# Forages and manure – a match made in heaven?

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It's a most natural cycle. Forages are fed to livestock that produce manure, and manure is returned to the soil to provide the nutrients to produce the next crop. After all, it's what has happened on pastures and rangelands for millennia.

And there is more for today's sustainable farmers. Compared to other crops, forages often need a lot of nutrients (N, P, K, S), the actual amounts of each nutrient needed depending on the grass-legume ratio. And there is a longer growing season, which means opportunities for earlier application, later application and mid-season applications. Grasses in particular have a ravenous appetite for nitrogen and are well adapted to capture whatever nitrogen is available in the soil – even to excess (hence high feed nitrate levels that sometimes occur).

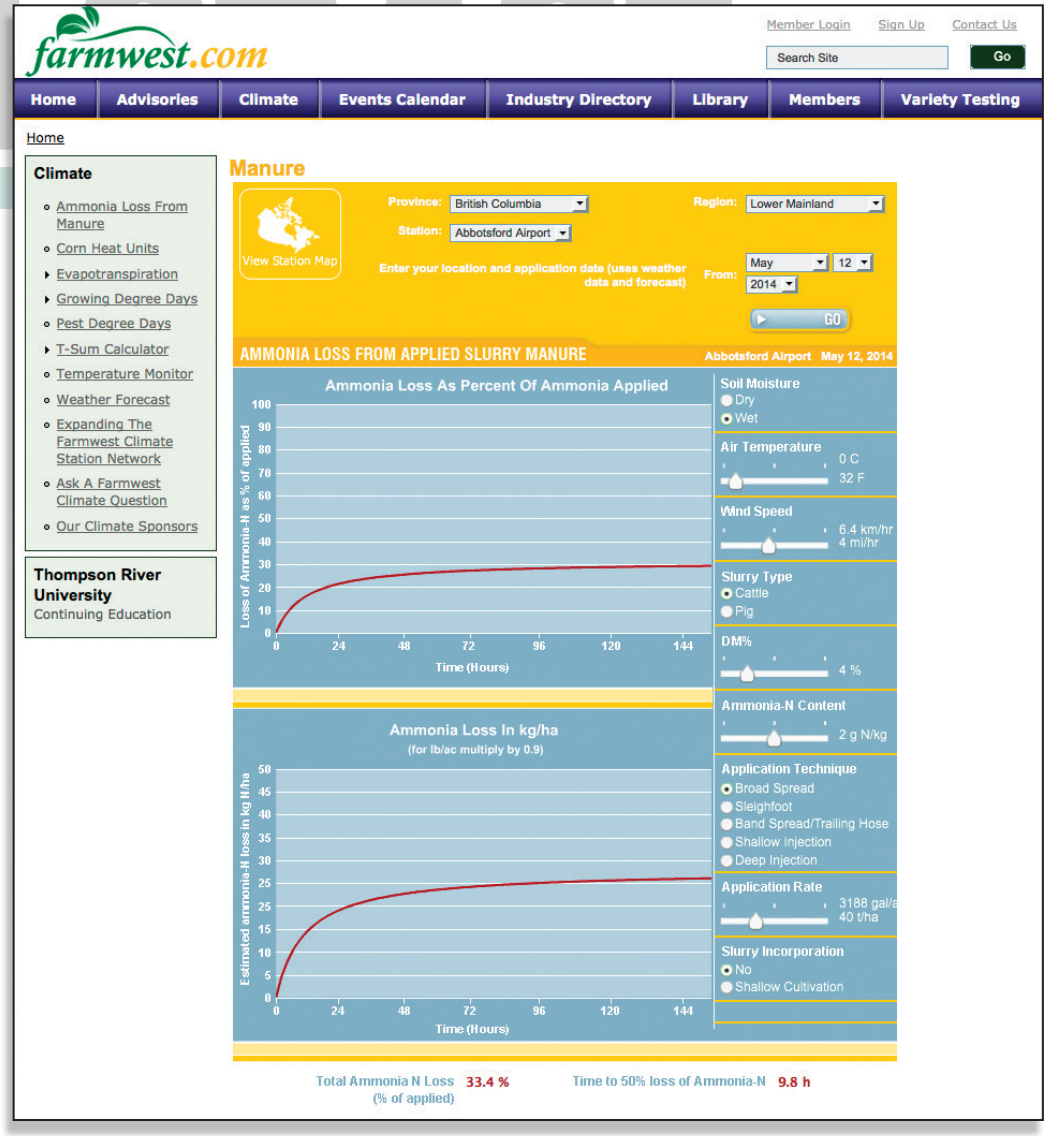
In our research over many years, we have found that grass systems which include the associated beneficial microbes (such as bacteria, fungi and nematodes) that store and recycle nutrients supported by decaying roots and root exudates are surprisingly protective of nitrogen. For that reason, and because of their long growing season and continuous ground cover, forages are less subject to nitrate leaching losses and less subject to manure runoff than cultivated crops. Also, there is less worry with forages about contamination by pathogenic microbes like E. coli, since microbes are very far from the food end-products.

But there are complications – many and indeed serious ones. Let's begin with grazing animals. It has been shown by European researchers that the potentially volatile nitrogen that comes from urine, the same nitrogen that is readily available to crops, soaks easily into the soil where it is adsorbed before the ammonia can be released into the atmosphere.

This is very beneficial for conserving nitrogen but hardly ideal. The nitrogen dosages in urine patches are far too high to be efficiently taken up by the grass – and in fact may be somewhat toxic. In fact, the ammonia is soon oxidized to nitrate, and the high concentrations of nitrate are prone to leaching in sandy soils and are prone to emitting nitrous oxide (a greenhouse gas) on fine-textured, clayey soils. Also, the spatial and temporal distribution of the urine patches is such that only a small proportion of the grass receives nitrogen when it can best be used. Furthermore, the feces left on the surface do not contribute as much to soil carbon as they would if incorporated into the soil.

Thus, the inability to incorporate manure into existing forage stands

**Figure 1**




Tool for calculating ammonia from www.farmwest.com; click on manure tab on top right of home page.

> **"... like all marriages made in heaven, manure and forages are very compatible but are not without their issues."**

strains the love affair between manure and forages. When manure is spread on the surface of forage fields, there is a great tendency for the available portion of the manure nitrogen to volatilize and be lost into the air. How much will be lost? For liquid manure, the probable loss is determined using online calculators that take into account the application method, properties and conditions of the manure, the soil and the air (**Figure 1**).

The situation is not hopeless, however. Making the manure thinner by removing some of the solids or adding water helps the manure soak into the soil, and this protects the nitrogen from volatilizing. The solids, or thicker portion, that is removed is rich in carbon and phosphorous so it can be used for composting, anaerobic digesters or precision-applied for phosphorous-loving crops like corn.

Besides thinning the manure, it can theoretically be injected into the soil, but injection is not usually a great choice for forages because the soil may be unsuitable (stony or very hard), meaning a lot of tractor power is needed, which means using heavy equipment that can cause compaction.

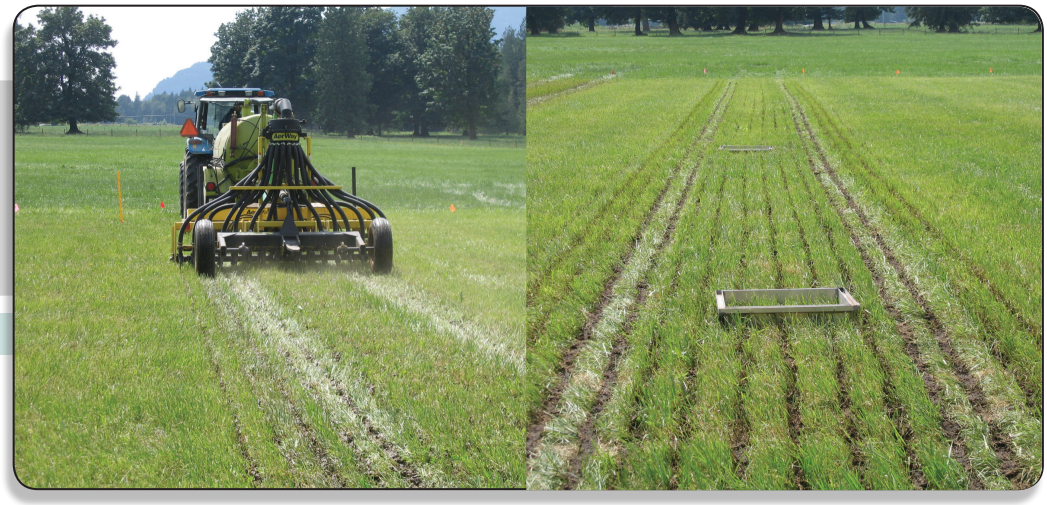
An alternative application method that is cheaper, easier and does not damage the crops was first developed in the Netherlands and is now widely gaining in popularity. Described as surface banding (**Figure 2**), the manure stream from the tank or the umbilical hose is divided by a chopper-distributer into multiple hoses which deliver the manure to applicators placing it in narrow bands (2 to 4 inches wide) spaced about 8 to 15 inches apart.

The best applicators place the

Figure 2

Surface banding dairy slurry on grass with a sliding-shoe applicator in Agassiz BC, Canada.

Figure 3



Applying dairy slurry using combined banding and rolling-tine technologies in Agassiz BC, Canada.

manure directly on the soil surface through sliding shoes that follow the contour of the land, but simpler drop hoses are also effective. According to many studies conducted in Europe and North America, surface banding can reduce ammonia loss by 30 to 60 percent compared to conventional splash-plate applicators. This is because the narrow bands have a smaller exposed surface area for ammonia volatilization and because the manure is under (not on top of) whatever canopy or stubble is present. We found over several years and weather conditions that liquid dairy manure applied with sliding shoes will consistently coax an equivalent grass yield and protein content as commercial fertilizer applied at equivalent rates of mineral nitrogen.

And there are other advantages to surface banding: Even in wind, manure is applied evenly, which makes it more effective and can be applied nearer to sensitive areas than with broadcasting, since there is no risk of drift. Also, there is much less odor.

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The banding method is particularly useful when the forage has started to re-grow because instead of coating and contaminating the re-growing grass, the re-growth acts like an umbrella and helps reduce the loss of ammonia. If the grass is hungry for nitrogen, it can obtain some of the ammonia from the air under the canopy through the stomates (pores) on the underside of leaves.

In the Netherlands and Denmark, farmers are now expected to further reduce ammonia loss by applying liquid manure with shallow injection (2 to 4 inches deep), and there are several shallow injector systems in Europe. Shallow injectors are not very popular in North America, so an injection tool has been developed that uses rolling tines to puncture holes in the soil to help with rapid infiltration ahead of the hose emitters, which are made of firm rubber (**Figure 3**). The applicator is ruggedly built and can be used on most soils, and in some circumstances will even reduce runoff, which is a particular problem with shallow injectors. The applicator reduces ammonia emissions and improves yield, and does not appear to damage the swards even with two passes per year.

So like all marriages made in heaven, manure and forages are very compatible but are not without their issues. Researchers around the world are developing the tools and technology to strengthen the relationship so manure nutrients will become as effective for forages as commercial fertilizers. **FG**

*For more information, Pacific Field Corn Association has released "Cool Forages – Advanced Management of Temperate Forages" by Dr. Bittman, available at www.farmwest.com/node/1303 on the PFCA website.*

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