Impact of 4R Management on Crop Production and Nitrate-Nitrogen Loss in Tile Drainage

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Matthew Helmers, professor
Department of Agricultural
and Biosystems Engineering
John Sawyer, professor
Department of Agronomy
Carl Pederson, agricultural specialist
Department of Agricultural
and Biosystems Engineering

Introduction

Corn Belt corn and soybean producers are increasingly challenged to maximize crop production while addressing the contributions farm practices make to Gulf hypoxia. Based on the need for nitrate-N reductions in surface water systems to meet water quality goals, new management practices are needed to reduce nitrate-N losses at minimal cost and maximum economic benefits. This three-year field research and demonstration project is evaluating various promising N management methods and technologies by documenting the nitrate-N export and crop yield from various systems.

Materials and Methods

The project objectives are being implemented at a new drainage facility in northwest Iowa (Sutherland). The site had tile drainage installed in 2013. In 2014, the study site was uniformly cropped, with treatments implemented for the 2015 growing season. The site has 32 individually subsurface drained plots for drainage water quality evaluation. Drainage lines from individual plots are directed to separate collection sumps, where drainage is diverted for water sampling.

Each treatment is replicated four times. Treatments consist of corn-soybean rotation with each phase of the rotation present each year. The nitrogen management practices being studied are shown in Table 1. The initial plan was to have an in-season sidedress rate of N applied prescriptive for the season. Instead, the planting-sidedress N rate is being held constant at the same total rate as applied in the fall and spring.

Results and Discussion

Crop yield information from 2015 and 2016 is summarized in Table 2. There was a 40-bushel yield increase with the use of N fertilizer in 2015 and over 50-bushel yield increase in 2016. Overall, in the first two years, we have not seen a statistically significant yield difference in the N timing treatments (Treatments 1–3).

The project also is evaluating nitrate-N loss with drainage and this information will be summarized in subsequent progress reports.

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Table 1. Treatments at the Northwest Iowa Tile Drain Water Quality Study Site.

Treatment number	Tillage	Nitrogen application time	Nitrogen application rate (lb N/acre)*
1	Conventional tillage**	Fall (Anhydrous Ammonia with nitrapyrin)***	135
2	Conventional tillage	Spring (Anhydrous Ammonia)	135
3	Conventional tillage	Split (40 lb N/acre 2 x 2 starter urea at planting and sidedress surface broadcast urea plus Agrotain at 95 lb N/acre in-season no later than mid-vegetative corn growth stage)	135
4	Conventional tillage	None	0

*****For corn plots only. The 135 lb N/acre rate is based on the Corn Nitrogen Rate Calculator output for corn following soybean in Iowa at a 0.10 price ratio (http://extension.agron.iastate.edu/soilfertility/nrate.aspx).
**Fall chisel corn stalks with spring disk/field cultivate, and spring disk/field cultivate soybean stubble.
***In fall of 2014, freezing conditions occurred early and prevented fall application. Application occurred in early spring 2015.

Table 2. Crop yields for 2015 and 2016.

		Corn (bu/ac)				Soybean (bu/ac)			
Treatment	N application time	2015		2016		2015		2016	
1	Fall NH_3 With inhibitor	221	a	198	a	62.2	a	74.0	ab
2	Spring NH_3 (no inhibitor)	223	a	200	a	64.1	a	75.0	a
3	Split-sidedress urea	224	a	196	a	64.2	a	72.4	b
4	None	183	b	141	b	61.3	a	73.6	ab