Survey of Farmers within the Middle Fork of the Whitewater River.

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General information: Farmers in the Middle Fork of the Whitewater River.

Water quality in the Middle Fork of the Whitewater River is a concern to the citizens of the surrounding area and many citizens of Minnesota who visit the area each year. Due to the Karst topography of steep hills and fractured bedrock both ground water and surface water are susceptible to contamination. This study focuses on the agriculture land use of the Middle Fork of the Whitewater River.

The watershed of the Middle Fork of the Whitewater River was detailed as the area of the watershed above the Minnesota Department of Agriculture (MDA) water monitoring location on the river. Local Soil and Water Conservation District personnel, Extension Educators, and Natural Resources Conservation Services personnel were contacted in January 1998 informing them of the specifics of the farm surveys and the overall goals. The SWCD, NRCS and MES served as an important link between the farmers and the MDA staff. Local agency staff made personal telephone calls to the farmers after an initial letter, signed by the commissioner, was sent from the Department of Agriculture. The letter's intent was to identify: 1) the overall project, 2) the purpose of the nutrient assessment; why they were selected, 3) and what types of information and amount of time would be necessary to successfully complete the project.

One forty acre plot was randomly chosen from each section within the watershed. Introduction letters signed by the Commissioner of Agriculture were mailed out to each of the farmers who managed those 40 acres. All of the farmer's land within the Upper Middle Fork of the Whitewater boundaries was inventoried. Letters were sent in January of 1998. The local SWCD contacted farmers to inform them of the local involvement in the surveys. Next, the MDA contacted the farmers to inquire if they would be involved in the survey process. If a farmer chose not to be interviewed, a second farmer within the section was contacted. Farmers were generally willing to be interviewed and all sections were represented except one. Once a farmer agreed to be interviewed, information was gathered on all acres within the area. A total of 22 farmers were interviewed and approximately 40% of the farmland in the watershed area was included in the survey.

The Minnesota Department of Agriculture has developed the Farm Nutrient/Pesticide Management Assessment Program (FANMAP) to obtain a thorough understanding of current farm practices regarding agricultural inputs. This information will be used to design effective water quality educational programs and serve as baseline data to determine program effectiveness over time. In the past six years, over 400 farmers have volunteered two to four hours of their time to share information about their farming operations. This previous information was collected as a result of funding through the Legislative Commission on Minnesota Resources or from Clean Water Partnership Programs.

Nutrient Management Data Collection

Inventory forms and database design were patterned after a previous successful project[1]. Timing, rates, and method of applications were collected for all nitrogen (N), phosphate (P_2O_5), and potassium (K_2O) inputs (fertilizers, manures, and legumes) on **a field-by-field basis for all acres within the watershed.** Timing, rates, and method of applications were also collected for all pesticides applied on crop acres. Soil and manure testing results were also collected if available. Nutrient and pesticide inputs, and yields, were specific for the 1997 cropping season. Crop types and manure applications (starting in the fall of 1996) were also collected from the 1996 season for purposes of 1997 nitrogen crediting. 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) were also recorded. Information was gathered from the farmer or the fertilizer dealer if the dealer kept the farmer's records.

Farm Size, Crop, and Livestock Characteristics of the Selected Farms in Middle Fork of the Whitewater River:

Twenty-two farmers were interviewed in January of 1998. Some of the "farmers" were actually a combination of farmers such as a father and son who farmed together. These combinations resulted in 22 operations within the Middle Fork of the Whitewater River. Fourteen of the farm operations had some type of livestock.

A total of 6,527 acres of farmland and pasture were inventoried in the Middle Fork of the Whitewater River Watershed. Farm interviews covered over 40% of all agricultural acres in the watershed.

Table 1 lists each type of crop and the number of acres of the crop surveyed in the Middle Fork of the Whitewater River Watershed. Corn acres dominated the crops with 48% of the acres planted to corn and an additional 24% of the acres planted to soybeans (Figure 1).

Table 1. Crop Type and Acres in the Middle Fork of the Whitewater River.

[1]Effective Nitrogen and Water Management for Water Quality Sensitive Regions of Minnesota, LCMR 1991-93

Crop	Acres	Percentage
Corn	3,069	47%
Soybean	1,532	23%
Sweet Corn	254	4%
Alfalfa	747	11%
Small Grains	185	3%
Pasture	467	7%
CRP	171	3%
Other	102	2%
Totals	6,527	100%

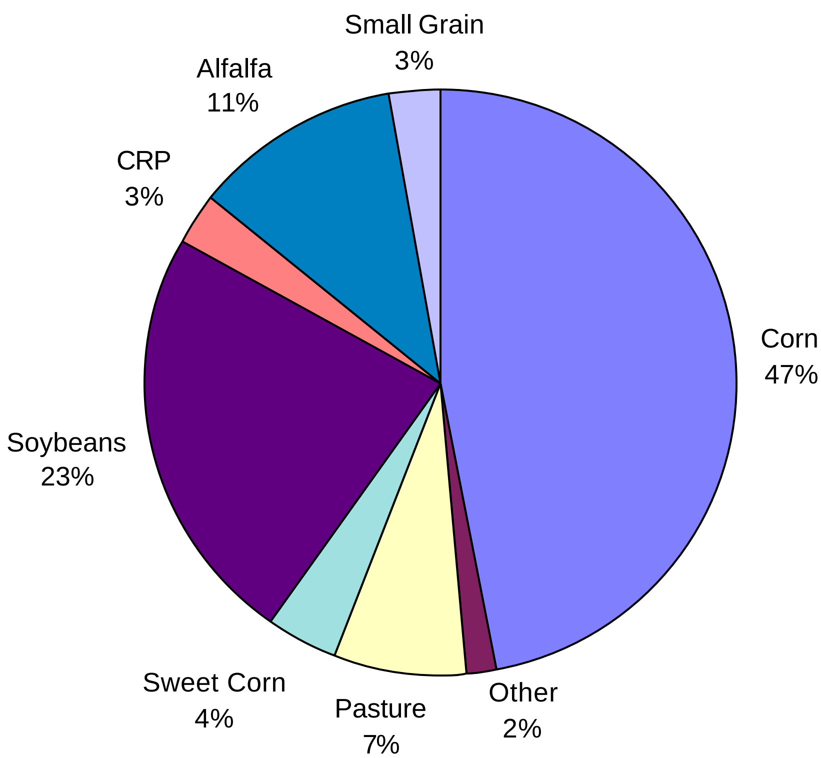

Figure 1. Crop distribution across Middle Fork of the Whitewater River Watershed.

Commercial Fertilizer Use Characteristics on Selected Farms of the Middle Fork of the Whitewater River Watershed:

Field corn accounted for 89% of all N commercial fertilizer use. Ninety-nine percent (99%) of corn acreage received commercial N fertilizer (Table 2). Average fertilizer N rate on corn acres with commercial fertilizer was 133 lb./A. This rate is calculated as the mean across all commercially N fertilized corn acres regardless of past manure or legume N credits. Total N inputs will be discussed later in the "Nitrogen Balances and Economic Considerations" section. All sweet corn acreage received N fertilizer. The average N rate on sweet corn was 129 lb./A.

Table 2. Distribution of commercial nitrogen applications on cropland - 1997.

Crop	Acres Receiving N Fertilizer	Total N Applied	Percent of Total Commercial Nitrogen
Corn	3,051	409,012	89%
Sweet Corn	254	32,754	7%
Other	155	16,556	4%
TOTALS	**3,460**	**458,322**	**100%**

Only 155 acres(3%) of the 5,202 acres planted with crops other than corn/sweet corn were applied with N fertilizer. Sweet corn accounted for 66% of “non-corn” commercial N.

The timing of N fertilizer applications is an important consideration in maximizing fertilizer use efficiency and minimizing environmental effects. Spring preplant applications of nitrogen in the form of anhydrous ammonia or urea are recommended for Southeast Minnesota[2]. Ninety-three percent (93%) of the N was spring applied and the other 7% was sidedressed. There was no fall fertilization of N.

Anhydrous ammonia supplied 59% of the total amount of commercial N applied to corn. Urea ammonium nitrate (UAN) solutions accounted for 29% of all nitrogen while urea and, ammonium based fertilizers accounted for the rest (Figure 2).

[2] M.A. Schmitt and G.W. Randall 1993. Best Management Practices for Nitrogen Use in Southeast MN. AG-FO-6127-B.

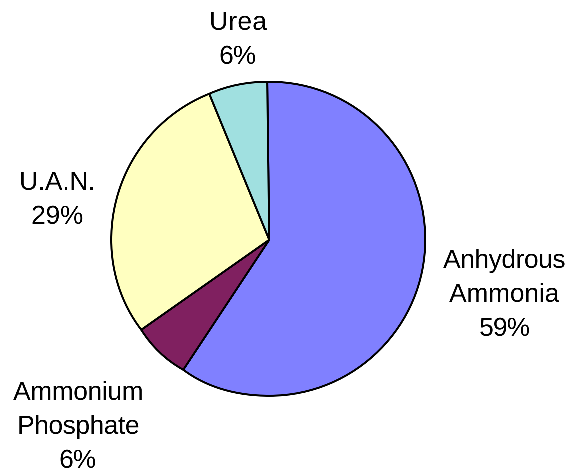

Figure 2. Type of N fertilizer used in Middle Fork of the Whitewater river watershed.

Livestock and Manure Characteristics of the Selected Farms:

Factors directly affecting crop nutrient availability from land applied manure (including manure storage, types, manure amounts being generated, application methods, incorporation factors and rates) were also quantified to complete the "whole farm" nutrient balance. Table 3 includes a complete animal inventory, including estimates of N, P_2O_5 and K_2O produced[3] and collected in various types of manure systems for spreading on acres in the survey (manure collected but not spread on acres specified in the survey are not considered in the collected amounts). Manure not collected from the cattle is usually due to time spent on pastures and large lots where manure is not collected, or, manure that was spread on land that was not within the Middle Fork of the Whitewater watershed area. Livestock numbers represent the livestock on hand from the fall of 1996 to the summer of 1997. This is the livestock that would contribute manure to the 1997 crops. Fourteen of the twenty-two farmers had livestock within the watershed area.

[3] Livestock Waste Facilities Handbook, Midwest Plan Services, Iowa State University, Ames, Iowa. 1993.

Table 3. 1997 livestock numbers, and manure N, P_2O_5 and K_20 produced and collected by livestock types in sample population.							
Livestock Type	Livestock Number	Manure Nitrogen Produced	Manure Nitrogen Collected	Manure P_2O_5 Produced	Manure P_2O_5 Collected	Manure K_2O Produced	Manure K_2O Collected
		Pounds		Pounds		Pounds	
Dairy Cows/Bulls	553	120,001	91,538	48,664	37,121	96,775	73,821
Dairy Calves	225	17,550	13,280	7,425	5,618	13,950	10,556
Replacement Heifers	148	22,940	14,751	9,176	5,900	18,352	11,801
Dairy Steers	41	4,256	2,993	2,687	1,857	3,646	2,555
Slaughter Hogs[4]	1300	10,920	10,920	7,800	7,800	8,424	8,424
Beef Cows/Bulls	198	26,146	7,104	19,904	5,404	22,772	6,189
Beef Feeders Under a Year	110	6,820	1,343	5,170	1,018	6,050	1,192
Beef Feeders Over a Year	170	18,760	12,131	13,710	8,860	16,300	10,508
TOTALS	**2,745**	**227,393**	154,060	**114,536**	73,579	**186,269**	125,044

Manure collection varied by type of livestock in the Middle Fork of the Whitewater River Watershed area. Dairy manure supplied 72% of the total amount of N collected from all livestock raised on the farm (Figure 3). One hundred percent of the manure produced from hogs in the survey was collected. In contrast, about three-fourths of the manure was collected from dairy operations and one-third of the manure from the beef operations.

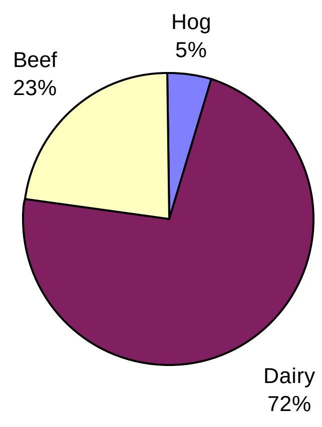

Figure 3. Amounts of nitrogen (total) generated by animal types across all selected farms.

[4] Slaughter Hogs are the number of animals sold per year. All other numbers are animals on hand per year.

Types of storage systems available for producers is an important consideration in efficiently retaining nutrients and allowing enough storage to field apply the manure in an environmentally safe manner. Fourteen farms produced or applied manure. Of these, three applied some liquid manure while the other eleven applied only solid manure.

Nutrient losses from collection and storage were estimated from accepted guidelines[5] for each individual storage system. Losses as a function of application methods and timing factors were calculated on a field-by-field basis. Solid manure systems were most often cleaned on a "as needed" basis, both in the barns and lots. Liquid systems were generally cleaned in the fall. One farm could have several systems for collecting manure, such as, a pit for hogs and a deep bed barn for cattle.

Amounts of N and P_2O_5 collected, lost in storage, and amounts retained for land application are summarized by collection systems in Table 4.

Table 4. Manure N, P_2O_5 and K_2O collected and storage losses by all livestock on all farms in 1997.

System Type	Number of Systems	Manure Nitrogen Collected	Retained N After System Losses	Manure P_2O_5 Collected	Retained P After System Losses	Manure K_2O Collected	Retained K After System Losses
		Pounds		Pounds		Pounds	
Solid Manure	15	105,381	75,290	50,423	50,423	86,199	86,199
Liquid Manure	3	48,679	34,894	23,156	23,156	38,846	38,846
TOTALS	**18**	154,070	110,184	73,579	73,579	125,045	125,045

Three farmers also had manure from sources other than their own livestock. An additional 26,740 lb. of additional N was applied from imported sources, although application losses must be added. The fate of manure-N is summarized in a simple flow diagram (Figure 4). This diagram simplifies the complexities associated with N from excretion to "plant available". Due to the large amount of pasture and small amount of incorporation of solid manure (majority of manure is dairy), only 10% of the total amount of N produced was available for the first year crop on non-imported manure.

[5] Livestock Waste Facilities Handbook, Midwest Plan Services, Iowa State University, Ames, Iowa. 1993.

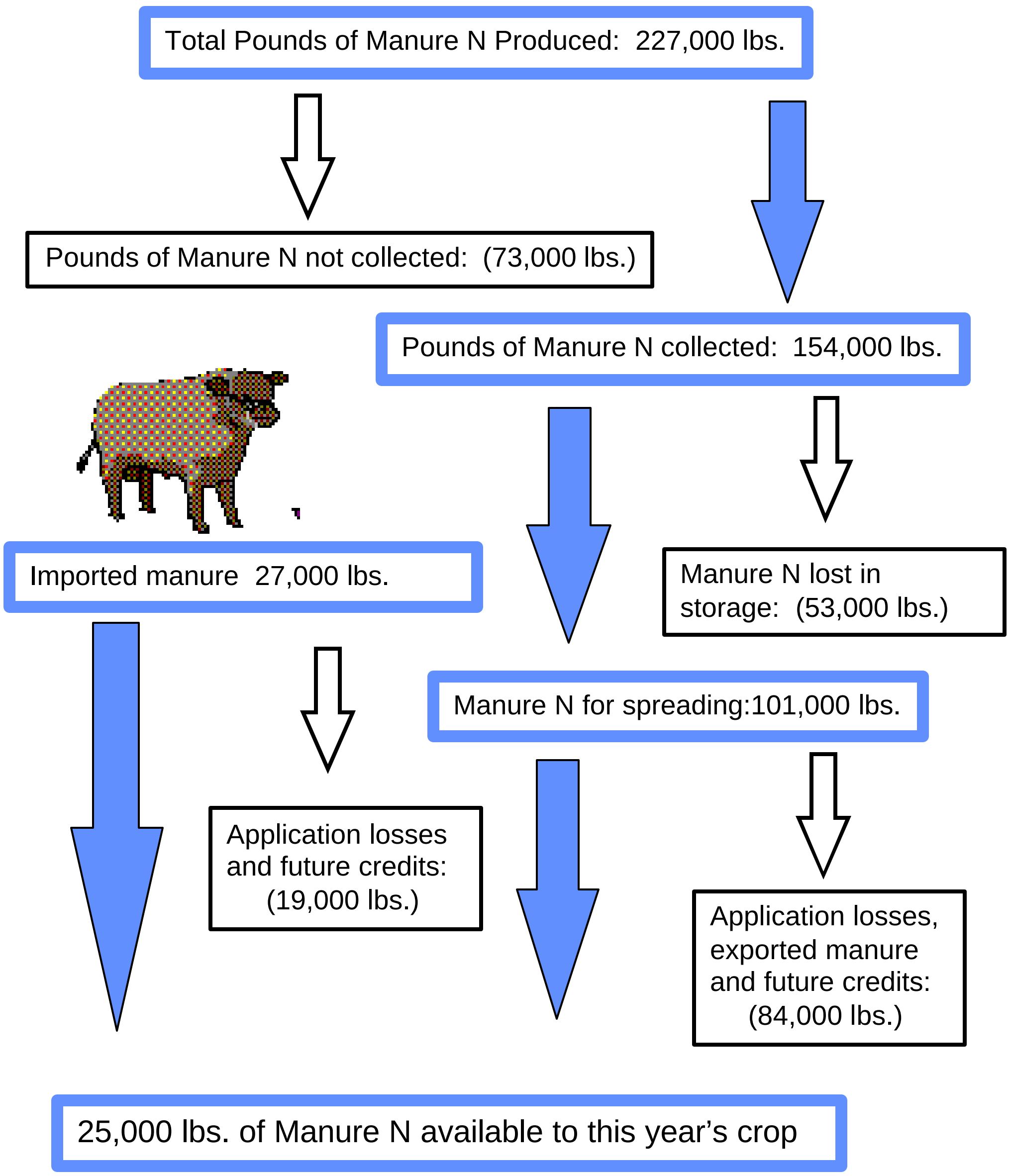

Figure 4. Fate of farm generated and imported manure-N across all storage and management factors. Three farmers applied manure on the neighbors fields outside the survey area. Those fields were not in the survey and the manure was labeled as exported manure.

Manure supplied 14,000 lb. of N to the 1997 corn crop. Sixty-nine percent (69%) of the farm generated manure on corn acres was applied as a broadcast with no incorporation.

Incorporation of broadcast manure within 4 days or less would generally double the amount of retained N available for crop use. Thirty-one percent (31%) of the manure was incorporated within 4 days or injected.

Manure, based on N available to the 1997 corn crop, was applied though-out the year based on field availability. Approximately 32% of the manure was fall applied (Figure 5). In addition to the 14,000 lb. of manure N applied to corn, 1,000 lb. of manure N was applied to sweet corn and 5,000 lb. of manure N was applied to alfalfa. The balance, 5,000 lb. of manure N, was applied to pasture and other forages.

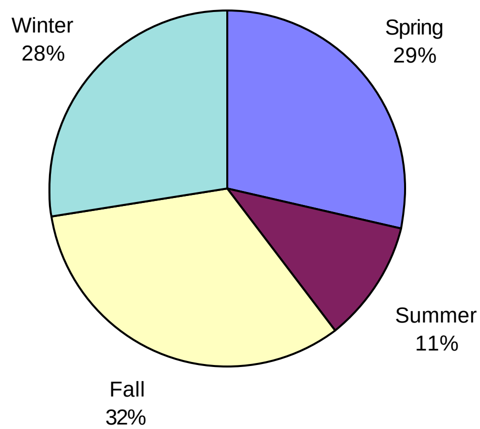

Figure 5. Timing of manure applications on corn acres based on manure N availability.

Relative Importance of Nitrogen Sources on the Selected Farms:

University of Minnesota (UM) recommendations for nitrogen provide N credits from legumes. In the Whitewater Watershed legume credits involved soybeans and alfalfa for the 1997 growing season. Soybeans provided a 40 lb./A credit. Alfalfa provided 75 lbs/A (assuming a fair stand). A total of 65,000 lb. of N was contributed to the field corn acres through soybeans and alfalfa. Contributions of N past legumes to sweet corn acres totaled 5,000 lb.

Commercial fertilizer (83%), manure (9%), and legumes (12%) contributed a total of 495,000 lb. of "first year available N" to **corn acres** (Figure 6). Proper crediting for these sources is critical in maintaining economic and environmental balances.

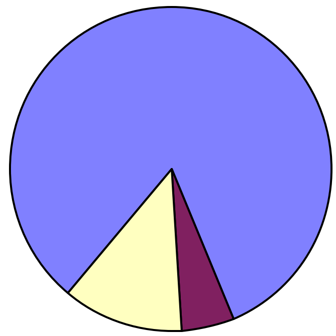

Figure 6. Relative N contributions from fertilizers, manures and legumes across all corn acres. N inputs totaled 495,000 for all sources.

Relative Importance of N Sources on the Selected Farms: Middle Fork of the Whitewater River Watershed

University of Minnesota recommendations for nitrogen provide N credits from legumes. Alfalfa was assumed to have 2-3 plants per square foot when tilled for the following corn crop. First year corn following alfalfa provided a 75 lb./A credit, and second year corn following alfalfa provided a 50 lb./A credit. Soybeans provided a 40 lb./A credit. These N credits will later be compared to the reductions in nitrogen on corn acres with no legume N credits to those corn acres with legume N credits. In the Whitewater survey, soybeans were by far the most important source of legume N, supplying approximately 82% of all legume N. Alfalfa supplied the balance.

Nitrogen Balances and Economic Considerations: Whitewater Watershed Area:

The corn yield goal across all 22 farms averaged 154 bushels/A. University of Minnesota N recommendations (based on yield goal, crop history, and soil organic matter level) were compared to actual amounts of fertilizer and manure applied to each field. University of Minnesota N recommendations to fulfill this goal averaged 122 lb./N/A (Figure 7). Actual amounts of N applied from fertilizer and manure averaged 133 lbs/N/A and 5 lbs/N/A respectively across all corn acres. Factoring in all appropriate credits from fertilizer, legumes and manures, there was an average over-application rate of 16 lb./N/A.

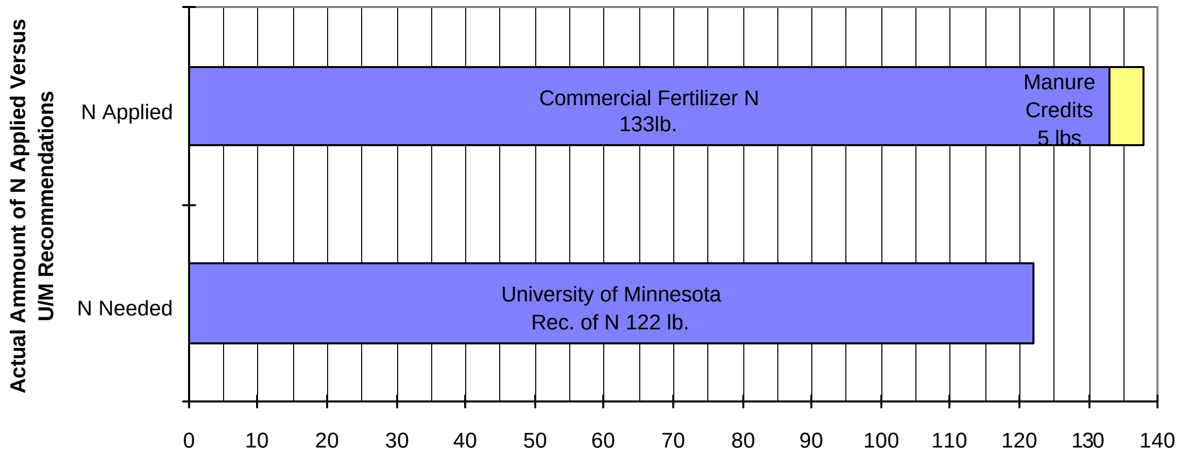

Figure 7. Crop N requirements based on UM recommendations in comparison to actual N inputs (fertilizer, and manure) across all corn acres. Total corn area in this analysis was 3,069 acres. Legumes grown in 1996 also provided 20 lb./A N across all corn acres and is already reflected in the UM recommendations.

Over 40% of the corn acres were planted following soybeans in 1996. Figure 8 details the rotation of corn acres.

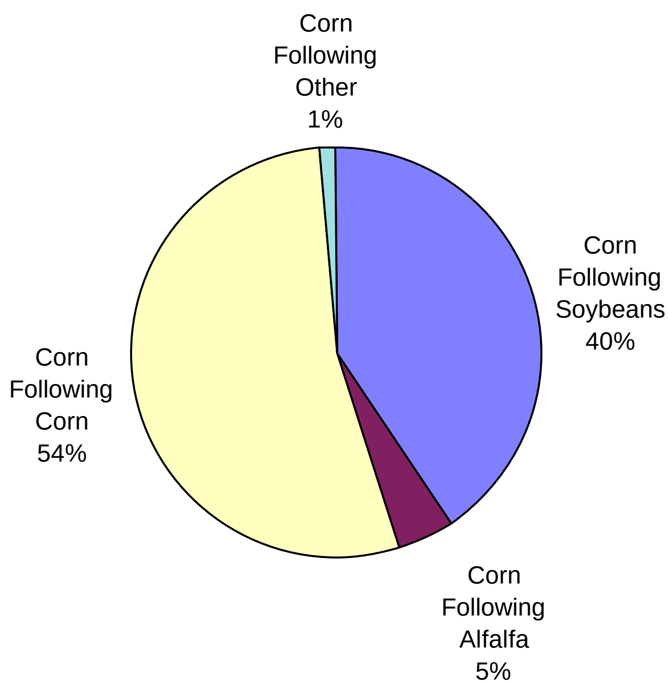

Figure 8. Rotation on corn acres in the Whitewater Survey Area. The majority of the corn acres were planted to corn the previous year (1996).
Factoring in legume N credits and manure N inputs into the process on a field-by-field basis, the comparison of actual rates, to the 1997 UM recommended rates, are illustrated

in Table 5. One of the big advantages of the technique developed through the nutrient assessment process, is the ability to examine in great detail the nutrient balances and make some inferences on where the biggest gains in water quality can be obtained through focused educational programs.

Table 5. Excess Nitrogen on Corn Acres				
Crop Rotation	Total Acres	Excess N Average lb./A (On All Acres)	Excess N[6] Acres (>30 lb./N/A)	Excess N Total lb.
Corn/Soybeans	1,241	26	358	31,914
Corn/Corn	1,645	9	209	14,748
Other Corn Rotations	183	13	55	2,360
Totals/(Averages)	3,069	(16)	662	49,022

Farmers in the Whitewater watershed are averaging 16 lb./A over-application of N. The largest reductions in N could be made on those acres with the largest excess of N applied. Twenty percent (20%) of the total corn acres were applied with N amounts that were more than 30 lb. above UM recommendations (Figure 9).

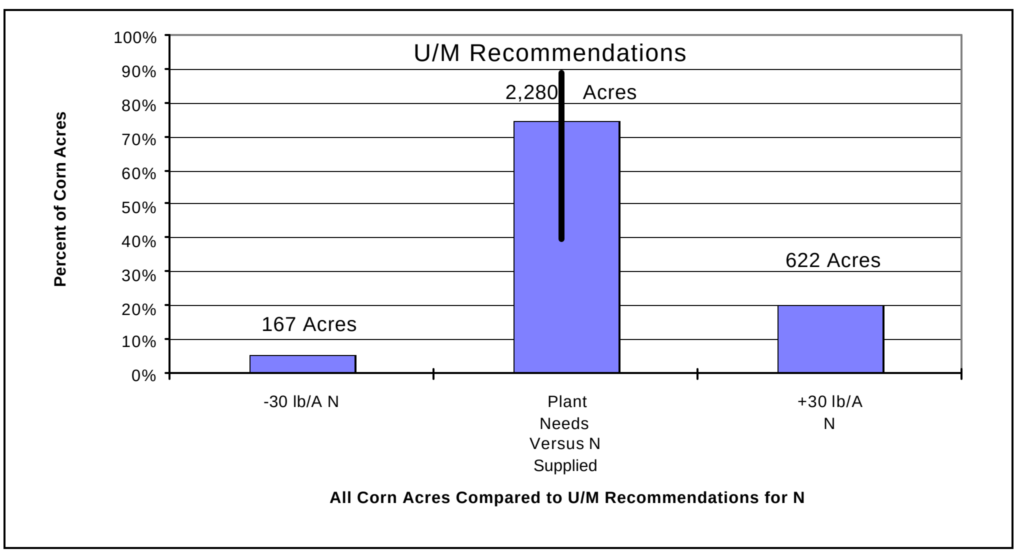

Figure 9. Percentage of corn acres either below, at, or in excess of UM nitrogen recommendations.

Figure 10 further details the percentage that each type of crop rotation that contributes to the total excess N on corn acres.

[6] Acres where the nitrogen applied exceeded the amount recommended from the UM by more than 30 lbs. an acre.

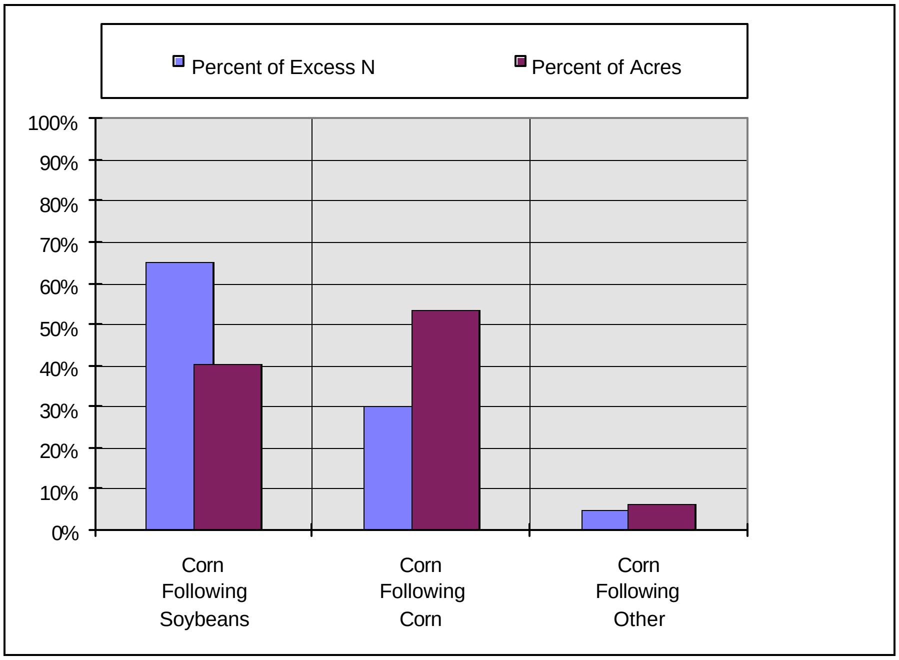

Figure 10. Percent of acres and excess N across corn rotations in 1997.

Forty percent (40%) of the corn acres planted in 1997 were in soybeans the previous year and also accounted for 65% of the over application of N on all corn acres.
Twenty percent of all corn acres were classified in the excess N category. Twenty-eight percent (28%) of all corn acres following soybeans were over-applied by more than 30 lb. N compared to 13% of all corn following corn acres and 30% of corn following any other crop (figure 11). Increasing the amount of soybean crediting for N would reduce the amount of commercial fertilizer needed and provide savings for farmers.

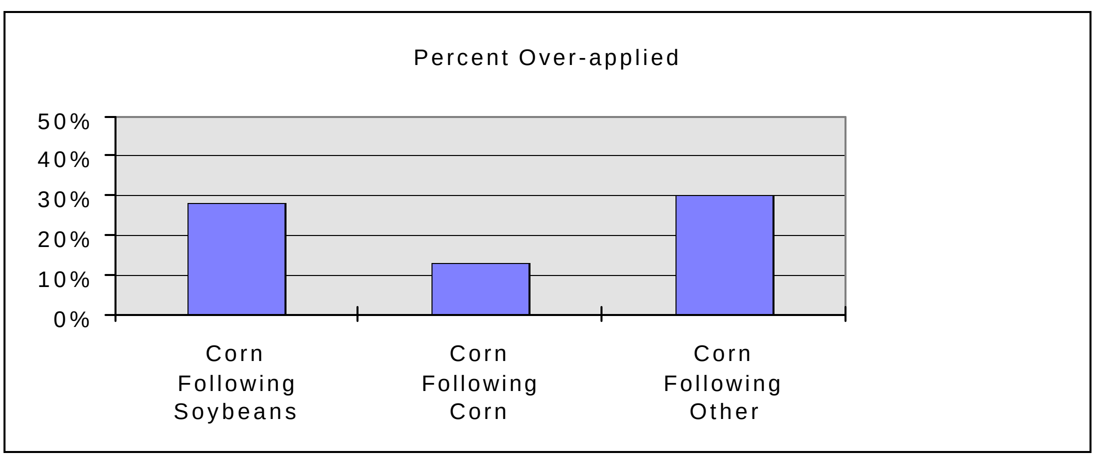

Figure 11. Percentage of each crop rotation over-applied with more than 30 lb. N above UM recommendations.

Manure was applied to 15% (463) of all corn acres in 1997. Over-application of N on manured acres averaged 26 lbs/N/A (Table 6). Over 80% of the manured corn acres were either corn following soybeans or corn following corn. Comparisons between these two cropping rotations reveal an over-application of 52 lbs/N/A on manured corn following soybeans compared to a 2 lbs/N/A over-application on manured corn following corn. On all manured acres, corn following soybean acres accounted for 75% of the excess nitrogen (Table 7). Increasing the amount of manure crediting for N would reduce the amount of commercial fertilizer needed and provide savings for farmers.

Table 6. Excess Nitrogen on Corn Acres

Crop N Sources	Total Acres	Excess N[7] Average lb./A	Excess N Total lb.
Commercial N Only	2,606	14	36,808
Manure[8]	463	26	12,219
Totals	3,069	16	49,027

Table 7. Excess Nitrogen on Manured Corn Acres

Crop Rotations	Total Acres	Excess N[9] Average lb./A	Excess N Total lb.
Corn Following Corn	207	2	281
Corn Following Soybeans	174	52	9,212
Corn Following Other Crop	82	33	2,725
Totals (Averages)	463	(26)	12,218

[7] Excess N averages and totals include N from both commercial fertilizer and manure for the manure total. Excess acres also include in averages acres below the UM recommendations.

[8] Manure acres include all corn acres with manure regardless of whether commercial N was also added.

[9] Excess N averages and totals include N from both commercial fertilizer and manure for the manure total. Excess acres also include in averages acres below the UM recommendations.

University of Minnesota recommendations are based on economic and environmental factors. Research at both the Southwest Experiment Station (Lamberton) and the Southern Experiment Station (Waseca) has shown that the recommendations are based on sound economic decisions and, in the long term, generally result in the most economic profit. If all corn acres were applied with N using UM recommendations, the annual amount of N would be reduced by 49,000 lb. in the Whitewater Watershed. Reduction of nitrogen on corn acres to within 30 pounds of the UM recommendations would reduce 17,000 of lb. nitrogen from the farmers interviewed. By including the additional 60% acres of corn not in the survey process, an additional 25,000 lb. of nitrogen could be reduced for a total of 42,000 lb. reduction of nitrogen for the Middle Fork of the Whitewater Watershed. The reductions in N should lead to substantial economic savings with little or no loss of yield to many of the farmers in the Whitewater watershed.

Farmers were asked how they determined the amount of fertilizer to apply. Nine of the farmers relied on their knowledge to determine the amount of fertilizer to apply. Three farmers relied only on the fertilizer dealers and three relied on information from the involvement in the EQIP Program. The remaining seven relied on their knowledge and some additional input from a variety of sources or crop consultants. Farmers that relied only on the fertilizer dealers for application amounts were over-applying nitrogen by 34 lb./acre compared to an average over-application of 16 lbs/N/A on all corn acres (Table 8). The EQIP Program provides expertise in nutrient management and N recommendations.

Table 8. Nitrogen Applications to Corn Based on Who Makes the Recommendations.

How Fertilizer Rate is Determined.	Number of Acres	Percent of Acres	Total Over-Application	Percent of Over-Application	Average Rate of Over-Application
Farmer Knowledge	694	23%	3,285	7%	5
Fertilizer Dealer	734	24%	25,092	51%	34
EQIP Personnel[10]	799	26%	8,410	17%	11
Other	842	27%	12,240	25%	15
TOTALS (Averages)	**3,069**	**100%**	**49,027**	**100%**	**(16)**

[10] Environmental Quality Incentive Program (EQIP) is designed to provide an incentive to farmers to follow best management practices and UM recommendations for fertilizer. The NRCS hired a person to write or review nutrient management plans. She worked with the farmers, fertilizer dealers and crop consultants in writing or reviewing nutrient management plans.

Pesticide Applications:
Middle Fork of the Whitewater River:

Data on pesticide use were gathered on all crop acres. Pesticides were used on 99% of corn and soybean acres (Table 9). Pesticide use on the Middle Fork of the Whitewater River included herbicides and insecticides. Insecticide use was applied to 61% of corn acres. Those acres receiving insecticide were corn following corn acres.

Table 9. Crop Acreage And Percentage Treated With Pesticides.

Crop Grown	Total Acres	Treated for Control of: Weeds/Insects		Insects	
		Acres	Percent	Acres	Percent
Corn	3,069	3,060	99%	1,876	61%
Soybean	1,532	1,523	99%	0	0%
Sweet Corn	254	254	100%	0	0%
Alfalfa	747	141	19%	0	0%
Small Grains	185	10	5%	0	0%
Pasture	467	4	1%	0	0%
CRP	171	0	0%	0	0%
Other	102	0	0%	0	0%
Totals (Averages)	6,527	5,037	(77%)	1,876	(29%)

Pesticide use on all acres consisted of 52 different formulas (different EPA numbers) of which 42 were herbicide formulas and 10 were insecticides. Table 10 describes the active ingredients (A.I.) of each pesticide product. Table 11 details herbicide use and the number of acres covered with each specific compound. Compounds were included that covered over 500 acres or 300 total pounds. There were a total of 11,205 pounds of active ingredients from all pesticides used on all crops. Herbicide active ingredients totaled 10,729 pounds and insecticide active ingredients totaled 476 pounds. Corn acres accounted for 78% of all herbicides A.I. (Figure 12) and 72% of all insecticides (Figure 13).

Table 10. Pesticide Active Ingredients and Percent of Active Ingredients.

Name Of Pesticide	EPA Number	Active Ingredients	Percent Active Ingredient
AATREX 4L	100-497	ATRAZINE	0.41
ACCENT	352-560	NICOSULFURON	0.75
AMINE 2,4-D	9779-263	2,4-D	0.47
ATRAZINE	100-585	ATRAZINE	0.43
ATRAZINE	9779-255	ATRAZINE	0.86
AZTEC	3125-412	TEBUPIRIMPHOS CYFLUTHRIN	0.02 0.001
BANVEL	55947-1	DICAMBA	0.49
BASAGRAN	7969-45	BENTAZON	0.42
BUCTRIL	264-437	BROMOXYNIL	0.33
CLARITY	55947-46	DICAMBA DIGLYCOLAMINE	0.57
COMMAND 3ME	279-3158	CLOMAZONE	0.31
COUNTER 15G	241-238	TERBUFOS	0.15
COUNTER-20CR	241-314	TERBUFOS	0.20
DUAL	100-673	METOLACHLOR	0.87
DUAL II	100-711	METOLACHLOR	0.84
ERADICANE	10182-223	EPTC	0.83
EXCEED	100-774	PROSULFURON PRIMISULFURON	0.32 0.32
EXTRAZINE	352-577	CYANAZINE	0.68
FLEXSTAR	10182-418	SODIUM SALT OF FOMESAFEN	0.22
FORCE 1.5	10182-130	TEFLUTHRIN	0.02
FORCE 3G	10182-373	TEFLUTHRIN	0.03
FRONTIER	55947-140	DIMETHENAMID	0.63
FURADAN	279-2876	CARBOFURAN	0.44
FUSION	101182-343	FLUAZIFOP-P-BUTYL FENOZAPROP-P-EHTYL	0.24 0.07
GALAXIE	7969-77	BENTAZON ACIFLOURFEN	0.33 .07
HARNESS	524-473	ACETOCHLOR	0.75
HIDEP	2217-703	2,4-D DIMETHYLAMINE DIETHANOLAMIN	0.39 0.06 0.07
HORNET	62719-253	FLUMETSULAM CLOPYRALID	0.23 0.63
LADDOK	7969-100	BENTAZON ATRAZINE	0.27 0.25
LASSO	524-314	ALACHLOR	0.45
LIGHTING	241-377	IMAZETHAPYR IMAZAPYR	0.53 0.18
LORSBAN	62719-34	CHLORPYRIFOS	0.15
MALATHION	34704-108	MALATHION	0.57
MARKSMAN	7969-136	DICAMBA POTASSIUM SALT ATRAZINE	0.13 0.22
PERMIT	524-465	HALOSULFURON-METHYL	0.75
PINNACLE	352-525	THIFENSULFURON	0.25
POAST	7969-58	SETHOZYDIM	0.18
POUNCE	279-3014	PERMETHRIN	0.38
PRESTIGE	7969-88-241	SETHOZYDIM	0.13
PROWL	241-337	PENDIMETHALIN	0.37
PURSUIT	241-310	IMAZETHAPYR	0.23
PURSUIT DG	241-350	IMAZETHAPYR	0.70
REFLEX	10182-83	SODIUM SALT OF FOMESAFEN	0.23
RESOURCE	59639-82	FLUMICLORAC PENTYL ESTER	0.10
SCORPION III	62719-264	FLUMETSULAM CLOPYRALID 2,4-D	0.09 0.25 0.50
SELECT	59639-3	CLETHODIM	0.26
SENCORE	3125-314	METRIBUZIN	0.41
STATUS	7969-79-241	ACIFLUORFEN	0.20

SURPASS	10182-325	ACETOCHLOR	0.71
THIMET 15G	241-145	PHORATE	0.15
TREFLAN	62719-250	TRIFLURALIN	0.43
ULTRA ROUNDUP	524-475	GLYPHOSATE	0.41

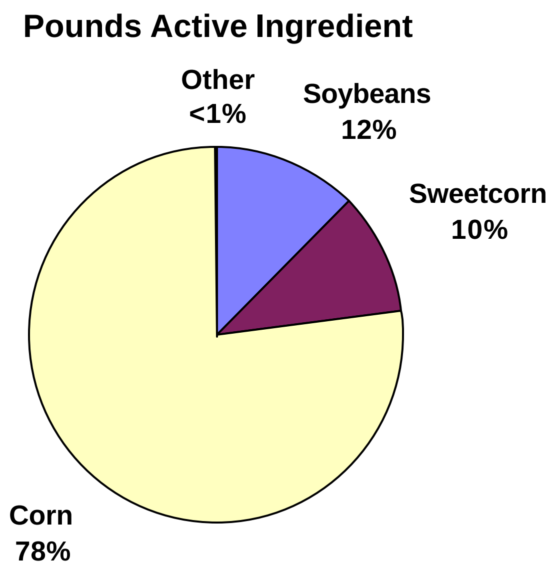

Figure 12. Herbicide use by crop type vs. A.I.

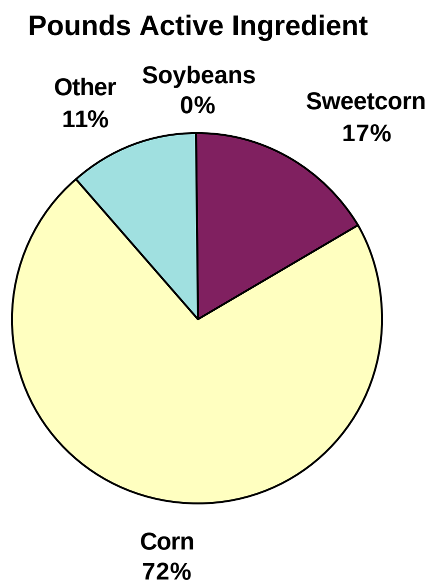

Figure 13. Insecticide use by crop type vs. A.I.

Table 11. Herbicide Use And Acres Covered by Compound.		
Name Of Compound	**Acres Covered**	**Total Pounds**
Acetochlor	2,247	5,277
Alachlor	141	316
Atrazine	1,963	1,231
Dicamba	2,204	615
EPTC	101	508
Halosulfuron-methyl	567	11
Imazethapyr	1,382	74
Metolachlor	363	890
Nicosulfuron	513	13
Pendimethalin	332	387
Sethozydim	545	136
Thifensulfuron	529	1

Table 12 details the insecticides used and the amount of acres to which the product was applied.

Table 12. Insecticide Use And Acres Covered.		
Name Of Compound	**Acres Covered**	**Total Pounds**
Carbofuran	57	57
Chlorpyrifos	24	22
Cyfluthrin	623	4
Malathion	35	39
Permethrin	106	15
Phorate	33	40
Tebupirimphos	623	81
Tefluthrin	788	64
Terbufos	210	159

Seventy percent (70%) of all pesticides were applied by the farmer who purchased the pesticides. Sixty-six percent of herbicides were self-applied and the farmer applied 100% of all insecticides. The method of application for herbicides consisted of broadcast applications and includes 22 acres of spot applications. Spot applications indicate just portions of the field with weed infestations that were applied with herbicides. Insecticides were banded on corn acres.

Herbicide use on corn acres consisted of 19 separate compounds. Table 13 and Figure 14 details each compound used and the number of acres covered by each compound. Table 14 and Figure 15 details each compound used and the number of acres for insecticides on corn.

Table 13. Herbicide Use on Corn Acres.

Name Of Compound	Acres Covered	Pounds of Compound Applied
2,4-D	111	23
Acetochlor	2,185	5,128
Alachlor	81	136
Atrazine	1,810	1,099
Bromoxynil	246	58
Clopyralid	204	221
Cyanazine	105	142
Dicamba	2,142	613
Dimethenamid	85	89
Flumethsulam	204	9
Halosulfuron-methyl	505	11
Imazapyr	247	4
Imazethapyr	247	10
Metolachlor	300	701
Nicosulfuron	483	12
Primisulfuron	217	4
Prosulfuron	217	4

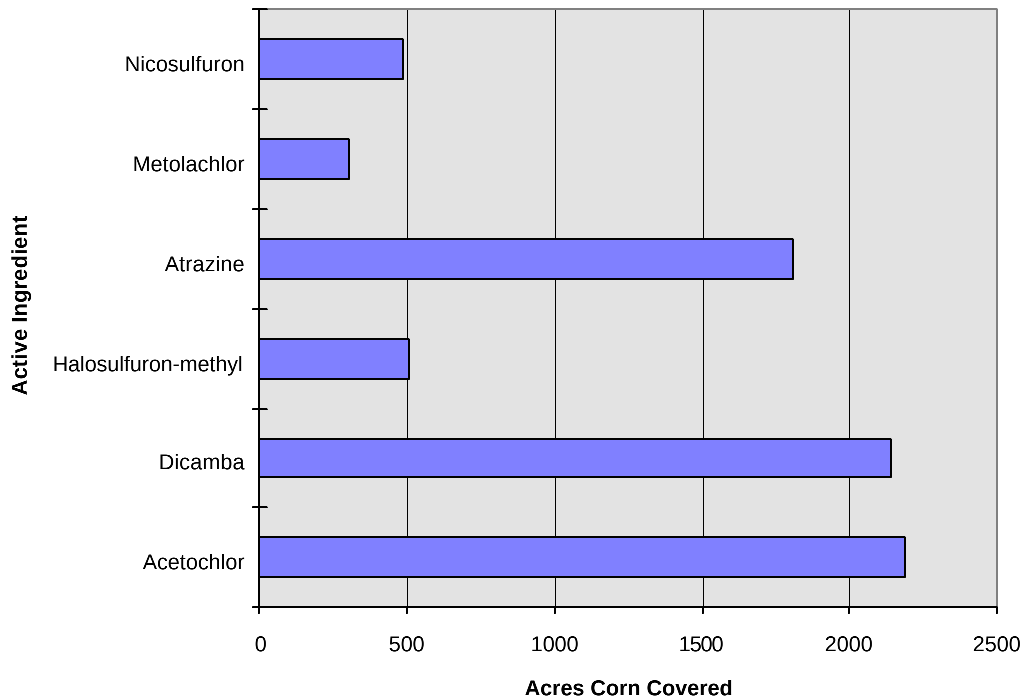

Figure 14. The top six active ingredients from herbicides applied to corn acres . There were a total of 3,069 acres of corn in the survey. An additional 1,964 acres of corn were covered with other herbicides.

Table 14. Insecticide Use on Corn Acres.

Name Of Compound	Acres Covered	Pounds of Compound Applied
Carbofuran	57	57
Chlorpyrfos	24	22
Cyfluthrin	560	3
Phorate	33	40
Tebupirimhpos	560	73
Tefluthrin	726	59
Terbufos	132	89

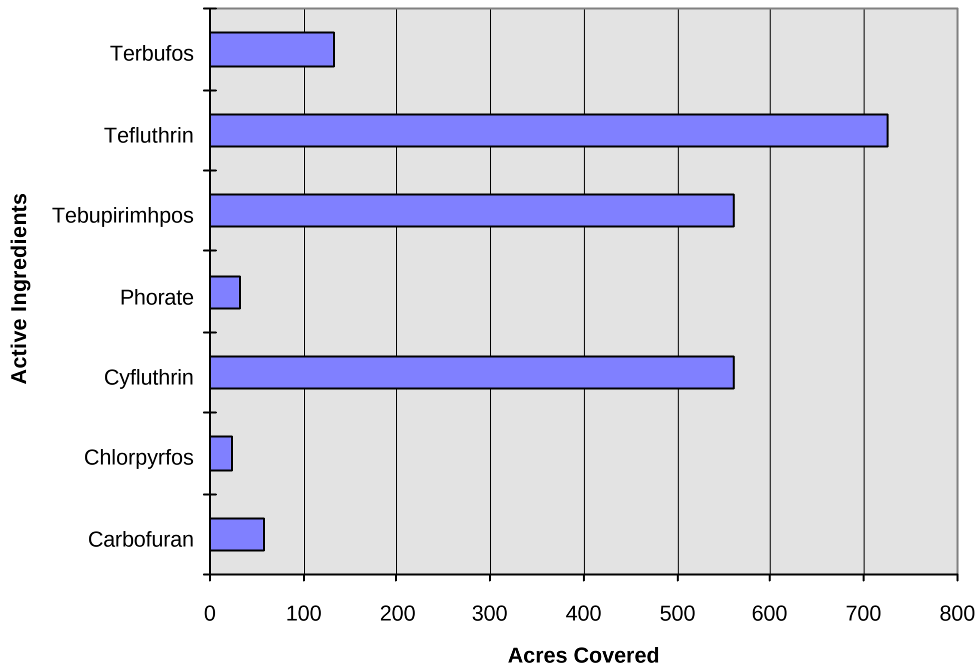

Figure 15. Insecticides applied to corn acres . There were a total of 3,069 acres of corn in the survey.

Acetochlor accounted for 60% of the herbicide applied to corn (Figure 16).

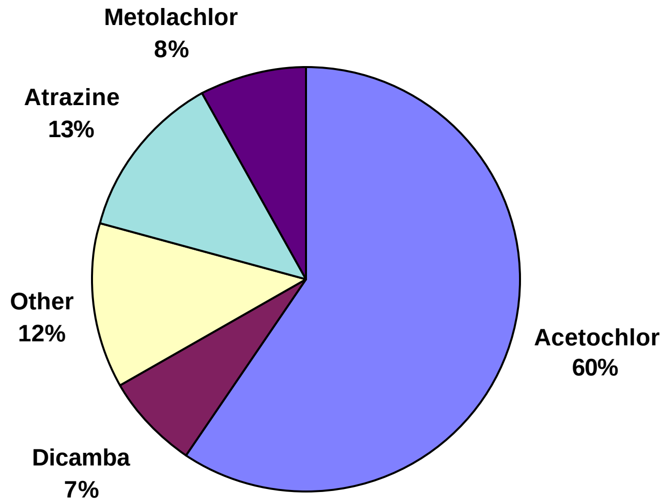

Figure 16. Herbicide used on corn by A.I. A total of 8,607 pounds of active ingredients from pesticides were used on corn.

There were 19 separate compounds of herbicides used on soybean acres. Table 15 and Figure 17 details each compound used and the number of acres covered. There was no insecticide use on soybean acres.

Table 15. Herbicide Use on Soybean Acres.

Name Of Compound	Acres Covered	Pounds of Compound Applied
Acetochlor	62	149
Acifluorfen	146	24
Bentazon	263	197
Clethodim	292	24
Clomazone	255	195
Dicamba	62	2
Fenozaprop-P-Ethyl	123	5
Fluazifop-P-Butyl	123	19
Flumiclorac Pentyl Ester	64	2
Glyphosate	80	80
Halosulfuron-Methyl	62	1
Imazethapyr	1,135	63
Metribuzin	15	2
Pendimethalin	287	343
Sethozydim	545	136
Sodium Salt of Fomesafen	182	70
Tefluthrin	62	4
Thifensulfuron	529	1
Trifluralin	21	16

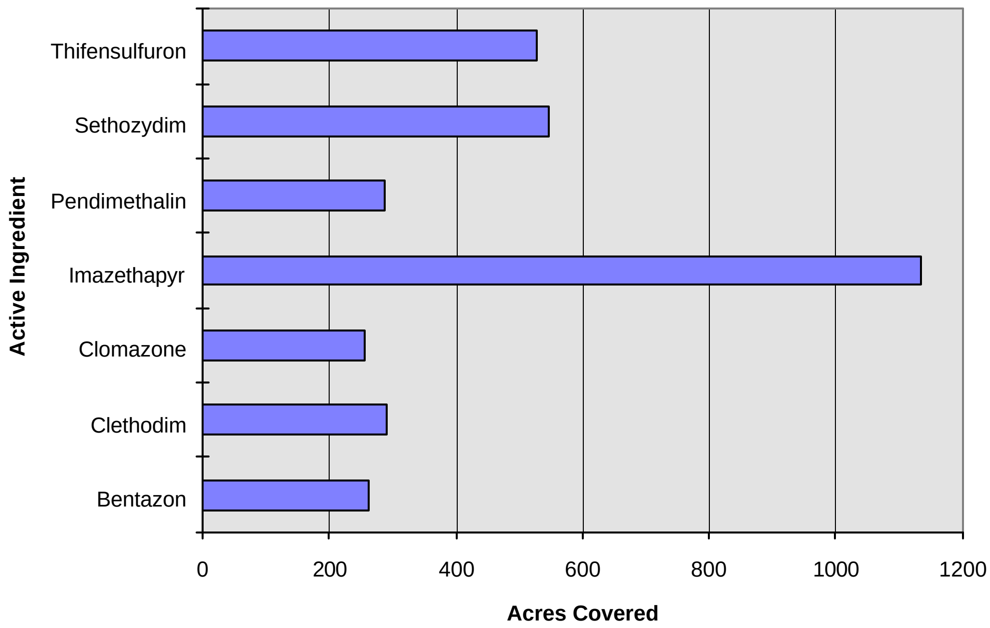

Figure 17. The top seven herbicides applied to soybean acres . There were a total of 1,532 acres of corn in the survey. An additional 1,002 acres of soybeans were covered with other herbicides.

Pendimethalin accounted for 26% of herbicde applied to soybeans from all (Figure 18).

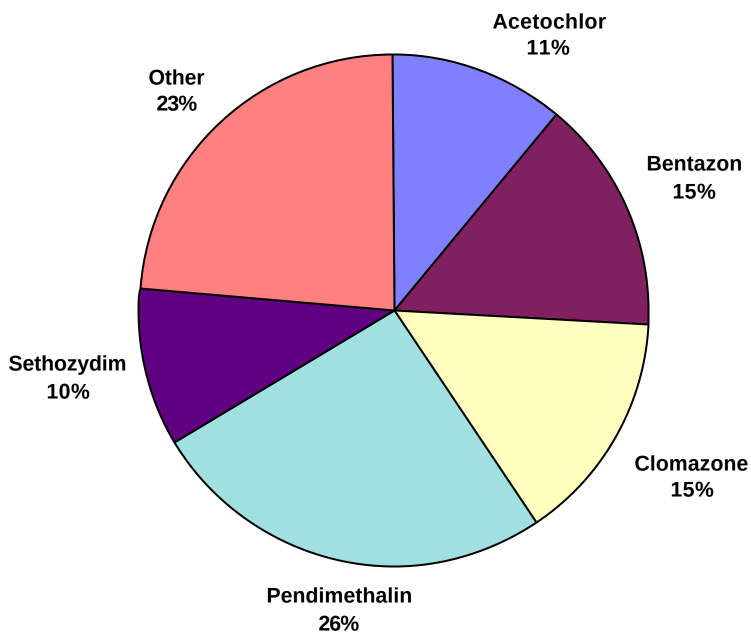

Figure 18. Herbicide used on soybeans by pounds A.I. A total of 1,333 pounds herbicide were used on soybeans.

There were 7 herbicides used on sweet corn. Table 16 details each compound used and the number of acres covered. Table 17 details each compound used and the number of acres covered for insecticide use on sweetcorn.

Table 16. Herbicide Use on Sweetcorn.

Name Of Compound	Acres Covered	Pounds of Compound Applied
Alachlor	60	180
Atrazine	153	132
Bentazon	123	72
Dimethinamid	30	45
EPTC	101	507
Metolachlor	63	189
Nicosulfuron	30	1

Table 17. Insecticide Use on Sweetcorn.

Name Of Compound	Acres Covered	Pounds of Compound Applied
Cyfluthrin	63	1
Tebupirimphos	63	8
Terbufos	78	70

Other crops and herbicide/insecticide use is listed in table 18.

Table 18. Herbicide and Insecticide Use on Other Crops.				
Crop	Compound	Herbicide or Pesticide	Acres Covered	Pounds of Compound Applied
Alfalfa	Malathion	Insecticide	35	39
Alfalfa	Permethrin	Insecticide	106	15
Small Grains	2,4-D	Herbicide	10	1
Pasture	2,4-D	Herbicide	4	3
Pasture	Deithanolamin	Herbicide	4	1
Pasture	Dimethylamine	Herbicide	4	1

Conclusions and Summary of the Current Nutrient Management Practices for the Middle Fork of the Whitewater River.

Twenty-two farms, covering over 6,500 acres, participated in the FArm Nutrient/ pesticide Management Assessment Program (FANMAP) with staff from the Minnesota Department of Agriculture. Producers volunteered two to four hours of their time to share information about their farming operation. The overall purpose of the program was to develop a clear understanding of current farm practices regarding agricultural nutrients and to utilize this knowledge for future water quality educational programs.

The cropping land use was: Corn 48%, soybeans 24%, and alfalfa 11%. Field corn received 89% of the 450,000 lbs of commercial N applied. Commercial fertilizer N was spring applied(97%) or sidedressed (3%). Anhydrous ammonia accounted for 59% of all N applied.

Dairy manure supplied 72% of the N generated from all livestock. Manure was often spread year round and 69% of all manure was broadcast with no incorporation. Crops received 25,000 pounds of N from first year available N from manure. Commercial N fertilizer account for 83% of all N while legumes and commercial N accounted for 12% and 5%, respectively. Soybeans were the dominant source of legume N credits. Fifteen percent (15%) of corn acres received applications of manure leaving ample land available for manure application, if based on N inputs.

Amounts of N applied to corn acres through both manure and commercial fertilizer contributed 138 lb./N/A. The UM recommendations for N were 122 lb./A. There was an over-application of 16 lb./N/A on all corn acres. Twenty percent (20%) of all corn acres were applied with N amounts that were more than 30 lb./A above UM recommendations. A rotation of corn following soybeans accounted for 40% of the corn acres but resulted in 65% of the total amount of excess N.

Average rates of over-application on corn acres also varied according to manure applications. Over-applications on manured corn versus non-manured corn were 26 lb./N/A and 14 lb./N/A respectively. Manured acres of corn following soybeans averaged 52 lb./N/A. If farmers who are over-applying N would reduce N to within 30 lbs/A, 42,000 lbs of N would be reduced across all acres within the Whitewater watershed.

Pesticide use consisted of 52 different formulas. Sixty-six percent (66%) of all herbicides were applied by the farmer. The most applied pesticide on corn acres was Surpass and was applied on 46% of all corn acres. The most applied pesticide on soybean acres was Pursuit and was applied on 41% of all soybean acres. Acetochlor was the most applied of the active ingredients accounting for 2,200 acres of coverage and 5,200 lbs. of active ingredient.

Producers appeared to be applying approximately 16 lb./A of nitrogen above recommendations that were made by UM on corn acres on average. Corn following soybean acres accounted for most of the excess N in this survey. Reducing the average amount of N applied and accounting for soybean credits could save farmers approximately $2 per acre.

There were some very positive findings from this study. First, there is strong evidence that producers are voluntarily adopting the educational materials and strategies developed by the UM. It is evident that promotional activities need to be specifically targeted to deliver the most recent technology and recommendations. Soybeans crediting is an area where there is a strong need for more education. Strong similarities are present in all FANMAP projects: producers are generally managing commercial N inputs successfully (although frequently using outdated recommendations) but under-estimate the N credits associated with manure and legume inputs.