Cover Crops for Soil and Water Quality

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INTRODUCTION

- Agro-chemicals (fertilizers and pesticides) applied to corn and soybean production in Midwest United States can be major contributors to surface and groundwater contamination.
- Excess nitrate and phosphate from agricultural fields can be transported into headwater streams and ultimately to the Mississippi River, resulting in eutrophication and hypoxia in the Gulf of Mexico (Alexander et al., 2007).
- A promising best management practice to control nutrient leaching and sediment runoff loss during winter fallow periods is use of cover crops (Ball-Coelho and Roy, 1997).
- Leguminous cover crops like hairy vetch can fix atmospheric nitrogen (Poffenbarger et al. 2015) whereas, non-leguminous cover crops like cereal rye can scavenge residual N in the soil after fall harvest, which can helps in reducing nitrate leaching to groundwater (Staver and Brinsfield, 1998).
- Benefits of using cover crops include improvement in soil quality and health, efficiency in nutrient cycling, better pest-management and higher cash crop productivity.

OBJECTIVE

- To evaluate the influence of cover crops (Hairy vetch/Oats-Raddish and Cereal Rye) on nutrient dynamics in soil and nutrient leaching through pan lysimeters.

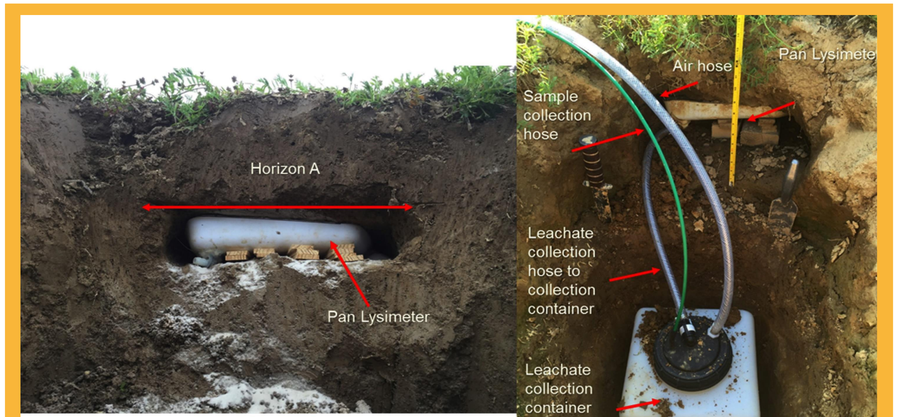

Figure 1. Pan lysimeter Installation.

MATERIALS & METHODS

- Research site was located on west side of the City of Carbondale, IL on agricultural research farms of the Southern Illinois University (Figure 2).
- Cover crop and no cover crop treatments were set up in completely randomized design with three replicates for each treatment.
- Soil samples were collected to depth of 45 cm after cover crop termination in spring 2015, after corn harvest in 2015 and after cover crop termination in spring 2016. They were analyzed for standard soil fertility parameters.
- Soil solution was collected with pan lysimeters (Figure 1). Samples were collected on a weekly or biweekly basis depending on the amount of precipitation and were analyzed for Nitrate-N concentrations.
- The PROC GLIMMIX procedure of the SAS statistical software was used for data analysis.

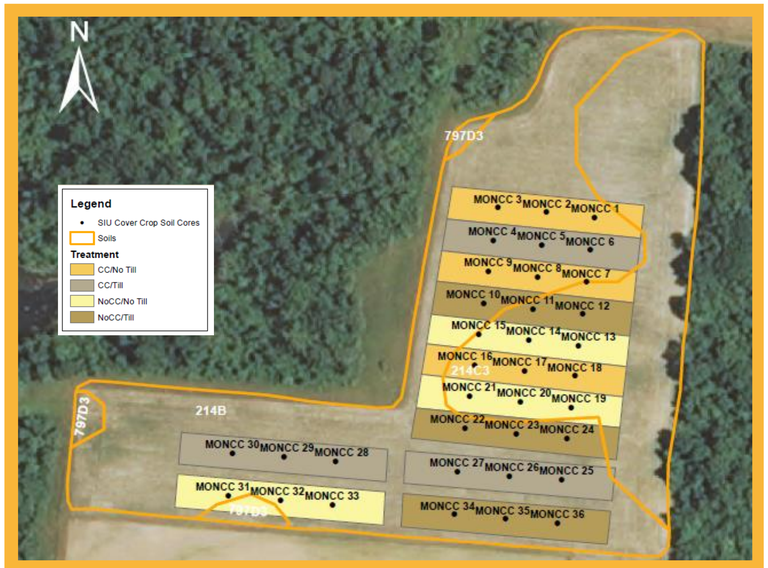

Figure 2. Cover crop research site at Southern Illinois University.

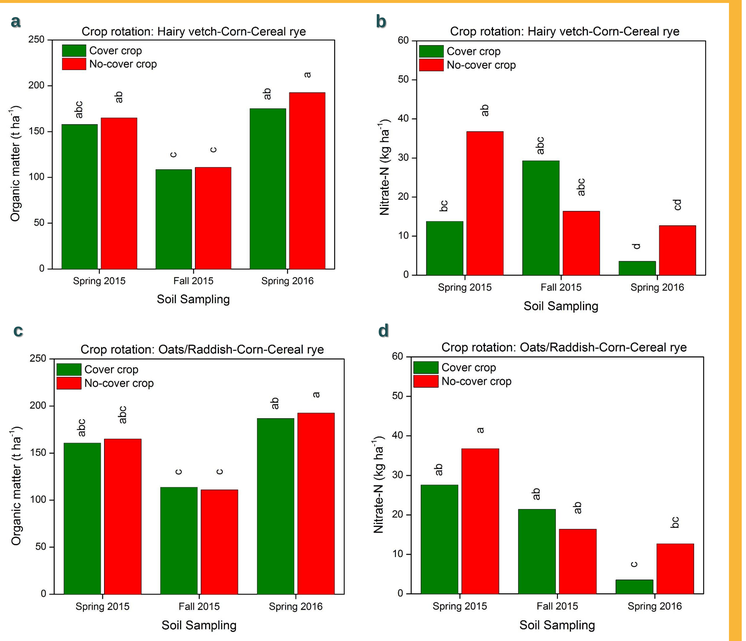

Figure 3. Changes in organic matter and nitrate-N from surface to 45 cm depth of soil profile for three soil sampling events under no-tillage treatments. Different letters between bars indicate a significant difference at p<0.05 probability level.

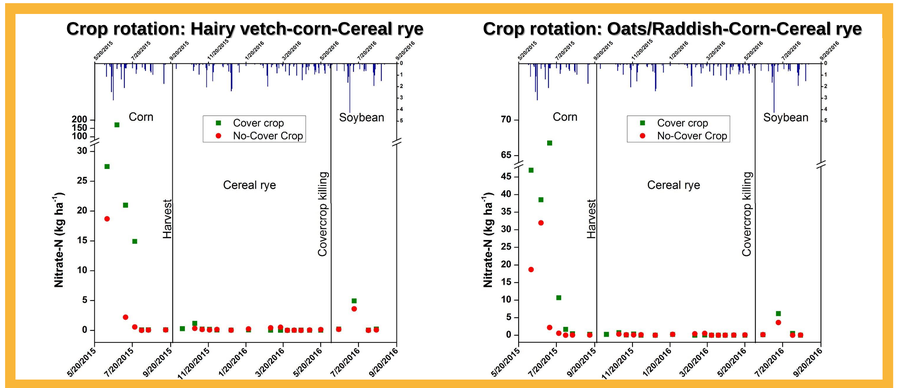

Figure 4. Average nitrate-N flux between sampling dates for cover crop and no-cover crop treatments under no-tillage system for two different crop rotations. Blue bars represent average daily precipitation received at research site.

RESULTS & DISCUSSION

- Increased concentration of organic matter was observed in spring 2016 for both crop rotations compared to spring and fall 2015 (Figure 3a and 3c).
- Significant reduction in nitrate-N concentrations in soil profile up to depth of 45 cm of cover crop treatment was observed for spring 2016 compared to spring and fall 2015 (Figure 3b and 3d)
- Exponential decrease is observed in nitrate-N leaching after fertilizer application for both crop rotations (Figure 4).
- Nitrate-N concentration in leachate collected with pan lysimeters were less for no-cover crop treatments compared to cover crop treatments during corn growing season. This could be due to rapid decomposition and mineralization of N (low C:N ratio of hairy vetch biomass, Figure 4a).
- In winter and early spring, (normally considered as a vulnerable time for nutrient loss) we saw lower amounts of nutrient loss for all treatments.
- Amount of precipitation in a single storm event played an important role in nitrate-N leaching. Peak nitrate-N loss was observed to be higher with higher precipitation events in both corn and soybean growing season.

CONCLUSIONS

- Soil properties and nutrient leaching were significantly influenced by the cover crops.
- Fertilizer application rate to main crop (corn) should be adjusted according to cover crop biomass and initial soil N content.
- Long term research is needed to observe seasonal change in nutrient leaching from corn/soybean cropping system.

REFERENCES

Alexander RB, Smith RA, Schwarz GE, Boyer EW, Nolan JV, Brakebill JW. 2007. Differences in phosphorus and nitrogen delivery to the Gulf of Mexico from the Mississippi River Basin. Environmental Science & Technology 42: 822-830.

Ball-Coelho B, Roy R. 1997. Overseeding rye into corn reduces NO_3^- leaching and increases yields. Canadian Journal of Soil Science 77: 443-451.

Poffenbarger, H. J., Mirsky, S. B., Weil, R. R., Maul, J. E., Kramer, M., Spargo, J. T., & Cavigelli, M. A. (2015). Biomass and nitrogen content of hairy vetch–cereal rye cover crop mixtures as influenced by species proportions. Agronomy Journal 107(6): 2069-2082.

Staver KW, Brinsfield RB. 1998. Using cereal grain winter cover crops to reduce groundwater nitrate contamination in the mid-Atlantic coastal plain. Journal of Soil and Water Conservation 53: 230-240.