

Fact sheet



U.S. Dairy Forage Research Center
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Easy does it with manure on alfalfa and grass

What to do and what to avoid when applying manure to perennial forages

by Michael Russelle and Bill Jokela

For years, the common practice among Midwest livestock producers has been to apply manure mainly on corn fields; and the most common time to put manure on alfalfa has been before terminating a stand and rotating to the next crop. But times have changed; manure nutrients are more closely monitored, and land-to-animal ratios are shrinking, so there's a greater need to put manure on perennial forages that are still in production.

Research has changed our understanding of how to handle manure on forage crops. Applying manure to a stand as it's being rotated out of a perennial forage could be the worst approach, although it is less risky on grass than on alfalfa. And manure applied before planting or during perennial forage production can improve yield and performance of the crop – if manure application rates, method, and timing are appropriate.

In this Fact Sheet, we'll answer a few commonly asked questions about applying manure to alfalfa and grasses.

Don't corn crops need the manure nutrients more than legumes?

Yes, especially nitrogen and especially when corn is harvested as silage. However, the window of opportunity to apply manure is often narrow in spring due to planting operations. Early fall applications of manure (after silage harvest) are not recommended; excessive nitrate formation increases the risk of leaching losses and possible ground water contamination.

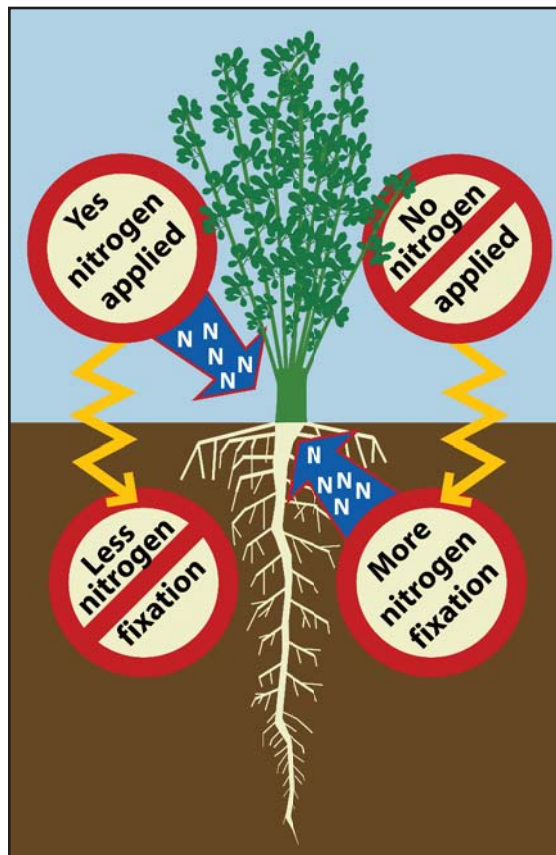
Since legumes fix nitrogen, and manure contains lots of nitrogen, won't we be creating more nitrate runoff and leaching when applying manure to legumes?

Not if applied properly. It's true that legumes, like alfalfa, can fix most of the nitrogen they need for growth – up to 500 pounds N/acre in high-yield, low-N supply environments. But legumes reduce nitrogen

fixation rates when nitrogen from other sources is available. In other words, alfalfa adds new nitrogen to the crop and soil when nitrogen supplies are low, but also effectively reduces excess nitrogen. Consequently, alfalfa can serve as a friendly buffer of nitrogen buildup on the farm.

Since grasses don't fix nitrogen, are grass fields a better place for manure than alfalfa fields?

Yes. Forage grasses have a high nitrogen requirement, in some cases higher than that of corn. Research has shown large yield increases from manure application on grass, equal to or approaching those from fertilizer N. And because of the year-round vegetation and fibrous root system of grasses, there is less potential for nitrate leaching than with corn.



Alfalfa can adjust how much nitrogen it fixes depending on how much it receives from other sources, like manure. Consequently, it can serve as a friendly buffer of nitrogen buildup on the farm.

When should manure be applied to alfalfa and other perennial forages?

There is no single answer. Commonly there are three approaches to the timing of manure applications:

1. before terminating a stand and rotating to an annual crop – supplies nutrients to that annual crop;
2. before forage stand establishment – supplies nutrients to the new perennial crop;
3. on established stands – supplies nutrients to existing perennial crop.

Each time of application has its own considerations.

What should we consider when applying manure just before terminating a stand?

The primary risk is that excess nitrogen will be available to the next crop because of a double dose of nitrogen credits from both the legume crop and manure. If a field has been in alfalfa for two or more years, the next crop usually needs much less or even no additional fertilizer nitrogen, other than a little starter. The nitrogen credit is lower with poor alfalfa stands or with mechanically harvested grasses.

What should we watch for with pre-plant manure applications?

This approach could cause excessive nutrient leaching or runoff if not done properly. There's also a risk of damaging the seedlings by salts and high ammonia concentrations, and weed competition can increase in manured fields.

What are the special considerations for applying manure to established alfalfa stands?

This strategy opens the most windows of opportunity for manure application. It also may improve alfalfa yield. In some experiments, alfalfa production was better with manure than with an equivalent amount of fertilizer P and K. Alfalfa can respond to micronutrients in manure and to the improved water supply provided directly in a slurry application or indirectly by improved soil organic matter levels.

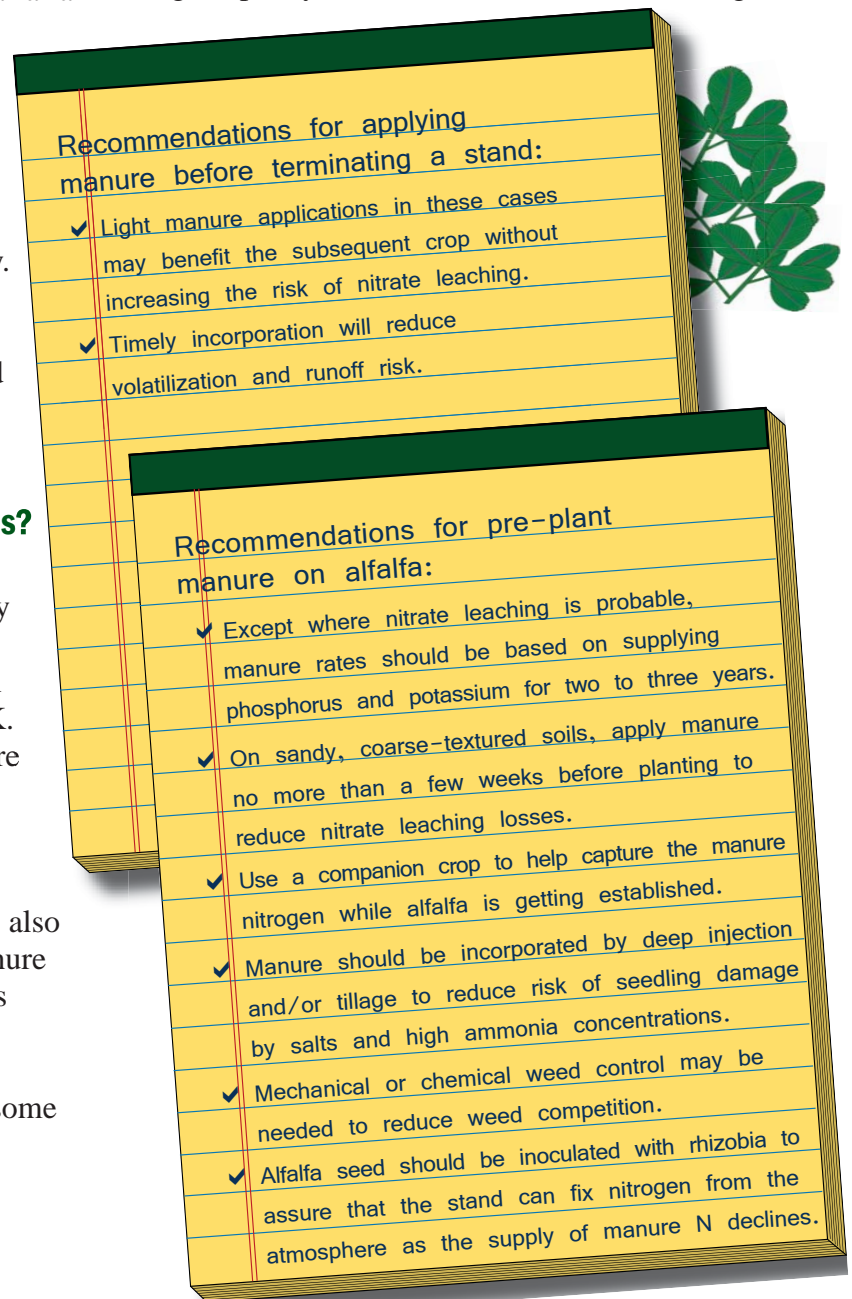
However, applications to established stands also involve the most risks. Traditionally, solid manure or slurry has been broadcast on alfalfa either as soon after harvest as possible or during winter. Wintertime surface applications of manure are now less acceptable and have been banned in some northern states because of the risk of runoff.

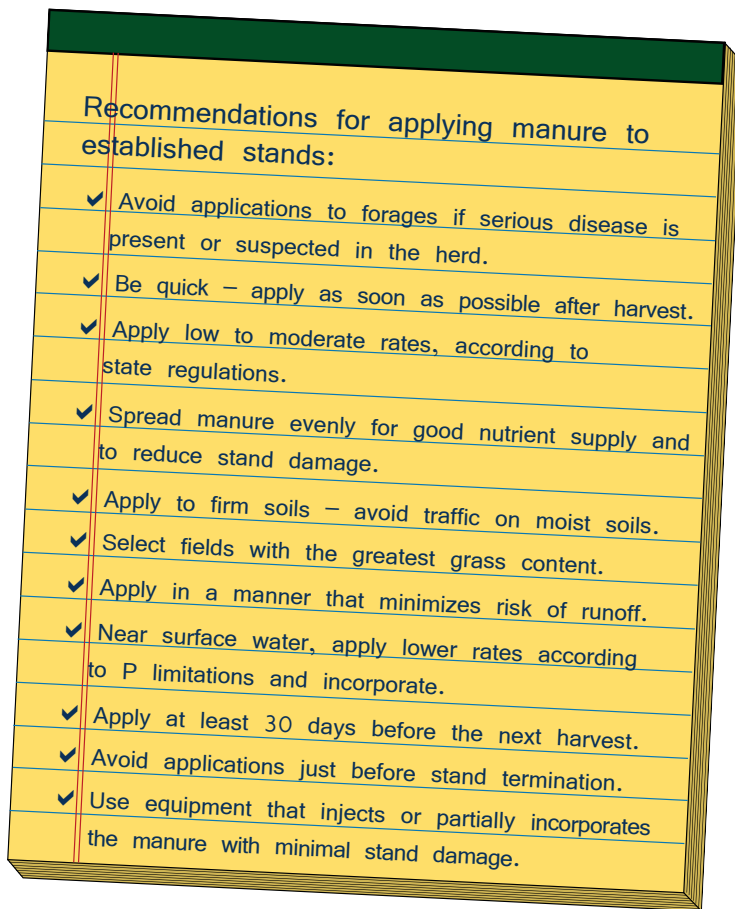
What about manure on established grass stands?

For best yields and manure N utilization, use split application – early spring and after each cutting. As with any surface broadcast applications, there can be large losses to the air as ammonia. To minimize these losses, avoid applying under warm, windy conditions. Equipment is now available to partially incorporate or band-apply liquid manure, which cuts volatile and/or runoff losses of nutrients. This equipment works well on alfalfa, too.

Is winter the only time to worry about nutrient runoff?

No. There are nutrient issues when manure is applied after harvest, too. Although alfalfa has a high capacity to absorb nitrate, nitrate leaching





grass yields began to decline when manure solids exceeded 1.5 tons/acre. 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. If you consistently see wheel track damage after manure application, consider driving along the same tracks to reduce the total area of the field affected by traffic. Avoiding traffic when soils are moist also helps reduce stand damage.

A special case: Tile-drained soils

With greater use of low-dry matter slurries, there is increasing concern about rapid movement of nutrients through the soil. For example, in fields drained by subsurface tiles, manure nutrients and pathogens have been detected in the tile water within minutes of slurry application. This has occurred with both surface broadcast and injected slurry.

Tile-drained soils are mainly fine-textured and well structured. Cracks in the dry soil, natural flow paths between soil aggregates, root channels, and animal burrows all contribute to the risk of rapid manure leaching. With artificially drained soils, water and its components have a shorter pathway to leave the field.

In such situations, farmers should:

- keep application rates low;
- avoid ponding of slurry on the soil surface;
- apply on moist, but not dry or wet, soils;
- apply when tiles are not running;
- apply manure slurry with higher dry matter content to improve plugging of soil pores.

Under conditions where manure must be applied to tile-drained soils and where contamination of surface water might occur, installation of water table management structures at the tile outlets are the best way to insure water quality protection. Tile plugs often fail to stop drainage.

Tile lines are designed to drain excess soil water. Consequently, slurry application rate should be based on the capacity of the soil to hold that amount of water. An acre-inch of rainfall is about 27,150 gallons. A slurry application of 15,000 gallons per acre containing 4% dry matter is equivalent to a half-inch rainfall.



losses may be significant after manure application to alfalfa or grass on coarse-textured soils or under humid or irrigated conditions. At manure application rates greater than the crop can use, soil nutrient concentrations climb rapidly, increasing the risk of leaching and runoff.

Remember that manure contains more P than N, relative to plant needs. When manure rate is based on crop N needs, too much P is applied. Soil P test levels typically are high where manure has been applied over time. Because of runoff risk on high-testing soils, regulations may limit manure rates to P removal by the crop.

How can we minimize plant damage?

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. Consequently, it's more difficult to avoid stand damage with 'fast regrowth' alfalfa varieties.

Heavy application rates and wheel traffic also damage plants. Our research found that alfalfa and



Closing thoughts . . .

The value of manure has increased with the rising cost of fertilizer. For many farms, summertime application on alfalfa or grass will improve manure use efficiency, reduce time pressure on springtime field operations, and lower the risk of nutrient loss from early fall application on annual cropland. If you haven't tried it, talk with neighbors who have a system they like, then begin with small trials to find out what works for you.

Contact:

Michael Russelle, Soil Scientist
612-625-8145, St. Paul, MN
michael.russelle@ars.usda.gov

Bill Jokela, Soil Scientist
715-387-2052, Marshfield, WI
bill.jokela@ars.usda.gov

What is the risk of disease spreading via manure pathogens?

We know that manure contains large numbers of bacteria, protozoa, and viruses that can have human and herd health impacts. Significant bacterial pathogens are *Salmonella*, *Listeria*, *E. coli*, and *Mycobacterium paratuberculosis* (causes Johne's disease). Pathogenic protozoa include *Giardia* and *Cryptosporidium*. A wide variety of viruses are shed in feces, as well. Many of these organisms survive in stored manure and in soil for 3 to 12 months.

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.

Johne's Disease

Johne's disease affects about 25% of U.S. dairy herds. It is transmitted by manure and milk from infected animals, and young stock are more susceptible. The Johne's bacterium, *Mycobacterium paratuberculosis*, is sensitive to both low and high pH. It appears that populations on forage can be reduced or eliminated by proper ensiling, but they do survive on hay. A broadcast application of limestone can increase the pH of the soil surface to about 8, which also will reduce survival of *M. paratuberculosis*. When an alfalfa cutting is to be used to feed young stock on a farm with known Johne's infections, it would be best to avoid manure applications ahead of that harvest.

In herds with Johne's:

When to topdress manure on forage fields

Forage	Young stock	Cows
Pasture	NO	Avoid
Dry hay	Avoid	Avoid
Good silage	OK	OK
Greenchop	Avoid	Avoid

E.D. Thomas, Miner Institute, 2006

Survival of bacteria at different DM of forage

Forage DM %	Bacteria survival %
<40	0
55	13
90	100

Katayama et al., 2001