The Northeast Research and Demonstration Farm (NERF) has 36 1-acre research plots equipped with a drainage water monitoring system installed in 1988 (Figure 1). Plots have 1-4 percent slope with Kenyon, Floyd, and Readlyn soils. Tile lines are installed at a depth of four feet spaced 95 feet apart (Figure 2). Management practices are evaluated for their impact on nitrate-N and dissolved phosphorus (P) loss and crop yield. To quantify the impact of these practices, researchers are monitoring subsurface drainage volume and collecting flow-proportional water samples for nitrate-N and dissolved P analysis (Figure 3). The 30-year average annual rainfall for NERF is 29.7 inches. The average tile drainage flow from 2001-2015 is 4.5 inches.

At NERF, multiple management practices have been examined for their impact on N and P loss and crop yield:

**Crops:** Continuous corn, corn-soybean rotations, extended corn-oats-alfalfa rotation (1993-1998)

**Management Practices:** Rye cover crop, tillage/no-till, swine manure/urea ammonium nitrate (UAN), varied N application rates and timing, stover removal, nitrification inhibitor

**Key Findings from 27 Years of Research (1990-2016):**

- Corn-soybean-oat strip crop and alfalfa forage systems resulted in the lowest nitrate-N concentrations (<10 mg/L) in subsurface drainage water in comparison to other practices evaluated at this site from 1993-1998.

- Continuous corn systems required higher input of N fertilizers and resulted in significantly higher nitrate-N leaching losses compared to corn-soybean rotations fertilized with manure or urea ammonium nitrate (UAN).

- Over a 15 year period, fall manure applied to both corn and soybeans resulted in significantly higher nitrate-N concentrations than fall manure on corn only in a corn-soybean rotation (31 vs 19 mg/L).
• A cereal rye cover crop significantly reduced nitrate-N concentrations in drainage water compared to a similar treatment without a cover crop (10 mg/L with cover crop vs 14 mg/L without cover crop).

• An eight-year study found minimal difference in dissolved P concentrations in drainage water from six different management systems, with total losses less than 0.03 lb/acre yr from all systems.

• Stover removal in a continuous corn system had no significant impact on nitrate-N or dissolved P levels in drainage water.

• Chisel plowed and no-till plots had similar overall nitrate-N concentrations and total N losses via subsurface drainage water.

• Total nitrate-N losses averaged over the years 2008-2015 ranged from 13.6 lb/acre/yr from a corn-soybean no-till rye cover crop treatment with spring application of UAN to 34.4 lb/acre/yr from annual swine manure applied to continuous corn (Figure 4).

**Preliminary findings:**

• Flow-weighted nitrate-N concentrations in 2016 tile drainage water ranged from 10.3 mg/L (spring UAN at 150 lb N/acre) to 18.5 mg/L (fall manure on continuous corn at 200 lb N/acre).

• There was no significant difference in nitrate-N concentrations between late fall and spring swine manure applications for 2016.

• A rye cover crop significantly reduced flow-weighted nitrate-N concentrations in both corn (11.3 mg/L with cover crop vs 20.5 mg/L without cover crop) and soybeans (6.7 mg/L with cover crop vs 10.9 mg/L without cover crop) (Figure 5).

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**Figure 4. Cumulative nitrate-N losses from 2008 - 2015.**

**Ongoing Research and Preliminary Findings:**

Since 2016, treatments aim to study the impacts of N-management and in-field practices, including:

1. Early fall vs. late fall vs. spring application of swine manure
2. Conventional tillage vs. no-till
3. Cereal rye cover crop vs. no cover crop
4. Nitrification inhibitor
5. One ton/acre gypsum application

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