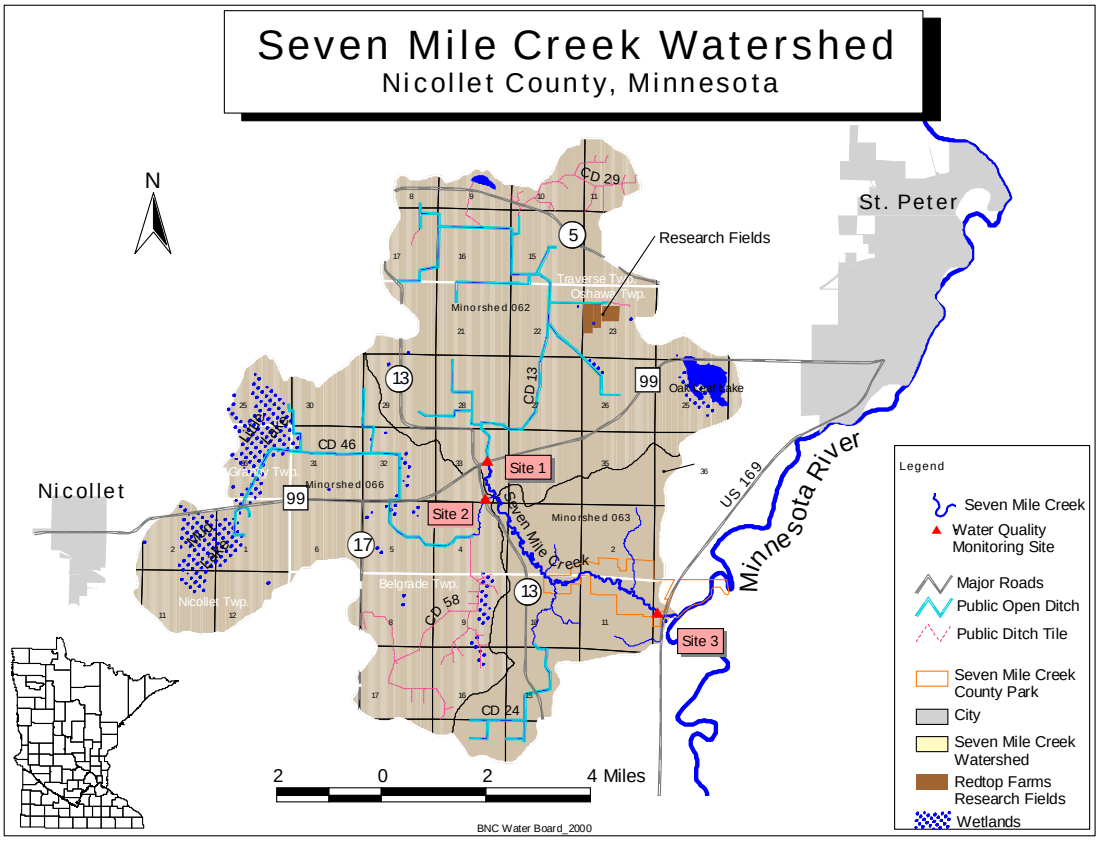
2007 Nutrient and Pesticide Management Assessment of Producers



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General information:
The Seven Mile Creek Watershed

The Seven Mile Creek Watershed (SMCW) is a collaborative effort to help protect and enhance the water quality of the South Branch of the Root River. Seven Mile Creek is Nicollet County's most visible natural resource with a 630-acre county park located at the mouth of the watershed. The park and designated trout stream is used by thousands of visitors every year. Efforts in the late 1980s to help protect the drinking water for the city of St. Peter sparked local interest to investigate the water quality of unique streams like Seven Mile. The watershed project has turned into one of the most showcased and studied watersheds in the Middle Minnesota Major River Basin.

In 2002, work began to accelerate the voluntary adoption of Best Management Practices (BMPs). The three-year Clean Water Partnership project (2002-2005) focused on accelerating conservation practices by providing additional technical and financial assistance to watershed landowners and producers. The project focused on education, nutrient management, septic system upgrades, filter strips, wetlands, water storage, stream trout habitat creation, and stream bank erosion control using soil bioengineering techniques. Intensive water quality monitoring and watershed assessments continued throughout the project.

Farm Nutrient Management Assessment Program (FANMAP) survey was one tool used to ultimately evaluate water pollution prevention by documenting farming practices. In early 2003, the first FANMAP for this project was conducted. It was to gather information about the 2002 crop season in effort to determine the adoption of the 1993 version of Nitrogen Best Management Practices (NBMP) and the 1998 University of Minnesota recommendations for nitrogen (N) on corn according to "Fertilizing Corn in Minnesota"[1]. The electronic results from the 2002 FANMAP are located at: http://www.mda.state.mn.us/news/publications/protecting/soilprotection/fanmap7milecreek.pdf

In early 2008, the second FANMAP for this project was conducted. Efforts were made to continue to evaluate the adoption of both the 1993 version of NBMP and the 2006 University of Minnesota revised recommendations for nitrogen (N) on corn. For more information on current BMP's for nitrogen use in southeastern Minnesota and rates of nitrogen application, visit http://www.extension.umn.edu/distribution/cropsystems/DC8557.pdf

Comparison of the 1998 to the 2006 U of M nitrogen (N) recommendations can be found in Appendix 1 along with comparisons of different practices used in 2002 and 2007 in the Seven Mile Creek Watershed.

[1]Fertilizing Corn in Minnesota, G.Rehm, G.Randall, J.Lamb, R.Eliason, University of Minnesota, 2006.

Cooperators

The SMCW Project is a mutual effort of watershed farmers, landowners, citizens, county, state, and federal groups. The coalition that was interested in improving this watershed includes traditional water resource agencies: Soil and Water Conservation District (SWCD), Natural Resource Conservation District (NRCS), Environmental Services, Farm Service Agency (FSA), Minnesota Department of Agriculture (MDA), Minnesota Pollution Control Agency (MPCA) and Minnesota Department of Natural Resources (DNR).

The coalition agreed to focus this study on agricultural inputs (nutrients and pesticides) and management practices associated with the SMCW and then summarize results of farm assessments conducted for the 2007 cropping season. Several field days were sponsored through the watershed project to educate cooperators on research study results and BMPs for nitrogen application.

A list of farmers/operators in the SMCW was obtained from the Nicollet SWCD and NRCS. All farmers within the watershed were given the opportunity to be interviewed. Eighteen farmers participated and provided input data on 9,183 acres. Over 50 percent of the watershed-cultivated acres are represented in the survey. However, it should be noted that it was not the same identical farmers as interviewed for the 2002 crop year. Introduction letters describing the project were mailed to the farmers in January of 2008. The letter's intent was to explain: 1) the overall project; 2) the purpose of the nutrient assessment; 3) the selection process; 4) types of information; and 5) the amount of time necessary to successfully complete the project.

The MDA used a data-gathering tool and analysis system called FANMAP to conduct the study. FANMAP was developed 15 years ago to provide an understanding of current farm practices regarding agricultural inputs. This information was used to design effective water quality educational programs and provide baseline data to determine program effectiveness over time. In the past decade, more than 800 farmers throughout Minnesota have volunteered one to three hours of their time to share information about their farming operations. Previous FANMAP studies have been funded, in part, by programs such as the Legislative Citizen Commission on Minnesota Resources, Clean Water Partnership, USDA programs, and supplemental funding from the fertilizer tonnage fee account at the MDA. Previous reports can be found on the MDA website at http://www.mda.state.mn.us/protecting/soilprotection/fanmap.htm.

The survey in 2008, for the 2007 crop season, was designed for phone interviews rather than the traditional in-person survey used in the past. The phone interviews captured basic nutrient and pesticide data rather than the more complex data that is gathered in a normal person-to-person survey. A typical phone interview lasted less than 30 minutes; whereas a normal FANMAP in-person interview would last between 30 minutes and two hours, depending on the complexity of the farming operations.

Nutrient Information of the Selected Farms in the Seven Mile Creek Watershed

Inventory forms and database design have been designed and perfected over the past15 years. The following types of information were collected on a field-by-field basis for all inventoried acres within the SMCW through Farm Nutrient Management Assessment Program (FANMAP) interviews:

- Timing, rates and method of applications were collected for all nitrogen (N), phosphorus (P_2O_5) and potassium (K_2O) inputs[2] (fertilizers, manures and legumes);
- Pesticide information (product, rate, timing, etc);
- Soil and manure test results (if available);
- Tillage practices;
- Sink holes and streams.

Livestock types, manure storage, application rates, and application timing information were also recorded.

Nutrient inputs and yields were collected for the 2007 cropping season. Crop types and manure applications (starting in the fall of 2006) were also collected for purposes of nitrogen credit for crops grown during the 2007 season. Long-term yield data generally reflected the past three to five years. Livestock census and other specifics for the entire farm (i.e. types of manure storage systems, total farm sizes, etc.) were also recorded. Information was gathered from the farmer or from the fertilizer dealer, if the dealer kept the farmer's records.

The Minnesota Department of Agriculture used a data-gathering tool and analysis system called the FANMAP to conduct the study in 2002.

Farm Size, Crop and Livestock Characteristics of the Selected Farms in the Seven Mile Creek Watershed

The eighteen farm interviews were conducted between February and April of 2008. A total of 9,183 acres of farmland was inventoried in the SMCW study for the 2007 crop season. Nicollet County Farm Service Agency farm and tract information for the cropping year 2007 indicated there were approximately 19,000 crop acres in the SMCW. Farm interviews covered approximately 50% of all agricultural acres in the SMCW. The SMCW cropland was dominated by a field corn/soybean rotation accounting for 97 percent of all acres. Figure 1 lists each type of crop grown and the corresponding percentage of acres. Other crops included alfalfa, sweet corn and oats.

[2] The analysis grade of phosphorus (P) and potassium (K) in fertilizers are expressed in the oxide form, hence, P_2O_5 and K_2O. Once the fertilizer is added to the soil, the amount of these nutrients analyzed in the soil is expressed as pounds of P and K per acre.

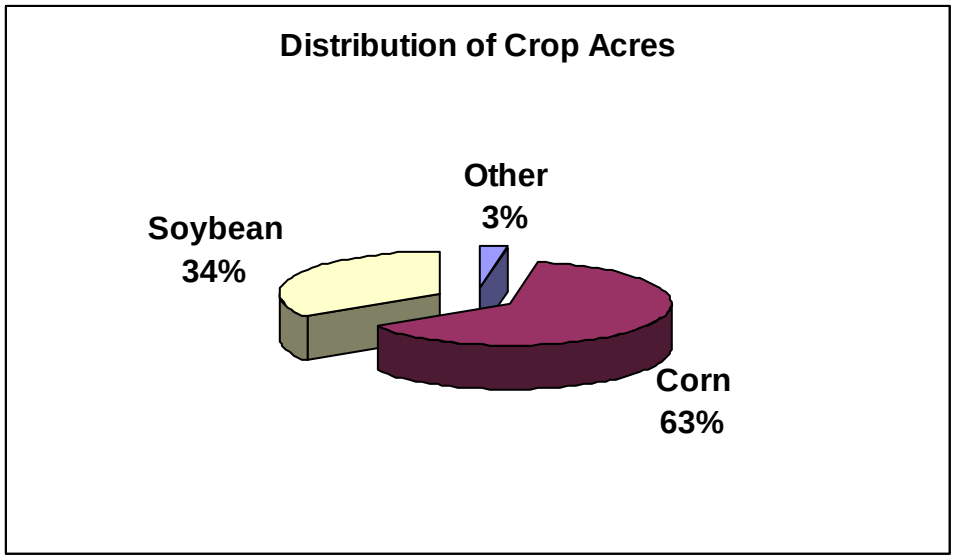


Figure 1. Crop types and corresponding percentages during the 2007 cropping season on 18 farms within the SMCW. Cropland totaled 9,183 acres.

Commercial Fertilizer Use Characteristics on Selected Farms: Seven Mile Creek Watershed

Nitrogen Contributions

Nitrogen (N) applied on surveyed acres in the watershed totaled 917,438 pounds. It was derived from both commercial sources and manure. Table 1 details the nutrient applications on acres within the Seven Mile Creek Watershed. Corn acres accounted for 99 percent of the nitrogen applied and 100 percent of the manure applications. Nitrogen applications to corn averaged 157 pounds per acre with 127 pounds contributed from commercial fertilizer and 32 pounds from manure, as shown in Table 2. Forty-two percent (42 percent) of the manure N was from dairy manure and 58 percent from hog manure.

Table 1. Fertilizer Applications on Acres Within the Seven Mile Creek Watershed

All Acres	N	P	K
Commercial	732,578	247,037	165,912
Manure	184,860	132,240	134,315
Total	**917,438**	**379,277**	**300,227**
Corn Acres	**N**	**P**	**K**
Commercial	731,498	244,277	162,312
Manure	184,860	132,240	134,315
Total	**916,358**	**376,517**	**296,627**

Table 2. Nitrogen Applications on Corn Acres

Crop Rotation	Acres	Nitrogen per Acre	Commercial Nitrogen	Manure Nitrogen
		Pounds	Pounds	Pounds
Corn Following Soybeans	4,048	150	118	32
Corn Following Corn	1,730	175	143	32
Total	**5,778**	**157**	**125**	**32**

Best Management Practices for Nitrogen Use in South Central Minnesota[3] have been developed by the University of Minnesota.

Timing of nitrogen (N) applications on corn acres were dominated by fall applications. Seventy-one percent of the commercial N fertilizer and 76 percent of the manure N was fall applied. Overall, 72 percent of N was fall applied (Figures 2, 3 and 4).

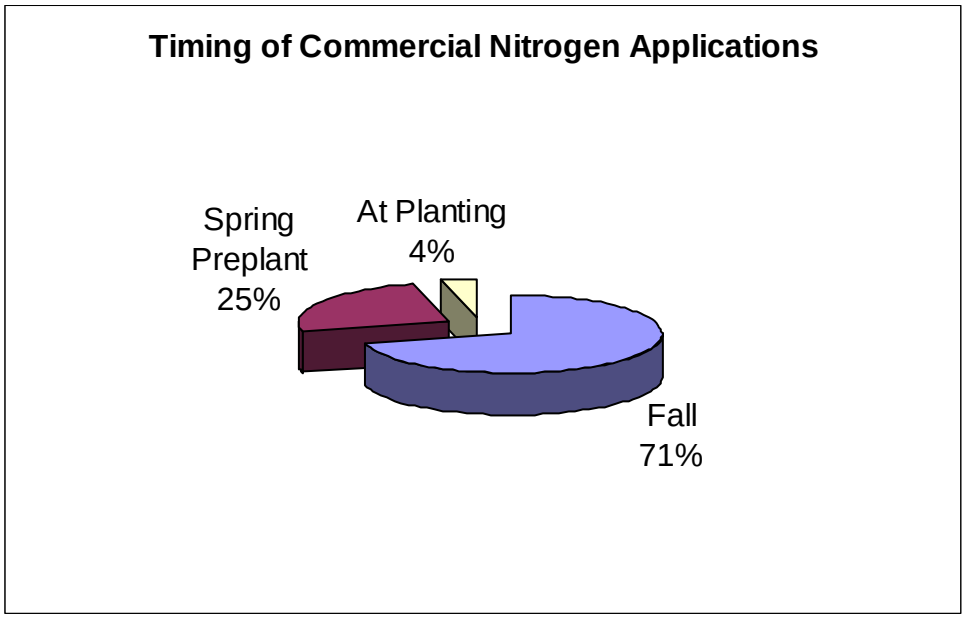
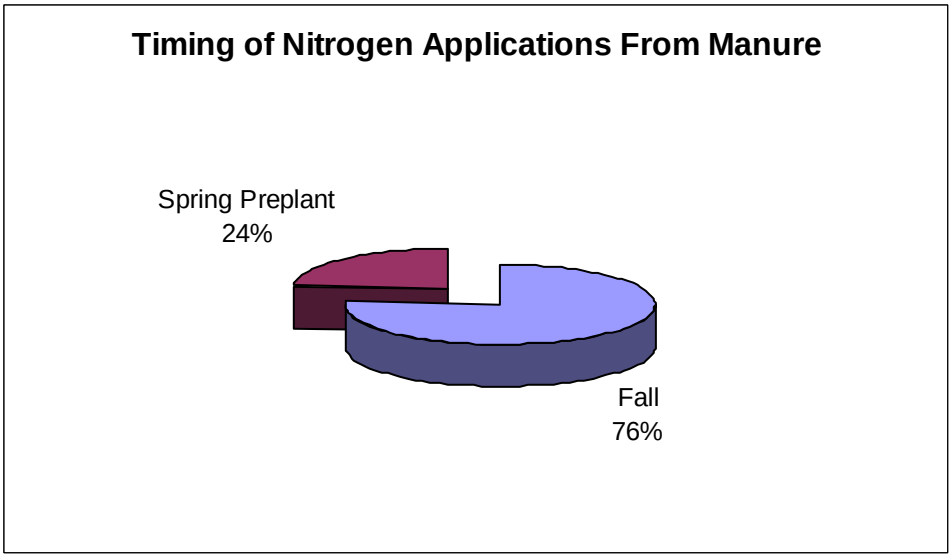


Figure 2. Timing of commercial nitrogen applications on corn acres in the Seven Mile Creek Watershed was dominated by fall applications for the 2007 crop season.



[3] Best Management Practices for Nitrogen Use in South Central Minnesota. M.A. Schmitt, G.W. Randall, University of Minnesota. 1993.

Figure 3. Timing of manure nitrogen applications on corn acres in the Seven Mile Creek Watershed was dominated by fall applications for the 2007 crop season.

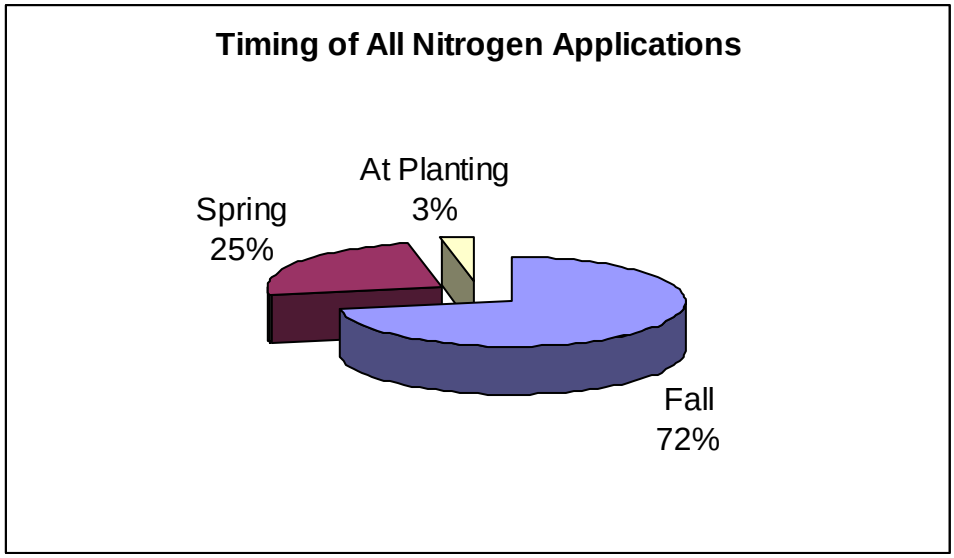


Figure 4. Timing of all nitrogen applications on corn acres in the Seven Mile Creek Watershed was dominated by fall applications for the 2007 crop season.

Anhydrous ammonia supplied 82 percent of all commercial N on field corn acres (Figure 5). Seventy-six percent of the anhydrous ammonia was fall applied. Of all fall applied anhydrous ammonia, 66 percent was applied with an N inhibitor. All fall application was delayed until after November 1st. Nitrogen inhibitor was used only on fall applications.

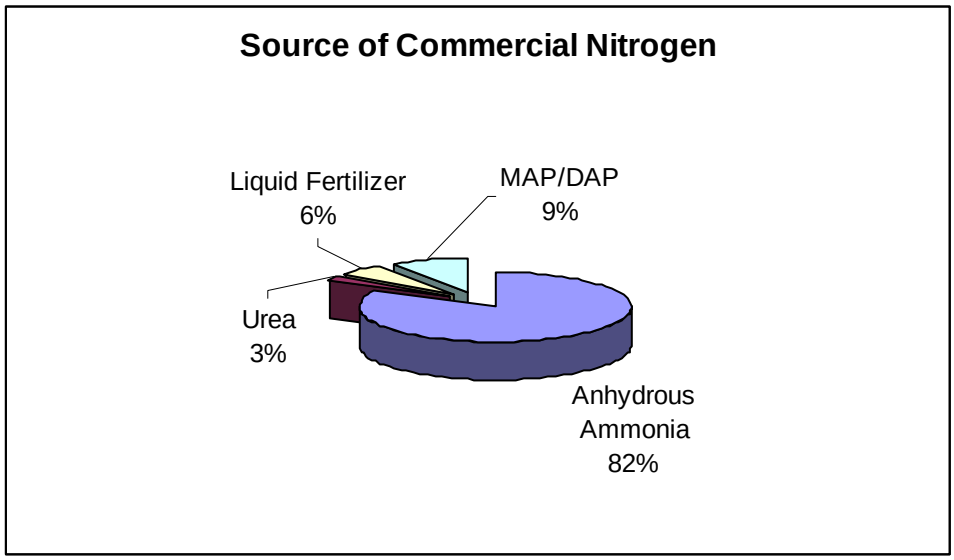


Figure 5. Anhydrous ammonia supplied most of the commercial N to corn acres in the Seven Mile Creek Watershed.

A very small percentage (<1 percent) of the commercial N was applied to crops other than corn. Because of the small sample size, analysis is not performed in regards to N on crops other than corn.

Nutrient Balances and Economic Considerations: Seven Mile Creek Watershed

Total nitrogen (N) from commercial fertilizer and manure applied to inventoried acres totaled 917,438 pounds. Field corn received most of the N, with 99 percent (916,358 pounds) of the total applied. Field corn yield goal for these farms averaged 182 bushels per acre (Bu/Ac) and were consistent with the five-year historical averages of 172 Bu/Ac. It appears farmers used realistic yield goals for field corn acres and that farmers have been growing excellent crops to reach their yield goals consistently in the past five years.

Current nitrogen recommendations are based on economic and environmental factors. Research at the Southern Minnesota Research & Outreach Center, located in Waseca, MN, has shown that these recommendations, in the long term, generally optimize profit. The next table compares current University of Minnesota N recommendations to actual amounts of N (fertilizer and manure) applied to each field. According to Gyles Randall, Soil Scientist and Professor at the U of M, the current N recommendations, or the "maximum return to nitrogen" (MRTN), will provide the greatest net return to the farmer and is the recommended rate. Current U of M recommendations (2006) can be found at http://www.extension.umn.edu/distribution/cropsystems/DC3790.html .

Current U of M nitrogen recommendations suggest that famers should use nitrogen to corn price ratio to determine the maximum return to nitrogen. Using this method, farmers were generally at a .10 N price to crop ratio for farmers without manure applications. Farmers with manure were at a .05 N price to crop ratio. Current U of M N recommendations (MRTN) for field corn across all inventoried acres averaged 122 lbs N/A. Actual amounts of N applied from fertilizer and manure averaged 157 lbs N/A across all corn acres (Figure 6). Factoring in all appropriate credits from fertilizer, legumes and manures, there was an over-application rate of 35 lbs N/A according to current U of M recommendations.

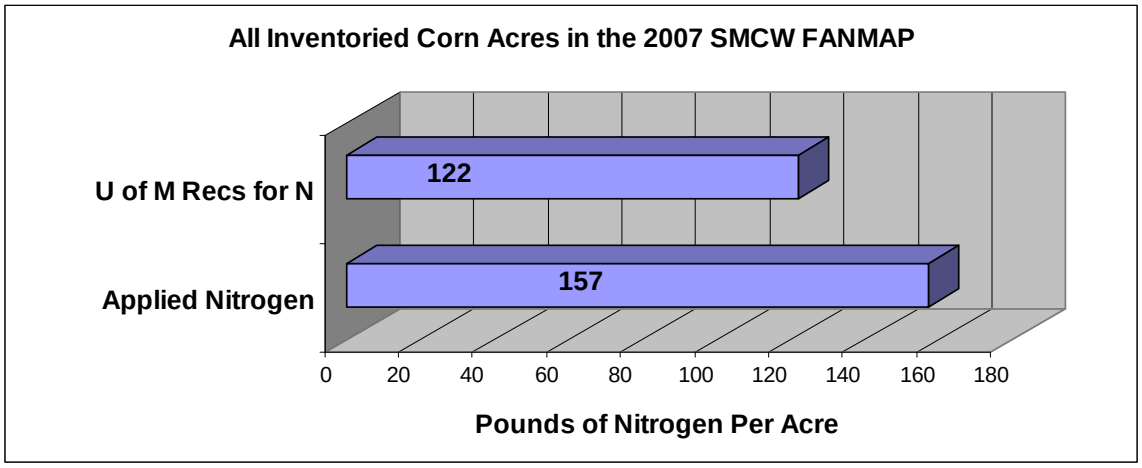


Figure 6. 2007 crop N requirements based on University of Minnesota nitrogen recommendations in comparison to actual N inputs (fertilizer and manure) for field corn acres in the inventoried area. Average N application was 157 lb N/A.

The next table compares current U of M nitrogen recommendations to actual amounts of N (fertilizer and manure) applied to each field. According to Gyles Randall, Soil Scientist and Professor at the U of M, the current N recommendations or the "maximum return to nitrogen" (MRTN) will provide the greatest net return to the farmer and is the recommended rate. The MRTN for field corn across all inventoried acres averaged 122 lb/A. Actual amounts of N averaged 157 lb/A. After factoring in all appropriate credits from fertilizer, legumes and manures, 35 lb/A of nitrogen was applied in excess of the current U of M recommendations.

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Table 3. Nitrogen Applied Compared to U of M Recommendations in the 2007 SMCW Survey for Corn Acres.

Crop Rotation	Manure	Average N applied	Low Range	MRTN	High Range
Corn Following Soybeans	No	148	90	110	125
Corn Following Soybeans	Yes	156	110	120	140
Corn Following Corn	No	174	120	140	165
Corn Following Corn	Yes	180	130	155	180
All Corn Acres	**	157	**	122	**

One major advantage of the technique developed through the nutrient assessment process is the ability to examine in detail the nutrient balances or lack thereof. Important gains in water quality can be obtained provided that farmers receive education in these areas.

Figure 7 details the percentage of corn acres that were applied at or below the lower recommended range, equal to the MRTN, and higher than the recommended range in regard to nitrogen applications

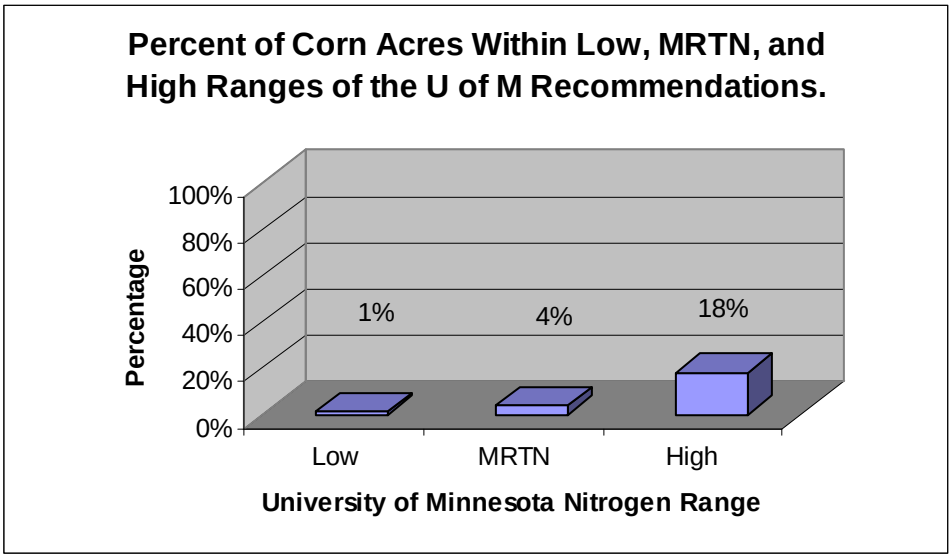

Figure 7. Distribution of corn fields within the University of Minnesota recommended range for N.

Tillage Practices:
Seven Mile Creek Watershed

Tillage practices were documented on all surveyed acres in the SMCW. All crop acres, except established alfalfa, were fall and spring tilled. Fall tillage, followed by secondary tillage in the spring, was performed on 96 percent of the corn acres within the watershed. Figure 8 details fall tillage on corn acres.

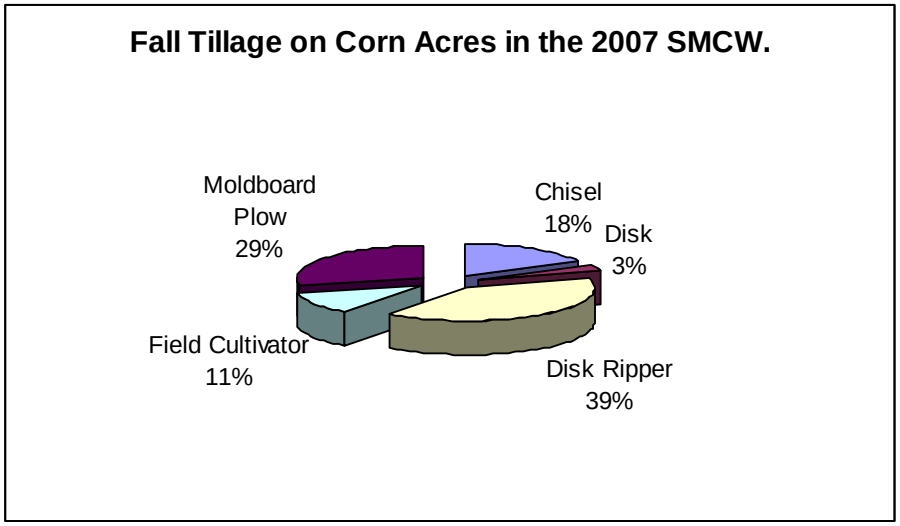

Figure 8. Fall tillage on corn acres within the SMCW for the 2007 season.

Soybean acres were generally worked in the fall (92 percent) and field cultivated in the spring (Figure 9).

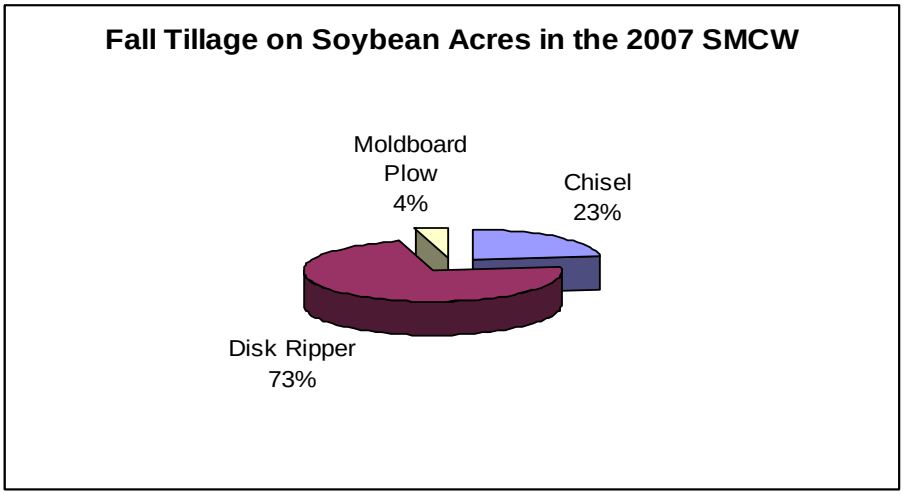

Figure 9. Fall tillage on soybean acres within the SMCW for the 2007 season.

No analysis was done on the "other" acres due to limited acres in this category.

Pesticide Applications: Seven Mile Creek Watershed 2007

Pesticide use data was gathered on all inventoried crop acres. Pesticides were used on 99 percent of all inventoried crop acres (Table 4). Pesticide use in the SMCW included only herbicides and insecticides.

Table 4. Inventoried Crop Acreage and Percentage Treated With Pesticides.

Crop Grown	Acres	Acres Treated	Percent of Total Acres
Corn	5,778	5778	100%
Soybean	3,160	3160	100%
Other	245	180	73%
Total	**9,183**	**9,118**	**99%**

Pesticide use on all acres consisted of 24 different formulas (different EPA numbers or products). Table 5 describes the pesticide, product used and the corresponding Active Ingredients (AI) of each pesticide product used.

Table 5. Product Name and Description of Pesticide Use in SMCW.

Name Of Product	EPA Number	Herbicide Insecticide	Active Ingredients (AI)	AI in Product	AI Expressed as
Aatrex 4L	100-497	Herbicide	Atrazine	4.000	Pounds per Gallon
Aatrex 90	100-585	Herbicide	Atrazine	0.855	Percent By Weight
Aztec 2	3125-412	Insecticide	Tebupirimphos Cyfluthrin	0.019 0.001	Percent By Weight
Boundary	100-958	Herbicide	S-Metolachlor Metribuzin	5.250 1.250	Pounds Per Gallon
Callisto	100-1131	Herbicide	Mesotrione	4.000	Pounds Per Gallon
Camix	100-1148	Herbicide	S-Metolachlor Mesotrione	3.334 0.333	Percent By Weight
Force 3G	100-1075	Insecticide	Tefluthrin	0.333	Percent By Weight
Glyphosate	42750-61	Herbicide	Glyphosate	4.000	Pounds per Gallon
Harness 20G	524-487	Herbicide	Acetochlor	0.200	Percent by Weight
Hornet	62719-253	Herbicide	Flumetsulam Clopyralid	0.231 0.630	Percent By Weight
Impact	7969-100	Herbicide	Topramezone	2.800	Pounds Per Gallon
Liberty	45639-199	Herbicide	Glufosinate-Ammonium	1.670	Pounds Per Gallon
Lorsban-4E	62719-220	Insecticide	Chlorpyrifos	4.000	Percent By Weight
Lumax	100-1152	Herbicide	Metolachlor Mesotrione Atrazine	2.680 0.268 1.000	Pounds Per Gallon
Marksman	7969-136	Herbicide	Dicamba Potassium Salt Atrazine	0.134 0.222	Pounds Per Gallon
Outlook	7969-156	Herbicide	Dimethenamid	6.000	Pounds Per Gallon
Regent	7969-223	Insecticide	Fipronil	6.200	Percent By Weight
Roundup Ultra Max	524-475	Herbicide	Glyphosate	4000	Pounds Per Gallon
Roundup Weathermax	524-537	Herbicide	Glyphosate	5.500	Pounds per Gallon
Steadfast	352-608	Herbicide	Nicosulfuron Rimsulfuron	0.500 0.250	Percent By Weight
Surpass EC	10182-325	Herbicide	Acetochlor	6.400	Pounds Per Gallon
Touchdown	10182-449	Herbicide	Glyphosate	3.000	Pounds Per Gallon
Volley ATZ	455467-8	Herbicide	Acetochlor Atrazine	4.000 1.500	Pounds Per Gallon
Warrior	10182-96	Insecticide	Lambda-Cyhalothrin	1.000	Pounds Per Gallon

There were a total of 20,599 pounds of active ingredients (AI) from all pesticides used on all crops. Herbicide AI totaled 20,441 pounds and insecticide AI totaled only 158 pounds. There were no fungicides applied on inventoried acres. Field corn acres accounted for 67 percent of all pesticide AI use by pounds of AI (Figure 10).

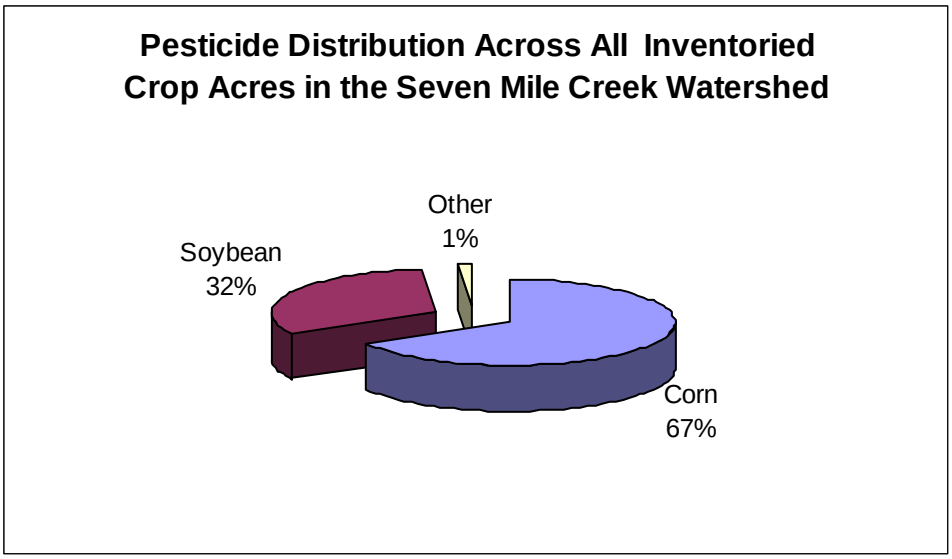

Figure 10. Application of pesticide AIs applied to inventoried acres by crop type.

Table 6 lists each AI, coverage, and total pounds for the 27 different AIs applied to inventoried acres.

Table 6. Pesticide Use And Acres Treated by Active Ingredient.

Name Of Compound	Acres Treated	Total Pounds Applied
Acetochlor	2,723	4,344.03
Atrazine	5,652	3,820.03
Chlorpyrifos	1,115	557.50
Clopyralid	700	433.59
Cyfluthrin	400	2.40
Dicamba	1,540	478.50
Dimethenamid	1,966	1,035.56
Fipronil	604	77.12
Flumetsulam	700	160.26
Glufosinate-ammonium	2,822	870.28
Glyphosate	7,967	7,393.86
Lambda-cyhalothrin	1,260	20.70
Mesotrione	1,021	140.52
Metribuzin	115	51.75
Nicosulfuron	180	4.21
Rimsulfuron	180	2.11
S-metolachlor	616	1,140.57
Tebupirimphos	400	48.00
Tefluthrin	80	9.60
Topramezone	699	8.63

Pesticide use on corn acres consisted of 17 separate herbicide AIs. Table 7 details each compound used and the number of acres covered by each compound.

Table 7. Pesticide Use on Corn Acres.

Name Of Active Ingredient	Percent of All Surveyed Corn Acres	Acres Treated	Pounds Applied
Acetochlor	47%	2,723	4,344.03
Atrazine	89%	5,133	3,820.03
Clopyralid	12%	700	433.59
Cyfluthrin	7%	400	2.40
Dicamba	27%	1,540	478.50
Dimethenamid	33%	1,905	1,001.25
Fipronil	10%	604	77.12
Flumetsulam	12%	700	160.26
Glufosinate-ammonium	49%	2,822	870.28
Glyphosate	30%	1,762	1,618.25
Mesotrione	17%	960	127.94
Nicosulfuron	3%	180	4.21
Rimsulfuron	3%	180	2.11
S-metolachlor	8%	440	795.88
Tebupirimphos	7%	400	48.00
Tefluthrin	1%	80	9.60
Topramezone	12%	699	8.63

Figure 11 compares the top 6 active ingredients of pesticides used on field corn, based on acres.

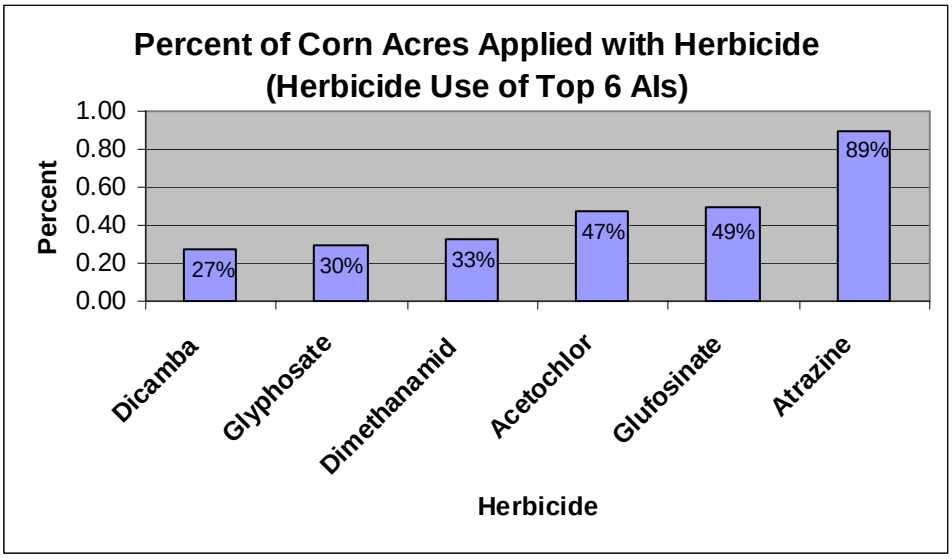

Figure 11. The top 6 active ingredients from herbicides applied to field corn acres, based on acres treated.

Figure 12 compares active ingredients of pesticides applied to field corn, based on pounds of active ingredients.

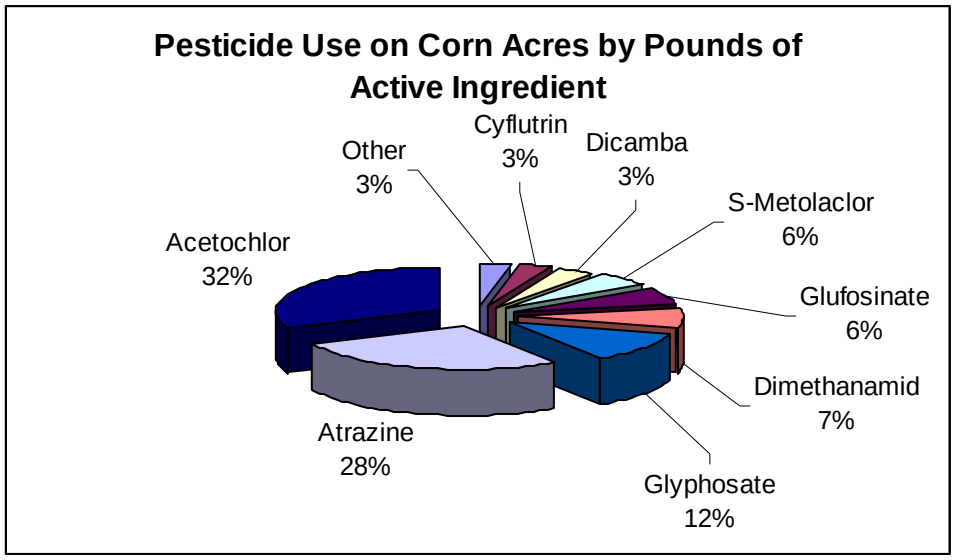

Figure 12. Percentage of pesticides applied to field corn by pounds of active ingredient applied.

Soybean acres received pesticide applications from five different AIs (Table 8).

Table 8. Pesticide Use on Soybean Acres.

Name Of Active Ingredient	Percent Of All Surveyed Soybean Acres	Acres treated	Pounds Applied
Chlorpyrifos	30%	935	467.50
Glyphosate	100%	3,160	5,775.61
Lambda-cyhalothrin	38%	1,200	19.53
Metribuzin	4%	115	51.75
S-metolachlor	4%	115	217.35

Pesticide applications to soybean acres were dominated by the herbicide glyphosate with all inventoried soybean acres receiving at least one application. Ninety-eight percent of all soybean acres received two applications of glyphosate. No other AI was applied in multiple applications on inventoried soybean acres. Insecticides were applied on 68 percent of all soybean acres.

Table 9 lists all pesticide applications to crops other than field corn or soybeans.

Table 9. Pesticide Use on Other Crop Acres.

Crop Type	Compound AI	Acres Covered	Pounds Applied
Alfalfa	Chlorpyrifos	180	90
Alfalfa	Lambda-Cyhalothrin	60	1
Sweet Corn	Dimethenamid	61	34
Sweet Corn	Mesotrione	61	13
Sweet Corn	S-Metolachlor	61	127

Herbicide timing on corn acres was dominated by post-emergence applications as shown in Figure 13.

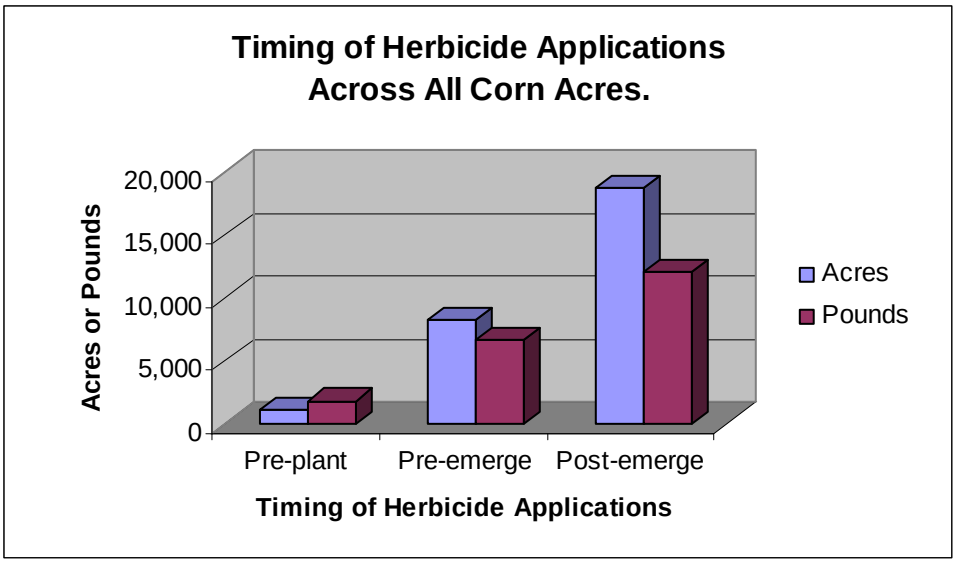

Figure 13. Timing of herbicide applications on corn acres.

Most atrazine applications on corn acres were applied post-emergence as shown in Figure 14.

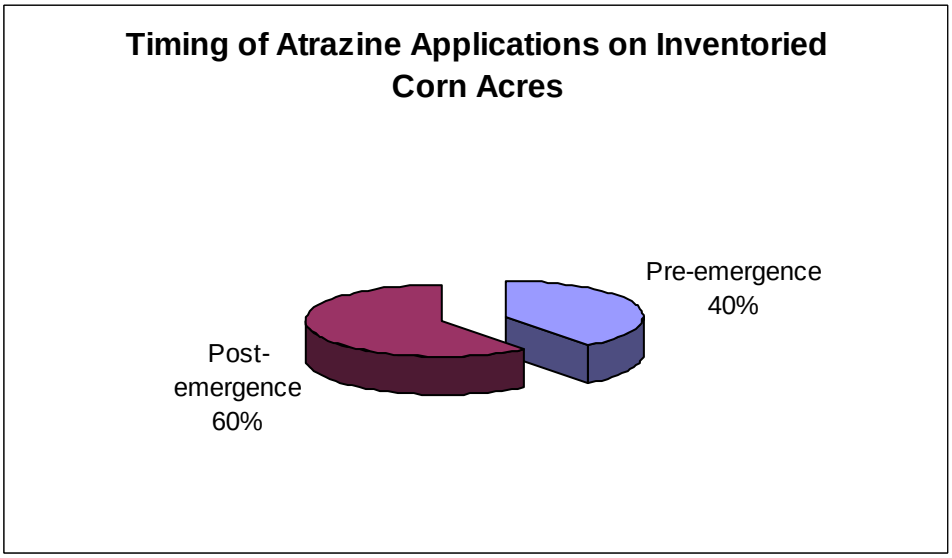

Figure 14. Timing of atrazine applications on corn acres

Farmers in the SMCW applied up to one pound of atrazine on corn acres (Figure 15).

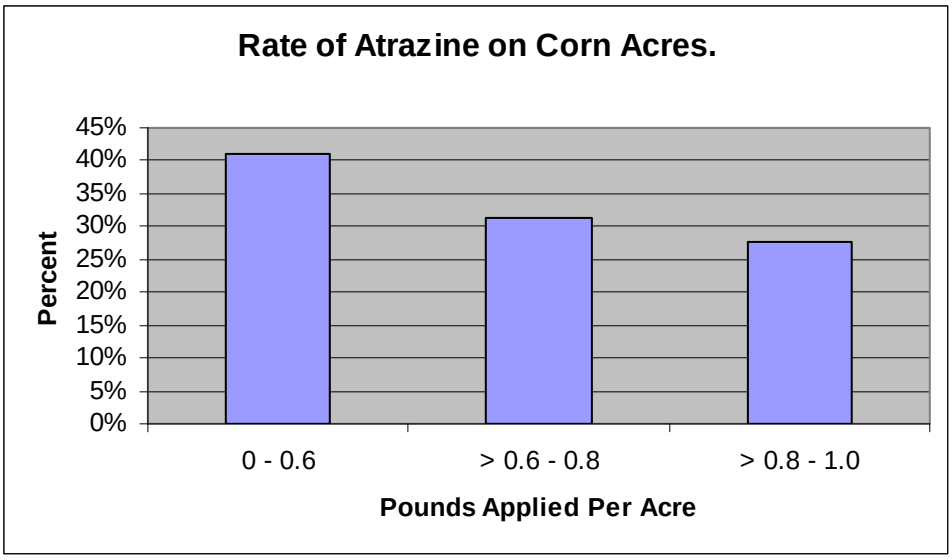

Figure 15. Rate of atrazine applied on corn acres.

Most acetochlor applications on corn acres were applied pre-emergence as shown in Figure 16.

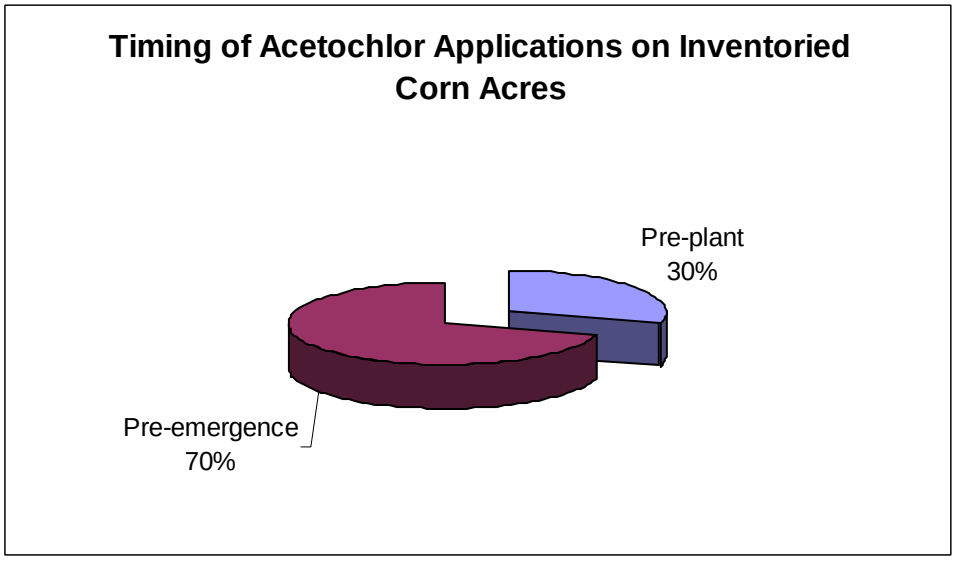

Figure 16. Timing of acetochlor applications on corn acres.

Farmers in the SMCW applied between one and 2.5 pounds per acre of acetochlor on corn acres (Figure 17).

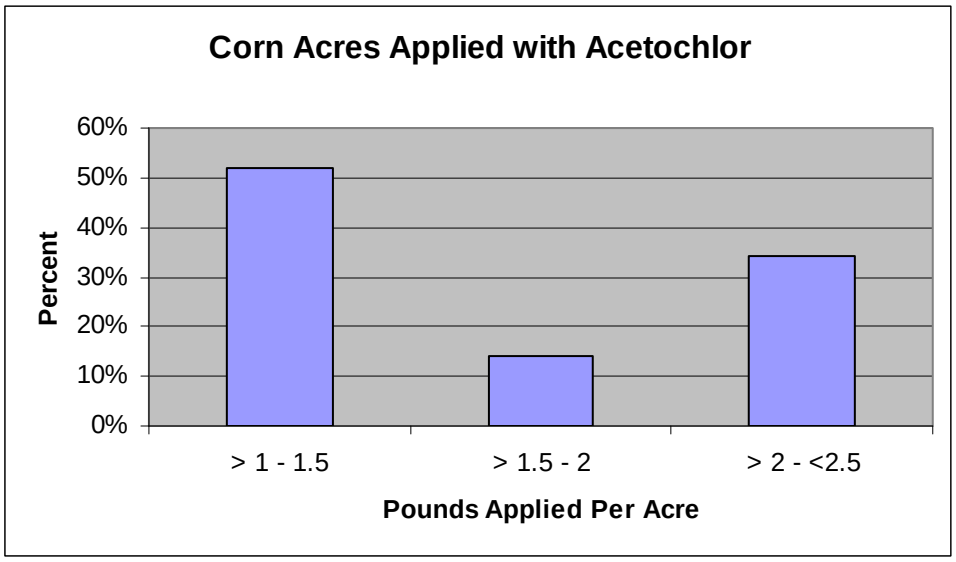

Figure 17. Rate of corn acres applied with acetochlor

All S-Metolachlor applications on corn acres were applied pre-emergence as shown in Figure 18.

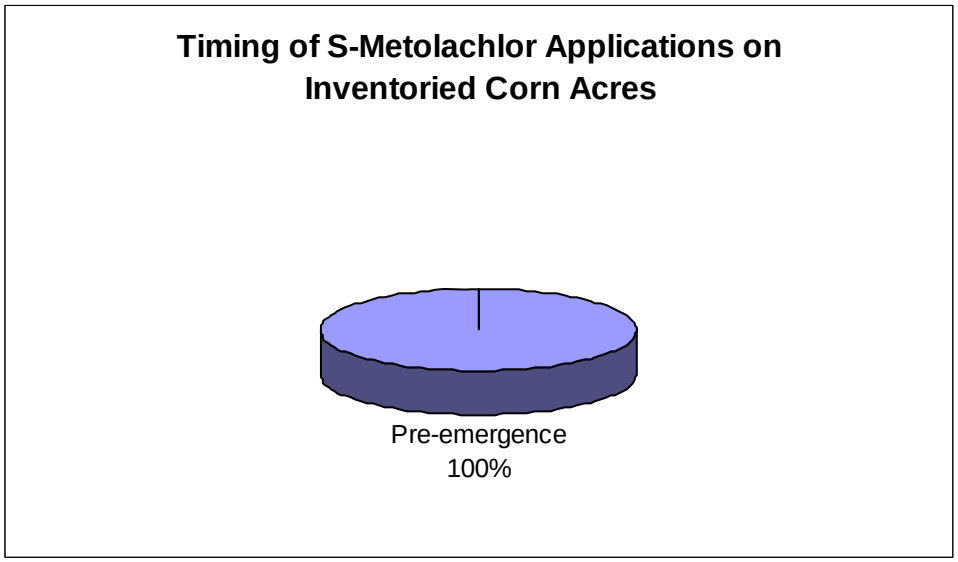

Figure 18. Timing of S-Metolachlor applications on corn acres

Farmers in the SMCW applied between 1.5 and 2.5 pounds per acre of S-Metolachlor on corn acres (Figure 19).

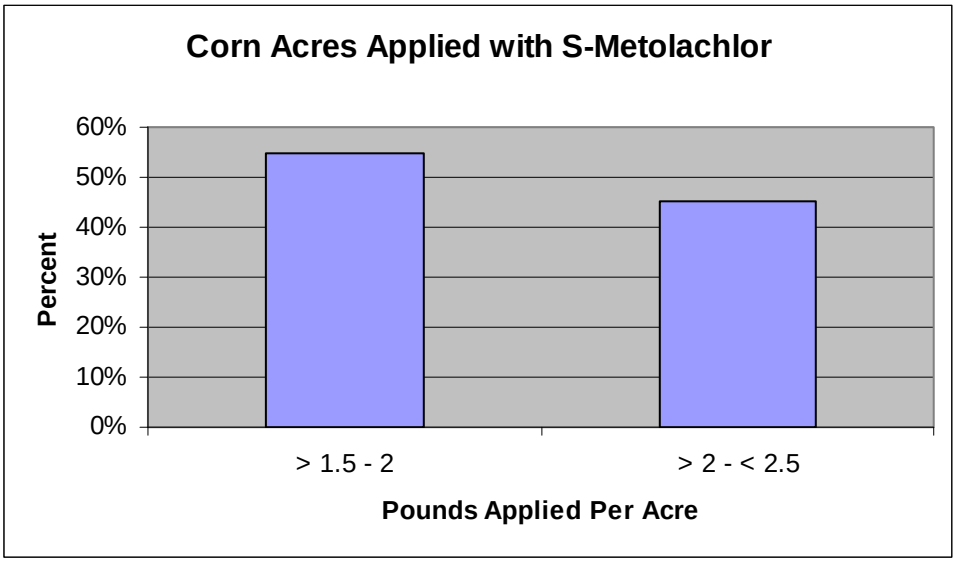

Figure 19. Rate of S-Metolachlor on corn acres

Conclusions and Summary of the Current Nutrient, Tillage and Pesticide Management Practices for the Seven Mile Creek Watershed.

The Seven Mile Creek Watershed consists of fine-textured soils which are common in the South Central Minnesota region. Eighteen farmers, farming 9,000 acres in the SMCW, were interviewed by the Minnesota Department of Agriculture using the Farm Nutrient Management Assessment Program (FANMAP) tool. The total watershed area consists of 19,000 crop acres. Producers volunteered 30 minutes of their time to share information about their farming operations. The overall purpose of the program was to develop a clear understanding of current farm practices regarding agricultural nutrients, tillage and pesticides, and to use this knowledge for future water quality educational programs. This phone survey was an ongoing process.

Approximately 50 percent of the crop acres within the SMCW were inventoried. Field corn and soybeans were the dominant crops with 97 percent of all acres planted to these crops. Sixty-three percent of the crop acres were planted with field corn and 99 percent of the 917,438 pounds of commercial N was applied to those field corn acres. Seventy-one percent of all commercial N applied was fall applied. Anhydrous ammonia accounted for 82 percent of N applied to field corn. Sixty-six percent of field corn acres applied with fall anhydrous ammonia used nitrogen inhibitors.

Livestock manure, in regards to nitrogen, in the SMCW was dominated by hog manure (58 percent) with the balance from dairy manure (42 percent).

On average, inventoried farmers were over-applying N by 35 lb/A when compared to the MRTN. Eighty-two percent of the corn acres were applied at rates above the U of M high range for N applications.

Tillage practices varied across the inventoried farms. Thirty-nine percent of the acres planted to corn received fall tillage in the form of a disk ripper followed by secondary tillage in the spring. Seventy-three percent of the acres planted to soybeans received fall disk-ripper and spring secondary tillage.

Pesticide use was prevalent in the SMCW, as 99 percent of all crop acres were treated with herbicides or insecticides. Field corn and soybeans accounted for 67 percent and 32 percent of all AI applied, respectively.

Atrazine and acetochlor were the two active ingredients most often used on field corn in regards to total pounds applied and atrazine and glufosinate-ammonium were applied on the most acres. Glyphosate was the most commonly used pesticide on soybeans and was applied on all soybean acres. Insecticide was applied on 68 percent of all soybean acres.

It appears that tillage, pesticides and nutrients are closely tied together in this watershed. It also appears that promotional activities need to continue and be specifically targeted to deliver the most recent advances in technology and revised N management and U of M recommendations for the area.

Current University of Minnesota recommendations for nitrogen applications to corn, compared to the previous 2005 recommendations, can be found in Appendix 1 along with sample comparisons of different N source and rate scenarios in the South Branch of the Root River.

Appendix 1:

University of Minnesota's brochure "Fertilizing Corn in Minnesota" provides the reasons for the change in the recommendations. It states the following:

> "Because of technology improvements in corn production practices such as weed and pest control, expected yield is not as important a factor in determining N rate as it has been in the past. Soil productivity has become a better indicator of N needs. A majority of Minnesota soils are highly productive and have generally produced maximum economic corn yield with similar N rates over the last 15 years. Some soils have a reduced potential attributed to erosion, reduced water holding capacity caused by lower organic matter content, sandy soil texture, poor drainage, and any restriction to root growth."

With the current volatility in energy costs, fertilizer N cost has risen dramatically in the past three years. This increase does affect the economic optimum N rate. To account for this change, the ratio of the price of N per pound to the value of a bushel of corn has been added to the N rate decision. An example calculation of the price/value ratio: if N fertilizer costs $0.30 per lb N or $492 per ton of anhydrous ammonia, and corn is valued at $2.00 per bushel, the ratio would be 0.30/2.00 = 0.15".

The differences in the recommendations are detailed in Figure 20. Prices for corn and nitrogen were the current Minnesota prices on September 9, 2008. Numbers attached to the bars represent the current recommendations for farmers using UAN priced at $0.98 per pound.

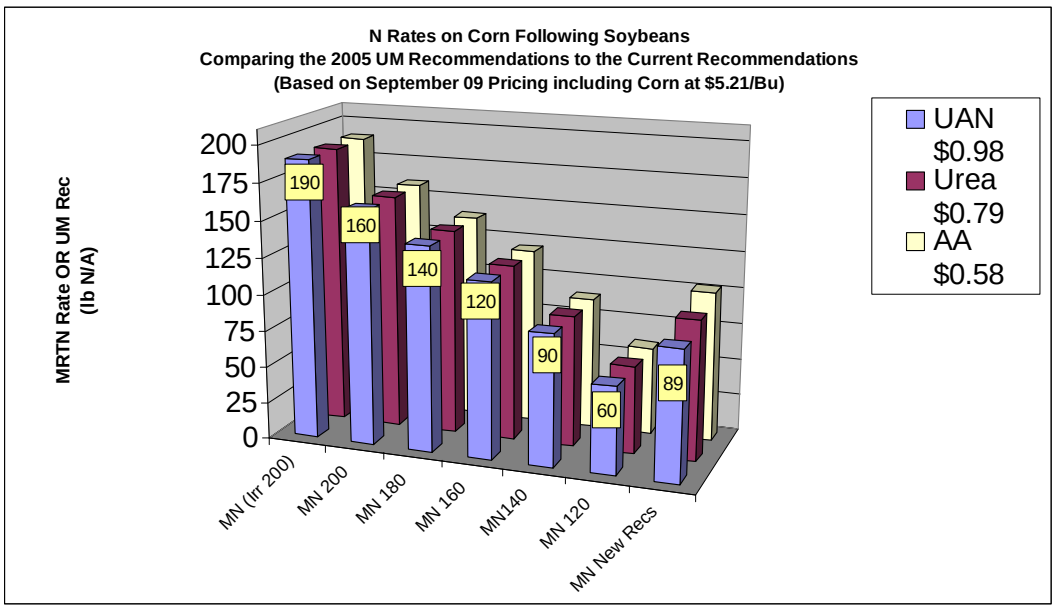

Figure 20. Current University of Minnesota recommendations for nitrogen applications to corn compared to the previous recommendations.

Soil fertility specialists in Wisconsin, Minnesota, Iowa, Indiana, and Illinois agreed to use the same philosophy to develop N rate guidelines for corn (grain). The philosophy used is based on maximizing return to N (MRTN) fertilizer. The new N rate guidelines were developed as a means to provide growers guidance on how much they might adjust their N application rates and maintain or enhance profitability depending upon their individual farm situation. Research data collected in these states over a period of 20 years was used to develop the guidelines. Figure 21 details the differences in the recommendations for the states involved based on September 9, 2008 prices.

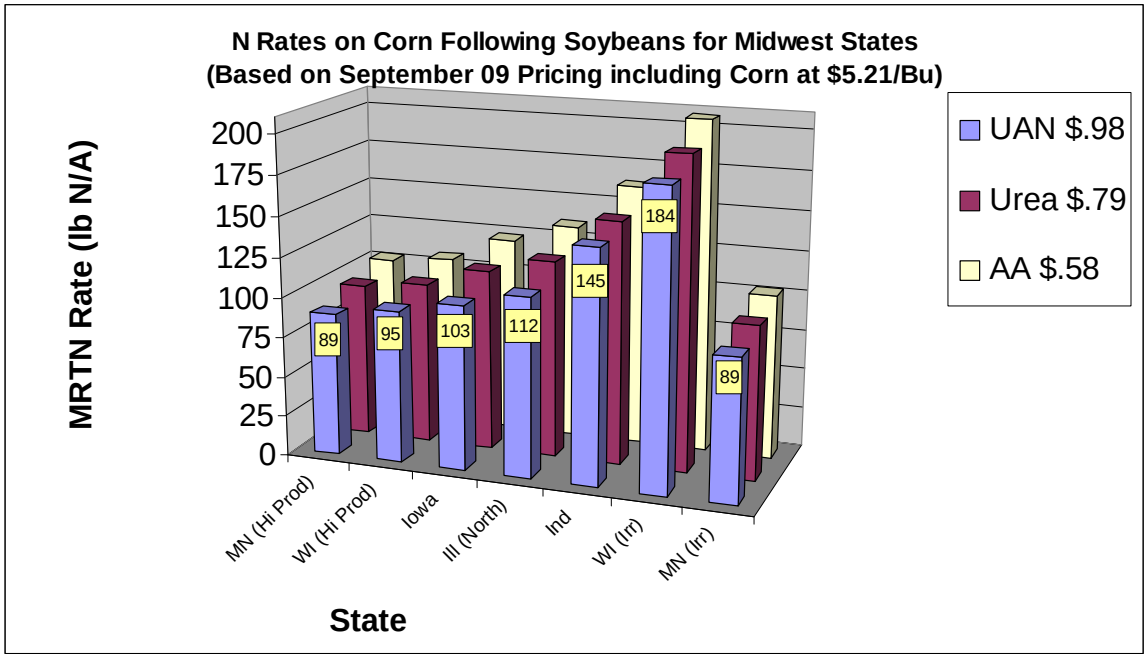

Figure 21. Current University of Minnesota recommendations for nitrogen applications to corn compared to other participating states.

Farm practices are detailed in Table 11, comparing practices from the 2002 FANMAP to the 2007 FANMAP. Although each survey had 18 respondents, they were not the same 18 respondents each year. Therefore, some of the changes could be do to interviewing different farmers in each survey. It appears that famers were more in line with the University of Minnesota nitrogen rates recommendations in 2002 than they were in 2007. Pesticide use has changed in the watershed, but tillage and nutrient use has remained stable.

Table 11. Comparisons of the 2002 and 2007 FANMAP Surveys		
Catagory	**2002 FANMAP**	**2007 FANMAP**
Type of Interview	In-person	Phone
Percent of cropland acres surveyed	60%	50%
Average corn yield	171 bu./acre	182 bu./acre
Average soybean Yield	50 bu./acre	51 bu./acre
Percent of cropland acres planted to corn	42%	63%
NUTRIENTS		
Average UM Nitrogen Recommendations for Corn	137 lbs./acre	122 lbs./acre
Average amount of N applied to corn from manure and commercial N	160 lbs./acre	157 lbs./acre
Average over-application of Nitrogen	23 lbs./acre	35 lbs./acre
Percent fall-applied anhydrous ammonia utilizing N inhibitor	66%	66%
Average amount of P applied to corn from manure and commercial P	48 lbs./acre	41 lbs./acre
Percent of commercial N applied in the fall	81%	71%
Percent of corn acres receiving anhydrous ammonia	77%	82%
PESTICIDES		
Percent of acres applied with the three most used corn herbicides	48% Atrazine 42% Mesotrione 36% Acetochlor	89% Atrazine 49% Glufosinate 47% Acetochlor
Percent of soybean acres receiving at least two applications of glyphosate	67%	98%
TILLAGE		
Percent of soybean acres receiving fall and spring tillage	92%	100%
Percent of corn and soybean fields using fall moldboard tillage	6%	17%