Nitrogen Credits from Manure

Nitrogen Sources

There are often four main sources of nitrogen (N) on farms: (1) soil organic matter; (2) organic residues (animal and green manure, compost, plowed under sods); (3) N fixed by legumes; and (4) inorganic fertilizer N. To calculate the amount of fertilizer N required for optimum economic yield, adjustments need to be made for fixed N and any N released from the organic sources. This fact sheets provides an overview of nitrogen credits from manure.

Nitrogen in Manure

There are primarily two forms of N in manure: inorganic (ammonium) N and organic N (Figure 1). The ammonium N is initially present in urine as urea in dairy or beef manure, and may account for about 50% of the total N. Urea in manure is no different from urea in commercial fertilizer. It converts rapidly to ammonium when conditions allow.

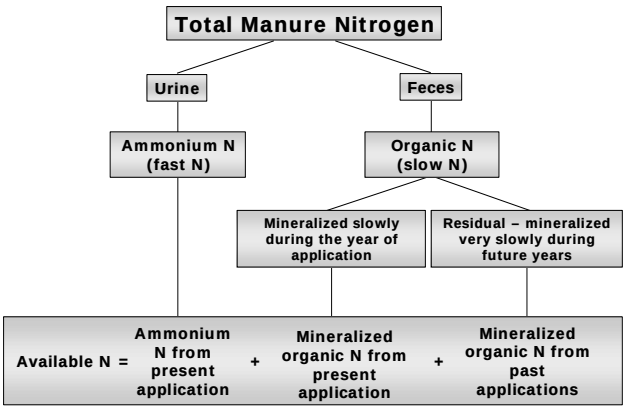

Figure 1: Manure N consists of ammonium and organic N (modified from Klausner, 1997).

Ammonium N in Manure

In principle, the ammonium from urea in manure is available for plant growth. However, part or all of it may be lost because ammonium is rapidly converted to ammonia gas. When manure is spread on the surface of the soil (especially high pH soils), ammonia enters the air or "volatilizes". Whenever manure is exposed to air on the barn floor, in the feedlot, in storage, or after spreading, N loss occurs. Testing is essential to determine how much inorganic N could potentially be conserved. Samples should be taken while loading the spreader or while spreading in the field for a good estimate of the nutrient value of the manure. Table 1 shows the estimated amount of ammonium N available for plant use for different application methods and timing. The table shows the benefits of manure incorporation shortly after spreading in the spring. For example, if manure contains 14 lbs inorganic N per 1000 gallons, incorporation of 6000 gallons within 1 day can save 55 lbs of fertilizer N!

Table 1: Estimated ammonia-N losses as affected by manure application method.

Manure Application Method	% remaining
Injected during growing season	100
Incorporated within 1 day	65
Incorporated within 2 days	53
Incorporated within 3 days	41
Incorporated within 4 days	29
Incorporated within 5 days	17
No conservation or injected in fall	0

Figure 2: Surface application of manure without incorporation will result in the loss of inorganic N from the manure.

Organic N in the Manure

The feces contain organic N that is more stable and slowly released. The organic N breaks down over time, some the first year after application, some in the following years. Repeated application to the same field results in an accumulation of a slow release manure N source.

A decay or mineralization series is commonly used to estimate the rate of N availability from stable organic N over the years following application. A decay series of 35, 12, and 5% in years 1, 2, and 3 is used to estimate the rate of decomposition of organic N in liquid (<18% dry matter) dairy manures in New York (Table 2). This sequence of numbers means that 35% of the organic N is mineralized and potentially taken up by the growing crop during the year the manure was applied, 12% of the initial organic N application is mineralized and taken up during the second year, and 5% is mineralized and taken up in the third year. There is evidence that manure containing large amounts of bedding may mineralize at a slower rate than fresh manure so the estimated availability of N during the year applied is reduced from 35% to 25% when the dry matter content of manure exceeds 18%. Nitrogen fertilizer recommendations from Cornell University need to be adjusted for the release of N from previous years' applications.

Table 2: Decay series for stable organic N in manure by animal type. A "Next Year" release rate of 12% indicates that an estimated 12% of the organic N applied in the manure is expected to be utilized by the crop a year after application.

		Release rate for organic N in manure (%)		
Source	Dry matter (%)	Present Year	Next Year	In Two Years
Cows	<18	35	12	5
Cows	≥18	25	12	5
Poultry	<18	55	12	5
Poultry	≥18	55	12	5
Swine	<18	35	12	5
Swine	≥18	25	12	5
Horses	<18	30	12	5
Horses	≥18	25	12	5
Sheep	<18	35	12	5
Sheep	≥18	25	12	5

Practical Applications

- Base manure application rates on field histories (rotation and manure), soil characteristics and environmental conditions.
- Minimize fall and/or winter manure application on good grass and/or legume sods that will be rotated the next spring.
- Conserve ammonia. Losses can either be reduced by immediately incorporating after spreading in the spring or directly injecting manure as a sidedress application to growing crops.
- Manure may be applied in the fall where there is a growing crop. Fall manure can be applied on perennial crops or winter hardy cover crops. Fall applications should not exceed 50-75 lbs/acre of available N. Manure application on hayland stands is acceptable to satisfy agronomic requirements when legumes represent less than 50% of the stand. If more than 50% of the stand is legume, manure applications should not exceed 150 lbs of available N/acre.

Additional Resources

- To download a spreadsheet to calculate "Crop Available Nutrients from Manure": nmsp.css.cornell.edu/nutrient_guidelines
- Cornell Guide for Integrated Field Crop Management: www.fieldcrops.org
- Cornell University Agronomy Fact Sheet #1: Nitrogen Basics – The Nitrogen Cycle: nmsp.css.cornell.edu/publications/factsheets.asp
- Cornell Nutrient Guidelines for Field Crops: nmsp.css.cornell.edu/nutrient_guidelines
- "Recommended Methods of Manure Analysis":cecommerce.uwex.edu/pdfs/A3769.pdf

For more information

Cornell University Cooperative Extension

Nutrient Management Spear Program
http://nmsp.css.cornell.edu

Quirine M. Ketterings, Greg Albrecht, Karl Czymmek, Shawn Bossard
2005