

# Red Top Farm Demonstration Site

A Joint Project Between:

## Minnesota Department of Agriculture

### Special Projects Unit

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And the following Partners:

**Red Top Farms**

**Blue Earth Agronomics**

**University of Minnesota**

**Minnesota River Friendly Farmer Program**

**Brown Nicollet Environmental Services**

**Brown Nicollet Cottonwood Water Quality Board**

**AND**

**Brown Nicollet Environmental Health**

## SYNOPSIS

The ability to demonstrate the effectiveness of Best Management Practices (BMPs) is an important component in the 1989 Ground Water Protection Act. A ninety-acre site located on the Red Top Farm near St. Peter provides a unique opportunity to study the quality and quantity of water and agricultural chemicals moving through the subsurface tile drainage system. Results from Red Top fills a critical gap between university research, which is typically conducted on a small-scale under a very controlled environment, and effectiveness on a production-scale.

Implementation of existing Nitrogen BMPs and University of Minnesota Fertilizer Recommendations resulted in a significant reduction in fertilizer inputs, maintained yields, and appears to have decreased nitrogen losses by 40 to 50 percent. Additionally, the results have been extremely positive for the majority of pesticide products that have been studied since 1996.

The overall concept of Red Top has proven to be a highly effective educational approach for farmers, agricultural professionals, and the non-agricultural community. The site has hosted many educational field days and has been featured in numerous agricultural magazines and newspaper articles.

## HISTORY

The concept and funding evolved from a LCMR<sup>1</sup> project titled *Developing Soil Specific Nitrogen Management as a BMP* (1993-95). Locating one of the sites in the St. Peter area was ideal because of the long-term problems with nitrates in the city's water supply prompting the city to become one of the state's first to develop wellhead protection (WHP) strategies. The MDA joined a consortium of interested parties to address St. Peter's WHP concerns. Local farmers, county health staff, extension

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<sup>1</sup> Legislative Commission on Minnesota Resources

agents, and city water planners, among others, came together to assess the problems and develop appropriate responses. The need for the development of nitrogen demonstration work and accelerated educational efforts were the result of these discussions.

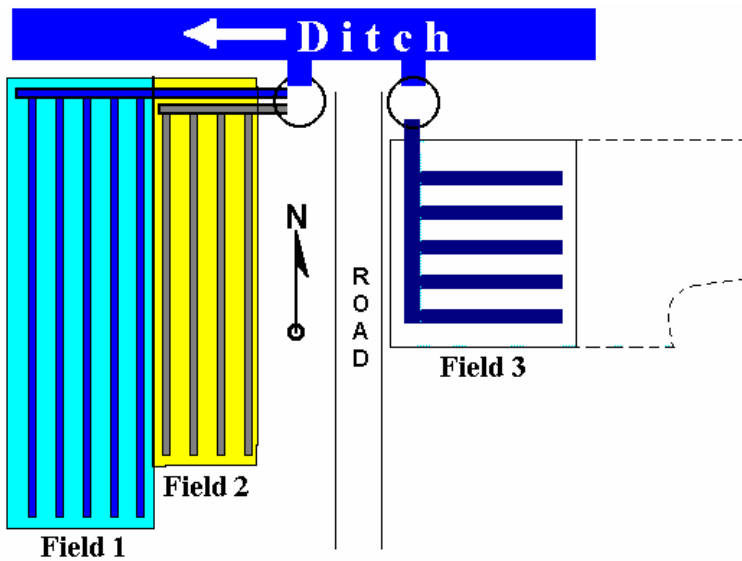
Red Top Farms, owned and operated by Rob and Janice Meyer, had an existing tile-drainage system that was ideal for monitoring the water quality and quantities from two 30 acres parcels. With only minor alterations in the drainage design, a manhole was installed which allowed the monitoring for each of these discrete parcels of land. The manhole and subsequent monitoring equipment was installed during the winter and spring of 1994-95. The field layout and the resulting monitoring installation will be discussed in the next section. Nitrate concentration data has been collected since the 1995-cropping season. In 1996, MDA made a very dramatic move by adding a pesticide-monitoring component. However, the ability to measure water quantity was not perfected until 1997 when the Monitoring and Assessment Unit staff became closely involved with the project. The site now provides continuous year-around monitoring for water flow, nitrate, and pesticides. In the fall of 1997, a third parcel of land was tiled and a similar monitoring setup was installed (See Figure 1).

One of the long-term goals at this site is to determine if *site specific* technology can reduce nitrogen leaching losses while maintaining or improving corn yields. A variety of nitrogen fertilizer strips were imposed on the 1997 and 1999 corn crops and responses were measured with a yield monitor at harvest. The purpose of collecting this type of data is to better understand the nitrogen response curve recognizing that there is a great deal of soil and nutrient variability across the landscape. This information will then be used to make management decisions when applying the N fertilizer in a “site specific” fashion to future corn crops. “GPS referenced” yield maps and intense soil sampling grids have also been collected but will not be discussed in this report due to space limitations.

## PROJECT DESCRIPTION

As shown in Figure 1, Red Top features three different fields with each field ranging between 25 to 30 acres. Each field is drained by its own subsurface tile drainage system.

**Figure 1. Research fields at Red Top Farms showing tile lines layout and location of the monitoring stations (designated by the circles).**



Understanding the localized hydrology is the key to evaluating non-point agricultural chemical movement. The automated equipment allows MDA staff to create continuous hydrographs similar to the one shown in Figure 4.

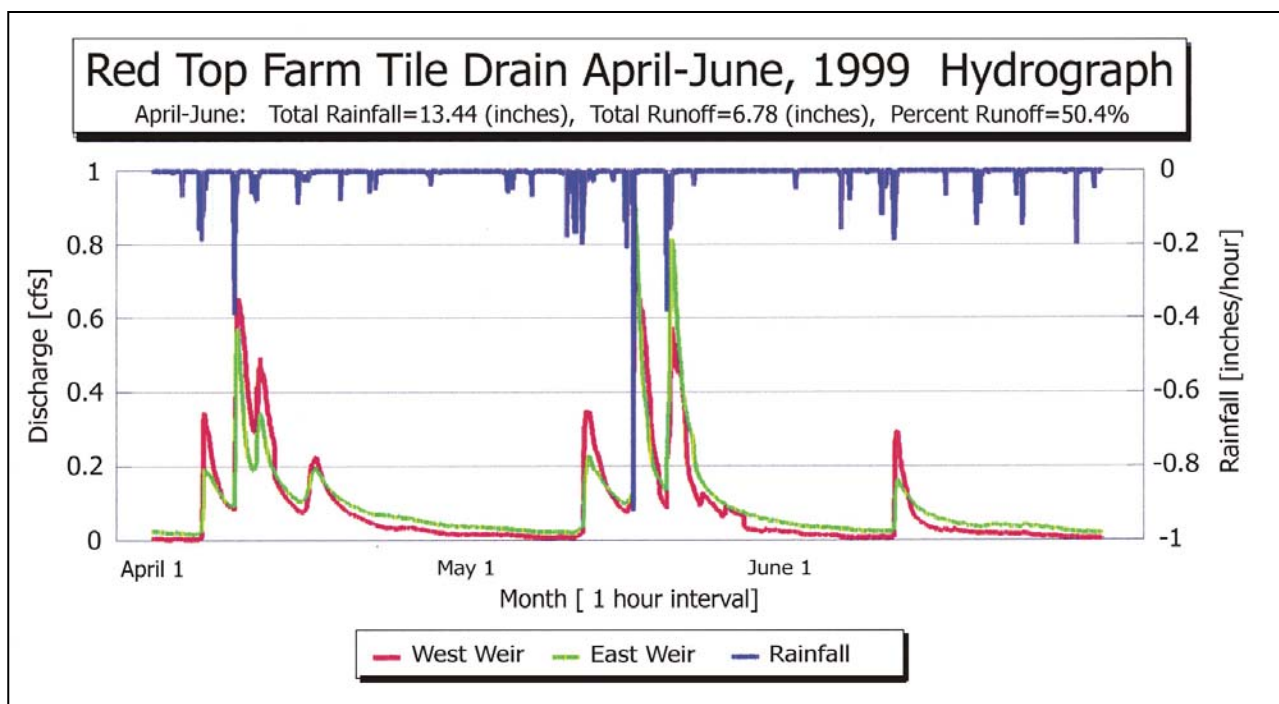
**Figure 2. A view of the automated monitoring station and rain gauge. This southwest view shows parts of Field 1 and Field 2.**



**Figure 3. ISCO samplers collect tile water samples. A pair of weirs, in tandem with “pressure bubblers”, is used to measure the flow rate from Field 1 and Field 2.**



**Figure 4. An example of a hydrograph during the spring of 1999. Hydrographs assist in the understanding the relationships of inputs (rainfall is the top chart) to outputs (subsurface drainage). Note the striking similarities of the drainage distributions from the east (Field 1) and west (Field 2) sites. Also, note the fast response times after a major rainfall event.**

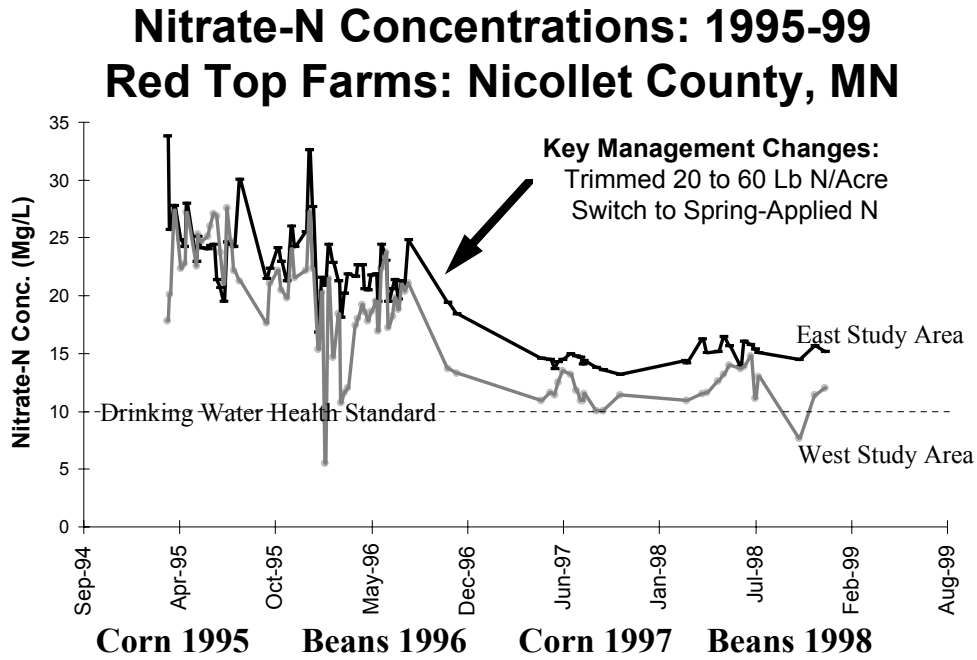


### HIGHLIGHTS OF FINDINGS: 1995-1999

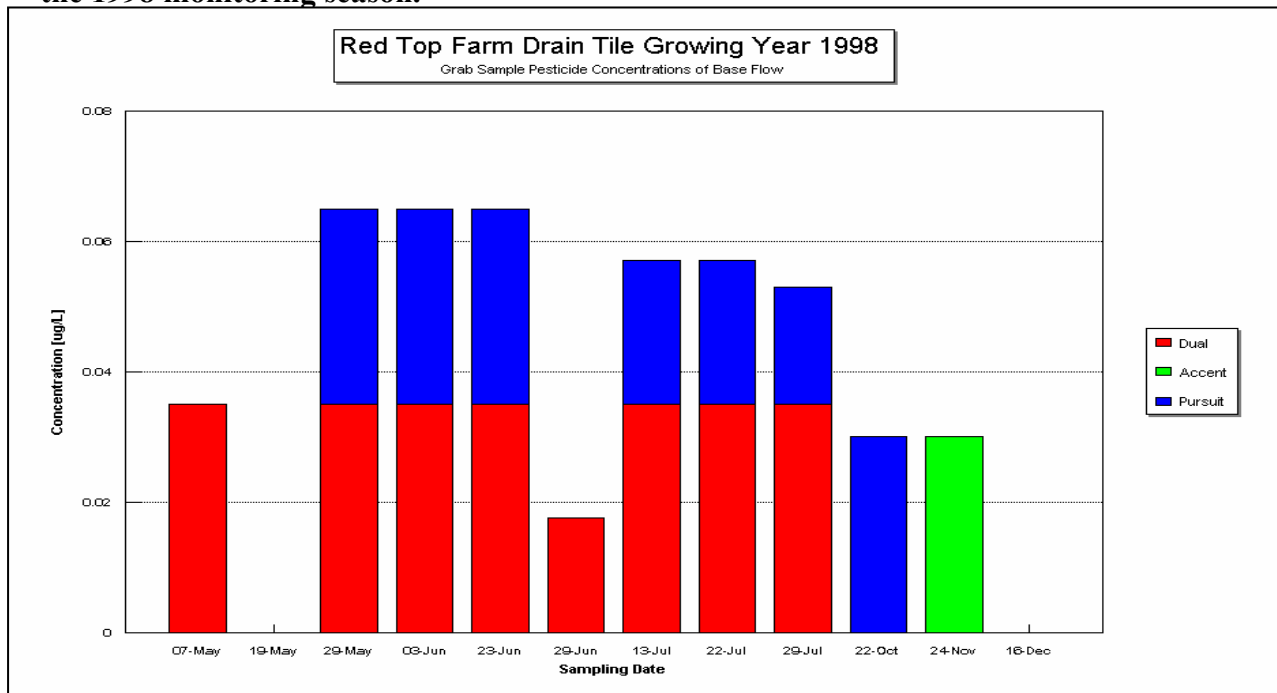
Water quality results from the first four years indicate that producers can have a profound impact on the amount of nitrogen leaching from their fields. Nitrate-N ( $\text{NO}_3\text{-N}$ ) concentrations in 1995-96 drainage waters at the start of the demonstration were typically 20-25 mg/L. These numbers appeared to be typical ranges found under tile-drained fields in southern Minnesota. By simply changing several basic nitrogen management strategies during the 1997 corn season, significant water quality improvements were observed. Rob Meyer switched to a spring-applied nitrogen program and lowered his fertilizer inputs to take the full 40 Lb/A legume credit from the soybeans. Implementation of BMPs for south-central MN, along with the UM fertilizer recommendations, resulted in a 40 to 60% reduction in the  $\text{NO}_3\text{-N}$  concentrations and no yield loss.

Very minimal concentrations of Banvel, Accent, Pursuit and Dual were found in the tile drainage waters during 1997-1998. Concentrations were usually less than 100 times below the Health Risk Limits. A lack of surface intakes may be an important factor for the low concentration of pesticides found in the tile water. However, significant losses of acetochlor (Harness or Surpass) did occur in the spring of 1999. Substantial May rainfalls (Figure 4) immediately after the application, coupled with the soluble characteristics of this product, help explain these findings.

**Figure 5. A summary of the continuous nitrate monitoring from 1995-1999. The graphic shows the response after improvements in nitrogen management were implemented.**

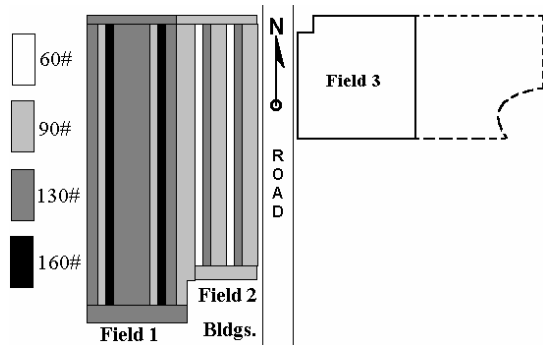


**Figure 6. A summary of the concentrations of Pursuit, Dual and Accent found during the 1998 monitoring season.**



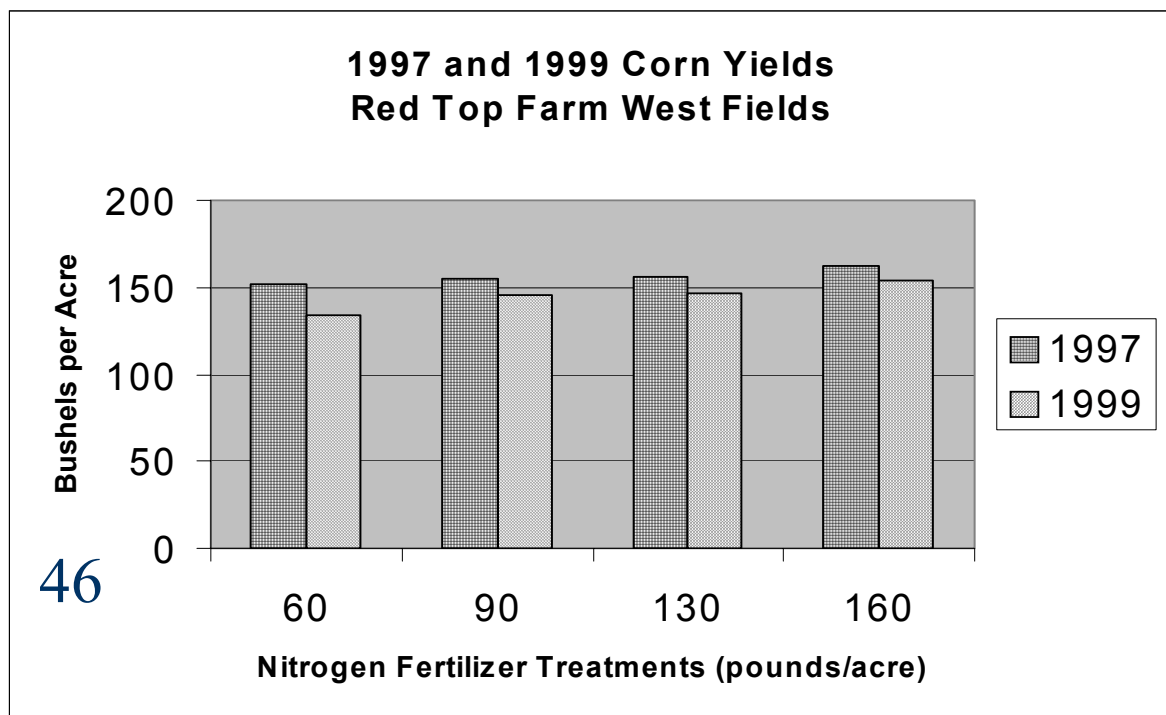
Many producers firmly believe that most land grant university fertilizer recommendations are too conservative and, as a result, frequently use nitrogen rates 20 to 60 lb/A more than the crop can effectively use. In St. Peter, over 90% of the corn acres were receiving 30+ lb/A compared to UM recommendations. Convincing producers that these lower rates will perform under a variety of climatic conditions can be difficult. One effective method is to conduct “on-farm” strip trials over several growing seasons. Figure 7 illustrates the design used at Red Top and is currently being expanded to 10 additional farms in the St. Peter Wellhead Protection area in 2000.

**Figure 7. Design of the nitrogen rate strips used in 1997 and 1999.**



The fields are planted in a corn and soybean rotation with nitrogen fertilizer applied on the land going into corn. For the initial part of the research, nitrogen fertilizer was applied in strips with application rates of 60, 90, 130, and 160 lb/acre. The UM nitrogen recommendation for 150 bushel corn is approximately 110 lb/N/A. The strips were then harvested with a combine equipped with GPS and a yield monitor. Very basic results are shown in Figure 8. Strong interaction between soil type, N rate and yields were found.

**Figure 8. Corn response (1997 and 1999) to the various nitrogen treatments.**



## PLANS FOR FUTURE YEARS

“Roundup Ready” soybeans have increased 40-60% in the Midwest during the last two years. However very little work has been done on a national level to quantify the fate of Roundup in tile-drained agricultural settings. “Roundup Ready” soybeans will be planted at Red Top and two applications of Roundup herbicide will be applied during the growing season. Currently the MDA-Lab Services are preparing for the new analysis methods. In addition, other innovative research will be conducted at Red Top:

- The use of rye as a cover crop as a means to reduce soil and nitrogen losses. Rye would be planted in the fall, and sprayed with round up soon after planting.
- Utilizing organic fertilizers such as manure to meet the majority of crop needs. This information will be very valuable to crop producers since one of the state’s largest dairies-Northern Plains Dairy is planning construction of a 3,000 head Jersey dairy four miles south of Red Red Top Farms.
- Expand Red Top field demonstrations to other areas and watersheds of the state.
- Expand information to the Seven Mile Creek Watershed Project and Middle Minnesota Major Watershed.

Partly because of the success at Red Top, we have been able to obtain grants to continue the work on a larger scale. The plan for 1999 to 2000 is to have 50 percent of the farmers in the St. Peter Wellhead Area participate in field scale nitrogen rate demonstrations. The initial funding for this project is from an EQIP Educational Grant. Additional funding is available from the Minnesota River Initiative (1999 to 2000) and a 319 Clean Water Act Grant (2000 to 2002). For participating in the Nitrogen Recommendation Validation Project, farmers are eligible for the following benefits on 40 acres per farm:

- Custom combining with a crop yield monitor (\$25 to \$30 per acre)
- Custom nitrogen application
- GPS mapping
- Profit differential if yields are reduced

## PUBLICATIONS AND EVENTS

On September 14, 1999 a field day was held. Approximately 60 participants, mainly crop retailers and agency staff, attended the half-day event. On September 13, 2001 state and local units of government, farmers, researches and agricultural professionals teamed up to provide another unique opportunity to understand water quality. Over 60 participants attended the full day event. Some of the topics included Red Top research results, UM fertilizer Recs., drainage and pesticide losses at Red Top, nutrient impacts at local and national level, and manure management. The afternoon session was concluded in Seven Mile Creek Park where speakers discussed the field scale research like Red Top and the importance it has for a watershed project like Seven Mile.

The project has been written up in the following agricultural magazines:

- *Top Producer*, November 1998
- *The Furrow*, 1999 Special Conservation Issue
- *Farm Industry News*, December 1999

- *The Farmer*, February 9, 2000

Information from Red Top has been popular with a variety of audiences:

- “*Water Quality and Drainage Performance of an Agricultural Tile Drainage System*” presented at the 32<sup>nd</sup> Annual Water Resource Conference, University of MN, October, 1999.
- “*End of the Story: One Community’s 10-year Search for Drinking Water Solutions*” presented at the MN Community Health Conference, Craguns-Brainerd, September, 1999. (part of a joint presentation with MCPA and Brown-Nicollet Community Health).
- “*Challenges of Water Quality Protection in Agricultural Communities*” presented at the MN Environmental Health Association Conference, Brainard-Madden’s, May, 1999.
- “*Using Tile Drainage Systems as an Educational Tool*” presented at the Farmland Water Management Workshop, Southwest State University, March, 1999.
- “*Red Top Farms-Tile Drainage Monitoring Results*” presented at the Agricultural Land Drainage Forum, Blue Earth, January, 1999.