season combined with dry weather

Mode of Action

- Plants absorb nitrogen from soil in nitrate form and convert this to protein. Any condition which inhibits this conversion of nitrate to protein can contribute to high nitrate levels. Nitrates are converted to nitrite in the digestive tract. These nitrites combine with hemoglobin (the oxygen carrying entities) in the blood, to form methemoglobin. The production of methemoglobin reduces the efficiency of the blood to supply oxygen to muscle and tissue.

Symptoms of Nitrate Poisoning

Acute Symptoms:

1. rapid breathing
2. muscle tremors
3. staggering
4. rapid weak heart beat
5. death if untreated

Chronic Symptoms:

1. poor growth
2. poor milk production
3. abortion

Management:

Action To Reduce Potential Of Nitrate Poisoning

- High nitrate levels may persist in forages cut for hay, but will be reduced by 50% when ensiled for 30-60 days. During ensiling, nitrogen dioxide is given off. This appears as a yellow to reddish orange gas settling in silo rooms or at the base of storage facilities. Care and safety precautions should be exercised when working around these facilities.

To Reduce Nitrate Levels:

1. Cut frozen crops immediately after a frost.
2. Leave high stubble - nitrates accumulate in lower portions of the plant and stalk.
3. Nitrates (ppm) By Part of Corn Plant*

Sample	4-8" above grnd	8-12" above grnd	>12" above grnd
1	5100	4000	700
2	5400	2000	400
3	5600	3900	700
Average	5400	3600	600

4. Nitrates and Yield by Height of Cut Corn*

Height of Cut	Nitrates (ppm)	Silage DM ton/acre
4"	1500	5.0
8"	1000	4.4
12"	600	3.8

5. Allow susceptible crops 10 days after drought conditions cease before cutting or harvesting.
6. Dilute high nitrate feeds with low nitrate feeds. Grains are usually lower in nitrates than forages, and provide adequate energy for rumen microbes to metabolize nitrates.
7. Avoid applying any non protein nitrogen to ensiled crops.
8. Supply extra iodine, sulfur and vitamin A in rations.
9. Introduce feed gradually. Ruminants can be fed high nitrate feeds if rumen bacteria are allowed time to adapt.
10. Test suspected feed for nitrates –best done on an as fed basis, therefore include 250-300 grams of sample if nitrates are to be done.

*Adapted from Ward, Nebraska Extension Service

LEVELS OF NITRATES IN FORAGES FOR CATTLE

NITRATE ION %	NITRATE NITROGEN ppm	RECOMMEND
0.0-0.44	<1000	Safe to feed under all conditions
0.44-0.66	1000-1500	Safe to feed non pregnant animals, limit feed use in pregnant animals to 50 % of total ration on DM basis
0.66 – 0.88	1500-2000	Safely fed if limited to <50% total DM ration
0.88 – 1.54	2000 – 3000	Limit feeds to 30-40% of total DM in ration (feed over 2000 ppm nitrate nitrogen should not be fed to pregnant animals)
1.54 – 1.76	3500-4000	Limit feeds to 25% of DM in ration – do not feed pregnant animals
Over 1.76	>4000	Potentially toxic do not feed

References:

1. Pioneer Forage Manual; A Nutritional Guide; Pioneer Hi Bred International Inc. Des Moines Iowa 1995
2. Nitrate Poisoning Gwen McBride Feed Advisory Program OMAFRA 1989.
3. Cropest Ontario Issue No. 6(a) June 5 1998. Beth Wheeler, OMAFRA Dairy Nutritionist, Joan McKinlay OMAFRA Soil and Crop Specialist.