Impact of 4R Management on Crop Production on Tile Drainage Plots

Matthew J. Helmers—professor, Department of Agricultural and Biosystems Engineering

Carl Pederson—agricultural specialist, Department of Agricultural and Biosystems Engineering

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 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. Due to the dry conditions there were few water samples.

Site Description and Treatments

The project objectives are being implemented at a drainage facility near Sutherland, Iowa. 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. Nitrogen management practices studied from 2015-2020 are shown in Table 1 and results from that work have been detailed in prior reports.

Table 1. Treatments at the Northwest Iowa Tile Drain Water Quality Study Site (2015-2020).

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 (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.

New treatments were implemented as seen in Table 2. These new treatments allow for evaluating timing and rate on crop yield and nitrate-N loss. For treatment 3, a target of 80 lbs. N per acre was planned preplant but 110 lbs.N per acre was actually applied. In-season N application was planned for this treatment if model predictions indicated a need, but due to dry conditions, additional N was not recommended.

Results and Discussion

Crop yield information is summarized in Table 3. There was greater than a 60-bushel yield increase with the use of N fertilizer in 2021. While there were absolute corn yield benefits of additional N application, there was not a statistically significant difference in Treatments 1-3. This will continue to be analyzed in future years and the economics of the additional N application will be assessed.

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

Acknowledgements

Funds for establishing the drainage facility were provided by the Iowa State University Department of Agronomy Endowment. This work would not be possible without the support and dedication of the Northwest Research and Demonstration Farm staff.

Table 2. Current treatments at the Northwest Iowa Tile Drain Water Quality Study Site (2021-?).

Treatment Number	Tillage	Nitrogen Application Time	Total Nitrogen Application Rate (lb N/acre)*
1	Conventional tillage**	Spring (Anhydrous Ammonia)	200
2	Conventional tillage	Spring (Anhydrous Ammonia)	MRTN (140)
3	Conventional tillage	Split with variable N at sidedress (110 lb/acre of N as Anhydrous preplant plus in-season agrotrain treated urea)	Based on Model
4	Conventional tillage	None	0

* For corn plots only. The 140 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, extension.agron.iastate.edu/soilfertility/nrate.aspx. MRTN as of April 6. ** Fall chisel corn stalks with spring disk/field cultivate, and spring disk/field cultivate soybean stubble.

Table 3. Crop Yields for 2021

Treatment	N Application	Corn*	Soybean
1	200 lbs/acre Preplant	211 a	64
2	140 lbs/acre Preplant	202 a	73
3	110 lbs/acre Preplant	197 a	67
4	None	133 b	67

*Means with the same letter in the same crop are not significantly different, P=0.05.