Drainage Water Quality Impacts of Agricultural Management Practices: Effect of Manure Application Timing and Cover Crops

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Introduction

A primary objective of this study is to evaluate the impact of various cropping and nutrient management systems on crop yields and drainage water quality. This progress report only includes the first-year corn grain yield results. Treatment comparisons include the impact of early fall vs. late fall vs. spring application of liquid swine manure, nitrification inhibitor with late fall swine manure application, cereal rye cover crop, and gypsum application. These comparisons will be conducted for multiple years and used to develop appropriate manure and nutrient management practices to minimize water contamination potential and enhance the use of swine manure as a nutrient resource.

Materials and Methods

Table 1 lists the treatments established in the fall of 2015 on 36, one-acre plots at the ISU Northeast Research Farm, Nashua, Iowa, water quality drainage site. Two treatments compare timing of liquid swine manure application with corn in a corn-soybean rotation. Four treatments compare the effect of manure application timing with continuous corn, with and without a nitrification inhibitor, and with and without a high gypsum application rate. Two treatments compare a fall early manure application with corn in a corn-soybean rotation, with and without a cereal rye cover crop. The fall early manure with and without cover crop, and early fall and fall late manure treatments are no-till, and the rest of the treatments are fall chisel plowed.

Results and Discussion

Table 2 gives the monthly precipitation for the 2016 growing season. This was the wettest year at the Northeast Research Farm (NERF) since recordkeeping began in 1976, and exceeds yearly rainfall totals from the National Weather Service station in Charles City, Iowa, going back to 1951. June and September were unusually wet compared with the historical average.

Table 3 gives the treatment effects on grain yield of corn rotated with soybean for 2016. Soybean yields are not reported due to 2016 being a transition year to different nitrogen (N) management practices. Plots receiving late fall manure (System 6) had a statistically greater corn yield than those receiving early fall manure (System 2). The highest average corn yield of 228 bushels/acre was achieved with spring UAN application and conventional tillage (System 1). Early fall manure on no-till plots (System 2) had a yield of 168 bushels/acre. In comparison, early fall manure on no-till plots with a rye cover crop (System 5) had a statistically significant yield decrease, with average yields of 142 bushels/acre. It should be noted the fall of 2015 was wetter than average, as was June, so the early fall manure application may have had more of a corn yield issue in 2016 than in years with normal rainfall.

Table 4 gives the yield results for the continuous corn in 2016. Spring manure application (System 3b) resulted in a statistically significant higher corn yield compared with late fall manure application (System 4a), 224 and 187 bushels/acre, respectively. Late fall manure plus the Instinct nitrification inhibitor (System 3a) had higher yield on average than with no inhibitor (System 4a). However, System 3a is in transition from a corn-soybean rotation to continuous corn so there may have been a rotation effect from the 2015 soybean crop compared with continuous corn. There was no difference in corn yield with the 1 ton/acre gypsum application (System 4b) compared with no gypsum (System 4a).

These are preliminary results based on the first year of study. Corn yields will continue to be monitored in 2017 and 2018 to get a better estimate of differences due to manure application timing, cover crops, nitrification inhibitor, and gypsum treatments over a range of weather conditions.

Table 1. Experimental treatments for ISU Northeast Research Farm manure management and water quality study beginning fall of 2015.†

System	Application timings and source of N	Crop in 2016	Plot	Tillage	Nitrogen application rate, lb/ac
1	Spring UAN	Corn	29,10,15	Chisel plow	150
		Soybean	28,3,24	Field cultivate	-
2	Early fall manure	Corn	30,1,7	No-till	150
		Soybean	27,11,23	No-till	-
3a	Late fall manure + Instinct	Continuous Corn	18,4,33	Chisel plow	200
3b	Spring manure	Continuous Corn	32,6,36	Chisel plow	200
4a	Late fall manure	Continuous Corn	21,5,26	Chisel plow	200
4b	Late fall manure + gypsum at 1 ton/ac	Continuous Corn	22,13,35	Chisel plow	200
5	Early fall manure	Corn + rye cover	19,9,8	No till	150
		Soybean + rye cover	17,12,34	No till	-
6	Late fall manure	Corn	20,2,16	No till	150
		Soybean	31,14,25	No till	-

†Phosphorus fertilizer is applied as needed according to soil testing to Systems 1, 2, 5, and 6. Potassium is applied as needed according to soil testing to all systems.

Table 2. Precipitation during the 2016 growing season at the ISU Northeast Research Farm,Nashua, IA.

	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Total
Precip. (in.)	2.34	3.04	11.62	6.05	7.32	14.91	2.32	1.32	48.92
30-yr avg	3.88	4.44	5.40	4.75	4.37	2.64	2.47	1.75	29.70

Table 3. Corn yield data for the 2016 crop year for corn-soybean rotation systems.

System	1	2	5	6
Crop rotation	CS	CS	CS	CS
Yield, bu/ac	228a	168c	142d	194b

Different letters denote significant yield differences at the P < 0.05 level.
CS = corn phase of corn-soybean rotation.

Table 4. Corn yield data for the 2016 crop year for continuous corn systems.

System	3a	3b	4a	4b
Crop rotation	CC	CC	CC	CC
Yield, bu/ac	211*	224a	187b	179b

*Treatment 3a was planted to soybean in 2015 so it was not included in the statistical analysis due to possible rotation effects. Lowercase letters denote significant yield differences at the P < 0.05 level.
CC = continuous corn rotation.