

# Drainage Water Quality Impacts of Various In-field Nutrient Management Practices: Northwest Research and Demonstration Farm



The Northwest Research Farm (NWRF) is located near Sutherland, Iowa. Drainage research on the impacts of 4R N-management on crop production and nitrate-nitrogen (nitrate-N) loss began in 2015. Treatments include three N-management treatments and one treatment with no N-fertilizer (Table 1). The site includes 32 individually subsurface drained plots (Figure 1). Tile lines were installed in 2013 at a depth of 3.5 feet spaced 80 feet apart. The center tile line from each plot is pumped and monitored continuously for drainage volume with a flow meter (Figure 2 and 3). A flow-proportional sample is passively collected and subsamples are taken for nitrate-N, total-phosphorus (P) and total-reactive-phosphorus analysis. Soils are predominantly Marcus, Primghar and Galva, all silty clay loams. The 30-year average annual precipitation at NWRF is 30.7 inches.

At NWRF, 4R N-management practices are examined for their impact on drainage N and P loss and crop yield:

**Crops:** Corn-soybean

**Management Practices:** Fall N-application with inhibitor, spring application, split N-application and no N-fertilizer application

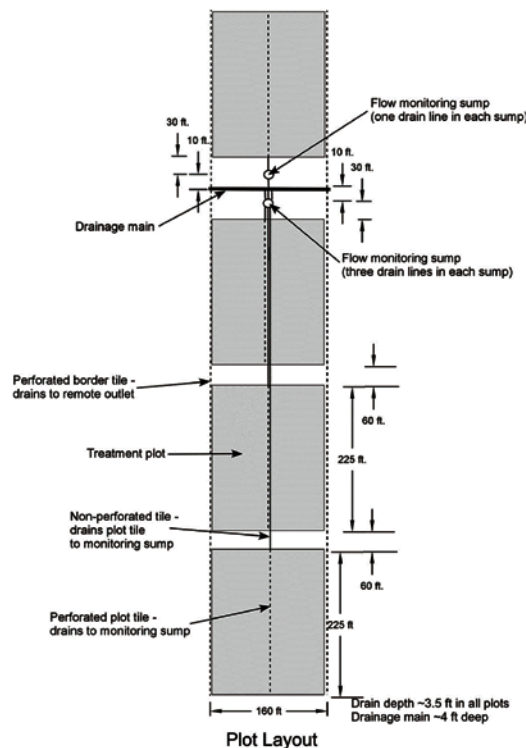
**Table 1. Treatments at the Northwest Research Farm drainage facility.**

Treatment Number	Tillage	Nitrogen Application Time	Nitrogen Application Rate (lb N/acre)
1	Conventional tillage	Fall (anhydrous ammonia (NH <sub>3</sub> ) with nitrapyrin inhibitor)*	135
2	Conventional tillage	Spring (anhydrous NH <sub>3</sub> )	135
3	Conventional tillage	Split N, with 40 lb/acre of urea 2x2 starter at planting plus remainder in-season agrotain treated urea	135
4	Conventional tillage	None	0

Material for Nitrogen and Water Week, June 27-29, 2017.



**Figure 1. Schematic of plot layout and drainage monitoring system.**



**Figure 2. Schematic of drainage collection and monitoring system.**

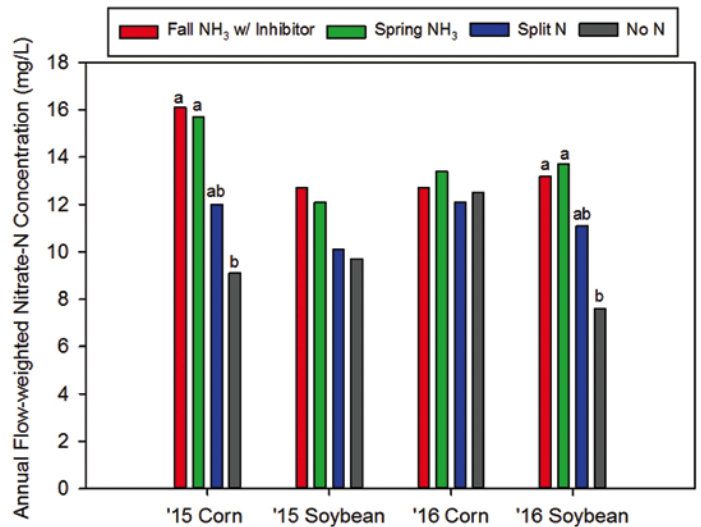
AE 3617 June 2017



**Figure 3. Pumped flow monitoring setup inside drainage monitoring sump at NWRP.**

### Preliminary findings, 2015-2016:

- In 2015, there was a 40 bu/ac corn yield increase with the application of N-fertilizer (treatments 1-3) compared to with no N-fertilizer. In 2016, this yield increase was greater than 50 bu/ac.
- No significant differences in corn yield were found between the three N-application methods.
- Soybean yield was similar for all four treatments in 2015. In 2014, all plots were cropped with soybeans and received no N-application. In 2016, however, soybean yield was about 3 bu/ac greater with a spring anhydrous  $\text{NH}_3$  application (to the previous corn crop) compared to a split N-application (to the previous corn crop).
- There were no significant differences in drainage flow-weighted nitrate-N concentration between soybean plots in 2015 (Figure 4). This was expected as there were no N-applications in 2014.
- In corn plots with no N-fertilizer application, annual flow-weighted nitrate-N concentration was significantly lower in 2015. In 2016, however, there were no significant differences in flow-weighted nitrate-N concentrations between N-application and no N-application.
- In the soybean phase of 2016, the treatment without N-fertilizer application (to 2015 corn) was significantly lower than treatments with spring anhydrous  $\text{NH}_3$  and fall anhydrous  $\text{NH}_3$  with inhibitor (both to the 2015 corn crop).
- For both years and crop phases, the nitrate-N concentration was statistically the same for the control (no N-fertilizer) and the split N-application.
- There were no significant differences in total-P and total-reactive-P concentrations in drainage found between the four treatments.



**Figure 4. Annual flow-weighted nitrate-N concentrations for the corn and soybean phases in 2015 and 2016.** Bars with the same letter (or no letters) for the same crop and year are not significantly different at the  $P=0.05$  level.

### Acknowledgements

This research is supported by the 4R Research Fund and the Iowa State University Department of Agronomy.

#### For more information:

Dr. John Sawyer  
 Professor and Extension Soil Fertility Specialist  
 Dept. of Agronomy  
 Iowa State University

Dr. Matt Helmers  
 Dean's Professor and Extension Agricultural Engineer  
 Dept. of Agricultural and Biosystems Engineering  
 Iowa State University  
 Phone: 515-294-6717  
 Email: [mhelmers@iastate.edu](mailto:mhelmers@iastate.edu)

This institution is an equal opportunity provider. For the full non-discrimination statement or accommodation inquiries, go to [www.extension.iastate.edu/diversity/ext](http://www.extension.iastate.edu/diversity/ext).