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

Carl H. Pederson
Iowa State University, carl@iastate.edu

Rameshwar S. Kanwar
Iowa State University, rskanwar@iastate.edu

Matthew J. Helmers
Iowa State University, mhelmers@iastate.edu

Antonio P. Mallarino
Iowa State University, apmallar@iastate.edu

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Abstract

The primary design of this project was to determine the impact of appropriate rates of swine manure applications to corn and soybeans based on nitrogen and phosphorus requirements on crop yields, soil phosphorus accumulation, and nitrate and phosphorus leaching to groundwater. Another purpose of this design was 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 inorganic fertilizer. A third component was to determine the potential effects of rye as a cover crop to reduce nitrate loss to shallow ground water.

Keywords

RFR A10111, Agricultural and Biosystems Engineering, Agronomy

Disciplines

Agricultural Science | Agriculture | Agronomy and Crop Sciences | Bioresource and Agricultural Engineering

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

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Carl Pederson, ag specialist
Ramesh Kanwar, professor
Matt Helmers, assistant professor
Department of Agricultural and Biosystems Engineering
Antonio Mallarino, professor
Department of Agronomy

Introduction

The primary design of this project was to determine the impact of appropriate rates of swine manure applications to corn and soybeans based on nitrogen and phosphorus requirements on crop yields, soil phosphorus accumulation, and nitrate and phosphorus leaching to groundwater. Another purpose of this design was 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 inorganic fertilizer. A third component was 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 compared the effect of timing and source of N on subsurface drain water quality and crop yields in a corn-soybean rotation and two treatments compared the effect of manure use on water quality under continuous corn rotation with and without stover removal. The spring applied UAN (urea-ammonium nitrate) with cover crop and fall applied manure are the only treatments using no-till and the rest of the treatments used fall chisel plow as method of tillage following corn.

Results and Discussion

Effect of nutrient management treatments on NO_3-N concentration in subsurface drain water is summarized in Table 2. Four-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 in comparison 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 (1 and 5) receiving UAN resulted in the lowest NO_3-N concentrations in tile water. Overall, the four year experimental data show that nitrate concentrations in tile water from Treatment 1 without a cover crop was slightly higher than from Treatment 5 with a cover crop, but these two treatments need to be evaluated over a range of weather patterns for the next five to six years.

The effect of source and timing of nitrogen application on corn and soybean yields for 2007 through 2010 are shown in Figure 1. The spring UAN application at 150 lb N/acre resulted in the highest average corn yield of 203.8 bushels/acre compared with other systems. Treatments 2 and 3 had higher yields than Treatment 5. The 200-lb N/acre plots under continuous corn with and without stover removal produced the lowest corn yields, which was an interesting outcome of this study. Our next step will be to identify reasons for these research results from this study. Soybean yields from Systems 2 and 3 receiving swine manure resulted in the highest average soybean yields of 66 bushels/acre

Table 1. Experimental treatments for Northeast Research Farm 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	-
4.1	Fall (manure)	Cont. corn	Chisel plow	Inject	200	As needed
4.2	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		2009		2010		2007-2010	
Experimental treatments	C	S	C	S	C	S	C	S	C	S
1. Spring UAN 150 lb N/ac	10.1	11.7	15.1	8.0	12.1	9.5	12.3	8.0	12.4	9.3
2. Fall manure 150 lb N/ac	15.9	11.8	17.7	8.3	19.8	10.3	12.8	8.4	16.6	9.7
3. Fall manure 150 lb N corn and 100 lb N soybean	13.4	12.8	20.3	14.2	20.2	11.1	16.1	14.0	17.5	13.0
4.1. Fall manure 200 lb N/ac	20.0	--	23.1	--	20.9	--	15.1	--	19.8	--
4.2. Fall manure 200 lb N/ac + stover removal	23.9	--	23.0	--	17.6	--	16.0	--	20.1	--
5. Spring UAN 150 lb N/ac + rye removal	9.6	11.5	12.3	8.6	8.9	8.3	10.4	4.4	10.3	8.2
6. Fall manure 150 lb N/ac	14.8	7.9	15.3	8.9	15.8	8.3	12.8	8.0	14.7	8.3

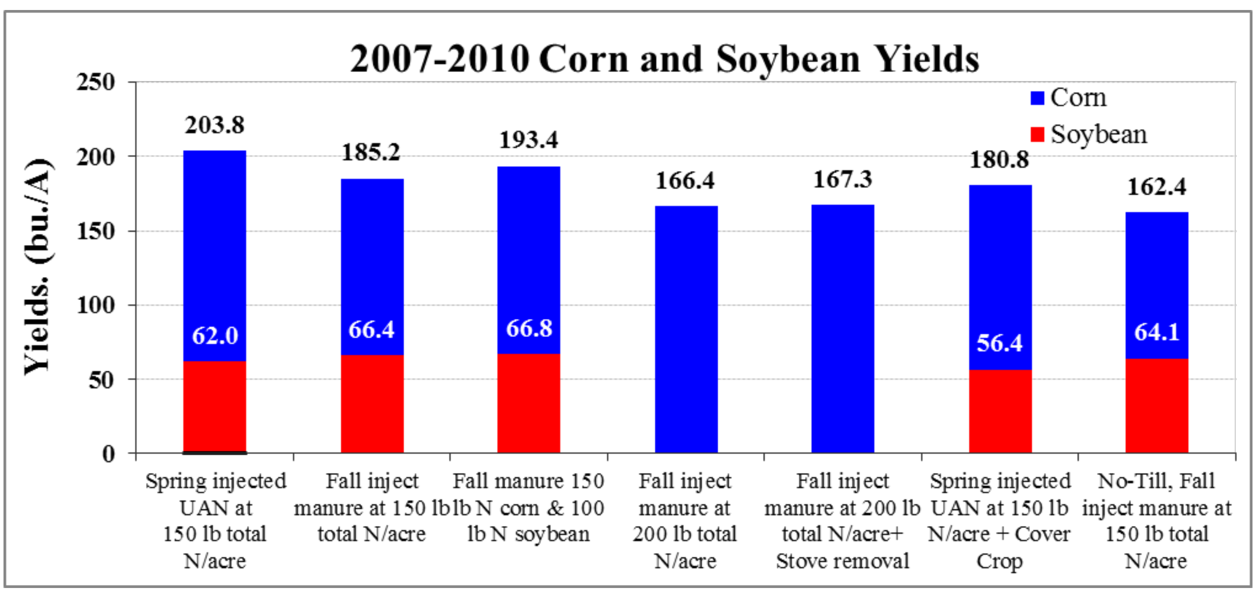

Figure 1: **Corn and Soybean crop yields for years 2007-2010**.