IOWA Pork Producer Headlines

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Evaluating the Impact of Nutrient Management Practices on Drainage Water Quality

The use of cover crops is one nutrient management practice that can help prevent nitrate-N losses and using manure as a nutrient source can be an economical way to provide nutrients for crop growth. The Iowa Pork Producers Association continues to fund research through Iowa State University seeking to better understand cover crop opportunities in manure nutrient scenarios. Read more about initial results from the first year of this study, demonstrating the value manure and cover crops can offer to soil health, water quality and farmer profitability.

By: Representatives of the Department of Agricultural and Biosystems Engineering, Iowa State University
Brian Dougherty, graduate research assistant
Dr. Dan Andersen, assistant professor
Dr. Matt Helmers, professor

Using manure as a nutrient source can be an economical way to provide nutrients for crop growth. Manure also has been linked to improvements in soil health, including increased organic matter, reduced bulk density and greater levels of mineralizable nitrogen (N) in the soil. However, proper timing of manure application is critical to avoiding nutrient losses and maximizing economic returns. Applying manure in the fall when soil temperatures are greater than 50° F increases the risk that N from manure will nitrify and leach from the root zone before it can be taken up by the crop the following year. Soil temperature is the primary factor that determines the rate of nitrification in the soil, with a rapid decrease in the nitrification rate as soils cool below 50° F (Sawyer, 2014).

The use of cover crops is one nutrient management practice that can help prevent nitrate-N losses. Cover crops have the potential to take up N in the soil in late fall and early spring when fields would otherwise lack vegetation. After the cover crop is terminated, this N is recycled back into the soil and subsequently re-released over time. Cover crops also can improve soil structure and water holding capacity, increase soil organic matter and enhance soil biological activity (Villamil et al., 2006; Basche et al., 2016). Adding a nitrification inhibitor is another practice that can reduce nitrate-N losses. Nitrification inhibitors slow the conversion of N from the ammonium form, which is stable in the soil, to nitrate, which is easily lost via leaching or denitrification.

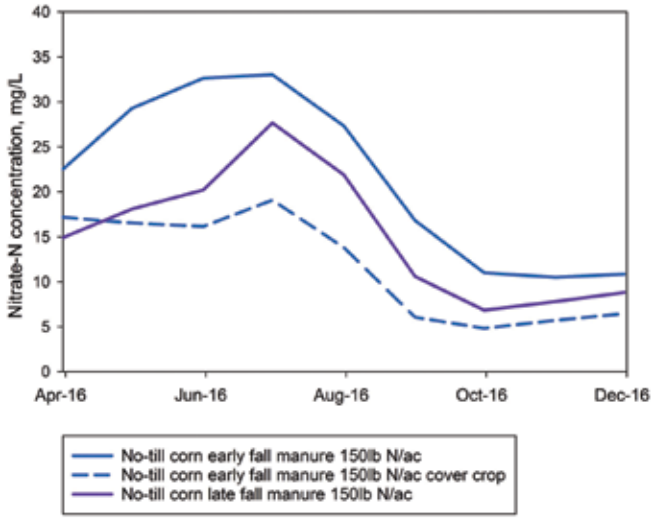

Figure 1. Comparison of nitrate-N concentrations in corn plots with early vs. late fall manure application.

A three-year study was initiated in 2016 at the Northeast Research and Demonstration Farm in Nashua to evaluate the impacts of these management practices on nitrogen and phosphorus loss through subsurface drainage tile. This is particularly interesting to livestock producers regarding the impacts of manure application timing on drainage water quality. The study allows for comparisons between early fall swine manure application (soil temperatures above 50° F) with and without a cereal rye cover crop and late fall manure applications (soil temperatures below 50° F) in corn-soybean rotation plots receiving 150 lbs. of N/acre from manure prior to corn. Late fall swine manure with and without a nitrification inhibitor also is being compared to spring manure application in continuous corn plots receiving 200 lbs. of N/acre from manure annually. Results from this study will give producers valuable information regarding the water quality impacts of different manure management practices.

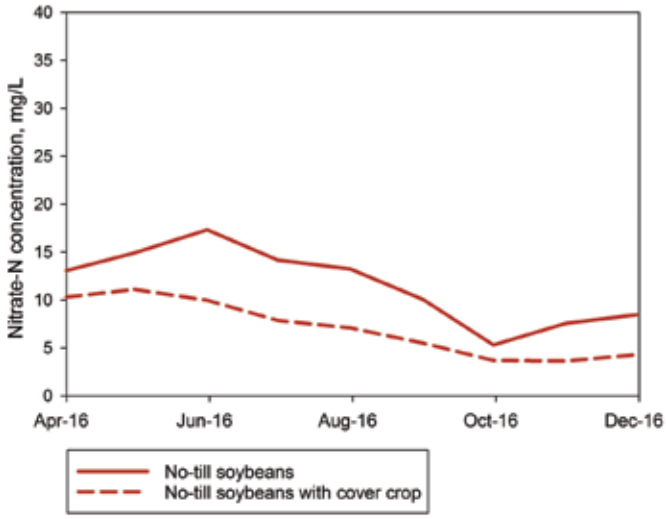

Figure 2. Comparison of nitrate-N concentrations in soybean plots with and without a cover crop.

First-year results from 2016 showed that adding a cereal rye cover crop resulted in a significant reduction in annual average nitrate-N levels via subsurface tile drainage water in both corn (Figure 1) and soybeans (Figure 2). In corn plots, early fall manure application had the highest annual average nitrate-N concentrations of 20.5 mg/L, followed by late fall manure with 15.7 mg/L, and early fall manure with a cover crop at 11.3 mg/L. Where early fall manure was applied to corn plots (Oct. 6, 2015, with soil temperature above 50° F), nitrate-N concentrations in drainage water in 2016 were reduced by 45 percent when a cereal rye cover crop was added. Late fall manure application (Nov. 3, 2015, with soil temperature below 50° F), resulted in a 23 percent decrease in nitrate-N levels in 2016 compared to the early fall manure treatment. Nitrate-N concentrations were 38 percent lower when cereal rye was added prior to soybeans with no manure applied.

Figure 3. Rye cover crop growth in a drainage plot that received early fall manure injected on 30-inch spacing. Photo taken on April 6, 2016.

Measurements of above-ground rye cover crop biomass also are included in the study. By the spring of 2016, the rye cover crop showed considerable within-plot variation in above ground biomass. There was considerably more biomass growth over the fall manure injection bands compared to between the injection bands (Figure 3). Figure 4 shows the cover crop above ground biomass and N uptake in the spring of 2016.

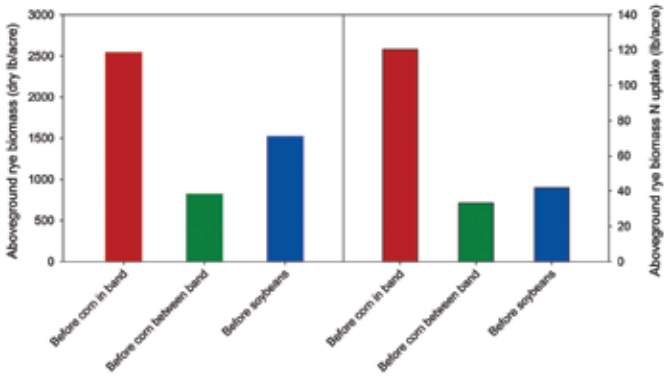

Figure 4. Rye cover crop above ground biomass and N uptake in the spring of 2016.

Another part of this study is focused on spring vs. fall timing and how the use of the Instinct® nitrification inhibitor with fall manure impacted nitrate-N concentrations in tile drainage water. No significant differences in nitrate-N levels between late fall manure, late fall manure with nitrification inhibitor, and spring swine manure applications to continuous corn were seen (Figure 5). No significant differences in dissolved phosphorus concentrations were observed between any of the treatments in either corn-soybean or continuous corn systems.

The impact of nutrient management practices on corn and soybean yields also is being monitored. In 2016 we saw significant variation in corn yields at the Nashua research farm. No-till corn-soybean rotation plots receiving late fall manure averaged 194 bu/acre, compared to 168 bu/acre in plots receiving early fall manure, and 142 bu/acre with early fall manure and a cover crop. In continuous corn plots, spring manure application resulted in a yield of 224 bu/acre compared to 187 bu/acre with late fall manure application. These yield differences are significant, but it is important to note that November of 2015 and all of 2016 was considerably wetter than average in Nashua. Yields in the plots receiving early fall manure in particular may have been impacted by weather. Research indicates that wet conditions can lead to denitrification and/or leaching of N from the root zone, causing a shortage of N for the corn crop (Sawyer, 2004). In comparison, the Gilmore City drainage research site had close to average precipitation in 2016 and saw no significant difference in corn or soybean yields with and without a rye cover crop. Similarly, other research sites around Iowa have shown no yield decrease in corn when cover crops were used (Fawcett et al., 2016; Appelgate, 2016). Soybean yields and corn yields from plots receiving the nitrification inhibitor in Nashua were not reported due to 2016 being a transition year to different N management practices in those plots.

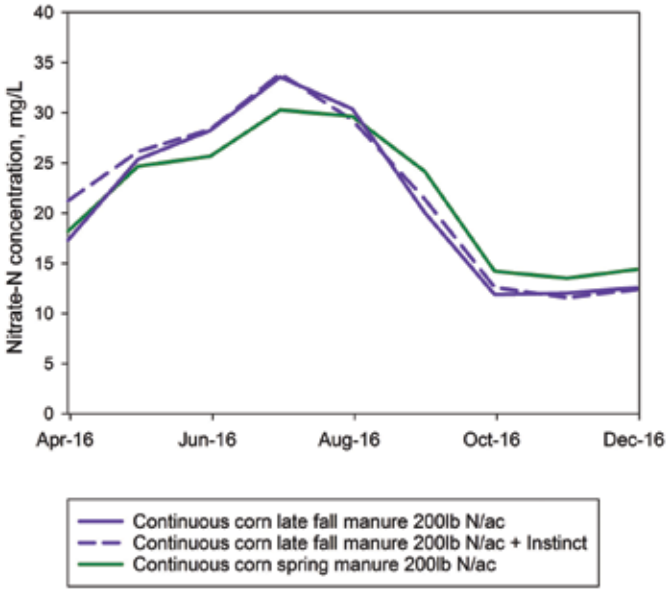

Figure 5. Comparison of nitrate-N concentrations in continuous corn plots with late fall vs. spring manure application.

The first-year results suggest that delaying fall swine manure application until soil temperatures are below 50° F and using cover crops can benefit drainage water quality. The plots will continue to be monitored in 2017 and 2018 to get a better estimate of treatment differences over a range of weather conditions and to evaluate the impact these different practices have on drainage water quality and crop yield.

For more information on this research or other IPPA environmental research or programs, please contact IPPA state public policy director, Tyler Bettin at tbettin@iowapork.org or (515) 225-7675.

IOWA PORK PRODUCERS ASSOCIATION

Iowa Pork Producers Association
P.O. Box 71009
Clive, IA 50325-0009

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