Perennial Forages Benefit Soils, Other Crops, & Water Quality

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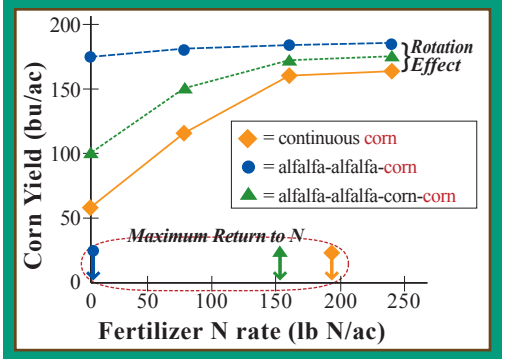
Alfalfa is the most widely grown perennial forage species in the U.S., with the greatest acreage in the upper Midwest and West. But alfalfa acreage has been declining steadily for the past 50 years, while the acreage of soybeans and, more recently, corn has been increasing.

There are costs associated with the displacement of perennial forage acreage. Entering a period with heightened public scrutiny of agriculture's environmental 'footprint' (water and air quality, greenhouse gas production, and energy use), farmers need to consider the total value of adding perennial forages to their crop rotations. This article covers: a) the direct benefits of perennial forages used in rotation or as a cover crop; and b) the more far-reaching benefits of perennial forages in terms of improved soil and water quality.

One of the reasons for the increase in corn acreage, and decrease in alfalfa acreage, is that the amount of corn silage fed to U.S. dairy herds has increased significantly in the past 20 years for a variety of reasons, according to Randy Shaver, University of Wisconsin dairy scientist. These include: higher yield and energy per acre from corn silage, improvement of corn silage hybrids, problems with winterkill of alfalfa, high rumen degradability of alfalfa protein, and better opportunities for manure management.

There are, however, a number of economic and environmental benefits from the production of alfalfa and other perennial forages that are sometimes overlooked when comparing them to corn silage. One of the most important economic reasons to incorporate perennial forages into a rotation is the nitrogen (N) credit for the crop following the forage. Nitrogen released from decomposing alfalfa tissue and from newly accumulated soil organic matter can supply most or all of the N requirement of a following corn crop (Figure 1).

Figure 1. *Yield response to fertilizer N for continuous corn and corn following alfalfa (first and second year). Note maximum return to N arrows at the bottom of figure and rotation effect at upper right. Mallarino & Pecinovsky, 2006.*



Estimates of fertilizer N credit vary depending on the forage species, the quality of the stand (Figure 2), and the amount of regrowth. For example, the University of Wisconsin recommends an additional first-year N credit of 40 lb/ac when 8" or more regrowth is incorporated. In addition, first-year corn grown after alfalfa may have 10-15% higher yield potential due to factors other than N supply ("rotation effect" in Figure 1), including improved soil tilth and fewer pest problems. Because of lower insect pressure, additional savings can be had in seed or insecticide with corn rotated after a perennial forage.

Figure 2. *Value of fertilizer N credits when alfalfa is grown the previous year.*

Stand Density	N Credits (lb/ac)	Value* of N Credits $/ac
Good	130	$104
Fair	100	$80
Poor	70	$56

*With nitrogen at $0.80/lb.

A major concern with corn silage production is the increased risk of soil erosion when there is little residue to protect the soil surface. Erosion can be greatly reduced by incorporating alfalfa into the rotation. An example from southern Wisconsin shows that soil erosion can be reduced to 3 tons/ac soil loss in a corn silage-alfalfa rotation, compared to 10 tons/ac with continuous corn silage (Figure 3). Erosion also can be reduced with a winter cover crop after corn silage, but not as much as with a perennial crop.

Decreasing soil erosion helps protect surface water from sediment, one of the most frequently cited impairments of water quality. In addition, most phosphorus (P) lost in surface runoff from row crop systems is associated with eroded sediment. Both sediment and P impair habitat for high-value fish species, and excessive P can increase algae growth, leading to water quality degradation and fish kills. Producers should be aware, however, that significant soil erosion and associated P loss can occur during establishment of perennial forages, and that dissolved P can be present in runoff from freeze-damaged forage. Quick tips: reduce erosion during establishment by including a companion small grain or forage grass. Reduce runoff of dissolved P by removing regrowth in late fall.