DISCOVERY FARMS MINNESOTA

Core Farm Year in Review – 2011

Discovery Farms Minnesota is a producer led effort organized and established for the purpose of gathering field-scale information to quantify the impact of a variety of farming enterprises across Minnesota. The mission of the program is to collect water quality information under real-world conditions and provide practical, credible, and site-specific information to support better farm management decisions.

There are currently eight Discovery Farm sites located in southern, southeastern, and central Minnesota (Figure 1). The network is expected to grow to better represent the diversity of agricultural enterprises and settings in Minnesota. A general description of the established sites is provided in table 1.

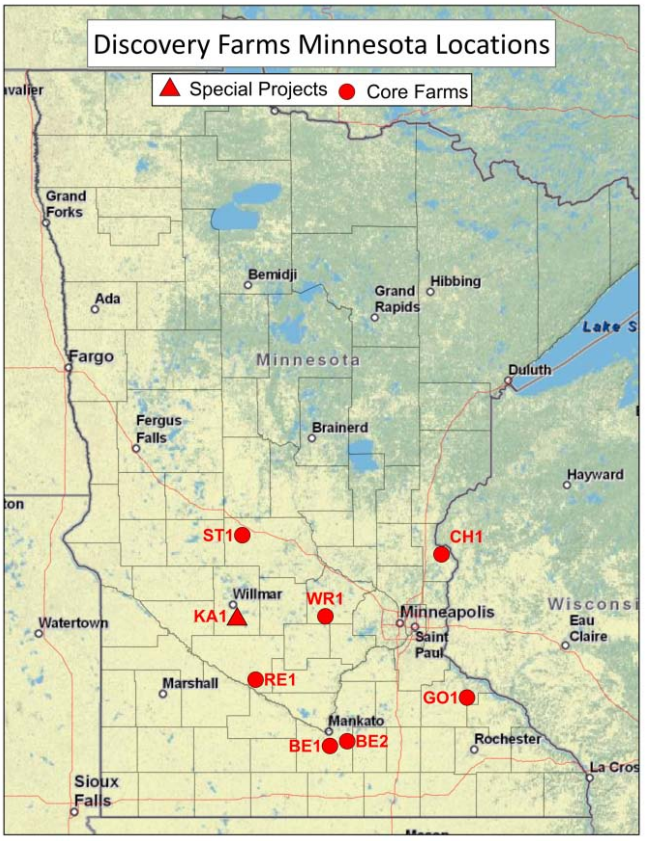

Figure 1: Discovery Farm Minnesota Locations.

This factsheet summarizes data collected at Core Farms in water year (WY) 2011 (October 2010 through September 2011). Surface water quality data from GO1, ST1, and CH1 are included as these sites were operational for all or most of this time period. Sub-surface data from ST1 is not included in this report as there were difficulties in delineating the drainage area for the tile system. The KA1 project is not included because it is a special project and will be summarized in a separate report. BE1, BE2, WR1 and RE1 were new sites in WY2011 and the first full monitoring season will be WY2012.

The data presented in this factsheet are generated from edge-of-field monitoring sites. Water quality results from edge-of-field monitoring sites are different than stream monitoring data or standards and therefore, direct comparisons should not be made. It is also important to consider that the information presented here is from only one year of data collection. Past research has shown that runoff losses can vary greatly from year to year. Final conclusions should not be made from this information, but rather these data should be used as a point of context for information gained in future years.

Table 1: Description of Discovery Farms Minnesota Projects

Farm ID	Farm Enterprise	Start of Project	Water Quality Monitoring
KA1	Turkey and corn-soybean	August 2007	Surface runoff and tile drainage
GO1	Swine farrow to wean & beef cow-calf	September 2010	Surface runoff
ST1	Conventional dairy	March 2011	Surface runoff and tile drainage
CH1	Corn-soybean (modified no-till)	March 2011	Surface runoff
BE1	Swine finishing & corn-soybean	June 2011	Surface runoff and tile drainage
BE2	Corn-soybean (conventional tillage)	July 2011	Surface runoff and tile drainage
WR1	Conventional dairy	December 2011	Surface runoff and tile drainage
RE1	Corn-soybean (conventional tillage)	December 2011	Surface runoff and tile drainage

Long term edge-of-field monitoring data from the Wisconsin Discovery Farms Program are summarized in: *Precipitation-Runoff Relations and Water Quality Characteristics at Edge-of-Field Stations, Discovery Farms and Pioneer Farm, Wisconsin, 2003/08*, which is available online at http://pubs.usgs.gov/sir/2011/5008/. The results provided in the Wisconsin Discovery Farms summary can be used as a reference for the data presented in this report.

Farm Descriptions

GO1 is a beef cow-calf and swine farrow-to-wean livestock operation located in Goodhue County. The site selected for monitoring provides edge-of-field surface runoff evaluation of a 6 acre field with an alfalfa-corn rotation and swine manure application. The monitored field has well-drained silt loam soils and an average slope of approximately 6%. In WY2011 the cropping rotation in the monitored field was in the second year of alfalfa. There were no manure or fertilizer applications in WY2011 and three cuttings of hay were harvested throughout the summer.

ST1 is a 175 cow dairy located in Stearns County. The site selected for monitoring provides an edge-of-field surface and sub-surface runoff evaluation of a field with an alfalfa-corn rotation and dairy manure application. Surface water runoff and sub-surface tile drainage are monitored from 28 and 24 acre watersheds, respectively. The monitored field has poorly drained loam soils and average slope of approximately 4%. In WY2011, the cropping rotation in the monitored field was in the second year of corn. The field was tilled with a chisel plow in October 2010 and manure was injected in April 2011 prior to planting of corn. The corn was harvested as silage in September.

CH1 is grain operation located in Chisago County. The site selected for monitoring provides an edge-of-field surface runoff evaluation of a 6 acre field with a corn-soybean rotation and a modified no-till management system. The monitored field has well drained loam soils and an average slope of approximately 3%. In WY2011, deep band applications of phosphorus and potassium took place in April. Corn was planted in early May and split applications of nitrogen occurred in June.

Precipitation

Precipitation at GO1, ST1, and CH1 during WY2011 (October 2010 through September 2011) can be characterized as heavy snow during the winter months, a deep snowpack prior to melt in March and April, a wet spring and early summer, and a dry late summer/early fall. Total precipitation and departures from normal are listed in table 2.

Table 2: Total Precipitation

Site	Observed (in)	30-Year Average (in)	Departure from Average (in)
GO1*	27.2	33.4	-6.2
ST1**	24.5	22.3	2.3
CH1**	18.7	24.5	-5.8

*October through September

**March through September

At all three monitoring sites, monthly precipitation was near historical area averages for the months of October through June (Figure 2). In July, precipitation at GO1 and ST1 was higher than area averages. At ST1, a large storm event occurred in July where 5.1 inches of precipitation was observed over a two day period. This storm event led to the much higher than average observed precipitation at ST1 for the month of July. Precipitation in the months of August and September was lower than historical area averages for all three sites.

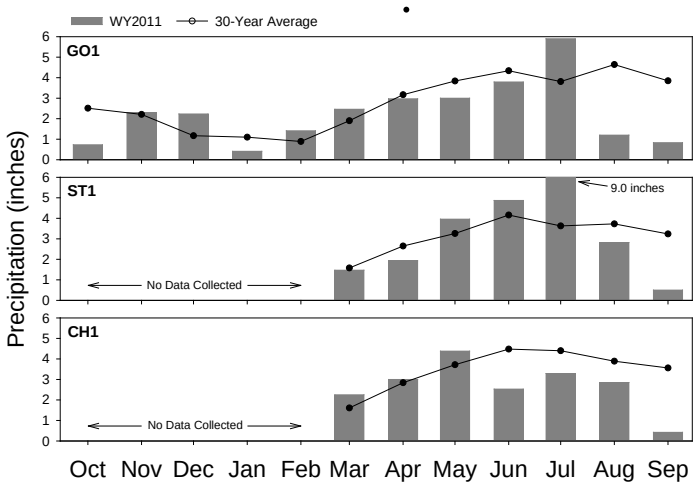

Figure 2: Monthly Precipitation Totals - Observed and Historical Averages

Surface Runoff

Total surface runoff observed at GO1, ST1, and CH1 was 4.3, 4.1, and 4.2 inches, respectively (Figure 3). About 18% of the total precipitation at each site left the monitored fields as surface runoff. During WY2011, surface runoff was only recorded on 8% of the days monitored.

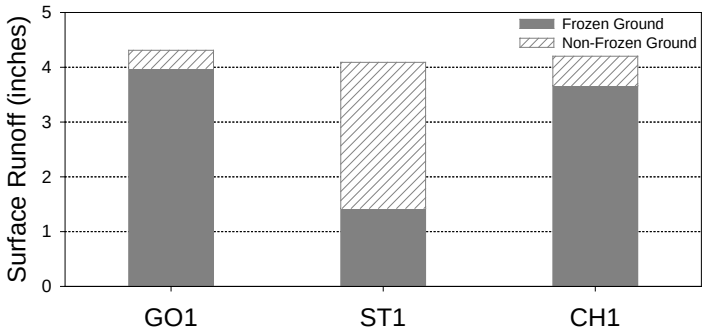

Figure 3: Total Surface Runoff (Monitoring Period: GO1 – October through September; ST1 and CH1 – March through September)

The snowmelt period and single storm events were significant contributors to the observed total runoff. Approximately 90%, 35%, and 90% of the total runoff was observed during frozen ground conditions at GO1, ST1, and CH1, respectively (frozen ground conditions were assumed any time that snow was present on the soil surface). The intense July storm event at ST1 generated 50% of the total surface runoff for the entire monitoring period.

Long term edge-of-field Wisconsin Discovery Farms sites had an average of 2.5 inches of surface runoff on an annual basis, which was about 8% of the total annual precipitation. About 55% of the total surface runoff occurred during frozen ground conditions and 45% during non-frozen ground conditions. Total surface runoff and percentages of precipitation leaving the monitored fields as surface runoff at GO1, ST1, and CH1 were greater than the long term Wisconsin Discovery Farms average. This was likely caused by a heavy winter/spring snowpack, which resulted in the large frozen ground runoff observed at GO1, ST1, and CH1.

Surface Sediment Loss

Since the majority of runoff occurred during the frozen ground period, total sediment losses at GO1, ST1, and CH1 were correspondingly low (Figure 4). Sediment loss ranged from 50 to 400 lbs/acre. Sediment loss at ST1 was higher than GO1 and CH1 because of the large July storm event which generated 75% of the total sediment loss at ST1.

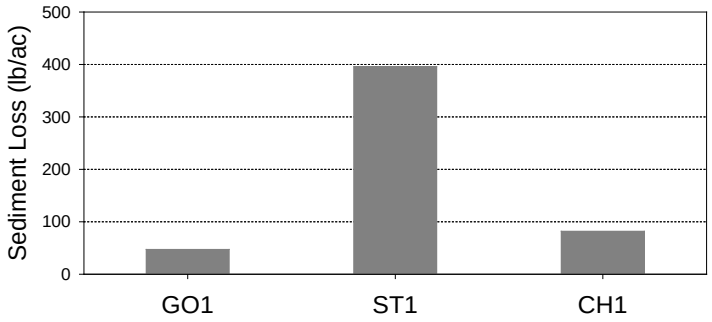

Figure 4: Surface Sediment Loss (Monitoring Period: GO1 – October through September; ST1 and CH1 – March through September)

Long term edge-of-field Wisconsin Discovery Farms sites had an average of 670 pounds per acre of sediment loss on an annual basis. Sediment losses measured at GO1, ST1, and CH1 were lower than the Wisconsin Discovery Farms long term average.

Surface Phosphorus Loss

Total phosphorus refers to the combined total of two different forms of phosphorus: the particulate form which is bound to soil particles and the dissolved form which is not. During WY2011, total phosphorus loss averaged 0.9 lbs/acre at GO1, ST1, and CH1 (Figure 5). On average, about 55% of the total phosphorus loss was in the particulate form and 45% was in the dissolved form. Dissolved phosphorus losses occur more commonly during frozen ground periods and 65% of the total phosphorus loss measured occurred during frozen ground conditions. Fifty-five percent of the total phosphorus loss at ST1 was measured during the large July storm event.

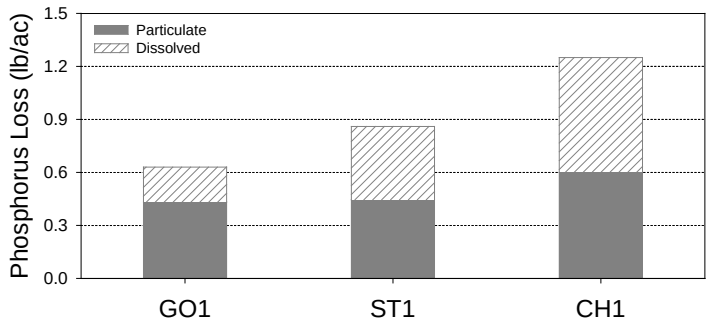

Figure 5: Total Surface Phosphorus Loss (Monitoring Period: GO1 – October through September; ST1 and CH1 – March through September)

Long term edge-of-field Wisconsin Discovery Farms sites had an average of 2 lbs/acre of phosphorus loss on an annual basis, with approximately 50% of the total phosphorus loss in the dissolved form and 50% in the particulate form. The percentages of dissolved and particulate phosphorus measured at GO1, ST1, and CH1 were similar; however, total phosphorus losses were lower than the Wisconsin Discovery Farms long term average.

Surface Nitrogen Loss

Total nitrogen refers to the combined total of nitrate nitrogen, ammonia nitrogen, and organic nitrogen. During WY2011, total nitrogen loss averaged 6.2 lbs/acre at GO1, ST1, and CH1 (Figure 6). Approximately 20% of the total nitrogen loss was in the nitrate nitrogen form, 25% was in the ammonia nitrogen form, and 55% was in the organic nitrogen form. Approximately 75% of the total nitrogen loss measured occurred during frozen ground conditions. Thirty percent of the total nitrogen loss at ST1 was measured during the large July storm event.

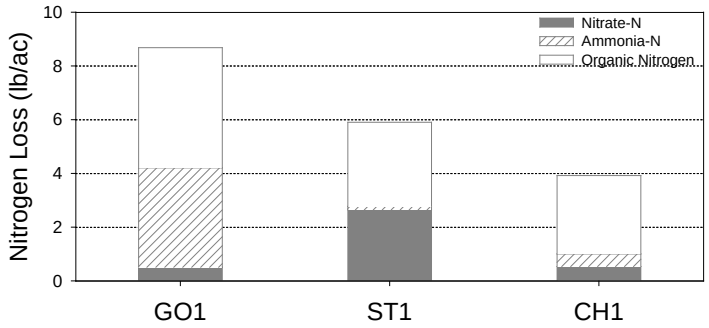

Figure 6: Total Surface Nitrogen Loss (Monitoring Period: GO1 – October through September; ST1 and CH1 – March through September)

Long term edge-of-field Wisconsin Discovery Farms sites had an average of 7 lbs/acre of nitrogen loss on an annual basis, with approximately 25% of the total nitrogen loss in the nitrate nitrogen form, 20% in the ammonium nitrogen form, and 55% in the organic nitrogen form. Percentages of nitrate, ammonia, and organic nitrogen measured at GO1, ST1, and CH1 were consistent with Wisconsin Discovery Farms results. Total nitrogen measured at GO1 and ST1 were also consistent with Wisconsin Discovery Farms results.

Conclusion

Land management practices affect surface runoff of water, sediment, and nutrients on an annual and seasonal basis. Data from the GO1, ST1, and CH1 sites displayed the importance of the snowmelt period and single storm events in determining total sediment and nutrient losses. Measured sediment and nutrient losses were at or below average values that have been recorded by the Wisconsin Discovery Farms program. Discovery Farms research has shown that several factors are important for reducing risk of nutrient and sediment loss, including:

- *Harvesting Precipitation Water*. Any management in and around agricultural fields that encourages infiltration of precipitation water very close to where it falls is beneficial from a sediment and nutrient loss standpoint. Often this includes a network of conservation practices coupled with highly efficient crop and soil management. Usually, a lower volume of surface water runoff equals lower sediment and nutrient loss.
- *Avoid Nutrient Application Prior to Anticipated Runoff*. Whether it is manure (solid or liquid) or commercial fertilizer, applying nutrients shortly preceding a runoff event has the greatest risk for increased nutrient losses. Every runoff event can't be predicted, but using the forecast to understand when snow may be melting, rain on snow or frozen ground could occur, or a large rain event is looming helps to make the best management decisions and reduces the risk for nutrient losses throughout the year.

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