

# Manure on Perennial Forages: Benefits & Challenges

*Bill Jokela, U.S. Dairy Forage Research Center*

**W**hy apply manure on alfalfa and other perennial forage crops? There are several benefits, but also some concerns or challenges to be considered. For many farmers, the most important benefit of applying manure to perennial forage crops is it increases the acreage base, which may be important to meet nutrient management plan requirements and avoid over-application of phosphorus. Additionally, applying manure after harvest during the growing season opens up windows of time for manure application not available with most annual crops.



Alfalfa and other forages have a large nutrient need – potassium, phosphorus, sulfur, micronutrients, and for grass forages, nitrogen. Manure is a good nutrient source and can produce yield increases if nutrients are deficient.

While alfalfa and other legumes do not benefit from nitrogen in manure, applied nitrogen reduces the amount of symbiotic nitrogen fixation, helping to buffer nitrogen availability and reducing nitrate leaching risk due to nitrogen application from manure. Alfalfa's deep rooting pattern can capture nitrate leached beneath the root zone of other crops from excessive manure or fertilizer nitrogen application.

On the flip side, there are also some challenges or limitations associated with manure application on forages – smothering and leaf coating, soil compaction and crown damage from wheel traffic, pathogens and feed contamination, surface runoff of nutrients, and odor and ammonia emissions. Most of these concerns are associated with broadcast application after harvest and will be discussed in a second article in the August edition of Forage Focus.

## When to Apply

There are three general manure application strategies or times of application: preplant (before forage seeding), following last harvest at termination of the stand, and after a harvest during the season.

**Preplant application.** Before planting is a good time to apply manure, especially on medium- to fine-textured soils deficient in phosphorus and/or potassium, so manure can be incorporated. Manure applied at this time must be thoroughly mixed with the soil to avoid seedling damage from manure-seed contact.

Research has shown yield benefits from preplant application. Liquid dairy manure was applied before seeding of alfalfa at three sites, two in Minnesota (Rosemount and Waseca) and one in Wisconsin (Marshfield) (Kelling and Schmitt, 2003). Seeding year yields were greater than or equal to those from the treatment with phosphorus and potassium fertilizer and the no-fertilizer control at two of the sites. At the Waseca location, manure did not increase yields because of severe compaction with the large equipment. During the first full production year, yields from manure were greater than both control and fertilizer treatments at all sites. The yield benefit from manure compared to that from phosphorus and potassium fertilizer was attributed to some combination of other nutrients (e.g., sulfur, boron), soil physical and/or microbial effects, and possibly nitrogen in the seeding year.

**Application before stand termination.** Application after the last harvest, just before termination of alfalfa or other perennial forage, is a favored time of manure application because it avoids any potential damage to the forage stand and provides nitrogen for the following crop (e.g., corn). However, nitrogen mineralization after

alfalfa termination often meets or exceeds the need of the following crop, resulting in high levels of soil nitrogen and increased risk of nitrate leaching. The extent of this phenomenon depends on soil texture, the characteristics of the manure and how much is applied, as well as the density and quality of legume in the forage crop.

A summary of research results from 61 sites in Iowa, Wisconsin, Minnesota, and Pennsylvania determined that only seven sites showed any corn yield response to fertilizer nitrogen the first year following alfalfa plow-down (Kelling and Schmitt, 2003). A comprehensive review of recent research in Minnesota, as well as many other published results (Yost et al., 2015: 259 trials total), also concluded first-year corn after alfalfa is not likely to respond to fertilizer nitrogen application on medium textured soils. The response depends on specific factors such as length of alfalfa stand and early season soil conditions.

Thus, applying manure before terminating an alfalfa stand is not recommended because the resulting high levels of soil nitrogen are likely to exceed the need of the following crop and increase the risk of nitrate leaching. If it cannot be avoided, take care to limit the application rate to avoid excessive nitrogen.

**Topdress after harvest during season.** Surface broadcast is the dominant method of manure application for alfalfa and other perennial forages in North America. The wide spreading pattern of broadcast application reduces wheel traffic over the field and increases the speed of application. Broadcast slurry can also increase yields of forages, especially grasses. Much of the research on manure application on grass forages has been done in Europe, where most of the forage production is grasses. There has been some work done in North America.

Research in the Upper Midwest (MN, WI, IA) showed grass forage yield increases of 150% or more from broadcast manure compared to a no nitrogen control (Schmitt et al., 1999). In research from Vermont (Carter et al., 2010) and British Columbia (Bittman et al., 2007), liquid dairy manure increased grass yields 90-100%, approximately equal to that from fertilizer nitrogen.

Application of liquid manure on established stands of alfalfa has had mixed research results, showing yields with topdressed slurry increasing, decreasing, or having no effect in Minnesota and Wisconsin (Kelling and Schmitt, 2003; Coblenz et al., 2014), Maryland (Min et al., 1999), and Italy (Ceotto and Spallacci, 2006). Probably the most comprehensive study was in Ontario in which liquid dairy manure was band-applied using drop-hoses with fan nozzles twice annually to 49 alfalfa cultivars at 4,500 gal/ac for three years (Bowley et al., 2009). Average alfalfa yields were increased 14% with manure compared to the no-manure control, with some cultivars showing much larger yield responses to manure than others.

Challenges with broadcast manure application, as well as alternatives to this application method, will be discussed in the August Forage Focus.