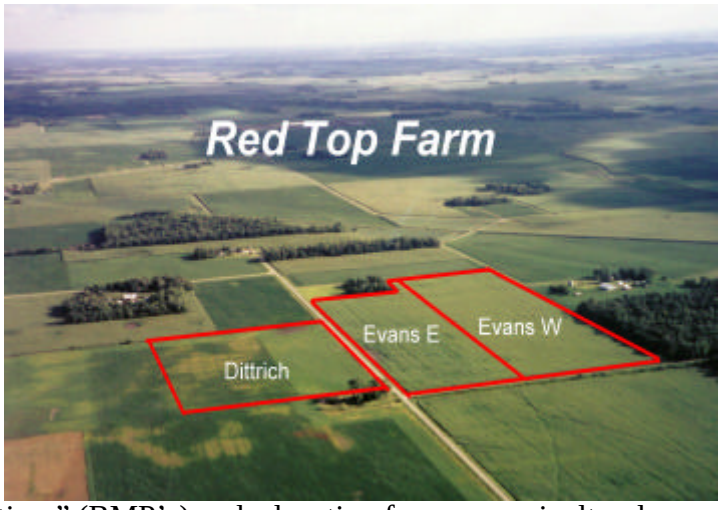
Red Top Farms
Field Tile Drainage and Water Quality Research



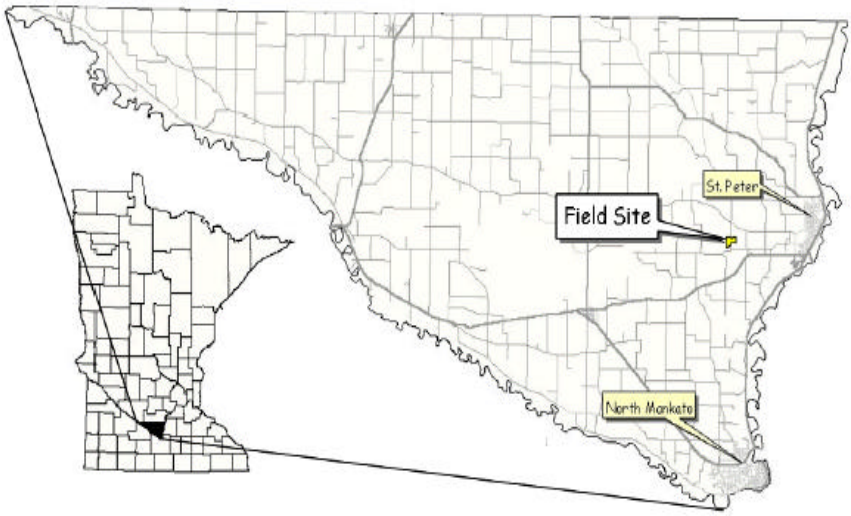
Farmers strive each year to produce an optimum crop yield to be profitable. Crop production can also impact water quality when water moves from the landscape and the root zone into our water resources carrying agricultural chemicals. An eighty acre site located on the Red Top Farm 3 miles west of St. Peter, Minnesota 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 fill 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. The overall concept of Red Top has proven to be a highly effective approach for evaluating nutrient and pesticide "Best Management Practices" (BMP's) and educating farmers, agricultural professionals, and the non-agricultural community on the use of these practices. This site has hosted many educational field days and has been featured in numerous agricultural magazines and newspaper articles.

RED TOP TILE DEMONSTRATION PROJECT GOALS

- Evaluate water quality response of field scale subsurface tile drainage to rainfall and snowmelt events.
- Evaluate pesticide and nutrient losses through a pattern tile system with typical weed control and nutrient management strategies
- Evaluate new technologies and methods available to farmers to determine water quality benefits.
- Conduct educational events and promote water quality improvement strategies on tile drained cropland in southern Minnesota.

HISTORY

Locating the site 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 Minnesota Department of Agriculture (MDA) joined a consortium of interested parties to address St. Peter's WHP concerns. Local farmers, county staff, U of M extension, 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 efforts were the result of these discussions.



FIELD CHARACTERISTICS

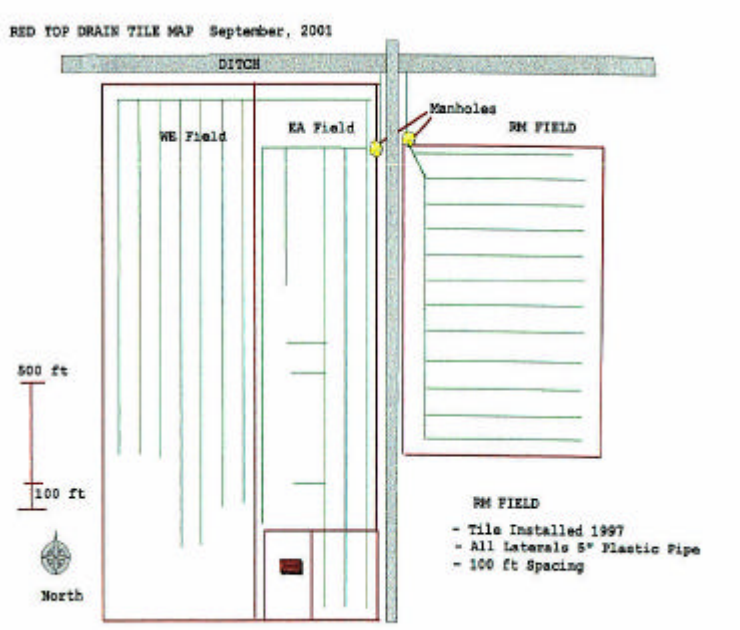
- Clay loam soil type
- < 3% slope—field elevation variation less than 8’
- Organic matter ranges 4-9%
- pH range 5.7-8.0
- Phosphorous soil tests (medium-high)
- Potassium soil tests (very high)
- Corn-soybean rotation
- Conventional tillage operations-fall chisel plow and spring cultivation

FINDINGS AND RESULTS

- On average 7” of annual precipitation is drained at the Red Top site which accounts for approximately 25% of the annual water budget.
- Approximately 75% of the total drainage occurs in April, May and early June, primarily from major storm events.
- Nitrate-nitrogen concentrations in drainage water have averaged 16 parts per million from 1995-2003. Average annual nitrate-nitrogen concentrations have ranged from 8 parts per million to 24 parts per million.
- Nitrogen losses have averaged 3.5 lbs./ acre inch of drainage. Nitrogen losses through tile water discharge have averaged 22 pounds per acre annually.
- Nitrate-nitrogen concentrations in drainage water are highly dependant on nitrogen rate, time of applications, and climatic conditions. Soil organic matter contributes a significant source of nitrogen under optimum environmental conditions.
- Implementation of existing Nitrogen BMPs and University of Minnesota Fertilizer Recommendations resulted in a significant reduction in fertilizer inputs (25-30%), maintained yields and appears to have decreased N losses at this site by 40-50%.
- Total phosphorous flow weighted mean concentrations have averaged .13 parts per million. Total phosphorous loss through the drainage system has averaged .22 pounds per acre annually.
- Climatic conditions have a huge impact on the movement of ag-chemicals to water resources.
- Drainage system design and age influences nutrient and herbicide movement characteristics.
- Monitoring field scale tile drains is an effective method for evaluating different agricultural Best Management Practices to improve water quality.

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).



WEST FIELD
Age: 16 to 30 years
Tile Material: Cement
Diameter: Mostly 6”
Main Lines: 6” and 8“
Avg. Grade: 0.3%
Avg. Spacing: 97.5 ft
Avg. Depth: 3.8 ft
Watershed: 51.7 acres
urface Inlets: None

EAST FIELD
Installed (1997)
Tile Material: Plastic
Diameter: Mostly 5”
Main Lines: 5” to 12”
Average Grade: 0.02%
Average Spacing: 100 ft
Average Depth: 4 ft
Watershed: 22.4 acres
Surface Inlets: None

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. Weirs monitoring drainage flows.