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Evaluation Of Nitrogen Application Technique And Tillage System On Nitrogen Runoff From An Erodible Soil

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TECHNICAL REPORT 174
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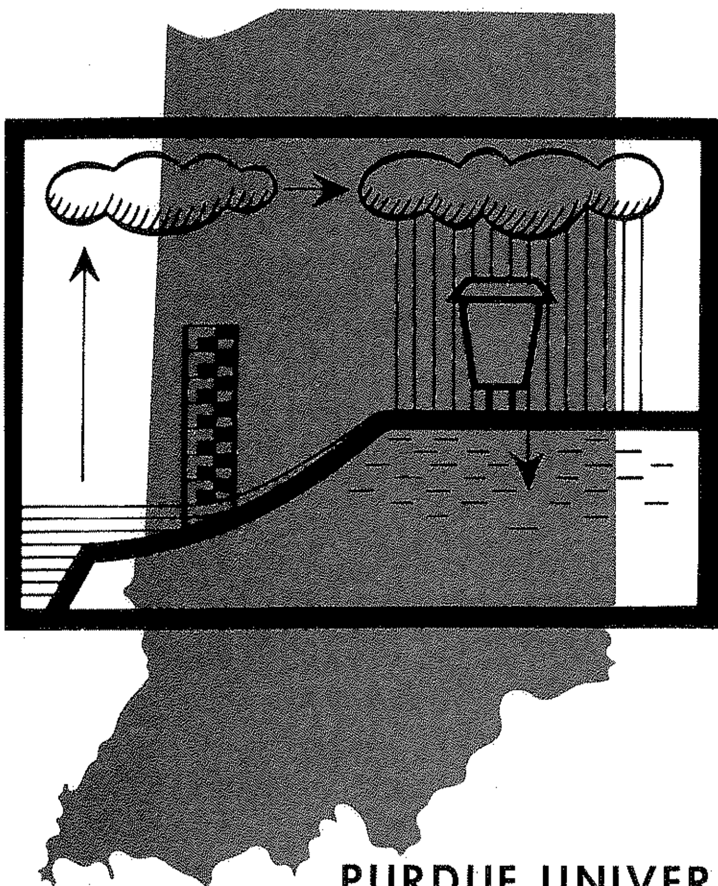

by

Carole A. Lembi
Michael D. Britton
and
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December 1985

PURDUE UNIVERSITY
WATER RESOURCES RESEARCH CENTER
WEST LAFAYETTE, INDIANA

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Project personnel were Carole A. Lembi (Professor), Michael D. Britton (Graduate Assistant), and Merrill A. Ross (Professor), all at Purdue University.

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ABSTRACT

Runoff studies were initiated in May 1985 on a highly erodible soil with slopes ranging from 4.6 to 13.8%. 100 ft^2 plots were divided into two tillage treatments: 1) no till and 2) conventional plow system. Within each tillage treatment, three nitrogen application techniques were used: 1) surface application of ammonium nitrate pellets (33.5% N), 2) injected anhydrous ammonia, and 3) injected anhydrous ammonia stabilized with the nitrification inhibitor nitrapyrin. A fourth set of plots was left unfertilized. All application rates were at 200 lbs nitrogen per acre. The plot area was wet throughout the study period from continuous light rains. Runoff collections were made after each of three heavier rainfalls of 2.0, 0.8, and 1.0 inches.

Runoff of water and sediment was greater from the conventional till plots than the no till plots at all three dates. Results of this and a 1984 study on these same plots suggest, however, that water runoff from no till areas can be as high or higher than from conventional areas when the soil is dry. In both years, the significant contribution of no till was the reduction in soil loss. Tillage system did not have a significant effect on the majority of nitrogen parameters measured, although the amount of nitrogen moving off the plots was generally greater from the conventional till areas than from no till areas. On

a per liter basis, NO_3-N and NH_3-N amounts were as high or higher in no till runoff as in conventional till runoff. Thus, reduction in inorganic nitrogen movement from no till areas appeared to be closely related to amount of water movement. Nitrogen application technique had a much stronger influence on the movement of NO_3-N and NH_3-N movement than on organic or soil-bound nitrogen. Inorganic nitrogen movement was significantly greater from surface applications. Movement of inorganic nitrogen from injected and injected stabilized plots was minimal and not significantly different from that moving off untreated control areas. The beneficial aspects of injected nitrogen applications to the aquatic environment and reduction of algal growth are discussed.

INTRODUCTION

One of the major consequences of nutrient inputs into lakes and streams is the excessive growth of algae and other aquatic weeds. These plants in turn cause fish kills and limit or prevent the use of water for recreation, fish culture, irrigation, and many other purposes. Nonpoint sources of nutrients, primarily from runoff from agricultural land, are thought to be primary factors in promoting algal growth. Much recent emphasis has been placed in evaluating and developing land use practices to reduce the movement of sediment into surface waters. No-till and other conservation tillage practices have been shown to reduce soil erosion thereby decreasing the total amount of nutrient entering the water (Wittmus and Swanson, 1964; McGregor and Green, 1982; Angle, et al., 1984). However, nitrogen fertilizers in no-till are frequently applied to the soil surface as broadcast treatments of ammonia compounds and urea. Nitrogen applied in this manner is susceptible to surface runoff with heavy spring rains (Romkens, et al., 1973; Hubbard, et al., 1982). An alternative method of handling nitrogen in no-till is to inject it (in the form of anhydrous ammonia) into the soil. This technique theoretically should reduce nitrogen runoff. Injection equipment for no-till has recently been developed and interest in the technique appears to be increasing. A relatively recent modification in injection on both conventional tillage and no-till has been to "stabilize" the nitrogen by adding nitrification inhibitors. These compounds reduce the loss of nitrogen from the crop root zone by preventing the conversion of ammonia to nitrate, the form most susceptible to soil leaching (Huber, et al., 1982; Timmons, 1984). Because of the longer persistance of ammonia when nitrification inhibitors are added, the potential exists for more nitrogen to enter runoff under conditions of heavy soil erosion than there would be if the ammonia had been converted to nitrate and leached into the soil.

The impact of each of these relatively new injection technologies on receiving waters is only now being evaluated. Since nutrient control offers the most consistent, long-term control for nuisance algae, it is important to determine the relative value of these agricultural management practices in reducing nutrient input into receiving waters.

This report gives the results of a second year of runoff collections from highly soil erodible plots comparing tillage treatments (conventional and no-till) and nitrogen application techniques (surface-applied, injected, and stabilized injected).

MATERIALS AND METHODS

Field plots for runoff tests were established on the Agnes Demaree farm east of Madision, IN on land leased for a USDA cooperative project with Purdue University to study integrated pest management systems. The major soil type on this farm is a Ryker silt loam, a highly erodible soil. A total of 64 runoff plots were established on slopes ranging from 4.6 to 13.8%.

Each plot consisted of a 100 ft^2 block bordered by 2 X 4 X 10 inch wood planks anchored with metal rods into the ground. Soil was tapped along the outside edges to prevent entry of runoff water from outside the plot. Gullies also were dug around each enclosure to divert outside runoff away from the plot area. Four inch diameter PVC pipe was used to direct runoff water from inside the plot area to a 5 foot diameter plastic pool sunk into the ground

(Figure 1). The pipe was placed at the lowest point in the enclosure to insure collection and movement of runoff toward the pool.

The plots were divided into two tillage treatments: 1) no-till and 2) conventional plow system. Within each tillage treatment, three nitrogen application methods were used: 1) surface application of ammonium nitrate pellets (33.5% N), 2) injected anhydrous ammonia, and 3) injected anhydrous ammonia stabilized with the nitrification inhibitor nitrapyrin. A fourth set of plots was left unfertilized. All application rates were at 200 lbs nitrogen per acre. Each combination of tillage treatment and nitrogen application method was replicated 8 times (see Figure 2 for plot layout). A separate pool was set out to collect rainwater for background concentrations of nutrients. Four rain gauges were also placed in the plot area.

Replicates 1 to 5 were established in 2 year-old corn stubble. Replicates 6-8 were established in 1 year old wheat stubble that had followed conventional tilled corn. All plots were seeded with wheat in the fall of 1984. The wheat was approximately 1.5 ft. tall at the time of plot establishment in May 1985. The conventional tillage plots received one pass with a chisel plow, two passes with a disk, and one pass with a field cultivator. The tillage and nitrogen injection equipment was operated at right angles to the slope. Nitrogen injection was with standard anhydrous knives on 30 inch centers at an injection depth of 8 inches. Injection slits (but no nitrogen) were also made in the control (unfertilized) plots and the plots receiving surface applied pellets.

All collection pools were set in place between May 13 and May 24, 1985. The conventional tillage areas were plowed on May 14. Nitrogen applications

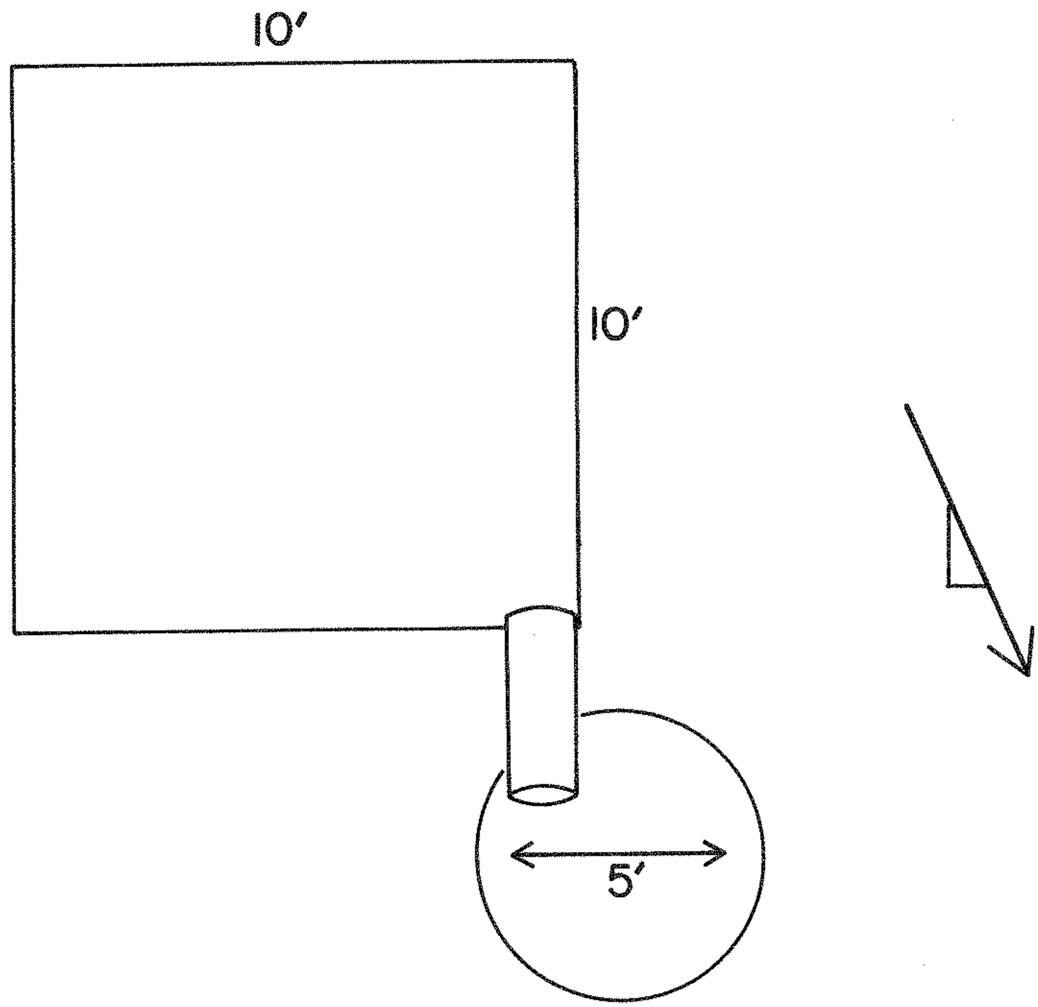

Figure 1. Runoff collection system (pipe not drawn to scale).

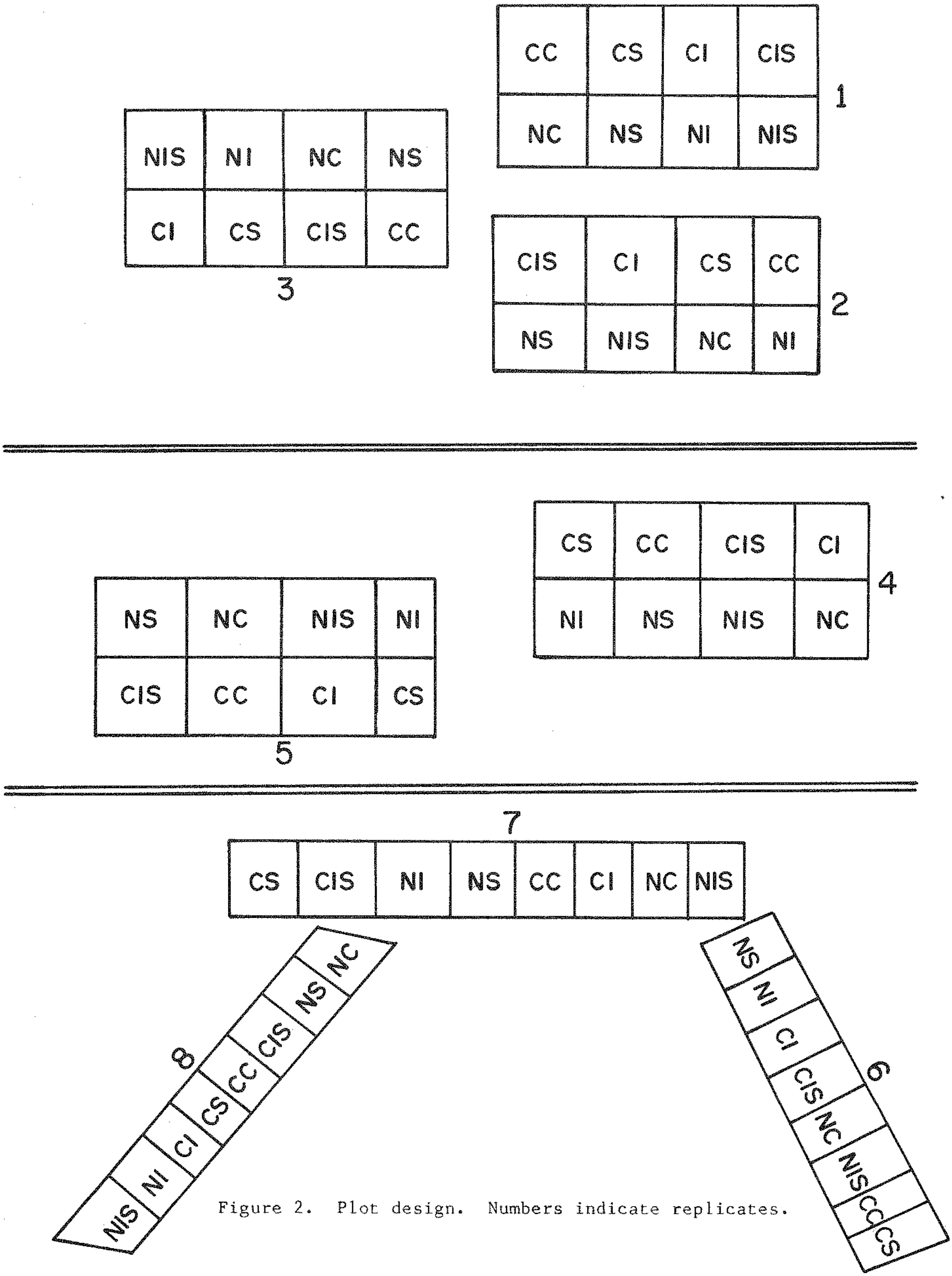

Figure 2. Plot design. Numbers indicate replicates.

were made on May 20 and 24. The boards to enclose the 100 ft^2 plot areas in the treated and control areas were set in place immediately after the nitrogen applications.

Runoff samples were collected from each pool within 24 hours after a measureable rain. Three collections were made: 1) June 12 following a 1.9-2.0 inch rain, 2) June 25 following a 0.7-0.8 inch rain, and 3) July 15 following a 1.0 inch rain. Water was also collected from the rainwater pool. The water in each pool was vigorously stirred to suspend sediments during collection. Polyethylene bottles were used to collect a one liter sample from each pool. The samples were iced immediately, returned to the laboratory, and frozen. Following sample collection, the amount of runoff water in each pool (including the rainwater pool) was measured and then discarded.

Runoff and rainwater samples were analyzed for suspended (filterable) solids by filtering 150-200 ml samples on preweighed Whatman #1 filter paper (pore size 10 μm), drying the samples to constant weight at 105 C, and weighing. Total nitrogen was determined for unfiltered and filtered (0.44 μm Milipore filter) samples. NH_3-N and NO_3-N analyses were conducted on Milipore filtered samples. NH_3-N was determined according to the phenol-hypochlorite method described in Wetzel and Likens (1983). NO_3-N was measured using an Orion NO_3 ion electrode, Model 93-07. Total nitrogen was determined using the persulfate digestion method of Raveh and Avnimelech (1979) in which DeVarda alloy is used to convert all inorganic nitrogen species to ammonia. Ammonia was then measured using the phenol-hypochlorite method. Subtraction of ammonia and nitrate values in non-digested samples from ammonia values in digested samples was used to determine organic nitrogen in the filtered samples. Subtraction of total nitrogen values of filtered samples from the total nitrogen values of unfiltered samples resulted in estimates of soil-bound nitrogen.

Unless otherwise indicated, all data are expressed as mg/100 ft^2 and were obtained using the following formulas:

Rainwater: Amt. water in rainwater pool (l) x mg/l nutrient = total mg nutrient in rainwater pool

Runoff: Amt. water in runoff pool (l) x mg/l nutrient = total mg nutrient in runoff collection pool

Total mg (runoff) - Total mg (rainwater) = mg nutrient/100 ft^2

Soil cores were taken prior to plot establishment and after each of the runoff collection dates. Cores in the N-injected plots were taken both in the injection furrow and midway between injection furrows. These samples were dried and stored and will be analyzed for NO_3-N and NH_3-N at a later date.

Results

Data from the three runoff collection dates (12 Jun, 1.9 - 2.0 inch rain; 25 Jun, 0.7 - 0.8 inch rain; and 15 Jul, 1.0 inch rain) are summarized here. All original data are presented in Appendix A. Water in the runoff collection pools exceeded that in the rainwater pools on all but 8 out of a total of 192 collections (64 pools X 3 dates). Mean runoff water volumes measured at each date were 12 Jun, 100.3 l/100 ft^2; 25 Jun, 51.0 l/100 ft^2; and 15 Jul, 48.5 l/100 ft^2.

The 12 Jun and 25 Jun collections were taken from pools draining either bare ground plots (conventional till) or wheat stubble plots (no-till).

Considerable weedy vegetation, primarily giant foxtail, developed between the 25 Jun and 15 Jul dates and covered all plots. No crop was planted in the plots nor was any further disturbance of the plots conducted after the initial tillage procedures.

Slope of the plots varied from 2.6 to 13.8%, with a mean of 8.4% (SD = 2.1%). Analysis of variance revealed that slope did not differ significantly among treatments ($P>0.05$). Multiple regression analysis was conducted to compare all measured parameters with slope, all measured parameters with amount of water runoff, and soil-bound nitrogen with soil (solids) runoff. The only significant correlations ($P<0.05$) were those obtained between soil-bound nitrogen and soil runoff at all three dates (12 Jun, $r^2 = 0.92$; 25 Jun, $r^2 = 0.67$; 15 Jul, $r^2 = 0.54$) and between soil runoff and water runoff at two dates (25 Jun, $r^2 = 0.67$; 15 Jul, $r^2 = 0.48$). Mean soil runoff from the plots on each date was 12 Jun, 281.5 g/100 ft^2; 25 Jun, 207.2 g/100 ft^2; and 15 Jul, 216.8 g/100 ft^2.

A summary of a two-way analysis of variance of the data is presented in Table 1. In general, runoff parameters (e.g., runoff water, solids, soil-bound nitrogen) were significantly affected by tillage system (at the 25 Jun and 15 Jul dates) while nitrogen parameters (e.g., NO_3-N and NH_3-N, both in amount per plot and amount per liter of runoff water) tended to be significantly affected by nitrogen application technique at all dates. Tillage-nitrogen application interactive effects were detected for NO_3-N and NH_3-N per liter on 12 Jun, for NH_3-N per 100 ft^2 on 25 Jun, and for NH_3-N per liter on 15 July.

TABLE 1. Summary of two-way ANOVA comparing measured variables with tillage system and nitrogen application method.

Date	Variable	Tillage syst.	N-appl.	Tillage X N-appl.
12 Jun	Runoff (l/100 ft^2)	*	**	NS
	Solids (g/100 ft^2)	NS	NS	NS
	NO_3-N (mg/100 ft^2)	NS	***	NS
	NH_3-N (mg/100 ft^2)	NS	***	NS
	Org. N (mg/100 ft^2)	NS	NS	NS
	Soil-bound N (mg/100 ft^2)	NS	NS	NS
	gSolids/l runoff	NS	NS	NS
	mgNO_3-N/l runoff	NS	***	**
	mgNH_3-N/l runoff	NS	***	*
25 Jun	Runoff (l/100 ft^2)	***	NS	NS
	Solids (g/100 ft^2)	***	NS	NS
	NO_3-N (mg/100 ft^2)	NS	***	NS
	NH_3-N (mg/100 ft^2)	**	***	***
	Org. N (mg/100 ft^2)	*	*	NS
	Soil-bound N (mg/100 ft^2)	***	NS	NS
	gSolids/l runoff	NS	NS	NS
	mgNO_3-N/l runoff	NS	**	NS
	mgNH_3-N/l runoff	NS	***	NS
15 Jul	Runoff (l/100 ft^2)	***	**	NS
	Solids (g/100 ft^2)	***	NS	NS
	NO_3-N (mg/100 ft^2)	NS	NS	NS
	NH_3-N (mg/100 ft^2)	NS	**	NS
	Org. N (mg/100 ft^2)	**	NS	NS
	Soil-bound N (mg/100 ft^2)	**	NS	NS
	gSolids/l runoff	*	NS	NS
	mgNO_3-N/l runoff	NS	*	NS
	mgNH_3-N/l runoff	*	**	*

* = $P<0.05$; ** = $P<0.01$; *** = $P<0.001$

Means of the runoff and nitrogen parameters for the two tillage systems at each date are presented in Table 2. Both water and soil runoff amounts were consistently greater in the conventional till plots than in the no-till plots. Water and soil runoff amounts were generally reduced at the lower rainfall dates. The amount of soil runoff per 100 ft^2 increased slightly in the conventional till plots on the 15 Jul date; this probably was due to the slight increase in the amount of soil per liter of runoff water monitored on this date. All nitrogen parameters on a per plot basis also were higher in the conventional till plots than in the no-till plots. However, in terms of mg N per liter of runoff water, no-till values tended to be slightly greater than those for the conventional till plots.

Means of the nitrogen parameters for each nitrogen application technique at each date are presented in Table 3. In every case, the highest amounts of nitrogen were present in collections from the plots surface treated with ammonium nitrate. Amounts generally decreased with time. There was a tendency for nitrogen amounts from injected plots to be greater than those from injected-stabilized plots on a per plot basis; however, nitrogen amounts on a per liter basis generally were similar between the two treatments.

Analysis of variance comparing means of nitrogen parameter and water runoff for all tillage and nitrogen application treatments is presented in Table 4. The data confirm that runoff from the surface applied nitrogen plots contained significantly higher nitrogen amounts than runoff from untreated, injected, or injected-stablized plots. Although nitrogen amounts appeared to be higher in the injected plots than in the injected-stabilized plots, the differences were not significant at the 0.05% level.

TABLE 2. Means of selected variables for runoff from conventional till and no-till systems.

	12 JUN	25 JUN	15 JUL
		--Runoff (1/100 ft^2)--	
Conventional till	121.7	77.4	72.0
No-till	78.8	24.6	25.0
		--Solids (g/100 ft^2)--	
Conventional till	424.1	351.1	376.9
No-till	138.9	63.3	56.7
		--NO_3-N (mg/100 ft^2)--	
Conventional till	1231.0	215.8	109.3
No-till	843.6	159.1	142.1
		--NH_3-N (mg/100 ft^2)--	
Conventional till	275.6	59.8	34.2
No-till	265.4	21.5	8.8
		--Organic N (mg/100 ft^2)--	
Conventional till	99.0	25.0	40.7
No-till	54.2	6.8	9.3
		--Soil-bound N (mg/100 ft^2)--	
Conventional till	416.6	428.1	374.3
No-till	235.1	70.5	89.2
		--gSolids/1 runoff--	
Conventional till	3.5	4.5	5.2
No-till	1.8	2.6	2.3
		--mgNO_3-N/1 runoff--	
Conventional till	10.1	2.8	1.5
No-till	10.7	6.5	5.7
		--mgNH_3-N/1 runoff--	
Conventional till	2.3	0.8	0.5
No-till	3.4	0.9	0.3

TABLE 3. Means of nitrogen parameters in runoff from plots with different nitrogen application methods.

	12 JUN	25 JUN	15 JUL
		--NO_3-N (mg/100 ft^2)--	
Unfertilized control	353.4	54.0	37.7
Surface application	3213.0	552.7	400.7
Injected	439.0	89.6	27.9
Injected stabilized	143.5	53.3	36.5
		--NH_3-N (mg/100 ft^2)--	
Unfertilized control	14.6	1.7	4.4
Surface application	902.4	154.2	74.3
Injected	127.7	4.6	3.7
Injected stabilized	37.3	2.2	3.7
		--Organic N (mg/100 ft^2)--	
Unfertilized control	72.6	23.9	15.7
Surface application	148.4	30.7	44.1
Injected	55.5	3.0	19.0
Injected stabilized	29.9	5.9	21.3
		--Soil-bound N (mg/100 ft^2)--	
Unfertilized control	149.5	229.1	329.6
Surface application	495.2	379.3	326.7
Injected	522.9	319.1	142.2
Injected stablized	135.8	169.7	128.3
		--mgNO_3-N/l runoff--	
Unfertilized control	2.8	1.3	0.3
Surface application	22.0	17.9	5.3
Injected	3.8	3.0	0.7
Injected stabilized	3.0	2.6	1.3
		--mgNH_3-N/l runoff--	
Unfertilized control	0.3	0.1	0.02
Surface application	6.3	2.9	0.90
Injected	1.0	0.2	0.06
Injected stabilized	1.1	0.4	0.05

TABLE 4. Means of selected variables for runoff from each combination of tillage system and nitrogen application method.*

	NO_3-N (mg/100 ft^2)	NH_3-N (mg/100 ft^2)	NO_3-N (mg/l)	NH_3-N (mg/l)	Runoff (l/100 ft^2)
12 JUN					
Conventional					
Control	462.7 a	4.7 a	2.9 a	0.04 a	141.5 a
Surface	3968.0 b	1043.0 b	27.6 b	7.39 b	137.9 a
Injected	324.3 a	23.9 a	2.2 a	0.12 a	126.1 a
Injected-st.	167.4 a	10.4 a	1.9 a	0.14 a	81.2 ab
No-till					
Control	180.7 a	22.1 a	2.6 a	0.77 a	104.6 a
Surface	2457.0 c	741.3 b	16.7 c	5.01 c	131.4 a
Injected	553.7 a	231.5 a	5.4 a	1.90 a	50.6 bc
Injected-st.	119.6 a	64.2 a	4.1 a	2.09 a	28.6 bc
25 JUN					
Conventional					
Control	83.9 a	0.6 a	1.1 a	<0.01 a	80.9 a
Surface	592.4 b	236.7 b	8.7 a	3.28 b	83.8 a
Injected	106.4 a	0.0 a	1.6 a	0.00 a	76.7 a
Injected-st.	80.4 a	0.5 a	1.6 a	0.02 a	68.4 a
No-till					
Control	24.0 a	2.7 a	1.5 a	0.28 a	39.8 b
Surface	513.1 b	70.2 c	26.4 b	2.39 ab	34.3 b
Injected	72.9 a	9.2 a	8.1 a	0.76 a	13.3 b
Injected-st.	26.2 a	3.8 a	7.9 a	0.94 a	10.9 b
15 JUL					
Conventional					
Control	70.0 a	8.8 a	0.4 a	0.04 a	91.6 a
Surface	256.0 a	113.4 b	3.9 a	1.38 b	80.7 ab
Injected	48.4 a	7.4 a	0.8 a	0.12 a	59.6 abc
Injected-st.	62.7 a	7.4 a	0.7 a	0.10 a	56.1 abc
No-till					
Control	5.4 a	0.1 a	0.2 a	<0.01 a	36.7 cd
Surface	545.4 a	35.1 a	6.8 a	0.42 a	44.5 bc
Injected	7.3 a	0.0 a	0.3 a	<0.01 a	11.6 d
Injected-st.	10.3 a	0.0 a	1.7 a	<0.01 a	7.3 d

*Values within each column for a date followed by the same letter are not significantly different (P>0.05) by the Student-Newman-Keuls method.

Table 5 shows the tillage-nitrogen application treatments according to amounts of total soluble inorganic nitrogen (NO_3-N + NH_3-N) that moved off of the plots on a pound per acre basis. The highest amount, 6.2 lbs per acre from the conventional till, surface applied nitrogen plots, accounts for approximately 3% of the 200 lbs nitrogen originally applied.

Discussion

The results of the 1985 runoff study can best be evaluated by first comparing 1985 field conditions with those in 1984 during the first year of the study (Lembi et al, 1984). In both 1984 and 1985 three runoff collections were made from the plot areas. In 1984, the first two collections were made after extremely light rainfalls of 1.4 inches and 0.2 inches. The soil at the time of these light rains was dry and much of the rainfall was absorbed, particularly in the turned up soil of the conventional till plots. In fact, runoff (in excess of rainwater) was collected from only 58 of 128 pools (64 pools X 2 dates) sampled on those two dates. The runoff that did occur was greater from the no till plots in terms of both water volume and soluble inorganic nitrogen (NO_3-N + NH_3N) content than from the conventional till plots. Soil erosion, however, was consistently greater on the conventional till plots. It was not until the third date (almost 40 days after nitrogen application) that sufficient rainfall (2.5 inches) occurred to produce heavy runoff. At that point, runoff of water, soil, and inorganic nitrogen was greater from the conventional till plots than from the no-till plots.

The rainfall pattern in 1985 was quite different from that in 1984. Between the nitrogen application dates and first collection date (a period of

TABLE 5. Amount of soluble inorganic nitrogen (NO_3-N + NH_3-N) in runoff for each tillage and nitrogen application treatment.

	mg/100 ft^2				LBS/A TOTAL	% OF INITIAL APPLICATION*
	12 JUN	25 JUN	15 JUL	TOTAL		
Conventional						
Control	467.4	84.5	78.8	630.7	0.60	0.20
Surface	5011.0	829.1	369.4	6209.5	5.96	3.00
Injected	348.2	106.4	55.8	510.4	0.49	0.20
Injected-st.	177.8	80.9	70.1	328.8	0.32	0.16
No-till						
Control	202.8	26.7	5.5	235.0	0.23	0.12
Surface	3198.3	583.3	580.5	4597.1	4.40	2.20
Injected	785.2	82.1	7.3	874.6	0.84	0.42
Injected-st.	183.8	30.0	10.3	224.1	0.22	0.11

*200 lbs/A

20-22 days), approximately 2 inches of rain fell. This rainfall was in small increments averaging 0.3 inch on each of 7 days and was rapidly absorbed by the soil. No runoff was produced on any of the plots; however, these light rains did result in water saturation of the soil by the time of the first significant rainfall at which runoff could be collected (12 Jun). The 12 Jun rain was sufficiently heavy (2 inches) to permit sample collection from all 64 pools.

The 1985 field conditions of soil saturation plus the heavier first rain at which runoff samples could be collected suggest that the runoff characteristics at the first 1985 sampling date would be more similar to those of the last 1984 sampling date at which rainfall was heaviest. In general, the 1985 data support this conclusion with runoff of water, soil, and inorganic nitrogen being greater from the conventional till plots than from the no-till plots.

After the first collection date in 1985, numerous light rains continued to occur up to and through the other two sampling dates. Between 12 Jun and 25 Jun a total of 1.5 inches fell without producing runoff; another 1.5 inches fell between 25 Jun and 15 Jul also without producing runoff. Although the actual rainfall amounts that did produce runoff on these two dates were not great (0.7-0.8 inches and 1.0 inch, respectively), the saturated ground permitted the runoff of considerably more water than ever occurred during the entire sampling period in 1984. Mean water runoff from conventional till plots on 25 Jun 1984 after a 2.5 inch rain was 29 liters per 100 ft^2. In comparison, mean runoff from the same plots on 25 Jun 1985 after a 0.7-0.8 inch rain was 72 liters per 100 ft^2.

Another factor that may have accounted for greater water runoff in the conventional till plots in 1985 was the nature of the soil surface. In 1984 these plots were plowed and disked once and at a time when the soil was wet. This resulted in an extremely cloddy, ridged surface with some plant residue present (perhaps more analogous to a chisel plow system). Although the soil dried quickly, the clods, ridges, and wheel tracks probably restricted the flow of water to the collection tube, a phenomenon also reported by Lindstrom, etal. (1981) for roughly tilled ground. In 1985 more diskings plus the use of a field cultivator after plowing left the soil pulverized, smooth, and relatively level. When wetted with continuous rains, these soil conditions produced a flat, even surface for the mass flow of water to the collection tube.

It should be noted that, as in 1984, the newly tilled conventional plots did appear to absorb a large proporation of the initial rainfall. At the 12 Jun date water runoff from the conventional till plots was only 1.5 times greater than that from the no till plots. However, on the 25 Jun and 15 Jul dates, this ratio was 3.1 and 2.9, respectively. This suggests an initial absorption by the pulverized soil in the conventional till plots, but once the ground was thoroughly wetted, the ability of the no till residues to reduce runoff velocity and increase water infiltration became apparent at the two later dates. In fact, runoff from the conventional till plots appeared to more closely reflect total rainfall amounts. Runoff from the conventional till plots on 15 Jul was reduced by only 40% in comparison to the runoff from the same plots on 12 Jun. This compares well with the 50% reduction in rainfall between these two dates. In contrast, runoff from the no till plots on 15 July was 68% less than that of no till runoff on 12 Jun.

Angle, et al. (1984) suggested that there might be a period of time in the spring when water runoff volume might be greater from no till than conventional till areas. Mannering (1984) also reported greater water runoff from no till, but this was in land tilled and planted parallel to the slope. Much of the literature reports significant decreases in water runoff from no till in relation to conventional till. McGregor and Green (1982) reported runoff reductions of more than 45% in no-till compared to conventional; Klausner, et al. (1974), 50%; and Angle, et al. (1984), 81%. Reductions of 68% at the last two dates in 1985 and 57% at the last date in 1984 in our study support these findings.

In neither year did water runoff (or any of the other variables measured) correlate with slope. This suggests that other factors within the plots had more significant effects on runoff. Some of these factors might include variability in soil texture, channel formation and drainage pattern. Variation in duration, intensity, and direction of the rainfall at the different plot sites could also account for differences.

Soil runoff was consistently greater on the conventional till plots at all three dates. On 12 Jun soil runoff amounts were 3.1 times greater from conventional than no till plots. On 25 Jun and 15 Jul these ratios were 5.5 and 6.6, respectively. Comparisons between the 12 Jun and 25 Jul dates showed only a 13% decrease in soil runoff from the conventional till plots in comparison to a 59% reduction from the no till plots. Since soil content per liter of runoff in the no till plots remained relatively constant over the three dates, the decrease in soil runoff from these plots was probably due to lower amounts of water runoff.

The looser texture of the conventionally tilled soil surface in contrast to the firmer, more solid nature of the no-till surface undoubtedly resulted in greater susceptibility of the soil to mass movement. Not only was this observed in soil runoff per plot but in the soil content per liter of runoff water which was consistently higher (statistically significant at the 15 Jul date) in the conventional till plots.

Soil loss from both conventional and no till plots in 1985 on the heavy rainfall date of 12 Jun was greater than that from the heavy rainfall date (25 Jun) of 1984. On 25 Jun 1984, 165 and 72 g soil per 100 ft^2 were lost from conventional and no till plots, respectively. On 12 Jun 1984 these values were 424 and 138 g. However, at no time did the soil runoff values from the no till plots ever approach any of the values from the conventional till plots, either in 1984 or 1985. In fact, rainfalls of approximately 1 inch in 1985 produced almost exactly the same soil runoff values as those of a 1 inch rain in 1984: 63.3 g and 56.7 g in 1985 and 63.7 g in 1984.

Mean soil loss as a total of all three sampling dates was 1152 g/100 ft^2 (1254 kg/ha) for conventional till and 258.9 g/100 ft^2 (282 kg/ha) for no till. The 78% reduction in soil loss in no till compares well with those reported in the midwest (reviewed by Gebhardt, et al., 1985), Maryland (Angle, et al., 1984), and Florida (Hoyt, et al., 1977) of 75%, 88%, and 83%, respectively. A total of 1254 kg/ha for one month (3 date total, conventional till) is reasonably realistic when compared to a year's total of 5000 kg/ha monitored for the Maumee River watershed in Indiana (Nelson, et al., 1976). In a Michigan study, Hubbard, et al., (1982) reported early spring soil losses as high as 31,000 kg/ha in April following snow melt and thaw. Runoff after tillage and planting in mid-May resulted in soil losses of 300 to 400 kg/ha in

June. Other studies, however, have demonstrated higher soil losses. Mannering (1984), for example, reported a soil loss of more than 20,000 kg/ha on a Bedford silt loam (Indiana) and 9% slope after a 2.5 inch simulated storm event. Gebhardt, et al., (1985) report soil losses of 15,000 to 20,000 kg/ha in the Pacific northwest. Although the soil loss monitored in our study was significant, it was probably not great enough to cause the loss of soil layers that would also result in the loss of injected nitrogen.

Soil-bound nitrogen in the runoff samples was positively correlated with soil runoff on all three dates for both tillage types. In addition, runoff of soil-bound nitrogen was significantly affected by tillage system (greater on conventional till) but not by nitrogen application technique. This is further evidence that greater soil loss occurred from the conventional till plots than no till plots, a phenomenon which has serious implications for the later release of nitrogen in receiving waters. However, the data suggest that the application of nitrogen had little effect on the amounts of soil-bound nitrogen. The association of the soil-bound nitrogen with soil runoff, the generally stable values for soil-bound nitrogen at all three dates (Table 3), and the lack of significant differences in soil-bound nitrogen runoff among nitrogen application techniques (including untreated) indicate that the amounts measured reflect residual values rather than the tie-up of applied nitrogen to soil particles.

A similar lack of nitrogen enrichment of soil particles from surface fertilized plots when compared to unfertilized plots was also noted in a Bedford silt loam runoff study in Indiana (Romkens, et al., 1973). As in our study, delivery of nitrogen was associated with soil runoff values.

Tillage system did not have a significant effect on the majority of inorganic nitrogen parameters monitored at the three dates. Although inorganic nitrogen runoff was generally greater from the conventionally tilled plots than from the no till plots, points occurred at which the runoff was greater from the no till plots (e.g., NO_3-N on 15 Jul). Concentrations of NO_3-N and NH_3-N in runoff water were slightly higher from no-till plots than conventional till plots on all dates (Table 2) except for NH_3-N at 15 Jul.

Nitrogen application method had a significant impact on inorganic nitrogen runoff at all three collection dates. The majority of nitrogen moving off of the plots was from the surface applications. Significant differences in runoff between conventional till surface applications and no till surface applications occurred with NO_3-N at 12 Jun and NH_3-N at the 25 Jun and 15 Jul dates (Table 4). In these cases, runoff was greater from the conventional till plots. However, no statistical difference (including a higher NO_3-N value from the no till plots on 15 Jul) between runoffs from surface applications on the two tillage types was noted for NO_3-N on 25 Jun and 15 Jul and for NH_3-N on 12 Jun. Similar variability exists among NO_3-N and NH_3-N values per liter of runoff water at the three dates.

The data for 1985 thus suggest that under certain certain conditions soluble inorganic nitrogen can move off the surface of no till areas at levels similar to those from the surface of conventional till areas. Further support can be found in the 1984 data in which the amounts of inorganic nitrogen that moved off from surface applications were significantly greater from no till than conventional till on the first two low rainfall dates. This was probably due in part to the greater water volumes that moved off these plots in contrast to conventional till plots where movement did not occur until heavier rainfall caused the mass movement of soil and water. In 1985 the light rainfalls probably worked to incorporate some of the surface applied nitrogen into the soil on both tillage types, but because the ground was saturated by the time of the first significant rainfall, the effect of the dry absorptive surface was negated. Thus, values for both tillage types were more similar and, in addition, considerably higher than in 1984. The combination of both years data suggests no clear cut advantage of no till over conventional till in relation to soluble inorganic nitrogen movement. In a dry year, more may move off of the firm no-till surface than from the conventional till surface; in a wet year, nitrogen on the surface seems to be just as susceptible to movement from a no till plot as from a conventional till plot. The only factor that may prevent nitrogen from moving off a no till area is on those occasions when water runoff is reduced.

In contrast to our study, Angle, et al. (1984) reported considerably greater relative losses of surface applied nitrogen when applied to conventional till areas as compared to no till areas. Examination of the data, however, shows NO_3-N loss, in particular, to have been closely associated with water runoff. Water runoff from no till areas was 82% less than from conventional till areas over a threeee-year period. Similarly, NO_3-N loss was 88% less in no-till than conventional. The amount of NO_3-N per liter of water at some dates, however, was only 37% less in no till than in conventional runoff.

Organic nitrogen runoff was more closely associated with tillage than with nitrogen application technique. On the 25 Jun date where nitrogen application technique did have an effect, the value of organic nitrogen from the surface applied plots was similar to that of the untreated plots. This suggests that nitrogen application probably had a minimal impact on early formation of organic residues and that organic nitrogen runoff may be more closely related to soil loss or water runoff.

Runoff of inorganic nitrogen was not significantly different at any of the dates between injected, injected stabilized, and untreated plots. In addition, no statistical difference was detected between injected and injected-stabilized treatments either within or between tillage types. The high values for NO_3-N and NH_3-N on the no till injected plots at the 12 Jun date are due to a single plot in which inorganic nitrogen runoff was 10 times greater than that for the other 7 plots. This plot also showed high levels at the 25 Jun date and may represent a misapplication of nitrogen in which the injection knives were not lowered to the proper depth.

NH_3-N values were consistently lower than NO_3-N values in terms of both runoff and concentration in the runoff water. Ratios of NO_3-N/NH_3-N in the injected and injected stablized plot runoffs varied considerably between dates but were within the range for those of the untreated plots. Ratios were also similar within sampling days between injected and injected stabilized plots. Levels of both nitrogen species decreased over time and in a manner similar to that in the untreated plots. A decrease in NH_3-N in the runoff from injected stabilized plots at the 25 Jun date and apparent (although not statistically significant) increase at the 15 Jul date (Table 3) also occurred in the untreated plots and probably reflects normal variation. It is interesting to note, however, that concentrations of inorganic nitrogen in runoff water were consistently higher (although not significant statistically) in the injected plots in comparison to the untreated plots (Table 4) and probably accounts for the slightly higher runoff values from the injected plots.

A summary comparison of the total amount of inorganic nitrogen that moved off the plots is presented in Table 5. There is no evidence that would indicate that runoff of water and soil from nitrogen injected plots moves more nitrogen than it does from untreated areas. Injected and untreated areas contributed less than 0.4% of the original nitrogen applied in contrast to 3% from surface applications. The fate of the nitrogen not recovered in the surface runoff will be explored at a later date when we analyze soil and plant samples to develop a total nitrogen budget for the plots.

Romkens, et al. (1973), in a study of runoff from five different tillage systems (including conventional but not no till), noted that fertilized plots of all systems yielded runoff water which exceeded the levels of NO_3-N (0.3 mg/l) necessary to support algal growth in lake water, as suggested by Vollenweider (1968). Similarly, in our study, runoff from all treatments contained NO_3-N levels higher than 0.3 mg/l. However, as Romkens, et al. also noted, this concentration is often encountered in runoff waters from unfertilized, nonagricultural watersheds. This was also the case in our study in which, with the exception of the no till on 15 Jul, all untreated plots released runoff with NO_3-N levels greater than 0.3 mg/l.

Because nitrate is often in high concentrations in surface waters, phosphate is considered to a more important limiting factor to algal growth. Although this is presumably the case in the enrichment of planktonic algae, certain weedy filamentous algae have been shown to be limited in some Indiana waters by nitrogen (Spencer and Lembi, 1981). A reduction of 50% of the inorganic nitrogen concentration in Surrey Lake, Indiana, for example, would provide a much greater reduction of algal growth than a 50% reduction in phosphate and could be, as suggested in Lembi, et al. (1984), obtained by shifting from a conventional till, surface applied nitrogen regime in the cropland portion of the watershed to injected nitrogen applications (if all inputs were from surface runoff). The 1985 study confirms the utility of injected treatments for reducing nitrogen inputs to surface water and can be used to illustrate the benefits of using injected rather than surface applications, even in no till systems.

Less than 6% of Indiana cropland is planted with no till (1983 data). More could be planted if problems related to weed and other pest infestations could be resolved. A part of the Madison project is devoted to developing no till systems for corn in johnsongrass infested acreage. The coinjection of ammonia with thiocarbamate herbicides (which provide seedling johnsongrass control) followed by directed postemergence herbicides for emerged johnsongrass is one of the new management systems being studied that has potential for increasing the use of no till on the severely eroded, nutrient-poor, johnsongrass-infested areas of southern Indiana and the southeastern United States. Once these systems have been developed, we will to be able to illustrate, using this study, how the reduction of nitrogen loss by injection and stabilization is not only beneficial to crop production but to the aquatic environment as well.

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APPENDIX

Key to variable names:

TILL - tillage system

1. Conventional till
2. No till

NAP - nitrogen application method

1. Untreated control
2. Surface application
3. Injected
4. Injected stabilized

SLOPE - % slope

WATER - l water/100 ft2

SOIL - g suspended solids/100 ft2

SL - g suspended solids/l runoff water

NO_3 - mg NO_3-N/100 ft^2

NH_3 - mg NH_3-N/100 ft^2

NO_3L - mg NO_3-N/l runoff water

NH_3L - mg NH_3-N/l runoff water

SOILN - mg soil-bound N/100 ft^2

ORGN - mg organic N/100 ft^2

TOTAL - total N (filtered)/100 ft^2

TOTUN - total N (unfiltered)/100 ft^2

TILL	NAP	SLOPE	WATER	SOIL	SL
1.0000	1.0000	7.3000	192.10	500.90	2.6000
1.0000	1.0000	11.300	186.40	220.40	1.2000
1.0000	1.0000	10.200	214.80	270.40	1.3000
1.0000	1.0000	7.1000	91.800	72.500	8.0000E-01
1.0000	1.0000	9.4000	161.80	258.20	1.6000
1.0000	1.0000	11.500	44.500	207.80	4.7000
1.0000	1.0000	5.6000	48.300	295.70	6.1000
1.0000	1.0000	5.2000	192.10	84.800	4.0000E-01
1.0000	2.0000	7.5000	197.80	305.90	1.5000
1.0000	2.0000	13.500	220.50	384.40	1.7000
1.0000	2.0000	9.4000	199.70	398.00	2.0000
1.0000	2.0000	7.3000	99.300	261.70	2.6000
1.0000	2.0000	7.1000	127.70	314.90	2.5000
1.0000	2.0000	11.700	91.800	52.700	6.0000E-01
1.0000	2.0000	6.3000	78.500	107.50	1.4000
1.0000	2.0000	4.6000	88.000	152.90	1.7000
1.0000	3.0000	7.5000	216.70	7248.7	33.500
1.0000	3.0000	10.400	226.20	275.20	1.2000
1.0000	3.0000	6.7000	176.90	127.40	7.0000E-01
1.0000	3.0000	6.3000	40.700	57.900	1.4000
1.0000	3.0000	8.1000	135.30	233.20	1.7000
1.0000	3.0000	8.3000	106.90	82.700	8.0000E-01
1.0000	3.0000	7.5000	57.700	164.60	2.9000
1.0000	3.0000	8.3000	48.300	42.400	9.0000E-01
1.0000	4.0000	9.0000	211.00	718.30	3.4000
1.0000	4.0000	9.8000	38.800	96.100	2.5000
1.0000	4.0000	10.800	176.90	237.30	1.3000
1.0000	4.0000	6.7000	48.300	87.300	1.8000
1.0000	4.0000	8.1000	86.100	139.90	1.6000
1.0000	4.0000	5.8000	21.800	51.100	2.3000
1.0000	4.0000	5.6000	48.300	83.600	1.7000
1.0000	4.0000	6.9000	18.000	37.300	2.1000
2.0000	1.0000	9.8000	16.100	21.400	1.3000
2.0000	1.0000	9.4000	89.900	127.00	1.4000
2.0000	1.0000	8.8000	226.20	125.60	6.0000E-01
2.0000	1.0000	6.5000	14.200	50.500	3.6000
2.0000	1.0000	9.0000	184.50	M	M
2.0000	1.0000	7.9000	31.200	81.200	2.6000
2.0000	1.0000	9.2000	86.100	124.00	1.4000
2.0000	1.0000	9.6000	188.30	15.700	8.0000E-01
2.0000	2.0000	10.200	78.500	152.90	1.9000
2.0000	2.0000	10.200	214.80	178.40	8.0000E-01
2.0000	2.0000	9.4000	214.80	802.70	3.7000
2.0000	2.0000	13.100	180.70	33.000	2.0000E-01
2.0000	2.0000	7.3000	154.20	227.10	1.5000
2.0000	2.0000	6.3000	0.0000	0.0000	0.0000
2.0000	2.0000	8.1000	29.300	57.200	2.0000
2.0000	2.0000	7.1000	178.80	95.600	5.0000E-01
2.0000	3.0000	10.800	91.800	871.30	9.5000

2.0000	3.0000	5.8000	46.400	139.60	3.0000
2.0000	3.0000	7.9000	33.100	160.10	4.8000
2.0000	3.0000	11.500	175.10	114.10	7.0000E-01
2.0000	3.0000	6.0000	33.100	111.30	3.4000
2.0000	3.0000	6.3000	10.400	45.000	4.3000
2.0000	3.0000	5.8000	10.400	40.800	3.9000
2.0000	3.0000	10.200	4.7000	M	M
2.0000	4.0000	13.800	59.600	144.40	2.4000
2.0000	4.0000	8.1000	18.000	55.400	3.1000
2.0000	4.0000	7.7000	82.300	249.90	3.0000
2.0000	4.0000	9.4000	23.700	58.900	2.5000
2.0000	4.0000	6.5000	21.800	42.600	2.0000
2.0000	4.0000	10.600	8.5000	27.700	3.2000
2.0000	4.0000	8.8000	10.400	8.0000E-01	1.0000E-01
2.0000	4.0000	8.8000	4.7000	0.0000	0.0000

TILL	NAP	NO3	NH3	NO3L	NH3L
1.0000	1.0000	314.10	13.800	1.6351	7.1838E-02
1.0000	1.0000	293.90	0.0000	1.5767	0.0000
1.0000	1.0000	1240.9	1.9000	5.7770	8.8454E-03
1.0000	1.0000	249.90	9.4000	2.7222	1.0240E-01
1.0000	1.0000	608.70	3.5000	3.7621	2.1632E-02
1.0000	1.0000	106.40	0.0000	2.3910	0.0000
1.0000	1.0000	48.900	2.9000	1.0124	6.0041E-02
1.0000	1.0000	838.60	5.9000	4.3654	3.0713E-02
1.0000	2.0000	5933.6	2363.3	29.998	11.948
1.0000	2.0000	7861.8	1627.2	35.654	7.3796
1.0000	2.0000	5929.1	132.50	29.690	6.6350E-01
1.0000	2.0000	1934.6	737.20	19.482	7.4240
1.0000	2.0000	2396.2	1009.8	18.764	7.9076
1.0000	2.0000	4355.0	888.40	47.440	9.6776
1.0000	2.0000	1496.6	M	19.065	M
1.0000	2.0000	1839.8	686.20	20.907	7.7977
1.0000	3.0000	916.20	86.100	4.2280	3.9732E-01
1.0000	3.0000	937.80	80.400	4.1459	3.5544E-01
1.0000	3.0000	127.40	7.2000	7.2018E-01	4.0701E-02
1.0000	3.0000	67.000	6.0000E-01	1.6462	1.4742E-02
1.0000	3.0000	185.30	5.5000	1.3695	4.0650E-02
1.0000	3.0000	158.40	8.1000	1.4818	7.5772E-02
1.0000	3.0000	69.000	2.9000	1.1958	5.0260E-02
1.0000	3.0000	133.60	0.0000	2.7660	0.0000
1.0000	4.0000	676.20	32.900	3.2047	1.5592E-01
1.0000	4.0000	87.800	19.300	2.2629	4.9742E-01
1.0000	4.0000	239.80	2.2000	1.3556	1.2436E-02
1.0000	4.0000	75.500	4.1000	1.5631	8.4886E-02
1.0000	4.0000	114.90	21.300	1.3345	2.4739E-01
1.0000	4.0000	19.500	1.7000	8.9450E-01	7.7982E-02
1.0000	4.0000	79.100	1.6000	1.6377	3.3126E-02
1.0000	4.0000	46.700	1.0000E-01	2.5944	5.5556E-03
2.0000	1.0000	21.200	0.0000	1.3168	0.0000

2.0000	1.0000	10.800	0.0000	1.2013E-01	0.0000
2.0000	1.0000	934.80	56.500	4.1326	2.4978E-01
2.0000	1.0000	40.300	15.200	2.8380	1.0704
2.0000	1.0000	M	M	M	M
2.0000	1.0000	241.50	99.200	7.7404	3.1795
2.0000	1.0000	132.40	6.0000E-01	1.5377	6.9686E-03
2.0000	1.0000	327.50	0.0000	1.7392	0.0000
2.0000	2.0000	559.40	151.20	7.1261	1.9261
2.0000	2.0000	3387.1	960.00	15.769	4.4693
2.0000	2.0000	3246.1	1063.6	15.112	4.9516
2.0000	2.0000	3094.3	1278.1	17.124	7.0730
2.0000	2.0000	1117.3	681.90	7.2458	4.4222
2.0000	2.0000	55.700	13.100	M	M
2.0000	2.0000	218.20	68.500	7.4471	2.3379
2.0000	2.0000	7976.5	1713.9	44.611	9.5856
2.0000	3.0000	424.40	20.900	4.6231	2.2767E-01
2.0000	3.0000	60.800	1.4000	1.3103	3.0172E-02
2.0000	3.0000	103.30	18.600	3.1208	5.6193E-01
2.0000	3.0000	3488.4	1648.6	19.922	9.4152
2.0000	3.0000	316.30	161.70	9.5559	4.8852
2.0000	3.0000	8.7000	0.0000	8.3654E-01	0.0000
2.0000	3.0000	15.800	5.0000E-01	1.5192	4.8077E-02
2.0000	3.0000	12.200	0.0000	2.5957	0.0000
2.0000	4.0000	200.30	103.90	3.3607	1.7433
2.0000	4.0000	71.200	47.400	3.9556	2.6333
2.0000	4.0000	282.30	150.80	3.4301	1.8323
2.0000	4.0000	143.90	80.200	6.0717	3.3840
2.0000	4.0000	210.60	116.20	9.6606	5.3303
2.0000	4.0000	43.400	14.800	5.1059	1.7412
2.0000	4.0000	0.0000	0.0000	0.0000	0.0000
2.0000	4.0000	5.3000	2.0000E-01	1.1277	4.2553E-02

TILL	NAP	ORG	SOILN	TOTAL	TOTUN
1.0000	1.0000	25.000	503.40	352.90	856.30
1.0000	1.0000	57.300	70.700	351.20	421.90
1.0000	1.0000	241.80	196.10	1484.6	1680.7
1.0000	1.0000	0.0000	0.0000	245.90	237.30
1.0000	1.0000	51.100	200.50	663.30	863.80
1.0000	1.0000	9.9000	168.80	116.30	285.10
1.0000	1.0000	38.700	338.00	90.500	428.50
1.0000	1.0000	377.30	0.0000	1221.8	1123.8
1.0000	2.0000	0.0000	543.60	5587.8	6131.4
1.0000	2.0000	0.0000	1085.1	7824.3	8909.4
1.0000	2.0000	1231.1	764.90	7292.7	8057.6
1.0000	2.0000	16.100	263.40	2687.9	2951.3
1.0000	2.0000	262.50	689.10	3668.5	4357.6
1.0000	2.0000	0.0000	0.0000	4996.7	4962.9
1.0000	2.0000	M	220.00	1971.8	2191.8
1.0000	2.0000	38.900	341.30	2564.9	2906.2
1.0000	3.0000	0.0000	5537.4	742.10	6279.5

1.0000	3.0000	106.90	145.80	1125.1	1270.9
1.0000	3.0000	62.900	254.00	197.50	451.50
1.0000	3.0000	75.000	40.600	142.60	183.20
1.0000	3.0000	0.0000	152.10	144.60	296.70
1.0000	3.0000	19.200	86.700	185.70	272.40
1.0000	3.0000	0.0000	227.70	54.100	281.80
1.0000	3.0000	22.300	118.80	155.90	274.70
1.0000	4.0000	232.30	707.80	941.40	1649.2
1.0000	4.0000	23.700	23.600	130.80	154.40
1.0000	4.0000	7.9000	56.700	249.90	306.60
1.0000	4.0000	0.0000	145.50	77.100	222.60
1.0000	4.0000	0.0000	131.60	0.0000	131.60
1.0000	4.0000	24.000	68.000	45.200	113.20
1.0000	4.0000	24.300	133.40	105.00	238.40
1.0000	4.0000	0.0000	115.50	44.100	159.60
2.0000	1.0000	27.100	45.200	48.300	93.500
2.0000	1.0000	32.800	213.10	43.600	256.70
2.0000	1.0000	0.0000	53.100	718.50	771.60
2.0000	1.0000	0.0000	40.500	50.700	91.200
2.0000	1.0000	M	M	M	M
2.0000	1.0000	62.100	152.00	402.80	554.80
2.0000	1.0000	0.0000	216.80	97.600	314.40
2.0000	1.0000	193.90	78.800	521.40	600.20
2.0000	2.0000	131.80	272.90	842.40	1115.3
2.0000	2.0000	0.0000	981.50	4036.6	5018.1
2.0000	2.0000	400.10	1438.9	4709.8	6148.7
2.0000	2.0000	0.0000	435.00	3257.8	3692.8
2.0000	2.0000	0.0000	304.00	1735.6	2039.6
2.0000	2.0000	0.0000	40.000	60.300	100.30
2.0000	2.0000	72.200	88.500	358.90	447.40
2.0000	2.0000	0.0000	454.80	7061.0	7515.8
2.0000	3.0000	83.700	649.80	529.00	1178.8
2.0000	3.0000	0.0000	177.00	60.200	237.20
2.0000	3.0000	0.0000	226.30	38.800	265.10
2.0000	3.0000	458.00	373.40	5595.0	5968.4
2.0000	3.0000	12.300	191.40	490.30	681.70
2.0000	3.0000	18.100	64.200	26.800	91.000
2.0000	3.0000	13.900	85.700	30.200	115.90
2.0000	3.0000	15.600	35.400	27.800	63.200
2.0000	4.0000	0.0000	131.20	292.10	423.30
2.0000	4.0000	0.0000	103.60	63.200	166.80
2.0000	4.0000	111.50	272.90	544.60	817.50
2.0000	4.0000	23.700	78.400	247.80	326.20
2.0000	4.0000	0.0000	69.900	285.50	355.40
2.0000	4.0000	9.0000	69.900	67.200	137.10
2.0000	4.0000	21.800	50.000	21.800	71.800
2.0000	4.0000	0.0000	14.300	0.0000	14.300

TILL	NAP	SLOPE	WATER	SOIL	SL
1.0000	1.0000	7.3000	140.00	1292.6	9.2000
1.0000	1.0000	11.300	104.10	890.30	8.6000
1.0000	1.0000	10.200	88.900	628.90	7.1000
1.0000	1.0000	7.1000	94.600	265.00	2.8000
1.0000	1.0000	9.4000	94.600	386.90	4.1000
1.0000	1.0000	11.500	37.900	90.000	2.4000
1.0000	1.0000	5.6000	30.300	185.40	6.1000
1.0000	1.0000	5.2000	56.800	230.10	4.1000
1.0000	2.0000	7.5000	151.40	M	M
1.0000	2.0000	13.500	102.20	462.40	4.5000
1.0000	2.0000	9.4000	106.00	300.40	2.8000
1.0000	2.0000	7.3000	56.800	211.80	3.7000
1.0000	2.0000	7.1000	98.400	288.40	2.9000
1.0000	2.0000	11.700	60.600	436.40	7.2000
1.0000	2.0000	6.3000	56.800	100.10	1.8000
1.0000	2.0000	4.6000	37.900	93.000	2.5000
1.0000	3.0000	7.5000	174.10	1166.1	6.7000
1.0000	3.0000	10.400	109.80	723.20	6.7000
1.0000	3.0000	6.7000	79.500	286.40	3.6000
1.0000	3.0000	6.3000	22.700	61.700	2.7000
1.0000	3.0000	8.1000	104.10	76.500	4.7000
1.0000	3.0000	8.3000	51.100	42.400	1.5000
1.0000	3.0000	7.5000	37.900	42.400	1.1000
1.0000	3.0000	8.3000	34.100	44.400	1.3000
1.0000	4.0000	9.0000	185.50	1004.4	5.4000
1.0000	4.0000	9.8000	66.200	174.60	2.6000
1.0000	4.0000	10.800	113.60	204.90	1.8000
1.0000	4.0000	6.7000	18.900	70.900	3.8000
1.0000	4.0000	8.1000	94.600	895.70	9.5000
1.0000	4.0000	5.8000	15.100	130.30	8.6000
1.0000	4.0000	5.6000	34.100	118.80	3.5000
1.0000	4.0000	6.9000	18.900	60.200	3.2000
2.0000	1.0000	9.8000	26.500	56.100	2.1000
2.0000	1.0000	9.4000	30.300	71.500	2.4000
2.0000	1.0000	8.8000	75.700	231.70	3.1000
2.0000	1.0000	6.5000	3.8000	23.300	6.1000
2.0000	1.0000	9.0000	60.600	107.40	1.8000
2.0000	1.0000	7.9000	7.6000	55.500	7.3000
2.0000	1.0000	9.2000	37.900	112.00	3.0000
2.0000	1.0000	9.6000	75.700	67.700	9.0000E-01
2.0000	2.0000	10.200	11.400	33.500	2.9000
2.0000	2.0000	10.200	64.300	262.70	4.1000
2.0000	2.0000	9.4000	53.000	110.90	2.1000
2.0000	2.0000	13.100	43.500	76.300	1.8000
2.0000	2.0000	7.3000	71.900	41.300	6.0000E-01
2.0000	2.0000	6.3000	3.8000	77.900	20.500
2.0000	2.0000	8.1000	3.8000	25.400	6.7000
2.0000	2.0000	7.1000	22.700	50.900	2.2000
2.0000	3.0000	10.800	22.700	104.10	4.6000

2.0000	3.0000	5.8000	26.500	36.700	1.4000
2.0000	3.0000	7.9000	13.200	31.700	2.4000
2.0000	3.0000	11.500	26.500	43.200	2.4000
2.0000	3.0000	6.0000	5.7000	35.300	1.6000
2.0000	3.0000	6.3000	11.400	19.700	6.2000
2.0000	3.0000	5.8000	0.0000	0.0000	0.0000
2.0000	3.0000	10.200	0.0000	0.0000	0.0000
2.0000	4.0000	13.800	30.300	162.90	5.4000
2.0000	4.0000	8.1000	11.400	13.800	1.2000
2.0000	4.0000	7.7000	37.900	109.90	2.9000
2.0000	4.0000	9.4000	3.8000	44.700	11.800
2.0000	4.0000	6.5000	3.8000	17.900	4.7000
2.0000	4.0000	10.600	0.0000	0.0000	0.0000
2.0000	4.0000	8.8000	0.0000	0.0000	0.0000
2.0000	4.0000	8.8000	0.0000	0.0000	0.0000

TILL	NAP	NO3	NH3	NO3L	NH3L
1.0000	1.0000	133.90	5.1000	9.5643E-01	3.6429E-02
1.0000	1.0000	74.200	0.0000	7.1278E-01	0.0000
1.0000	1.0000	97.500	0.0000	1.0967	0.0000
1.0000	1.0000	97.900	0.0000	1.0349	0.0000
1.0000	1.0000	119.10	0.0000	1.2590	0.0000
1.0000	1.0000	37.200	0.0000	9.8153E-01	0.0000
1.0000	1.0000	27.200	0.0000	8.9769E-01	0.0000
1.0000	1.0000	84.700	0.0000	1.4912	0.0000
1.0000	2.0000	M	M	M	M
1.0000	2.0000	482.00	226.70	4.7162	2.2182
1.0000	2.0000	254.00	203.30	2.3962	1.9179
1.0000	2.0000	323.30	219.30	5.6919	3.8609
1.0000	2.0000	709.40	467.90	7.2093	4.7551
1.0000	2.0000	610.30	170.10	10.071	2.8069
1.0000	2.0000	1284.5	236.40	22.614	4.1620
1.0000	2.0000	482.90	142.90	12.741	3.7704
1.0000	3.0000	281.50	0.0000	1.6169	0.0000
1.0000	3.0000	108.70	0.0000	9.8998E-01	0.0000
1.0000	3.0000	84.700	0.0000	1.0654	0.0000
1.0000	3.0000	44.700	0.0000	1.9692	0.0000
1.0000	3.0000	84.200	0.0000	8.0884E-01	0.0000
1.0000	3.0000	73.500	0.0000	1.4384	0.0000
1.0000	3.0000	110.70	0.0000	2.9208	0.0000
1.0000	3.0000	63.400	0.0000	1.8592	0.0000
1.0000	4.0000	260.20	0.0000	1.4027	0.0000
1.0000	4.0000	81.300	0.0000	1.2281	0.0000
1.0000	4.0000	55.300	0.0000	4.8680E-01	0.0000
1.0000	4.0000	19.700	0.0000	1.0423	0.0000
1.0000	4.0000	29.400	0.0000	3.1078E-01	0.0000
1.0000	4.0000	32.900	1.7000	2.1788	1.1258E-01
1.0000	4.0000	118.20	2.6000	3.4663	7.6246E-02
1.0000	4.0000	45.800	0.0000	2.4233	0.0000
2.0000	1.0000	43.500	14.900	1.6415	5.6226E-01

2.0000	1.0000	0.0000	0.0000	0.0000	0.0000
2.0000	1.0000	59.500	0.0000	7.8600E-01	0.0000
2.0000	1.0000	24.900	6.5000	6.5526	1.7105
2.0000	1.0000	0.0000	0.0000	0.0000	0.0000
2.0000	1.0000	11.100	0.0000	1.4605	0.0000
2.0000	1.0000	53.100	0.0000	1.4011	0.0000
2.0000	1.0000	0.0000	0.0000	0.0000	0.0000
2.0000	2.0000	78.500	2.0000E-01	6.8860	1.7544E-02
2.0000	2.0000	377.70	63.000	5.8740	9.7978E-01
2.0000	2.0000	323.80	36.700	6.1094	6.9245E-01
2.0000	2.0000	229.20	43.900	5.2690	1.0092
2.0000	2.0000	270.70	142.20	3.7650	1.9777
2.0000	2.0000	57.100	0.0000	15.026	0.0000
2.0000	2.0000	210.10	10.600	55.289	2.7895
2.0000	2.0000	2557.8	265.20	112.68	11.683
2.0000	3.0000	48.900	0.0000	2.1542	0.0000
2.0000	3.0000	0.0000	14.300	0.0000	5.3962E-01
2.0000	3.0000	31.800	0.0000	2.4091	0.0000
2.0000	3.0000	467.20	59.400	17.630	2.2415
2.0000	3.0000	7.3000	0.0000	1.2807	0.0000
2.0000	3.0000	27.700	0.0000	2.4298	0.0000
2.0000	3.0000	0.0000	0.0000	M	M
2.0000	3.0000	0.0000	0.0000	M	M
2.0000	4.0000	62.000	0.0000	2.0462	0.0000
2.0000	4.0000	8.9000	0.0000	7.8070E-01	0.0000
2.0000	4.0000	88.700	18.600	2.3404	4.9077E-01
2.0000	4.0000	29.500	11.500	7.7632	3.0263
2.0000	4.0000	20.800	0.0000	5.4737	0.0000
2.0000	4.0000	0.0000	0.0000	M	M
2.0000	4.0000	0.0000	0.0000	M	M
2.0000	4.0000	0.0000	0.0000	M	M

TILL	NAP	ORG	SOILN	TOTAL	TOTUN
1.0000	1.0000	75.900	929.30	214.90	1144.2
1.0000	1.0000	0.0000	1022.0	68.200	1090.2
1.0000	1.0000	0.0000	613.10	7.2000	620.30
1.0000	1.0000	109.40	3.2000	207.30	210.50
1.0000	1.0000	0.0000	297.30	98.600	395.90
1.0000	1.0000	23.400	0.0000	60.600	47.300
1.0000	1.0000	76.900	18.400	104.10	122.50
1.0000	1.0000	41.400	138.70	126.10	264.80
1.0000	2.0000	M	M	M	M
1.0000	2.0000	43.600	838.40	752.30	1590.7
1.0000	2.0000	22.000	1116.6	479.30	1595.9
1.0000	2.0000	84.400	212.70	627.00	839.70
1.0000	2.0000	51.800	331.10	1229.1	1560.2
1.0000	2.0000	0.0000	464.10	778.80	1242.9
1.0000	2.0000	0.0000	1338.6	501.10	1839.7
1.0000	2.0000	110.10	165.90	735.90	901.80
1.0000	3.0000	0.0000	1038.2	247.60	1285.8

1.0000	3.0000	0.0000	555.90	90.200	646.10
1.0000	3.0000	0.0000	615.00	4.4000	619.40
1.0000	3.0000	0.0000	82.100	0.0000	82.100
1.0000	3.0000	22.400	424.10	106.60	530.70
1.0000	3.0000	0.0000	176.90	15.700	192.60
1.0000	3.0000	0.0000	85.400	60.600	146.00
1.0000	3.0000	0.0000	105.90	0.0000	105.90
1.0000	4.0000	51.300	1410.4	311.50	1721.9
1.0000	4.0000	0.0000	248.90	29.800	278.70
1.0000	4.0000	41.600	304.20	96.900	401.10
1.0000	4.0000	0.0000	10.900	0.0000	10.900
1.0000	4.0000	0.0000	167.70	0.0000	167.70
1.0000	4.0000	2.0000	153.70	36.600	190.30
1.0000	4.0000	0.0000	91.400	105.30	196.70
1.0000	4.0000	0.0000	101.30	0.0000	101.30
2.0000	1.0000	0.0000	113.70	45.800	159.50
2.0000	1.0000	11.400	22.400	11.400	33.800
2.0000	1.0000	9.3000	146.70	68.800	215.50
2.0000	1.0000	0.0000	15.100	0.0000	15.100
2.0000	1.0000	5.5000	76.400	5.5000	81.900
2.0000	1.0000	0.0000	139.20	7.1000	146.30
2.0000	1.0000	30.000	79.600	83.100	162.70
2.0000	1.0000	0.0000	50.700	0.0000	50.700
2.0000	2.0000	0.0000	3.1000	35.200	38.300
2.0000	2.0000	0.0000	359.30	428.90	788.20
2.0000	2.0000	0.0000	340.30	89.300	429.60
2.0000	2.0000	9.4000	87.900	282.50	370.40
2.0000	2.0000	125.30	0.0000	538.20	478.20
2.0000	2.0000	0.0000	61.900	23.200	85.100
2.0000	2.0000	0.0000	46.900	145.80	192.70
2.0000	2.0000	0.0000	63.100	2466.0	2529.1
2.0000	3.0000	0.0000	79.600	0.0000	79.600
2.0000	3.0000	0.0000	196.20	0.0000	196.20
2.0000	3.0000	0.0000	0.0000	0.0000	0.0000
2.0000	3.0000	26.000	88.000	552.60	640.60
2.0000	3.0000	0.0000	47.200	0.0000	47.200
2.0000	3.0000	0.0000	10.600	17.900	28.500
2.0000	3.0000	0.0000	0.0000	0.0000	0.0000
2.0000	3.0000	0.0000	0.0000	0.0000	0.0000
2.0000	4.0000	0.0000	80.200	0.0000	80.200
2.0000	4.0000	0.0000	0.0000	0.0000	0.0000
2.0000	4.0000	0.0000	102.10	55.300	157.40
2.0000	4.0000	0.0000	44.500	3.1000	47.600
2.0000	4.0000	0.0000	0.0000	0.0000	0.0000
2.0000	4.0000	0.0000	0.0000	0.0000	0.0000
2.0000	4.0000	0.0000	0.0000	0.0000	0.0000
2.0000	4.0000	0.0000	0.0000	0.0000	0.0000

TILL	NAP	SLOPE	WATER	SOIL	SL
1.0000	1.0000	7.3000	60.600	456.40	7.5000
1.0000	1.0000	11.300	58.700	952.20	16.200
1.0000	1.0000	10.200	64.300	273.90	4.3000
1.0000	1.0000	7.1000	104.10	458.40	4.4000
1.0000	1.0000	9.4000	64.300	424.90	6.6000
1.0000	1.0000	11.500	73.800	522.60	7.1000
1.0000	1.0000	5.6000	83.300	185.20	2.2000
1.0000	1.0000	5.2000	223.30	825.70	3.7000
1.0000	2.0000	7.5000	151.40	716.10	4.7000
1.0000	2.0000	13.500	60.600	128.90	2.1000
1.0000	2.0000	9.4000	30.300	80.100	2.6000
1.0000	2.0000	7.3000	98.400	35.400	4.0000E-01
1.0000	2.0000	7.1000	71.900	73.800	1.0000
1.0000	2.0000	11.700	73.800	900.70	12.200
1.0000	2.0000	6.3000	49.200	509.40	10.400
1.0000	2.0000	4.6000	109.80	521.80	4.8000
1.0000	3.0000	7.5000	68.100	447.40	6.6000
1.0000	3.0000	10.400	34.100	118.60	3.5000
1.0000	3.0000	6.7000	34.100	141.60	4.2000
1.0000	3.0000	6.3000	17.000	15.500	9.0000E-01
1.0000	3.0000	8.1000	90.800	209.90	2.3000
1.0000	3.0000	8.3000	53.000	384.80	7.3000
1.0000	3.0000	7.5000	85.200	628.90	7.4000
1.0000	3.0000	8.3000	94.600	302.80	3.2000
1.0000	4.0000	9.0000	56.800	375.70	6.6000
1.0000	4.0000	9.8000	15.100	54.100	3.6000
1.0000	4.0000	10.800	36.000	65.600	1.8000
1.0000	4.0000	6.7000	30.300	145.80	4.8000
1.0000	4.0000	8.1000	73.800	349.00	4.7000
1.0000	4.0000	5.8000	41.600	317.40	7.6000
1.0000	4.0000	5.6000	104.10	1014.2	9.7000
1.0000	4.0000	6.9000	90.800	424.60	4.7000
2.0000	1.0000	9.8000	7.6000	13.600	1.8000
2.0000	1.0000	9.4000	18.900	100.70	5.3000
2.0000	1.0000	8.8000	22.700	52.200	2.3000
2.0000	1.0000	6.5000	0.0000	0.0000	0.0000
2.0000	1.0000	9.0000	73.800	152.80	2.1000
2.0000	1.0000	7.9000	30.300	38.100	1.3000
2.0000	1.0000	9.2000	43.500	162.80	3.7000
2.0000	1.0000	9.6000	96.500	194.40	2.0000
2.0000	2.0000	10.200	11.400	27.600	2.4000
2.0000	2.0000	10.200	36.000	124.50	3.5000
2.0000	2.0000	9.4000	15.100	93.900	6.2000
2.0000	2.0000	13.100	41.600	11.400	3.0000E-01
2.0000	2.0000	7.3000	64.300	56.300	9.0000E-01
2.0000	2.0000	6.3000	43.500	106.20	2.4000
2.0000	2.0000	8.1000	41.600	51.700	1.2000
2.0000	2.0000	7.1000	102.20	97.800	1.0000
2.0000	3.0000	10.000	5.7000	31.200	5.5000

2.0000	3.0000	5.8000	5.7000	58.600	10.300
2.0000	3.0000	7.9000	13.200	9.1000	7.0000E-01
2.0000	3.0000	11.500	0.0000	0.0000	0.0000
2.0000	3.0000	6.0000	9.5000	33.800	3.6000
2.0000	3.0000	6.3000	34.100	125.50	3.7000
2.0000	3.0000	5.8000	18.900	88.600	4.7000
2.0000	3.0000	10.200	5.7000	25.800	4.5000
2.0000	4.0000	13.800	13.200	73.400	5.6000
2.0000	4.0000	8.1000	5.7000	3.9000	7.0000E-01
2.0000	4.0000	7.7000	3.8000	18.500	4.9000
2.0000	4.0000	9.4000	7.6000	8.5000	1.1000
2.0000	4.0000	6.5000	11.400	16.600	1.5000
2.0000	4.0000	10.600	7.6000	15.000	2.0000
2.0000	4.0000	8.8000	5.6000	9.7000	1.7000
2.0000	4.0000	8.8000	3.8000	12.700	3.3000

TILL	NAP	NO3	NH3	NO3L	NH3L
1.0000	1.0000	0.0000	0.0000	0.0000	0.0000
1.0000	1.0000	0.0000	0.0000	0.0000	0.0000
1.0000	1.0000	13.100	0.0000	2.0373E-01	0.0000
1.0000	1.0000	5.7000	0.0000	5.4755E-02	0.0000
1.0000	1.0000	2.2000	0.0000	3.4215E-02	0.0000
1.0000	1.0000	14.300	0.0000	1.9377E-01	0.0000
1.0000	1.0000	65.600	8.3000	7.8751E-01	9.9640E-02
1.0000	1.0000	459.30	61.700	2.0569	2.7631E-01
1.0000	2.0000	300.80	394.10	1.9868	2.6030
1.0000	2.0000	366.30	69.200	6.0446	1.1419
1.0000	2.0000	105.50	27.100	3.4818	8.9439E-01
1.0000	2.0000	103.40	31.800	1.0508	3.2317E-01
1.0000	2.0000	100.30	17.600	1.3950	2.4478E-01
1.0000	2.0000	149.70	141.80	2.0285	1.9214
1.0000	2.0000	611.30	162.80	12.425	3.3089
1.0000	2.0000	310.70	62.900	2.8297	5.7286E-01
1.0000	3.0000	43.700	40.500	6.4170E-01	5.9471E-01
1.0000	3.0000	62.800	0.0000	1.8416	0.0000
1.0000	3.0000	17.300	9.4000	5.0733E-01	2.7566E-01
1.0000	3.0000	10.000	0.0000	5.8824E-01	0.0000
1.0000	3.0000	16.200	0.0000	1.7841E-01	0.0000
1.0000	3.0000	21.200	0.0000	4.0000E-01	0.0000
1.0000	3.0000	214.50	8.9000	2.5176	1.0446E-01
1.0000	3.0000	1.6000	0.0000	1.6913E-02	0.0000
1.0000	4.0000	25.500	17.600	4.4894E-01	3.0986E-01
1.0000	4.0000	0.0000	0.0000	0.0000	0.0000
1.0000	4.0000	12.200	0.0000	3.3889E-01	0.0000
1.0000	4.0000	0.0000	0.0000	0.0000	0.0000
1.0000	4.0000	0.0000	0.0000	0.0000	0.0000
1.0000	4.0000	7.4000	0.0000	1.7788E-01	0.0000
1.0000	4.0000	9.6000	1.7000	9.2219E-02	1.6330E-02
1.0000	4.0000	446.70	39.900	4.9196	4.3943E-01
2.0000	1.0000	0.0000	0.0000	0.0000	0.0000

2.0000	1.0000	9.1000	0.0000	4.8148E-01	0.0000
2.0000	1.0000	0.0000	0.0000	0.0000	0.0000
2.0000	1.0000	0.0000	0.0000	M	M
2.0000	1.0000	11.300	0.0000	1.5312E-01	0.0000
2.0000	1.0000	0.0000	0.0000	0.0000	0.0000
2.0000	1.0000	22.800	9.0000E-01	5.2414E-01	2.0690E-02
2.0000	1.0000	0.0000	0.0000	0.0000	0.0000
2.0000	2.0000	26.500	0.0000	2.3246	0.0000
2.0000	2.0000	125.90	0.0000	3.4972	0.0000
2.0000	2.0000	5.9000	0.0000	3.9073E-01	0.0000
2.0000	2.0000	24.400	0.0000	5.8654E-01	0.0000
2.0000	2.0000	103.90	37.900	1.6159	5.8942E-01
2.0000	2.0000	22.800	14.900	5.2414E-01	3.4253E-01
2.0000	2.0000	396.20	15.800	9.5240	3.7981E-01
2.0000	2.0000	3657.9	212.40	35.792	2.0783
2.0000	3.0000	10.500	0.0000	1.8421	0.0000
2.0000	3.0000	0.0000	0.0000	0.0000	0.0000
2.0000	3.0000	0.0000	0.0000	0.0000	0.0000
2.0000	3.0000	0.0000	0.0000	M	M
2.0000	3.0000	0.0000	0.0000	0.0000	0.0000
2.0000	3.0000	0.0000	0.0000	0.0000	0.0000
2.0000	3.0000	48.000	0.0000	2.5397	0.0000
2.0000	3.0000	0.0000	0.0000	0.0000	0.0000
2.0000	4.0000	M	M	M	M
2.0000	4.0000	0.0000	0.0000	0.0000	0.0000
2.0000	4.0000	22.200	0.0000	5.8421	0.0000
2.0000	4.0000	7.8000	0.0000	1.0263	0.0000
2.0000	4.0000	0.0000	0.0000	0.0000	0.0000
2.0000	4.0000	41.900	0.0000	5.5132	0.0000
2.0000	4.0000	0.0000	0.0000	0.0000	0.0000
2.0000	4.0000	0.0000	0.0000	0.0000	0.0000

TILL	NAP	ORG	SOILN	TOTAL	TOTUN
1.0000	1.0000	36.600	468.00	36.600	504.60
1.0000	1.0000	2.0000	748.50	2.0000	750.50
1.0000	1.0000	45.000	305.10	58.100	363.20
1.0000	1.0000	69.100	384.80	74.800	459.60
1.0000	1.0000	0.0000	0.0000	0.0000	0.0000
1.0000	1.0000	M	M	M	M
1.0000	1.0000	31.600	354.20	105.50	459.70
1.0000	1.0000	0.0000	1906.5	273.60	2180.1
1.0000	2.0000	182.10	1021.1	877.00	1898.1
1.0000	2.0000	0.0000	283.50	412.80	696.30
1.0000	2.0000	8.8000	101.90	141.40	243.30
1.0000	2.0000	32.300	M	167.50	M
1.0000	2.0000	110.70	17.700	228.60	246.30
1.0000	2.0000	M	M	M	M
1.0000	2.0000	14.700	241.00	788.80	1029.8
1.0000	2.0000	76.700	865.00	450.30	1315.3
1.0000	3.0000	77.300	365.70	161.50	527.20

1.0000	3.0000	3.3000	79.400	66.100	145.50
1.0000	3.0000	M	M	M	M
1.0000	3.0000	0.0000	0.0000	0.0000	0.0000
1.0000	3.0000	140.70	194.30	156.90	351.20
1.0000	3.0000	0.0000	513.30	0.0000	513.30
1.0000	3.0000	0.0000	291.70	205.60	497.30
1.0000	3.0000	M	M	M	M
1.0000	4.0000	65.700	359.50	108.80	468.30
1.0000	4.0000	0.0000	0.0000	0.0000	0.0000
1.0000	4.0000	0.0000	176.90	0.0000	176.90
1.0000	4.0000	0.0000	179.40	0.0000	179.40
1.0000	4.0000	8.6200	125.98	8.6200	134.60
1.0000	4.0000	21.900	452.80	29.300	482.10
1.0000	4.0000	M	M	M	M
1.0000	4.0000	175.90	380.70	662.50	1043.2
2.0000	1.0000	0.0000	0.0000	0.0000	0.0000
2.0000	1.0000	0.0000	60.800	8.1000	68.900
2.0000	1.0000	10.700	87.500	10.700	98.200
2.0000	1.0000	0.0000	0.0000	0.0000	0.0000
2.0000	1.0000	29.400	104.90	40.700	145.60
2.0000	1.0000	0.0000	47.300	0.0000	47.300
2.0000	1.0000	0.0000	211.30	0.0000	211.30
2.0000	1.0000	0.0000	0.0000	0.0000	0.0000
2.0000	2.0000	3.1000	23.100	29.600	52.700
2.0000	2.0000	0.0000	124.90	79.500	204.40
2.0000	2.0000	0.0000	158.20	0.0000	158.20
2.0000	2.0000	62.500	90.100	86.900	177.00
2.0000	2.0000	126.90	98.100	268.70	366.80
2.0000	2.0000	M	M	M	M
2.0000	2.0000	0.0000	64.300	387.20	451.50
2.0000	2.0000	0.0000	1063.3	1969.9	3033.2
2.0000	3.0000	0.0000	0.0000	0.0000	0.0000
2.0000	3.0000	0.0000	82.200	0.0000	82.200
2.0000	3.0000	0.0000	0.0000	0.0000	0.0000
2.0000	3.0000	0.0000	0.0000	0.0000	0.0000
2.0000	3.0000	0.0000	35.800	0.0000	35.800
2.0000	3.0000	M	M	M	M
2.0000	3.0000	0.0000	117.50	35.400	152.90
2.0000	3.0000	7.2000	70.800	7.2000	78.000
2.0000	4.0000	M	M	M	M
2.0000	4.0000	2.1000	27.000	2.1000	29.100
2.0000	4.0000	5.0000E-01	21.000	22.700	43.700
2.0000	4.0000	13.100	0.0000	20.900	0.0000
2.0000	4.0000	6.1000	50.800	6.1000	56.900
2.0000	4.0000	0.0000	0.0000	20.600	0.0000
2.0000	4.0000	0.0000	4.6000	0.0000	4.6000
2.0000	4.0000	M	M	M	M