The alfalfa nitrogen (N) credit usually eliminates the need for manure N and/or fertilizer N to economically optimize yield of the first corn crop following alfalfa. Exceptions to this are when first-year corn is grown: 1) on sandy soils; 2) on fine-textured soils in years when there is excessive soil moisture in the spring and early summer; 3) following 1-year-old alfalfa; and 4) following a 2-year-old alfalfa stand (including establishment year) that was seeded with a small grain crop. Furthermore, the alfalfa N credit can provide nearly one-half or more of the N requirement for the second corn crop following alfalfa. These results have been confirmed with modern corn hybrids in over 40 on-farm research trials in Minnesota during the past five years. When alfalfa or manure N credits are not used for first- and second-year corn following alfalfa, total N rates can become excessive quickly. A survey of Minnesota growers was conducted in 2012 to better understand challenges to and opportunities for improved N management in corn following alfalfa.

**Nitrogen Credit Adoption for First-Year Corn Following Alfalfa**

Survey results from 421 growers in Minnesota indicate low adoption of alfalfa and manure N credits for first-year corn. Overall, only 35% of growers applied total N rates below or at University of Minnesota Extension guidelines for first-year corn. Adoption rates were slightly higher when no manure was applied to first-year corn (40%) than when it was applied (30%), but the majority of growers (67%) applied manure. By not fully accounting for alfalfa N credits for first-year corn, most growers (62%) without manure who exceeded Extension guidelines applied 100 to 150 lb N/acre above guidelines. When the combined N credits for manure and alfalfa were not fully accounted for, excessive N rates were even higher; one-third of growers exceeded guidelines by more than 150 lb N/acre.

**Nitrogen Credit Adoption for Second-Year Corn Following Alfalfa**

Adoption rates were slightly lower for second-year corn following alfalfa. There were 273 of 421 growers who planted two years of corn following alfalfa. Of those, 29% followed Extension guidelines for second-year corn. Again, adoption was slightly higher when no manure was applied (33%) than when it was applied (25%), but most growers applied manure (79%). Of the growers that applied manure, 78% applied it to both corn crops following alfalfa. In these cases, the total N rate for second-year corn includes four major N sources in addition to the N supplied from other soil organic matter. These sources include: 1) second-year manure N credit for manure applied to first-year corn; 2) second-year alfalfa N credit; 3) first-year manure N credit from newly applied manure; and 4) fertilizer N. When alfalfa N credits to second-year corn were not accurately accounted for, growers did not exceed the guideline rate by more than 100 lb N/acre, because alfalfa N credits for second-year corn are usually one-half of first-year credits. However, when manure was applied to one or both corn crops following alfalfa, almost one-half of the growers who exceeded guideline rates (75% of growers) did so by more than 150 lb N/acre.

**Challenges of and Opportunities for N Crediting in Corn Following Alfalfa**

One of the greatest challenges to N management in corn following alfalfa is manure N management. For example, N credit adoption rates were lowest and over-application of N was greatest when manure was applied for one or both corn crops following alfalfa. A particular challenge expressed by growers was the need to terminate alfalfa so that manure could be applied – more than one-half of the growers indicated that this was a primary reason for terminating their alfalfa. Therefore, growers may often feel constrained to apply manure to corn following alfalfa because they lack sufficient manure storage capacity, adequate land area for spreading manure in other crop rotations, or the ability or equipment to distribute or sell manure. Growers may also be constrained to apply manure to corn following alfalfa in order to replenish P and K that has been removed by multiple years of alfalfa production. Fertilizer P and K could be used to replenish what was used by the alfalfa, and P and K fertilizer guidelines are lower when banded as a starter than broadcast. However, the added cost of fertilizer may be a concern for growers who already have sufficient manure. These challenges to manure application for corn following alfalfa need to be addressed so that growers have more options for managing, distributing, or selling manure.

Another challenge to N management in corn following alfalfa is the acceptance and use of alfalfa N credits. Current guidelines indicate that N credits of 150, 75, and 50 lb N/acre should be used for first-year corn following good (>4 plants/sq ft), fair (2-3 plants/sq ft), and poor alfalfa stands (<1 plants/sq ft). For second-year corn, the N credit is 75 lb N/acre for good stands and 50 lb N/acre for fair stands, with no credit given for poor stands. Though we were not able to determine definitively why some growers use alfalfa N credits and others do not, we did learn that growers appeared to use N credits for worse stands than they reported having. For example, many growers who reported that they terminated a good alfalfa stand appeared to subtract the N credit for only a fair or poor alfalfa stand. In addition, when growers relied on corn yield goal for determining N rates for corn following alfalfa, they were less likely to use alfalfa N credits. Corn yield goal N rate guidelines are considered outdated and have been replaced with guidelines based on corn selling price and N fertilizer cost. In most cases, the older N rate guidelines based on yield goal were higher than current guidelines. Therefore, some growers may be using appropriate alfalfa N credits, but still...
exceed current N rate guidelines by subtracting the N credit from the higher, outdated guidelines for continuous corn. Efforts should be made to help growers use and develop confidence in current fertilizer N guidelines and alfalfa N credits.

Additional obstacles to adoption of alfalfa N credits may be linked to growers’ limited awareness of alfalfa N credits, resistance to changing fertilizer use, or previous experience with alfalfa N credits with unsatisfactory results. Efforts to help these growers gain confidence in alfalfa N credits could include enhanced education and outreach programs; simple field trials that demonstrate N credit accuracy; incorporation of N credits into crop insurance programs and nutrient management planning; or local, state, or federal incentives.

Conclusions

Alfalfa and manure N credit adoption is essential to farm efficiency and resource protection. Excess N application often can reduce farm profit, waste resources, and impair water quality. Efforts to improve N credit adoption will need to address the challenges of N management in corn following alfalfa, some of which are outlined in this article. We offer a few suggestions for improvement below, which are based on Minnesota Extension guidelines.

Suggestions for Improving N Management in Corn Following Alfalfa

**First-Year Corn:**

1) Use Extension guidelines to determine economically optimum N rates for continuous corn. Subtract the appropriate alfalfa N credit (up to 150 lb N/acre; see guidelines) to reduce the N rate for first-year corn.

2) Our recent on-farm research indicates that alfalfa N credits are reliable and often are larger than current guidelines suggest. We found that first-year corn rarely responds to N except on sandy soils, on fine-textured soils when there are prolonged wet early-season conditions, and when following 1-year-old alfalfa that was direct seeded or 2-year-old alfalfa (including establishment year) seeded with a small grain crop. However, current guidelines are a good starting point and will frequently improve net returns to fertilizer N application.

3) If possible, avoid manure application for first-year corn because additional N typically does not increase corn yield.

4) Many fields with a manure history may have adequate or more than adequate soil-test P and K at the end of alfalfa stands. Be sure to soil test. If manure is needed to replenish soil P or K at the end of an alfalfa stand, apply only the minimum rate needed to meet P or K requirements, based on a manure nutrient analysis. Consider applying solid manure if P need is greater and liquid manure if the K need is greater, because solid usually has higher P concentration and liquid usually has higher K concentration.

5) Consider using P or K fertilizer instead of manure to meet needs of first-year corn so that manure nutrients can be utilized for corn in other rotations or other crops that need N.

**Second-Year Corn:**

1) Use Extension guidelines to determine economically optimum N rates for continuous corn. Subtract the appropriate alfalfa N credit (up to 75 lb N/acre; see guidelines) to reduce the N rate for second-year corn.

2) If manure was applied to meet P and K needs for first-year corn, subtract second-year manure N credits to further reduce the fertilizer N rate applied for second-year corn.

3) If the second-year alfalfa N credit plus the second-year manure N credit from first-year corn do not meet the economically optimum N rate for second-year corn, use properly credited manure N or fertilizer N to bring the total N rate up to the Extension guideline.

To gain confidence in alfalfa N credits, consider using one or more ‘N-rich’ strips (a strip with a high N rate applied) in fields where alfalfa N credits are adopted. If significant differences in leaf color or tissue tests occur between the N-rich strips and adjacent corn, a sidedressed N application may be warranted (although early-season N deficiency does not always result in yield loss). If sidedressed N is applied, consider leaving one or more zero-N strips and do not sidedress the N-rich strips. This will allow you to compare yields with those different treatments.

**Links to Minnesota Guidelines and Further Information:**


2) N rate calculator: [http://extension.agron.iastate.edu/soilfertility/nrate.aspx](http://extension.agron.iastate.edu/soilfertility/nrate.aspx)
