EVALUATION OF REDUCED APPLICATION RATES OF ACETOCHLOR TO REDUCE CONCENTRATION IN TILE DRAINAGE WATER

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Introduction

Acetochlor, a commonly used herbicide applied to the soil surface for grass control in corn, has been found in some southern Minnesota rivers. Leaching of acetochlor to tile lines in poorly drained soils has been proposed as a mechanism transporting acetochlor from the soil surface to the rivers. Thus, a study was initiated in the spring of 2008 at the University of Minnesota Southern Research and Outreach Center at Waseca to determine if reduced application rates of acetochlor will result in reduced concentrations and losses of acetochlor and its metabolites in tile drainage water from a corn-corn-soybean rotation.

Experimental Procedures

Nine small plots in a 36-plot tile drainage research facility located on a Canisteo-Webster clay loam soil complex were used to conduct the acetochlor phase of the study. The nine plots were superimposed on a larger study examining nitrogen rate and timing practices in a corn-corn-soybean rotation study.

The experimental procedures used in the conduct of the study are shown in Table 1. The plot number for each plot in the acetochlor phase of the experiment is shown in Table 2. The acetochlor treatment number, collection culvert number, previous crops for 2006 and 2007, nitrogen rate used in 2008, and the tile discharge amount in 2007 for each plot are also shown in Table 2. All nine plots were planted to corn with five plots following corn in 2007 and four plots following soybeans. The tile discharge rates for 2007 were used to group the plots into three replications; one with plots having a high flow history, one with plots having a medium flow history, and one with plots having a low flow history. Thus, each treatment was evaluated on all three flow histories as can be seen in Tables 7 and 8.

Each plot measures 20’ wide by 30’ long, has a plastic perforated tile placed 3.5’ deep and 5’ from one end, and is isolated to a depth of 6’ by a 12-mil plastic sheet placed in a backfilled trench around each plot. Drainage from each of the 9 plots flows into a dedicated separate sump that a sump pump emptied when the water level exceeded a preset level. Flow from each pump went through a flow meter; flow volume was recorded daily with a data logger. Cumulative drainage for any specific period of time was calculated by summarizing the discharge volume from each plot and dividing by the plot area. Flow-weighted (FW) water samples were collected in glass bottles connected by a small diameter tube to each sump pump outlet such that a proportional sample was collected each time water was pumped. The bottles were kept in an ice chest, containing ice, located in each collection culvert. Water samples were returned to the laboratory on a 1 to 4 day basis, depending on tile flow rate, and refrigerated at 4ºC before sending via overnight delivery to the Monsanto laboratory for acetochlor analysis.

Specific procedures in Table 1 relative to the acetochlor study indicate that pre-acetochlor-application tile water samples were being accumulated from each plot starting on April 28 with the flow-weighted composite sample collected on May 5 for acetochlor analysis. After planting corn on May 12, the collection culverts were covered with tarps to prevent any potential contamination during acetochlor application. The acetochlor treatments were applied with a tractor-mounted plot sprayer using a 20' boom on May 15 between 9 and 10 AM. The tarps were left on the culverts for more than a week. They were then removed to allow access to the culverts for maintenance procedures. Unfortunately, extremely strong winds occurred prior to sufficient rainfall to incorporate the acetochlor. This resulted in some dust (soil) contamination in collection culvert #4, even though the covers were fitted with rubber gaskets to prevent this type of contamination. Significant rainfall beginning on May 29 initiated tile drainage beginning on May 30 and terminating on June 20. Another short flow period occurred starting on July 18 and concluded on July 22. Composite, FW tile drainage samples were collected on June 2, 6, 10, 12, 16 and July 21. Low drainage volumes on June 17th – 20th were not sufficient to generate a composite sample, thus acetochlor concentrations from the June 16 sample were used to calculate acetochlor losses during this period. Grab samples were taken on May 9, June 9, 12, and 16 and were delivered to MDA for analysis. A complete record of all tile water sampling information for acetochlor analysis is found in Table 3.

Results and Discussion

<u>Precipitation and Tile Discharge</u>

Available soil water in the 0-5' soil profile was determined twice each month on a continuous corn site adjacent to the study. The data shown in Table 4 indicate soil water levels greater than field moist capacity (11.05") on April 16, May 1, and June 2. These data are supported and agree with the precipitation data found in Table 5 and the tile flow data found in Table 6. Greatest rainfall occurred during the May 29-June 12 period when 5.41" was recorded in 10 rainfall events. Largest rainfall events occurred on May 30 (1.49"), June 8 (1.10"), and June 12 (1.24").

Tile flow did not occur in 2008 prior to April 11 (Table 6). From April 11 to April 16 tile flow was low with only an average of 1.3 plots out of 9 flowing each day. Flow increased during the April 20-30 period with an average of 4 of 9 plots having tile flow each day. Consequently, glass bottles were placed in the pump-flow system on April 28. Tile flow increased during the period from May 3-May 11 with greatest flow on May 4, 5, and 6. Composite, FW samples were taken on May 5 to define the pre-acetochlor application conditions. The tile lines did not flow from May 12-29 but flow did begin on May 30 with intermittent flow among plots through June 8. Tile flow was greatest and most consistent among plots from June 9-20, averaging 5.9 out of 9 plots per day for the 12-day period. During this period, composite, FW samples were taken on the 9th, 10th, 12th, and 16th. Grab samples were taken on the 9th, 12th, and 16th. The tile lines did not flow in June after the 20th, but did resume on July 18 for five days.

Tile discharge for each of the plots and acetochlor treatments are shown in Table 7 (pre-acetochlor application) and Table 8 (post-acetochlor application). Averaged across all nine plots, tile discharge averaged 0.51 acre-inches for the 13-day pre-application period and 1.09 acre-inches for the 21-day June post-application period. As is customary in small drainage plots, flow variability among plots was substantial, especially in the low flow, pre-application period where tile flow ranged from 0.07 to 1.64 acre-inches. Flow variability among the plots in the post-application period was also substantial with a 10-fold difference between plot 3312 and plot 3113. Due to a restricted randomization, where the acetochlor treatments were assigned to drainage plots based on tile flow in previous years, we were partially successful in removing some of the influence of random flow variability. Tile flow was greatest in rep 2, medium in rep 1, and lowest in rep 3. Averaged across replications, tile flow was greatest for the zero-acetochlor control treatment (1.38 acre-inches) and least for the 2.5 pt./acre acetochlor treatment (0.77 acre-inches).

Acetochlor Concentration

Concentration of acetochlor in the composite, FW water samples and grab samples for each of the plots is shown in Table 9. Surprisingly, low levels of acetochlor (0.04 to 0.11 ppb) were found in the water from all three drainage plots in rep 1 for the pre-application period. Levels of acetochlor were non-detectable in the six drainage plots in reps 2 and 3 and the two grab samples taken on May 9. Acetochlor (Harness) was last applied to these plots on April 30, 2004. Fifteen days passed between acetochlor application (May 15) and the first day of tile flow (May 30) in the post-application period.

The first three FW, composite water samples collected on June 2 all had detectable acetochlor concentrations (0.03 to 0.16 ppb) including 0.12 ppb in plot 3509, which was a zero-acetochlor control plot draining into culvert #6 (Table 9). On June 6, detectable levels of acetochlor (0.03 to 0.76 ppb) were found in all five samples collected. On June 9 and 10, 9 of the 12 samples collected had detectable levels of acetochlor. Two of the 3 samples with non-detectable levels of acetochlor were zero-acetochlor control plots. However, samples collected from all plots on June 12 showed detectable concentrations of acetochlor for 8 of 9 plots as well as both grab samples. Tile flow during the period from June 9-12 was on the declining portion of the hydrograph and was rather slow. A rainfall event of 1.24” occurring on June 12 led to brief but significant tile drainage from June 13 to June 16. Nine FW, composite samples and two grab samples collected on June 16 showed detectable levels of acetochlor in only 2 of 11 samples. Both of these samples were from the 1.5 and 2.5 pt./acre acetochlor treatments draining into culvert #4.

During the post acetochlor application period in June the arithmetic average of concentration detects ranged from 0.04 to 0.61 ppb for the 1.5 pt./acre treatment, from 0.08 to 0.13 ppb for the 2.5 pt/acre treatment, and from 0.04 to 0.14 ppb for the zero-acetochlor treatment (Table 9). The apparent soil/dust contamination in culvert #4 contributed greatly to this rather high variability, especially for treatment 1 (1.5 pt./acre) and treatment 3 (zero-acetochlor/acre). However, the acetochlor concentration variability of plots draining into collection culverts #5 and #6 is also troubling. For instance, the zero-acetochlor control plots (2308 and 3509) had non-detectable concentrations in five samples and concentrations ranging from 0.06 to 0.13 ppb in the other three samples. Perhaps the low tile flow (1.09 acre-inch) and the low concentrations, near the detection limit, were also factors contributing to this high variability.

Flow-weighted concentrations of acetochlor in the tile drainage water prior to acetochlor application are found in Table 7. As described earlier, acetochlor was found at low concentrations, ranging from 0.04 to 0.11 mg/L, from all three plots in rep 1. Samples taken from reps 2 and 3 did not contain detectable levels of acetochlor prior to establishment of acetochlor treatments.

Flow-weighted concentrations of acetochlor in the drainage water after the acetochlor treatments were applied are found in Table 8. When calculating the FW average concentrations, all samples containing non-detectable (ND) levels of acetochlor were considered to have 0.00 ppb acetochlor. The high FW acetochlor concentrations in rep 1, especially the 1.5 pt./acre treatment, are thought to be due to the soil/dust contamination. The FW concentrations in the water from reps 2 and 3 were very low, ranging from 0.01 to 0.04 ppb, with no relationship to acetochlor application rate.

<u>Acetochlor loss</u>
Acetochlor losses in the pre-application drainage flow period (0.51 acre-inch) ranged from 0.25 to 2.01 mg/acre due to the small amounts of acetochlor found in rep 1 (Table 7). In the post-application flow period with a total of 1.09 acre-inches of flow, acetochlor losses in the drainage water averaged from 3.6 to 7.9 mg/acre with no relationship to acetochlor application rate (Table 8). Acetochlor loses were primarily a function of drainage flow amount and the apparent contamination of plots 2108 and 3111 in culvert #4.

Four additional samples were taken on July 21 but the acetochlor concentrations are not known at this time.

Table 1. Experimental procedures used in the acetochlor drainage study at Waseca in 2008.

Procedure	Date
Moldboard plow entire site	Nov. 12, 2007
Collect pre-acetochlor application tile water samples from each plot	May 5, 2008
Field cultivate all plots	May 9
Broadcast-apply preplant N treatments as urea	May 10
Field cultivate all plots (E-W)	May 10
Plant DKC 50-44 at 34,000 seeds/A, this is a triple-stack hybrid so no CRW insecticide was used	May 12
Plant Pioneer 92M21 soybeans at 8 beans per foot in 30" rows	May 12
Applied acetochlor treatments to plots with a plot sprayer after covering each collection culvert with a tarp. Tarps were not removed until re-entry period was completed	May 15 (9:00-10:00 AM)
Collect composite/flow-weighted tile water samples and send to laboratories	June 2, 6, 9, 10, 12 and 16 July 21
Take plant population counts in all corn plots	June 12
Thin corn plots to uniform stand of 33,100 plants/A	June 13
Apply sidedress N as UAN injected mid-way between rows of specific treatments	June 14
Apply Roundup WeatherMax (24 oz/A) + AMS to all corn and soybean plots	June 19
Take 0-6" soil samples from selected plots and 0-12" PSNT soil samples from selected corn plots	June 23
Collect NDVI biomass from each corn plot using GreenSeeker and Crop Circle instruments	June 30

Table 2. Crop history of each plot used in the acetochlor drainage study in 2008.

Plot No.	Trt.[1/] No.	Collection Culvert	Crop 2006	Crop 2007	N Rate 2008	Tile Discharge 2007
		#			lb N/A	acre-inches
2108	1	4	Corn	Soybean	100	7.33
3111	3	4	Soybean	Corn	140	9.79
3112	2	4	Corn	Soybean	120	9.35
3113	1	4	Corn	Soybean	0	13.62
2308	3	5	Soybean	Corn	140	8.71
3311	2	5	Corn	Soybean	100	10.62
3312	2	5	Corn	Corn	160	5.28
3313	1	5	Corn	Corn	160	4.44
3509	3	6	Soybean	Corn	160	13.03

[1/] Trt. No. 1 = 1.5 pt. acetochlor/A, No. 2 = 2.5 pt. acetochlor/A, and No. 3 = No acetochlor.

Table 3. Acetochlor sampling information for the acetochlor drainage study at Waseca[1/].

Sample Number	Project	Plot Identification	Collection Date	Collection Time	Collection Person	Duplicate of Sample #	Sample Type (Composite or Grab)	Composite Sample Start Date & Time		Composite Sample End Date & Time		Flow Type (Base or Storm)	Pre-app or Post-app	Shipped Date	Received Date
001	ACE BMP -	17 (trt 1, 1.5 pt/A)	5-May	1030	Groh		Composite	28-Apr	800	5-May	1030	Storm	Pre-app.	14-May	15-May
002	ACE BMP -	19 (trt 3, none)	5-May	1030	Groh		Composite	28-Apr	800	5-May	1030	Storm	Pre-app.	14-May	15-May
003	ACE BMP -	20 (trt 2, 2.5 pt/A)	5-May	1030	Groh		Composite	28-Apr	800	5-May	1030	Storm	Pre-app.	14-May	15-May
004	ACE BMP -	20 Dup.	5-May	1030	Groh	3	Composite	28-Apr	800	5-May	1030	Storm	Pre-app.	14-May	15-May
005	ACE BMP -	21 (trt 1)	5-May	1030	Groh		Composite	28-Apr	800	5-May	1030	Storm	Pre-app.	14-May	15-May
006	ACE BMP -	22 (trt 3)	5-May	1030	Groh		Composite	28-Apr	800	5-May	1030	Storm	Pre-app.	14-May	15-May
007	ACE BMP -	24 (trt 2)	5-May	1030	Groh		Composite	28-Apr	800	5-May	1030	Storm	Pre-app.	14-May	15-May
008	ACE BMP -	25 (trt 2)	5-May	1030	Groh		Composite	28-Apr	800	5-May	1030	Storm	Pre-app.	14-May	15-May
009	ACE BMP -	26 (trt 1)	5-May	1030	Groh		Composite	28-Apr	800	5-May	1030	Storm	Pre-app.	14-May	15-May
010	ACE BMP -	28 (trt 3)	5-May	1030	Groh		Composite	28-Apr	800	5-May	1030	Storm	Pre-app.	14-May	15-May
011	ACE BMP -	21	9-May	1100	Groh		Grab					Storm	Pre-app.	14-May	15-May
012	ACE BMP -	24	9-May	1100	Groh		Grab					Storm	Pre-app.	14-May	15-May
013	ACE BMP -	20	2-Jun	1015	Vetsch		Composite	30-May	2200	2-Jun	1015	Storm	Post	11-Jun	12-Jun
014	ACE BMP -	21	2-Jun	1015	Vetsch		Composite	30-May	1300	2-Jun	1015	Storm	Post	11-Jun	12-Jun
015	ACE BMP -	28	2-Jun	1015	Vetsch		Composite	30-May	400	2-Jun	1015	Storm	Post	11-Jun	12-Jun
016	ACE BMP -	17	6-Jun	1400	Groh		Composite	1-Jun	1300	6-Jun	1400	Storm	Post	11-Jun	12-Jun
017	ACE BMP -	19	6-Jun	1400	Groh		Composite	30-May	100	6-Jun	1400	Storm	Post	11-Jun	12-Jun
018	ACE BMP -	20	6-Jun	1400	Groh		Composite	2-Jun	1015	6-Jun	1400	Storm	Post	11-Jun	12-Jun
019	ACE BMP -	21	6-Jun	1400	Groh		Composite	2-Jun	1015	6-Jun	1400	Storm	Post	11-Jun	12-Jun
020	ACE BMP -	21 dup.	6-Jun	1400	Groh	19	Composite	2-Jun	1015	6-Jun	1400	Storm	Post	11-Jun	12-Jun
021	ACE BMP -	25	6-Jun	1400	Groh		Composite	2-Jun	1200	6-Jun	1400	Storm	Post	11-Jun	12-Jun
022	ACE BMP -	26	6-Jun	1400	Groh		Composite	2-Jun	1200	6-Jun	1400	Storm	Post	11-Jun	12-Jun
023	ACE BMP -	17	9-Jun	1430	Groh		Composite	6-Jun	1400	9-Jun	1430	Storm	Post	11-Jun	12-Jun
024	ACE BMP -	19	9-Jun	1430	Groh		Composite	6-Jun	1400	9-Jun	1430	Storm	Post	11-Jun	12-Jun
025	ACE BMP -	20	9-Jun	1430	Groh		Composite	6-Jun	1400	9-Jun	1430	Storm	Post	11-Jun	12-Jun
026	ACE BMP -	21	9-Jun	1430	Groh		Composite	6-Jun	1400	9-Jun	1430	Storm	Post	11-Jun	12-Jun
027	ACE BMP -	22	9-Jun	1430	Groh		Composite	8-Jun	900	9-Jun	1430	Storm	Post	11-Jun	12-Jun
028	ACE BMP -	22 dup.	9-Jun	1400	Groh	27	Composite	8-Jun	900	9-Jun	1400	Storm	Post	11-Jun	12-Jun
029	ACE BMP -	24	9-Jun	1400	Groh		Composite	8-Jun	2300	9-Jun	1400	Storm	Post	11-Jun	12-Jun
030	ACE BMP -	25	9-Jun	1400	Groh		Composite	6-Jun	1400	9-Jun	1400	Storm	Post	11-Jun	12-Jun
031	ACE BMP -	26	9-Jun	1400	Groh		Composite	6-Jun	1400	9-Jun	1400	Storm	Post	11-Jun	12-Jun
032	ACE BMP -	28	9-Jun	1330	Groh		Composite	2-Jun	1015	9-Jun	1330	Storm	Post	11-Jun	12-Jun
033	ACE BMP -	21	9-Jun	1430	Groh		Grab					Storm	Post	11-Jun	12-Jun
034	ACE BMP -	24	9-Jun	1400	Groh		Grab					Storm	Post	11-Jun	12-Jun
035	ACE BMP -	20	10-Jun	830	Groh		Composite	9-Jun	1430	10-Jun	830	Storm	Post	11-Jun	12-Jun
036	ACE BMP -	21	10-Jun	830	Groh		Composite	9-Jun	1430	10-Jun	830	Storm	Post	11-Jun	12-Jun
037	ACE BMP -	22	10-Jun	830	Groh		Composite	9-Jun	1430	10-Jun	830	Storm	Post	11-Jun	12-Jun
038	ACE BMP -	17	12-Jun	800	Groh		Composite	9-Jun	1430	12-Jun	800	Storm	Post	24-Jun	25-Jun
039	ACE BMP -	19	12-Jun	800	Groh		Composite	9-Jun	1430	12-Jun	800	Storm	Post	24-Jun	25-Jun
040	ACE BMP -	20	12-Jun	800	Groh		Composite	10-Jun	830	12-Jun	800	Storm	Post	24-Jun	25-Jun
041	ACE BMP -	20 dup.	12-Jun	800	Groh	40	Composite	10-Jun	830	12-Jun	800	Storm	Post	24-Jun	25-Jun
042	ACE BMP -	21	12-Jun	800	Groh		Composite	10-Jun	830	12-Jun	800	Storm	Post	24-Jun	25-Jun
043	ACE BMP -	22	12-Jun	800	Groh		Composite	10-Jun	830	12-Jun	800	Storm	Post	24-Jun	25-Jun
044	ACE BMP -	24	12-Jun	800	Groh		Composite	9-Jun	1400	12-Jun	800	Storm	Post	24-Jun	25-Jun
045	ACE BMP -	25	12-Jun	800	Groh		Composite	9-Jun	1400	12-Jun	800	Storm	Post	24-Jun	25-Jun
046	ACE BMP -	26	12-Jun	800	Groh		Composite	9-Jun	1400	12-Jun	800	Storm	Post	24-Jun	25-Jun
047	ACE BMP -	28	12-Jun	800	Groh		Composite	9-Jun	1330	12-Jun	800	Storm	Post	24-Jun	25-Jun
048	ACE BMP -	21	12-Jun	830	Groh		Grab					Storm	Post	24-Jun	25-Jun
049	ACE BMP -	24	12-Jun	830	Groh		Grab					Storm	Post	24-Jun	25-Jun
050	ACE BMP -	17	16-Jun	830	Groh		Composite	12-Jun	800	16-Jun	830	Storm	Post	24-Jun	25-Jun
051	ACE BMP -	19	16-Jun	830	Groh		Composite	12-Jun	800	16-Jun	830	Storm	Post	24-Jun	25-Jun
052	ACE BMP -	20	16-Jun	830	Groh		Composite	12-Jun	800	16-Jun	830	Storm	Post	24-Jun	25-Jun
053	ACE BMP -	21	16-Jun	830	Groh		Composite	12-Jun	800	16-Jun	830	Storm	Post	24-Jun	25-Jun
054	ACE BMP -	22	16-Jun	830	Groh		Composite	12-Jun	800	16-Jun	830	Storm	Post	24-Jun	25-Jun
055	ACE BMP -	24	16-Jun	830	Groh		Composite	12-Jun	800	16-Jun	830	Storm	Post	24-Jun	25-Jun
056	ACE BMP -	25	16-Jun	830	Groh		Composite	12-Jun	800	16-Jun	830	Storm	Post	24-Jun	25-Jun
057	ACE BMP -	26	16-Jun	830	Groh		Composite	12-Jun	800	16-Jun	830	Storm	Post	24-Jun	25-Jun
058	ACE BMP -	28	16-Jun	830	Groh		Composite	12-Jun	800	16-Jun	830	Storm	Post	24-Jun	25-Jun
059	ACE BMP -	28 dup.	16-Jun	830	Groh	58	Composite	12-Jun	800	16-Jun	830	Storm	Post	24-Jun	25-Jun
060	ACE BMP -	21	16-Jun	1000	Groh		Grab					Storm	Post	24-Jun	25-Jun
061	ACE BMP -	24	16-Jun	1000	Groh		Grab					Storm	Post	24-Jun	25-Jun
062	ACE BMP -	20	21-Jul	830	Groh		Composite	17-Jul	1400	21-Jul	830	Storm	Post	29-Jul	30-Jul
063	ACE BMP -	21	21-Jul	830	Groh		Composite	17-Jul	1200	21-Jul	830	Storm	Post	29-Jul	30-Jul
064	ACE BMP -	21 dup.	21-Jul	830	Groh	63	Composite	17-Jul	1200	21-Jul	830	Storm	Post	29-Jul	30-Jul
065	ACE BMP -	28	21-Jul	830	Groh		Composite	17-Jul	1700	21-Jul	830	Storm	Post	29-Jul	30-Jul

[1/] All samples were sent in 250 ml Fl, plastic bottles to the ARP-Monsanto lab for acetochlor parent compound interpretation.

Table 4. Available soil water in the 0-5’ profile of a Webster clay loam, continuous corn site located adjacent to the acetochlor drainage site in 2008.

Date	Avail. soil water[1/]
	inches in 0-5’
April 16	11.36
May 1	11.12
May 15	10.49
June 2	11.94
June 16	10.69
July 1	9.26
July 16	6.65

[1/] Available water at 100% field moist capacity is 11.05”.

Table 5. Precipitation amounts in 10-day periods for April-July, 2008 at acetochlor drainage site at Waseca.

Month	Period	Precipitation		Long-term Normal
		inches		inches
April	1-10	0.89		
	11-20	2.10		
	21-30	1.16		
	Total		4.15	3.23
May	1-10	1.52		
	11-20	0.52		
	21-31	1.83		
	Total		3.87	3.96
June	1-10	2.37		
	11-20	1.24		
	21-30	0.66		
	Total		4.27	4.22
July	1-10	0.02		
	11-20	4.97		
	21-31	0.26		
	Total		5.25	4.47

Table 6. Tile flow periods and the number of drainage plots flowing in the acetochlor drainage study in 2008.

Period	No. Days	Drainage[1/]	Avg. No. of Plots draining/day	Tile Flow Recorded
		plot-days	plots/day	days all plots flowing
<4/11	--	No flow	--	--
4/11-16	6	8	1.3	0
4/20-30	11	44	4.0	0
5/3-11	9	44	4.9	2
5/30-6/8	10	20	2.1	0
6/9-20	12	71	5.9	4
6/21-7/17	27	No flow	--	--
7/18-22	5	9	1.8	0
>7/22	--	No flow	--	--

[1/] Includes all plots where >0.01 acre-inch/day of flow was recorded. This equals 3.75 gal/plot/d or 275 gal/A/d.

Table 7. Tile flow, F.W. acetochlor concentration and acetochlor loss in tile drainage for the three acetochlor treatments (prior to acetochlor application) from April 28 – May 10 in 2008.

Acetochlor		Rep				
		1	2	3		
		- - - - - - plots - - - - - -				
		2108	3113	3313		
		3112	3311	3312		
Trt. No.	Rate	3111	3509	2308	Avg.	SE[1/]
	pt./acre	- - - - - - - - - - - - - - - Tile flow (acre – inch) - - - - - - - - - - - - - - -				
1	1.5	0.18	0.99	0.06	0.41	0.29
2	2.5	0.53	0.54	0.07	0.38	0.16
3	0	0.30	1.64	0.28	0.74	0.45
					0.51	
		- - - - - - - - - - - - - - - Acetochlor Conc. (ppb) - - - - - - - - - - - - - - -				
1	1.5	0.04	0	--	0.01	0.01
2	2.5	0.11	0	0	0.04	0.04
3	0	0.04	0	0	0.01	0.01
		- - - - - - - - - - - - - - Acetochlor Loss (mg/acre) - - - - - - - - - - - - -				
1	1.5	0.75	0	0	0.25	0.25
2	2.5	6.02	0	0	2.01	2.01
3	0	1.23	0	0	0.41	0.41

[1/] SE = standard error of the mean.

Table 8. Tile flow, F.W. acetochlor concentration and acetochlor loss in tile drainage as affected by acetochlor application rate from May 30 – June 20 (post acetochlor application) in 2008.

Acetochlor		Rep 1	Rep 2	Rep 3		
		- - - - - - plots - - - - - -				
		2108	3113	3313		
		3112	3311	3312		
Trt. No.	Rate	3111	3509	2308	Avg.	SE[1/]
	pt./acre	- - - - - - - - - - - - - - - - Tile flow (acre – inch) - - - - - - - - - - - - - - - -				
1	1.5	0.48	2.63	0.27	1.13	0.75
2	2.5	0.97	1.11	0.23	0.77	0.27
3	0	0.77	2.26	1.11	1.38	0.45
					1.09	
		- - - - - - - - - - - - - - - - Acetochlor Conc. (ppb) - - - - - - - - - - - - - - - -				
1	1.5	0.32	0.03	0.01	0.12	0.10
2	2.5	0.06	0.04	0.02	0.04	0.01
3	0	0.02	0.04	0.01	0.02	0.01
		- - - - - - - - - - - - - - - Acetochlor Loss (mg/acre) - - - - - - - - - - - - - -				
1	1.5	15.8	7.8	0.2	7.9	4.5
2	2.5	6.1	4.3	0.4	3.6	1.7
3	0	1.8	9.2	1.0	1.0	2.6

1/ SE = standard error of the mean.

Table 9. Acetochlor concentrations in tile drainage samples collected at Waseca in 2008.

Sample collection date		Flow weighted samples									Grab samples	
	Plot:	2108	3111	3112	3113	2308	3311	3312	3313	3509	3113	3311
	Trt:	1	3	2	1	3	2	2	1	3	1	2
	Tile:	17	19	20	21	22	24	25	26	28	21	24
		- - - - - - - - - - - - - Acetochlor concentration (ppb) - - - - - - - - - - - - -										
May 5		0.04	0.04	0.11	ND[1/]	ND	ND	ND	ND	ND		
May 9											ND	ND
Jun 2				0.16	0.03					0.12		
Jun 6		0.76	0.27	0.09	0.03			0.07				
Jun 9		1.02	0.13	0.07	0.05	0.06	0.13	ND	0.08	ND	ND	0.16
Jun 10				0.05	0.10	ND						
Jun 12		0.37	0.03	0.06	0.04	ND	0.12	0.13	0.03	0.13	0.04	0.08
Jun 16		0.29	ND	0.05	ND	ND	ND	ND	ND	ND	ND	ND
Jul 21				?	?					?		
Arithmetic Avg. of Detects												
Pre application		0.04	0.04	0.11	ND	ND	ND	ND	ND	ND		
Post application		0.61	0.14	0.08	0.05	0.06	013	0.10	0.04	0.13		

1/ ND = not detected at the MRL of 0.03 ug/L (ppb).