VALUE OF ALFALFA IN ROTATION

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There are about 23 million acres of alfalfa in the US. Alfalfa plus other hay is the most valuable crop in the US, behind only corn and soybeans. In Kentucky alfalfa is planted on over 300,000 acres and is an economically important crop for beef and dairy farmers, cash hay producers, and
provides tremendous benefits for subsequent crops. There are also many non-agricultural benefits to alfalfa.

Nitrogen Credit from Alfalfa Available to Subsequent Crops

Alfalfa offers many benefits to subsequent crops. Many consider free nitrogen (N) from N fixation one of the greatest benefits of alfalfa. The amount of N available to subsequent crops varies some with soil type, but good stands of alfalfa that have been allowed to regrow (> 8 inches) provide 140 to 190 lb N/acre for next year's crop (Table 1). Additionally, since alfalfa roots decay over time, alfalfa also provides approximately 50 lb N/acre for crops planted the following year. The nitrogen benefits can total close to 250 lb N/acre over 2 years. In contrast, soybeans are also legumes which fix nitrogen, but most of their nitrogen goes into producing that year's bean crop. Farmers gain only1 lb N/acre for each bushel of soybeans harvested up to maximum of 40 lb N/acre.

Table 1. Nitrogen available to subsequent crops following growing alfalfa.

	Medium/Fine Soils		Sandy Soils	
Stand Density	-----Regrowth after last cutting------			
	>8 inches	**<8 inches**	**>8 inches**	**<8 inches**
	----------lb nitrogen/acre----------			
Good, > 4 plt/ft²	190	150	140	100
Fair, 1.5 to 4 plt/ft²	160	120	110	60
Poor, < 1.5 plt/ft²	130	90	80	40

Economic Benefit of Alfalfa to Subsequent Crops

Equally as important, alfalfa increases profit of other crops in the rotation. The difference is especially dramatic for corn grain. As shown in Figure 1, when N was at $0.96/lb and using a value of corn at $4.18/bu, then corn after corn lost about $10 per acre due to high nitrogen costs. On the other hand, following alfalfa, corn production resulted in a profit of $310/acre because there is no need for nitrogen fertilizer (other than starter) and because corn yielded 10 to 15% more following alfalfa compared to corn following corn (Figure 2). Currently, N prices are lower, but free N produced by alfalfa and the 10 to 15% higher corn yield still makes alfalfa a tremendous value for corn grain yield.

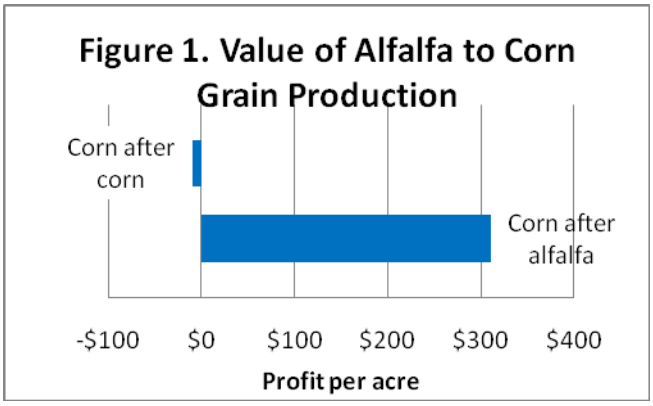
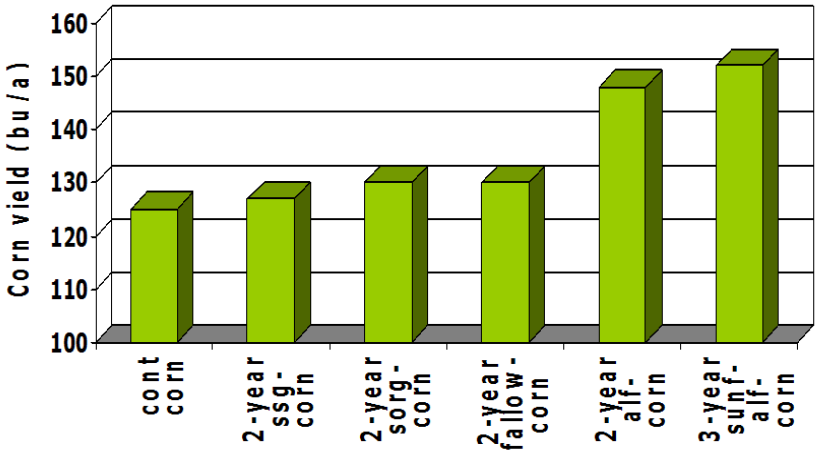


Figure 2. Improved Corn Yield from Alfalfa

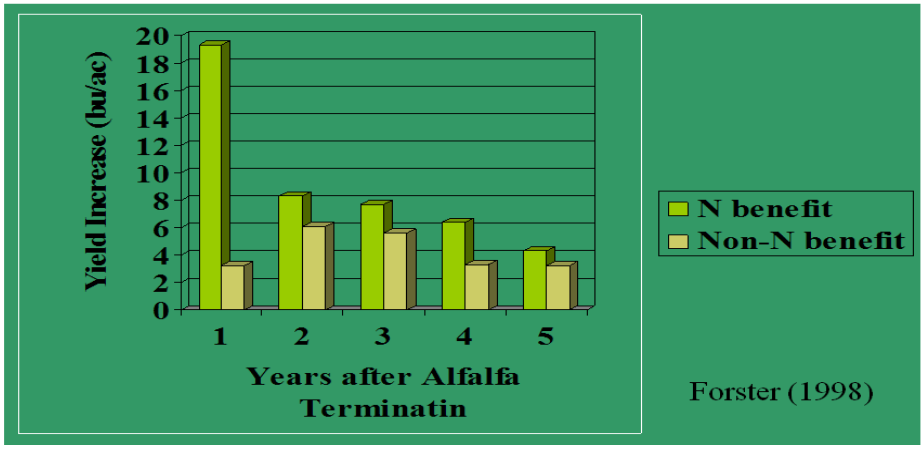


Wheat Yield Increase after 4 Years of Alfalfa

Corn is not the only crop that benefits from alfalfa in rotation. Research by Forster as reported in Entz (2002) showed that wheat yields following alfalfa were significantly higher than wheat following wheat (Figure 3). Alfalfa in the rotation not only benefited the next years wheat crop, but continued to produce higher wheat yields for

up to 5 years. The N benefits for subsequent wheat crops were obvious and expected, but the non-N benefits to wheat yield were also significant.

Figure 3. Rotational benefit of alfalfa to wheat yield.

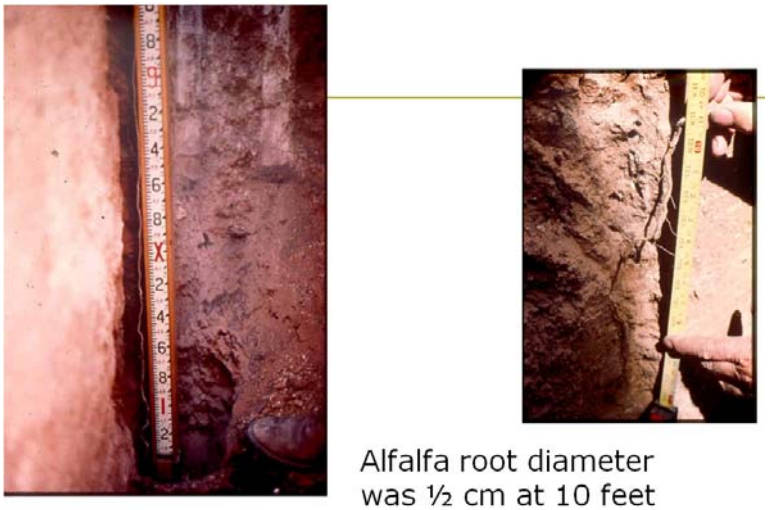


Breaks disease and insect cycles

There are many non-N benefits of including alfalfa in rotation. Examples include the reduction in nematodes for succeeding crops. One of the most dramatic is the reduction in soybean cyst nematode when alfalfa is included in rotation with soybeans.

Improves soil condition

Alfalfa is the most deeply rooted of all commercial agricultural crops. Alfalfa roots have the potential to grow 3 to 4 feet deep per year. It is not uncommon for a 4 year stand of alfalfa to have roots 15 feet deep. Not only is this a benefit for water uptake, but this deep root system improves soil tilth. Additionally, nutrients that have leached below the surface root zone of most agricultural crops can be utilized by alfalfa. These deep nutrients contribute to alfalfa yield and quality, but they are also returned to the surface soil layer for use by following crops. The photos below provide an example of rooting depth and indicate that it is not uncommon for an alfalfa root at 10 feet to still be ½ cm in diameter.

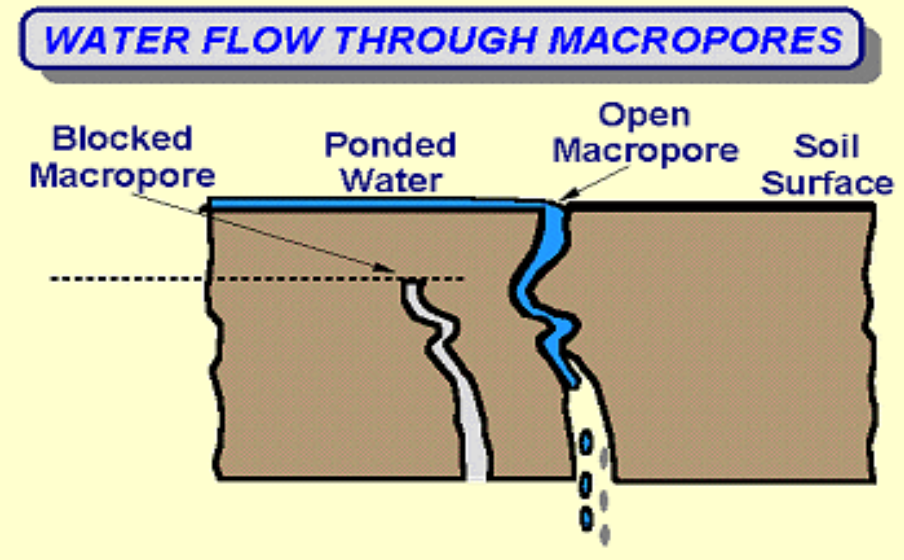


Alfalfa root diameter was ½ cm at 10 feet

Improved Water Infiltration

Alfalfa should not be planted on poorly drained soils, but water infiltration can be dramatically improved by cropping alfalfa on moderately drained soils. After an individual alfalfa plant dies or is sprayed out, its tap root decomposes producing a macropore (Figure 4). Each macropore provides a channel that improves soil drainage. When using zero or minimum tillage, macropores can last for several years after the termination of an alfalfa stand. Alfalfa also decreases soil bulk density and the potential for soil compaction by increasing organic matter. Exudates released by alfalfa roots allow colonization by fungal hyphae which in turn lead to the development of well defined soil aggregates.

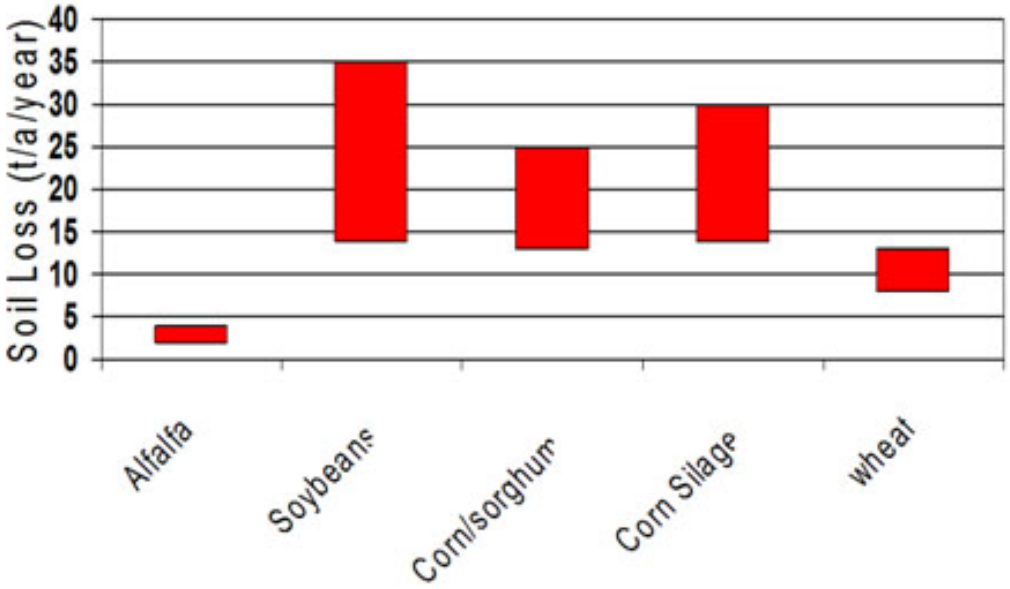
Figure 4. The development of large macropores following alfalfa.



Reduced Erosion from Alfalfa in Rotation

Most people do not think of alfalfa as a crop to plant to reduce erosion, but research reported by Jackobs in Missouri showed that erosion from an alfalfa field is essentially zero compared to values for corn or soybeans. No-till cropping will reduce erosion of corn and soybeans, but not as low as planting alfalfa.

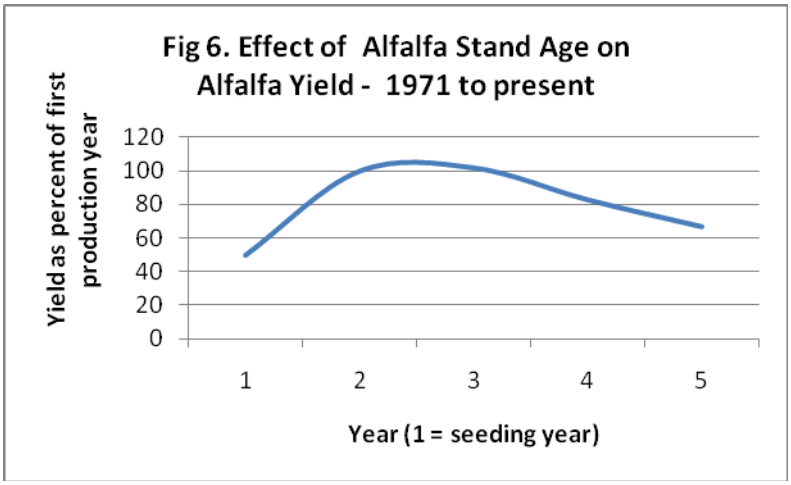
Figure 5. Erosion from crop fields including alfalfa, soybeans, corn, and wheat.



SOURCE: Dr. Dan Undersander, University of Wisconsin.

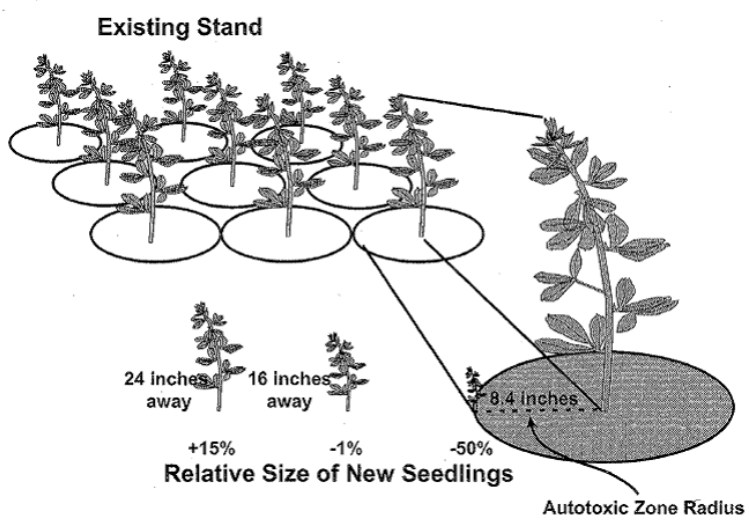
The Value of Younger Stands vs. Older Stands

Long term studies in Wisconsin show that one of the challenges to alfalfa profitability is decreasing yield as the stand ages. The declining yield is due to the environmental stresses, wheel traffic and diseases that build up over time. As Figure 6 shows, average yield decline of alfalfa in the Midwest is 17% in the third production year and 34% in the fourth production year. Declines were generally greater east of the Mississippi River and slightly less to the west of the Mississippi, unless under irrigation. Therefore, producers are encouraged to consider shorter term rotations on their alfalfa fields. The convenience of keeping alfalfa for "one more year" may be outweighed by the yield benefit of planting a new stand.



Avoid Thickening Up Old Alfalfa Stands

Although alfalfa shows tremendous benefits to subsequent crops, it is imperative to use other crops as a break between alfalfa stands in the same field. When alfalfa is replanted or overseeded into an existing alfalfa stand, the original alfalfa plant severely limits the growth of the newly seedlings. This is called autotoxicity, and extensive research by Jennings has shown that individual alfalfa plants severely limit the growth of new seedlings in an 8 inch radius around the original plant (Figure 7). New seedlings are weaker than normal up to 16 inches away and maximum growth of new seedlings does not occur until a full 2 feet away from the original plant.



Although the focus of this paper has been the benefit of alfalfa in rotation with annual crops like corn and wheat, alfalfa also provides many other benefits including:

Providing Significant Wildlife Habitat. Alfalfa is the beginning of a food chain, and contributes valuable habitat for hundreds of species of herbivores and animals of prey. It hosts several endangered species, plus many familiar ones.

Efficiency in Water Use. Alfalfa is a relatively efficient user of water; it produces high tonnage of dry matter in proportion to the available moisture. This is due to its season-long growth habit, its high yield, and the fact that all the above-ground portion of the plant is harvested. Alfalfa's deep-roots assure that a large proportion of available water is used by the crop.

Mitigating Contamination Problems. Alfalfa has been used to mitigate several environmental problems including absorbing nitrates from groundwater, recycling dairy or municipal wastes, and mitigating industrial compounds that could contaminate groundwater.

In Conclusion

Alfalfa has long been known as “The Queen of Forages” for its high quality and yield, but the tremendous benefits of alfalfa in rotation make alfalfa one of the most important crops in the world.

Special Thanks to Dan Undersander, Extension Forage Specialist, Univesity of Wisconsin. Many of the tables and figures used in this paper were taken from his presentation “Alfalfa in Rotation”.

References

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