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Impacts of Nitrogen Management Systems on Water Quality

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Comments
Objectives of the Study:

1. To determine the impacts on water quality of recommended application rates of swine manure, based on nitrogen uptake requirements of crops.
2. To study the long-term effects of over-application of swine manure on nitrogen leaching to groundwater.
3. To study the long-term effects of spring and fall injection methods of swine manure application on crop yields, and nitrogen, in surface runoff and shallow groundwater.
4. To develop and recommend appropriate manure and nutrient management practices to reduce the water contamination potential from manure and UAN applications and enhance the use of swine manure as an alternative to the use of inorganic fertilizers for Iowa's sustainable agriculture.

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Progress Report for the Year 2000

New field experiments were initiated Fall 1999 to demonstrate the impacts of six nitrogen and phosphorus management systems on crop yields and water quality. Table 1 gives a brief history of the past and current crop and nutrient treatments imposed on 36 one-acre plots.

The data given in Tables 1 through 3 are from the first year of the study. Table 2 gives yearly average NO_3-N concentrations in the tile water, yearly NO_3-N losses with tile water and total N removed by the grain. System #4, with application of 150 lbs-N/ac from swine manure, resulted in the highest yearly average NO_3-N concentration of 38.8 mg/l in tile water. The main reason for this high NO_3-N concentration in tile water was that these plots were under continuous corn from 1993 to 1998 and received continuous applications of swine manure during the past six years. Table 3 shows that System #4 with fall manure application resulted in the lowest corn yield of 153.5 bu/ac but the highest soybean yield of 71 bu/ac. Again, these yields are affected by the past management history of these plots. Table 3 also gives NO_3-N concentrations in the basal corn stalk in the fall and in the soil in the springtime, respectively.

The highest values of the corn stalk tests are associated with the highest corn yields, but trends are not consistent. Data in Table 3 indicate that four out of six treatments had adequate availability of nitrogen in the top foot of the soil profile in late springtime. The LCD treatments indicated a serious need for additional application of nitrogen in the springtime.

Table 1. Experimental treatments for the Nashua Water Quality Study.

		1999 Crop plan		2000 Crop plan			
CROP	SYS	TILLAGE	N-MANAGEMENT	TILLAGE	N-MANAGEMENT	SYS	CROP
Soybean	1	No-tillage, drilled beans	None	No-tillage, drilled beans	150# Single application UAN or Urea	1	Corn
Corn	1	No-tillage, row cleaners	25 lb/A Urea + LSNT 28% Applied 158# N	No-tillage, row cleaners		1	Soybean
Soybean	2	No-tillage, drilled beans	None	Chisel stover drilled beans	Spring manure 150#N	6	Corn
Corn	2	No-tillage, row cleaners	25 lb/A Urea + 125 lb/A 28% Split application	Field cultiv. soy residue		6	Soybean
Soybean	3	Chisel stover drilled beans	None	Chisel stover drilled beans	LCD 150 lb/A	5	Corn
Corn	3	Field cultiv. soy residue	25 lb/A Urea + 125 lb/A 28% Split application	Field cultiv. soy residue		5	Soybean
Soybean	4	Chisel stover drilled beans	None	Chisel stover drilled beans	Fall manure P Based w/N supplement	3	Corn
Corn	4	Field cultiv. soy residue	Spring manure application 150 lb N/A	Field cultiv. soy residue		3	Soybean
Soybean	5	Chisel stover drilled beans	None	Chisel stover drilled beans	Fall manure 150 # N based	2	Corn
Corn	5	Chisel plow soy residue	Fall manure application 150 lb N/A 3200 gal	Field cultiv. soy residue		2	Soybean
Cont. Corn	6	Chisel plow	Fall manure application Based on 170 # N 4000 gal resulted in 120# N Applied 50#N UAN in spring	Chisel stover	Manure each year Excessive P	4	Corn
Cont. Corn	7	Chisel plow	Fall manure application Based on P needs 3200 gal 170# N goal 93#N resulted in fall 77#N UAN applied spring	Chisel stover drilled beans	Manure each year Excessive P	4	Soybean

Table 2. Nitrogen rates, NO_3-N concentrations, NO_3-N Losses and total N removed by grain at the Nashua Water Quality site.

Systems	Experimental Treatments	N rate, lb/ac	Yearly Average NO_3-N Conc. mg/l	Yearly Average NO_3-N Loss, lbs/A	lbs. N Removed by Grain
1	Spring preplant spoke injected UAN at 150 lb N/acre	150	21.82	8.1	95.8
2	Fall inject swine manure at 150 lb N/ac	169.6	17.98	10.7	99.0
3	P from fall manure + Sidedress spoke inject UAN = to give total of 150 lb N/ac	99.8	16.62	1.9	92.0
4	Fall inject swine manure at 150 lb N/ac	185.4	38.76	13.1	88.1
5	Sidedress inject UAN with LCD at 150 lb N/ac	150	11.90	5.3	94.8
6	Spring inject swine manure at 150 lb N/ac	112.6	14.55	10.2	86.3

Table 3. Corn and soybean yields, basal stalk test, and LSNT for various N treatments.

System	Experimental Treatments	Corn yield, Bu/ac	Soybean yield, Bu/ac	Average stalk NO_3-N conc. ppm	LSNT soil test Conc, ppm
1	Spring preplant spoke injected UAN at 150 lb N/acre	163.6	54.9	283.7	23
2	Fall inject swine manure at 150 lb N/ac	170.5	57.5	1021.7	26
3	P from fall manure + Sidedress spoke inject UAN = to give total of 150 lb N/ac	166.2	58.4	182.1	19
4	Fall inject swine manure at 150 lb N/ac	153.5	71.0	307.7	24
5	Sidedress inject UAN with LCD at 150 lb N/ac	161.3	58.00	181.5	10
6	Spring inject swine manure at 150 lb N/ac	159.2	53.9	20	20