University of Wisconsin-Madison Extension

Watch Out For Silage Gas![1]

J.M. Sund, R.P. Niedermeier, and R.H. Burris[2]

Lethal silage gas can occur during silo filling if you don't take precautions. Protect yourself and your livestock from injury or death by avoiding this potential danger.

THE DANGER IS GREAT

Silage fermentation may produce several kinds of gas, including carbon dioxide and nitric oxide. Although carbon dioxide is non-poisonous, it can cause suffocation.

Nitric oxide chances to nitrogen dioxide when it contacts oxygen in the air. **Nitrogen dioxide (NO_2) is poisonous** and can injure and kill people as well as livestock.

Many Wisconsin farmers have reported serious lung injury from inhaling small amounts of silage gas, and some have suffered permanent damage. Numerous other cases have probably gone unreported. Silo gas severely irritates the upper respiratory tract and may inflame the lungs, even though the farmer may experience little immediate pain or ill effects. However, he may die later due to fluid that collects in the lungs.

Most people who develop the initial symptoms also develop additional symptoms. Frequently, a relapse with symptoms similar to pneumonia occurs one to two weeks after initial recovery from the exposure. This is why it's important for the victim of silo gas exposure to get immediate medical attention.

Nitrogen dioxide is a hazard on the farm because:

1. **Even a brief exposure can be fatal.**

2. Formation of nitrogen dioxide from nitric oxide may occur whenever silage is made.

3. Silage is a popular, highly desirable feed, which is produced on many Wisconsin farms.

WHAT IS THIS GAS?

Shortly after ensiling green plant material, oxygen is used in fermentation and the nitrates in the plant are released as nitric oxide (NO). This gas quickly escapes from the silage and combines with oxygen in the air to form toxic nitrogen dioxide.

The lethal gas is yellowish-brown and smells like some laundry bleaches. After more oxidation, it forms N_2O_5, which then forms highly corrosive nitric acid when combined with water. Since oxidation may occur in the lungs, nitrogen dioxide can produce permanent lung damage.

WHERE DOES IT HIDE?

Since nitrogen dioxide is heavier than air, it remains beneath the air mass over the silage. It layers on top of the silage below the upper edge of the top door or settles down through the chute. It may also seep through the drain at the base of the silo, or it may be present in the unloading chamber at the bottom of oxygen-limiting silos. It often concentrates in the silo room and moves into the barn. It leaves a yellow stain on silage, wood or other materials it contacts.

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1. This document is Fact Sheet A1871, a series of the Department of Agricultural Journalism, College of Agricultural and Life Sciences, University of Wisconsin-Madison, Madison, Wisconsin, 53706.

2. J.M. Sund, emeritus professor of agronomy; R.P. Niedermeier, professor of dairy science; R. H. Burris, professor of biochemistry, College of Agricultural and Life Sciences, University of Wisconsin-Madison, Madison, Wisconsin, 53706.

PREVENT EXCESS NITRATES

Some environmental conditions (particularly drought), cause nitrates to accumulate in plants fertilized with nitrogen, even at recommended rates. But by taking precautions, you may fertilize at recommended rates for maximum production of silage crops without fear of nitrogen dioxide production. Proper fertilization combined with good cultural methods (proper weed, insect and disease control) reduce the chances of nitrogen dioxide gas production when you ensile the crop.

HOW TO MINIMIZE THE DANGER

While growing the crop:

1. Apply adequate nitrogen, but don't overdo. As a guide, corn needs 1.2 lbs. of N per bushel yield, oats and/or sudangrass used for silage should have no more than 75 lbs, of N available for each harvest. Since this includes both N in the soil and that applied, follow the recommendations on soil analysis reports.

2. Use balanced N-P-K fertilizers, add minor elements if needed.

3. Use disease and insect resistant varieties and/or spray to control insect and disease damage to leaves and roots.

4. Keep fields relatively free of weeds. Weeds can make silage dangerous even though there is no nitrate in the corn itself.

5. After a drought, plants rapidly take up nitrate following rain. So, harvest the crop before fall rains, or wait at least five days after a rain.

6. Plants damaged by hail or frost should be harvested immediately before they take up nitrates.

7. To reduce the amount of nitrate going into the silage, cut higher than normal (10 to 12 inches). Most nitrates are in the lower stalk.

While filling the silo:

1. The greatest danger from nitrogen dioxide gas from silage is during the first 12 to 60 hours after filling. However, take care to avoid possible exposure for 10 days after filling the silo, and when opening the silo for feeding.

2. Be on the alert for bleach-like odors and/or yellowish-brown fumes in or near the silo. Small amounts of the gas may not be visible or easily detected by smell, but are still dangerous.

3. Stay out of and away from the silo right after filling and during the following 10 days.

4. If you must enter the silo. first run the silage blower for 15 to 20 minutes. Never enter the silo **alone** during the danger period.

5. Remove the upper chute doors down to the level of the settled silage. This allows the gas to flow down the chute and keeps it from collecting in the silo. **Be sure to run the blower first** and ventilate the silo chute with fans. Several people have died in Wisconsin because they didn't ventilate before going up the chute to remove the upper door.

6. Ventilate the silo room adequately for at least two weeks after filling. Open the windows and outside door of the silo room and use fans if necessary.

7. Keep the door between the silo room and the barn closed to prevent nitrogen dioxide gas from killing livestock.

8. Barricade enclosed silo areas to prevent children and strangers from entering the silo room and silo.

9. If you experience the slightest throat irritation or coughing in the silo, get into fresh air quickly and stay away from the silo area as long as gas may be present.

10. You can make test discs as follows, and hang them at the bottom of the silo chute to detect gas. Mix a solution of two grams corn starch and two grams potassium iodide in three ounces of water. Spray the solution on the filter-paper disc until soaked. Dry in oven at 100 to 125°F. Fold transparent tape over one edge and make hole for hanging. Wet the disc with water and hang it at the bottom of the chute, or inside the chamber of bottom-unloading silos. If the disc turns purple, gas is present. Discs may only be used once.

11. **See your doctor immediately after exposure to silage gas.** Treatment will prevent lung damage and keep pneumonia from developing later.

If you follow these precautions, you can make silage safely. Silage is an excellent livestock feed and the hazard of toxic gas production shouldn't discourage you from making and feeding grass or corn silage.

WHAT MAKES NITRATES ACCUMULATE IN PLANTS?

Nitric oxide gas is produced from ensiled plants that contain tree nitrate (NO_{3-}) which hasn't been converted to protein. Normally, nitrogen is taken up by plants as nitrate and converted to protein during growth. But when plant growth is retarded by adverse growing conditions or when excessive amounts of nitrogen are available in the soil, nitrates not converted to protein accumulate in the plant stems and leaves.

When such plants are ensiled, the nitrate present may be converted to nitric oxide or it may be lost in the seepage. Even though much nitric oxide escapes during ensiling, enough nitrate may remain in the silage to poison livestock in feeding (see A1889, Protect Livestock from Nitrate Poisoning).

Plants store nitrate if they take up more than they can convert to protein, some plants store more nitrate than others. Analyses of plants in Wisconsin revealed maximum percentages of stored nitrate (see Table 1).

Grass-legume silage is less apt to produce nitrogen dioxide gas than other ensiled crops. Weeds in the ensiled crop may produce nitric oxide (or nitrate poisoning) even when the crop itself is low in nitrate. ALL weeds commonly present in corn fields store nitrate under ALL growing conditions.

Table 1. Maximum percentage of dry matter as NO_{3-}

Weeds	7.5
Corn, sudan grass, sorghums	5.0
Oats, wheat, barley, rye	4.0
Brome, orchardgrass, timothy	3.0
Alfalfa, red clover	1.0

CAUSES OF NITRATE EXCESS IN CROPS

1. Prolonged summer drought followed by rain just before ensiling.

2. High levels of nitrogen in the soil created by excessive fertilization with commercial nitrogen or a combination of commercial nitrogen, barnyard manure, and/or plowing down leguminous green manure crops.

3. Unbalanced N-P-K fertility (especially high N, low P-K).

4. Unfavorable temperature (too cold for corn, too hot for oats).

5. Shade, prolonged cloudy weather, or dense stands which reduce photosynthetic activity.

6. Leaf damage — from partial drought, frost, insects, diseases or chemicals-while the stem remains active.

7. Root damage — from cultivation, insects, diseases or chemicals.

RELATED PUBLICATIONS

The following two publications are available through your county Extension office:

A1815, *Weed Control Will Prevent Lowland Abortion in Cattle*
A1889, *How to Protect Livestock from Nitrate Poisoning*