



Maximizing Manure Nitrogen

Dr. Heather Darby, UVM Extension Agronomist

All farmers know that livestock manure contains a spectrum of nutrients that can be used as fertilizer for their crops. High fertilizer prices, especially nitrogen (N), should encourage you to manage the manure nutrients as efficiently as possible. Below are a few techniques, both old and new, that can help you capture the most value from manure nitrogen.

The first step is to know what you've got in that pile of manure. The nutrient content of the average Vermont liquid dairy manure is displayed in Table 1. Since manure nutrient content can vary considerably from

Table 1. Nutrient content of average liquid dairy manure (Jokela et al., 2004).

Total N	Ammonium-N	Organic-N	P ₂ O ₅	K ₂ O
-----lbs per 1000 gallons-----				
25	12	13	8	20

farm to farm it is best to sample the manure on your farm to make the best estimate of application rate and nutrient availability. Manure tests can be conducted through the UVM Agricultural and Environmental Testing Laboratory. Manure sampling kits can be found at the UVM Extension offices throughout Vermont.

The next step is to understand what type of nitrogen is in the manure. Unlike, commercial fertilizers the availability of N from manure will not be 100%. Therefore even though the manure test indicates that there is 25 lbs of N this will not all be immediately available (Table 1). Manure nitrogen is divided into two fractions ammonium-N and the stable organic-N fraction. The organic-N is released over a longer period of time (years). Simply stated approximately one-third (4 lbs) of the organic-N is available to the crops in the first year. The remaining organic-N will become available over the next two years. The soil texture, temperature, moisture, and level of biological activity will influence how much of the organic fraction is available each year. The ammonium-N fraction of manure is generally equivalent to fertilizer N such as urea. This means that 100% of the ammonium-N is available for crop uptake as soon as it is soil applied. On average liquid manure contains 12 lbs of ammonium-N per 1000 gallons of manure. Therefore if you are applying 8000 gallons of manure per acre it has the potential to supply the crops with 96 lbs of ammonium-N per acre. This manure application can supply the majority of a corn crops nitrogen needs in a season. However, just like ammonium fertilizers the ammonium-N in manure can be easily lost through a process called volatilization.

The final step is to minimize manure ammonium-N losses via volatilization! Nitrogen is lost to the air (volatilized) when ammonium-N in manure is converted into ammonia gas. The amount of ammonia volatilization will vary greatly on both the environmental conditions and management strategies. Losses can range from close to 100% for surface application to only a few percent when manure is incorporated immediately into the soil. Well we can't control the weather but we can minimize N losses through various manure management strategies.

If manure is incorporated into the soil, ammonium-N is brought into direct contact with soil organic matter and clay, which absorbs ammonium-N and keeps it in the soil. Therefore the best practice to reduce N losses is to incorporate the manure immediately after spreading. The longer you wait to incorporate your manure the more nitrogen lost to the surrounding environment. Table 3 shows that immediate incorporation with standard tillage equipment or injection can increase N availability considerably.



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Generally, in the spring most folks are rapidly incorporating the manure as soon as it is applied to corn fields. However, even a brief lag between manure application and incorporation can result in a 30% loss in ammonium-N. There are situations, such as on grass fields, where manure incorporation is not possible. In these situations, where manure is primarily surface applied, ammonium-N losses can approach 100% if conditions are prime.

Recently, there has been interest in alternative manure incorporation systems such as aerators and various injection systems that could be used on both corn and hay ground. These systems can provide rapid incorporation of manure with reduced or no soil tillage, thus keeping more N in the soil to be made available for plant uptake. There are many types of injection systems available but all work on the same general principle, slice the soil and drop down the manure. There is evidence that deep injection can effectively reduce ammonia losses on hay fields but the practice has also been shown to cause root damage and occasional yield reductions. Aerator systems poke holes in the soil (prior to or at the time of application) and most of the manure makes its way into the holes. These systems result in reduced nitrogen runoff and volatilization as compared to surface applied manure. Some studies have also documented yield increases as a result of great nitrogen availability to the grass and alleviation of compacted layers.

Table 1. Ammonium-N availability from spring/summer manure (Jokela et al., 2004).

Time to incorporation by tillage	Liquid manure (10 % DM)
	% Ammonium-N Availability
Immediate (1 hr)	95
< 8 hr	70
1 day	55
2 days	50
3-4 days	45
5-7 days	40
> 7 days or not incorporated	40

These incorporation systems can also provide a host of other benefits. The advantages of using a rapid manure injection system include: fewer odors, ability to place nutrients directly into the seedbed, and the reduction in nutrient loss via surface runoff. There are some potential drawbacks to the systems such as they tend to be more expensive and may not be suitable for all soil types found in Vermont such as, steeply sloping ground or stony soils. Of course like any new practice you implement you must weigh all the advantages and disadvantages before making a decision for your farm.

Regardless, proper manure management can save you money. So the next time you look at your manure pile envision dollar bills. That's right proper crediting of manure can reduce fertilizer costs! For additional information or to obtain soil or manure test kits contact UVM Extension Agronomist, Heather Darby at 802-524-6501.