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Manure Management on Alfalfa

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Got milk? Then you've got manure.

The average cow in our 4-state area today produces 18,000 lbs of milk each year, and generates about 42,000 lbs of manure. This manure contains an average of 200 lbs of nitrogen (N) and 45 lbs of phosphorus (P) (your results may vary; be sure to test your manure). You do the math for your own operation including added bedding, wash water, etc. – it's a lot of material to move. Manure management is not the only task on your list, but in today's world it is increasingly important to do it right.

It is often difficult to apply all that manure in late fall and early spring for use by corn. Although alfalfa acreage is a relatively small proportion of total crop acreage on most dairy farms, this acreage can help open windows of opportunity for manure spreading. Alfalfa can utilize the nutrients efficiently and may produce higher yields with manure than without. In particular, alfalfa reduces its N fixation when N from other sources is available. Consequently, alfalfa can serve as a friendly regulator of N buildup on your farm – it adds more new N when N supplies are low, but cuts back as N supply increases. Of course, this characteristic depends on the presence of root nodules with rhizobia that can effectively fix N from the air. Inoculation of seed is recommended to improve effective nodulation.

Under some conditions alfalfa also responds well to the micronutrients in manure and to the improved water supply provided directly in a slurry application or indirectly by improved soil organic matter levels. In some experiments, alfalfa production has increased with manure compared to an equivalent amount of fertilizer P and potassium. This increase may be due in part to the lower energy cost of N uptake from the soil compared to building and maintaining root nodules and fixing N from the air.

Strategies

There are three manure application strategies on alfalfa. Two are meant to apply nutrients for the alfalfa and the other is meant to provide nutrients for the subsequent crop.

In the **first strategy**, manure is applied before alfalfa stand establishment. Except on soils where nitrate leaching is probable, manure rates should be based on P and K availability over 2 to 3 years. Apply manure within a few weeks of planting on sandy soils to reduce leaching losses and plant a companion crop that will be ensiled. The companion crop helps recover available N and ensiling helps reduce both lodging-related losses and potential nitrate toxicity problems. Manure can and should be incorporated well by deep injection and/or tillage to reduce risk of seedling damage by salts and high ammonia concentrations. Weed germination and growth can be worse during establishment of manured fields, so mechanical or chemical weed control may be required.

The **second strategy** is to apply manure after stand establishment to supply nutrients to the alfalfa. Traditionally, solid manure or slurry has been broadcast on alfalfa either as soon after harvest as possible or during winter. Wintertime surface applications of manure are becoming less acceptable in northern states because of the risk of runoff to surface water. This is particularly important for dissolved nutrients that can move large distances as runoff water flows over frozen soil.

Surface manure applications can effectively provide many manure nutrients to the alfalfa, although N availability is decreased by ammonia volatilization losses and sometimes by nitrate leaching. Suffocation of plants and damage by salts, ammonia, and traffic can be reduced by improving uniformity of application, using low to moderate rates, and growing salt- and traffic-tolerant cultivars. In some cases, stand damage has not translated into lower alfalfa yields, because of compensatory growth by the remaining plants that face less competition from neighbors. On coarse-textured soils or under humid or irrigated conditions, nitrate leaching losses may be significant after manure application to alfalfa.

Losses of manure nutrients due to runoff and volatilization can be reduced by partial incorporation. The AerWay® system is one method of partial incorporation, and shallow injection using disk openers represents another. Although widespread replicated research trials have not been conducted with these implements, manure applied by either method tends to improve alfalfa yield on low fertility soils. More aggressive incorporation tends to reduce yield, especially where nutrient levels are adequate without the manure. As with broadcast applications, wheel tracks cause stand and yield decline and this is exacerbated by soil disturbance. Application of manure slurry in surface bands may help reduce ammonia losses, reduce runoff losses, and protect crop quality. This technique requires drop hoses that ideally lay the manure between the rows. This method is used in Europe on grass forages to reduce power requirements and ammonia emissions. There has been little research done on surface banding slurry in alfalfa.

Because more tender stems can be broken and more herbage can be coated with manure, stand damage increases as the time between cutting and manure application increases. This implies that “fast regrowth” alfalfas probably are more poorly suited to manure application on established stands. The effect of manure applications on ensiling properties of the forage have been inconsistent, with some researchers suggesting that the forage should be inoculated before ensiling, but others concluding that inoculation is not necessary.

The **third strategy** is apparently a popular one that avoids problems of stand damage. This strategy involves application of manure before terminating the stand and rotating to another crop. The primary risk of this strategy is that excess N will be available to the next crop, because of the combined legume and manure N availability. If regrowth is removed and little alfalfa remains in the stand, manure applications before stand termination will benefit the following crop without increasing N losses. Timely incorporation is recommended to reduce runoff risk.

Drag hose systems may be used with any of these strategies, but physical damage from the hose may offset gains made by reducing heavy wheel traffic. As with any field traffic, it is wise to avoid soil compaction by timing operations to coincide with dry soil conditions. Deep

compaction by wheel traffic when soils are 'plastic' will cause long-term yield losses. In addition, compaction increases the likelihood of runoff. by reducing water infiltration Nutrient losses in runoff are highest when runoff occurs within a few days of manure application, whether runoff is caused by rainfall or snowmelt. The longer the period between manure application and a runoff event, the lower the risk of nutrient transport off the field. Because P usually is the most limiting nutrient in surface water, manure applications should be managed to prevent excessive increases in soil test P or the state's P Risk Index. This means that on high-testing soils, P applications should not exceed P removal by the crop and may be ill advised on slopes. Special precautions must be taken with manure applications near surface water or tile inlets.

Emerging problems

We all are aware of the increasing concern about how human activities affect the environment. Until recently, scientists and regulatory agencies have been focusing on nutrient management, but manure contains microorganisms can affect the health of humans, livestock, and wildlife. Dung can contain large populations of several bacteria (fecal coliform and *E. coli* O157:H7 in particular, *Salmonella*, *Listeria*, and *Mycobacterium paratuberculosis*, which causes Johnes Disease), viruses (including bovine viral diarrhea virus, foot and mouth disease virus, rotavirus, and coronavirus), and protozoa (such as *Cryptosporidium* and *Giardia*).

What is the risk of disease transmission within the herd or to humans, wildlife, or other livestock? How does manure management (storage, time of application, extent of incorporation) affect the viability of pathogens? These questions have economic and environmental ramifications, but our knowledge of the topic of pathogens and manure management is rudimentary and we generally cannot draw firm conclusions. However, in herds with diseased animals, manure should be applied to crop fields rather than to perennial forages to reduce the opportunity of transmission back to the herd in contaminated forage.

Research Needs

- Enhance the yield stimulation that occurs when N_2 fixation is reduced
- Improve genetics for traffic, salt, and disease tolerance
- Evaluate and improve partial incorporation, injection, surface banding techniques in established alfalfa
- Develop a reliable way to predict effects of manure on ensiling characteristics
- Fully understand pathogen transmission and effective control strategies

Recommendations for Preplant Applications

- Apply to fields with lowest fertility
- Add P and K for life of stand, but avoid excessive P buildup and test forage K levels
- Apply no more than a few weeks before planting on coarse-textured soils
- Incorporate deeply and thoroughly
- Inoculate seed with effective rhizobia

Recommendations for Applications to Established Alfalfa

- Avoid applications to forages if serious disease is present or suspected in the herd
- Be quick – apply as soon as possible after harvest
- Apply low to moderate rates, according to state regulations

- Break up chunks of solid manure
- Spread manure evenly for good nutrient supply and to reduce stand damage
- Apply to firm soils – avoid traffic on moist, 'plastic' soils
- Apply during cool weather if possible to reduce ammonia losses and salt burn
- Select fields or areas of fields with the greatest grass content
- Plant manure- and traffic-tolerant cultivars
- Apply in a manner that minimizes risk of runoff
- Near surface water apply lower rates according to P limitations and incorporate
- Apply at least 30 days before the next harvest
- Avoid applications before stand termination

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