Drinking Water Protection Series

Effectiveness of Nitrogen BMPs--South Central MN

INTRODUCTION

Elevated nitrate concentrations are a relatively common problem in Minnesota's vulnerable aquifers. In the south-central part of the state, many aquifers are less vulnerable to land use activities due to the thick glacial till and fine textured soils protecting them. However, some drinking water supplies are threatened from elevated nitrate levels as a result of losses through drainage water. With 3500 square miles of drainage, elevated nitrate levels in the Blue Earth River influence the City of Mankato's drinking water supply. Seventy-five percent of the city's drinking water is obtained through a supply well located 60' below the river. The City of St. Peter's water supply is also influenced by tile drainage water. Drainage water flows onto coarse textured outwash soils and percolates rapidly to the aquifer. Supply wells in close proximity to this area have experience elevated nitrate concentrations over the past decade. Wellhead Protection Plans will take specific action steps to address these existing problems and prevent future contaminant sources.

Researchers at the University of Minnesota (UM) and other land grant universities have spent several decades developing common sense agricultural practices that producers can implement to make sound economic *and* environmental improvements. Perhaps you have heard about **B**est **M**anagement **P**ractices **(BMPs)** but do you know how effective are these practices in protecting water quality? Thanks to the outstanding work conducted at the UM's Southern Research and Outreach Center, there is a warehouse of information which helps us understand how effective various practices are in reducing losses from agricultural fields. This fact sheet summarizes a collection of studies conducted over the past fifteen years. Much of this information is relatively specific for the fine-textured glacial till soils, climate and crops for the south central portion of the state. Similar information has been developed for producers by the MN Extension Service with additional emphasis on crop yields. Please visit the following website: http://www.extension.umn.edu/distribution/cropsystems/DC6127.html

SELECTED BMPS AND ASSOCIATED WATER QUALITY IMPACTS

Examples of the Statewide BMPs include:

- Do not apply nitrogen above recommended rates.
- Plan nitrogen application timing to achieve high efficiency of nitrogen use.
- Adjust nitrogen rate according to soil organic matter content, previous crop and manure applications.

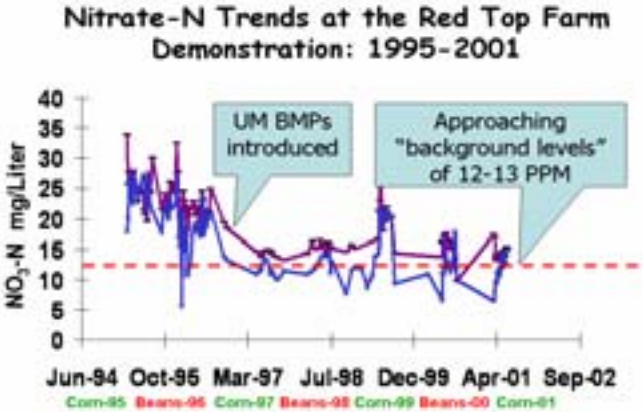

Figure 1. Nitrate-N concentrations in two tile drainage systems at the Red Top Farm Demonstration (Nicollet Co). Data Source: MN Department of Agriculture

Associated Water Quality Impacts: Red Top Farm Demonstration: This site was first developed in response to nitrate problems in St. Peter. Red Top is comprised of three 25 acre parcels of tile-drained cropland which have been fully instrumented to continuously monitor the year around losses of water, nutrients and pesticides. Because the water percolating through the soil is intercepted by the tile drains rather than making a very slow journey to the groundwater, researchers have the opportunity to measure BMP effectiveness within fairly short timeframes. In the spring of 1996, the N fertilizer rate and timing was converted to UM recommendations. Previously the producer was fall-applying 160-170 lb/N/A to the corn following the soybeans. Trimming N fertilizer rates by 20-30% and delaying to a spring application resulted in 40-50% reductions in nitrate leaching losses.

Examples of the BMPs for South Central Minnesota (UM, 1993) include:

- Applications of N before spring planting are highly recommended.
- Spring preplant applications (anhydrous or urea) are encouraged.
- Use a nitrification inhibitor with fall applications if soils are poorly drained and wet.
- Carefully manage nitrogen applications on soils characterized by a high leaching potential.

Associated Water Quality Impacts-University of Minnesota:

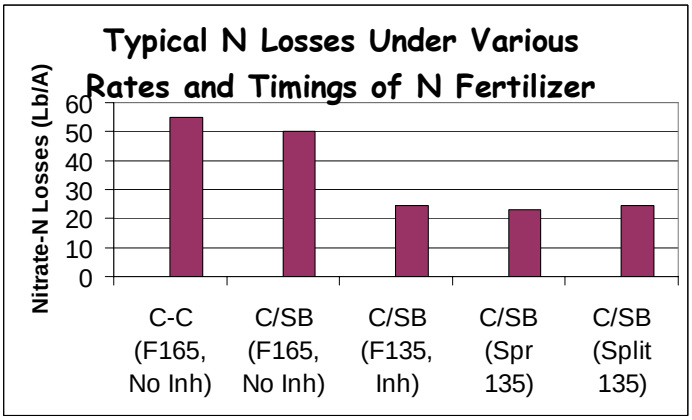

Figure 2. Approximate N losses under a variety of N rates and timings. (Losses were calculated using the best available concentration data (Randall et al, variety of sources) coupled with an average water loss of 8 inch/year. "C-C" represents Corn following Corn, C/SB represents Corn following soybeans, "F165" denotes fall applied N at 165 lb/A, etc, "No Inh or Inh" denotes treatments with and without a nitrification inhibitor (N-Serve), "Spr 135" and "Split 135" means spring or split rates at 135 lb/A, respectively.)

The following graphic shows the approximate amount of N moving past the root zone under various rates and timing scenarios. Please keep in mind that the actual losses are highly climatic dependent.

Many growers in SC and SW Minnesota prefer to put a majority of their N fertilizer on in the fall in order to conserve work time during the narrow spring planting window. Losses under either continuous corn (Case 1) or corn/soybean (Case 2) grown under fall-applied rates above UM recommendations will typically result in N losses at unacceptable levels. Producers reliant on fall applications need to carefully select the appropriate rate and apply after the soil temperatures are favorable. Teaming up with a nitrification inhibitor can significantly reduce N loss (Case 3).

Applying anhydrous ammonia or urea immediately before planting is generally the most efficient method for these types of soils (Case 4). Similar to the response illustrated at Red Top (*Figure 1*), producers can frequently reduce N inputs by 10-40 lb/A and leaching losses can be reduced 30-50%. Split applications are slightly inferior to spring preplant on the fine-textured soils (Case 5).

Introducing Perennial Forages and CRP into the Cropping System

Over the last decade, researchers have documented the effectiveness of perennial forages such as alfalfa for protecting groundwater. Although alfalfa obtains most of its N needs from the atmosphere, it is also very efficient at removing inorganic forms of N from the soil profile. Because this crop is an effective N scavenger, researchers at USDA-Agricultural Research Service are now developing methods for remediation at fertilizer spill sites and applying nitrate laden waters from treatment plants. Many of the perennial grasses or grass/legume mixtures used for CRP (Conservation Reserve Program) are also excellent in conserving N.

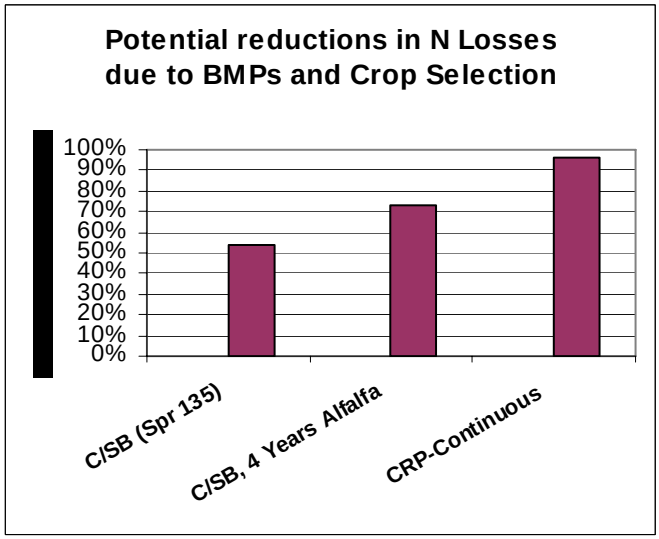

Figure 3. Potential net reductions in N losses from conventional management by implementing UM rates and/or introducing either alfalfa or CRP perennials.

Figure 3 shows the percent reduction by either applying BMPs or introducing perennial cropping systems. Scenario 1 (spring applied N at UM rates on corn) was previously illustrated in *Figure 2* and will reduce N losses between 30-50% over many conventionally managed corn/SB systems (Fall-applied at rates between 165-180 lb/A). Introducing four years of alfalfa into a corn/SB rotation will further reduce leaching losses. In highly.vulnerable, critical recharge regions of Source Water Protection Areas, wellhead teams should work with the area farmers to get the land into the CRP program.

Wellhead teams are encouraged to review the entire series of related fact sheets.
http://www.mda.state.mn.us./appd/waterprotect.htm

For more information:
Minnesota Department of Agriculture—www.mda.state.mn.us/appd/waterprotect.htm
Minnesota Department of Health— www.health.state.mn.us/divs/eh/water/index.html
Minnesota Rural Water Association—www.mrwa.com

Developed cooperatively between the Minnesota Department of Agriculture and the Minnesota Department of Health