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Impact of Liquid Swine Manure Application and Cover Crops on Ground Water Quality

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Abstract
The primary design ofthis project isto determine the impact of appropriate rates of swine manure applications to corn and soybeans based on nitrogen and phosphorus requirements, crop yields, soil phosphorus accumulation, and nitrate and phosphorus leaching to groundwater. Another purpose of this design is to develop and recommend appropriate manure and nutrient management practices to producers to minimize the water contamination potential and enhance the use of swine manure as an organic fertilizer. A third component is to determine the potential effects of rye as a cover crop to reduce nitrate loss to shallow ground water.

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Introduction

The primary design of this project is to determine the impact of appropriate rates of swine manure applications to corn and soybeans based on nitrogen and phosphorus requirements, crop yields, soil phosphorus accumulation, and nitrate and phosphorus leaching to groundwater. Another purpose of this design is to develop and recommend appropriate manure and nutrient management practices to producers to minimize the water contamination potential and enhance the use of swine manure as an organic fertilizer. A third component is to determine the potential effects of rye as a cover crop to reduce nitrate loss to shallow ground water.

Materials and Methods

Table 1 identifies the treatments established in 2007 on 36, one-acre plots. Five treatments compare the effect of timing and source of N on subsurface drain water quality and crop yields in a corn-soybean rotation and two treatments compare the effect of manure use on water quality under continuous corn rotation with and without stover removal. The spring applied UAN (urea-ammonium nitrate) and fall applied manure are the only treatments using no-till and the rest of the treatments use fall chisel plow as method of tillage.

Results and Discussion

Effect of nutrient management treatments on NO_3-N concentration in subsurface drain water is shown in Table 2. It summarizes experimental results of the yearly average NO_3-N concentrations for years 2007 through 2008. Two-year average NO_3-N concentrations in tile water from plots under continuous corn and receiving swine manure every year (system 4) were the highest compared with other treatments/systems. System 3, which received fall swine manure for both corn and soybean crops, gave the highest NO_3-N concentrations in tile water in comparison with other systems under corn-soybean rotation (Systems 1, 2, 5, and 6). Two systems (Systems 1 and 5) receiving UAN resulted in the lowest NO_3-N concentrations in tile water. Overall, the two year experimental data show that nitrate concentrations in tile water from Treatment 1 without a cover crop and Treatment 5 with a cover crop were very similar to each other, however, these two treatments need to be evaluated over a range of weather patterns for the next three to four years.

The effect of source and timing of nitrogen application on corn and soybean yields for 2007 and 2008 are shown in Figure 1. The spring UAN application of 150 lb N/acre resulted in the highest average corn yield of 199 bushels/acre compared to other systems. Potential benefits from spring N application can be observed from corn yield data for Systems 1 and 5 with UAN applications. All plots under continuous corn with stover removal produced the lowest corn yields, which was an interesting outcome of this study. Our next step would be to identify reasons for the results from this study. Soybean yields from Systems 2 and 3 receiving swine manure resulted in highest average soybean yield of 67 bushels/acre.

Table 1. Experimental treatments for Nashua water quality study.

System	Timings and source of N	Crop	Tillage	Application method	Rate, lb/acre N-based	Rate, lb/acre P-based
1	Spring (UAN)	Corn	Chisel plow	Spoke inject	150	As needed
	-	soybean	Field cultivate	-	-	As needed
2	Fall (manure)	Corn	Chisel plow	Inject	150	-
	-	soybean	Field cultivate	-	-	As needed
3	Fall (manure)	Corn	Chisel plow	Inject	150	-
	Fall (manure)	soybean	Field cultivate	Inject	100	-
4	Fall (manure)	Cont. corn	Chisel plow	Inject	200	As needed
4	Fall (manure)	Cont. corn Stover removal	Chisel plow	Inject	200	As needed
5	Spring (UAN)	Corn/rye cover	NT	Spoke inject	150	-
	-	Soybean/rye cover	NT	-	-	As needed
6	Fall (manure)	Corn	NT	Inject	150	-
		soybean	NT	-	-	As needed

Table 2. Effects of experimental treatments on flow weighted average NO_3-N concentrations in drainage water.

NO_3-N conc. in tile water, mg/l	2007		2008		2007–2008	
Experimental treatments	CS	SC	CS	SC	CS	SC
1. Spring spoke inject UAN 150 lb N/acre	10.1	11.7	15.1	8.0	12.6	9.9
2. Fall manure 150 lb N/acre	15.9	11.8	17.7	8.3	16.8	10.1
3. Fall manure 150 lb N/acre to corn and 100 lb N/acre to soybean	13.4	12.8	20.3	14.2	16.9	13.5
4.1 Fall manure 200 lb N/acre	21.6		23.1		21.6	
4.2. Fall manure 200 lb N/acre + stover removal	23.4		23.0		23.4	
5. Spring spoke UAN 150 lb N/acre + rye removal	9.6	11.5	12.4	8.7	10.9	10.1
6. Spring manure 150 lb N/acre	14.8	7.9	15.3	8.9	15.1	8.4

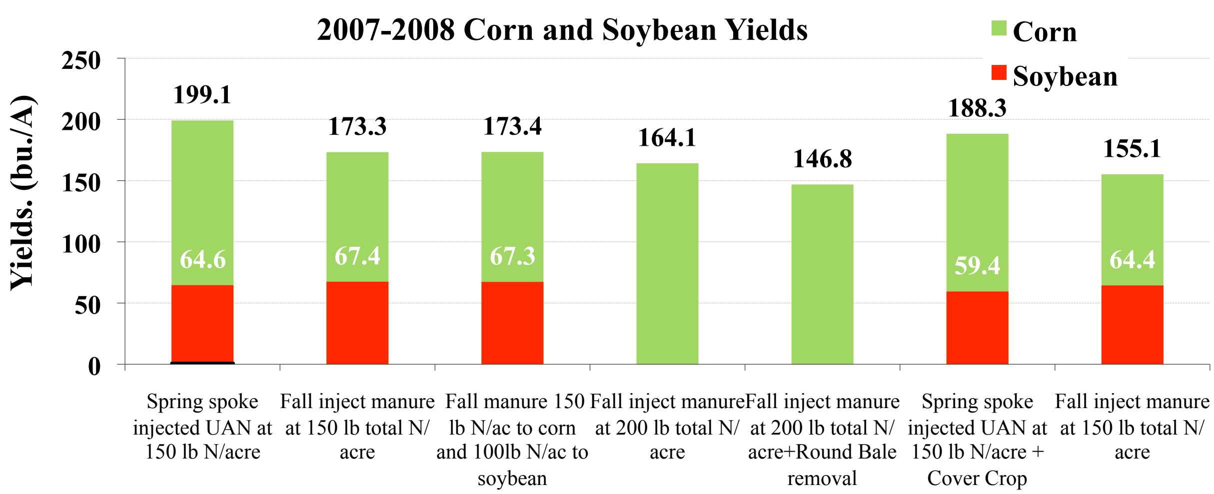

Figure 1. Corn and soybean crop yields for years 2007–2008.