IN-RANDOLPH

Controlled Drainage

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SITE SUMMARY

The Davis Purdue Agricultural Center (DPAC) is located near Farmland, IN (Figure 1). The site consist of silt loam and silty clay loam soils (Blount, Condit, Glynwood, and Pewamo). The overall elevation difference across the field is approximately 10 feet with an average slope of less than 1%.

There were 4 research plots, each approximately 9 acres in size, with two replications for conventional drainage and controlled drainage treatments.

The tile drainage system was installed in the fall of 2004 based on a depth of three feet and spacing of 45 feet. Each treatment is drained by a 6-inch sub-main that connects to an 8-inch main that outlets to a county main near the northwest corner of the field.

Figure 1. Map of Controlled Drainage site characteristics in Indiana.

Box 1. Site info

CHARACTERISTICS

- Drainage system installed in 2004
- Soil: Blount, Condit, and Glynwood silt loams, Pewamo silty clay loam
- Rotation: Corn-Soybean

WATER MANAGEMENT PRACTICES

- Conventional Drainage (depth 3 feet, spacing 45 feet)
- Controlled Drainage (depth 3 feet, spacing 45 feet)

MEASUREMENTS IN DATABASE

DRAINAGE SYSTEM

- Tile flow (2006-2017)
- Concentration of Nitrate-N (2006-2017),
- Soluble reactive phosphorus, Total phosphorus (2012-2017)
- Water table depth (2006-2017)

CROP

- Crop Yield: Corn (2005-2010, 2012, 2014, 2016), Soybean (2011, 2013, 2015, 2017)
- Final Plant Population; Biomass, Total N, and Total C: Vegetative, Grain, Cob (2012, 2014)

SOIL

- Soil moisture and temperature (2011-2017)
- Soil Texture, Infiltration Rate (2011)
- Soil Fertility: pH, Cation Exchange Capacity, Soil Organic Carbon, Total N (2011, 2013, 2015)
- Soil Nitrate and Ammonium (2011, 2012, 2013, 2014, 2015), Bulk Density, Water Retention: 0, 0.003, 0.05, 0.1, 0.33, 15 bar (2011, 2013, 2015)

WEATHER

- Precipitation, Air Temperature, Relative Humidity, Solar Radiation, Wind Speed and Direction (2005-2017)

USDA United States Department of Agriculture National Institute of Food and Agriculture

This material is based upon work that is supported by the National Institute of Food and Agriculture , U.S. Department of Agriculture , under award number 2015-68007-23193 , "Managing Water for Increased Resiliency of Drained Agricultural Landscapes", http://transformingdrainage.org. Any opinions, findings, conclusions, or recommendations expressed in this publication are those of the author(s) and do not necessarily reflect the view of the U.S. Department of Agriculture.

SUMMARY OF RESULTS

CROP YIELD

Controlled drainage increased the 9-year average corn yield by 2.3% (Figure 2). Classifying the years by wetness clarified that controlled drainage increased yields in the dry years even more, by 5.9%. Mean soybean yield was not significantly different between free and controlled drainage over 4 years.

WATER QUALITY

Nitrate-N concentration and drain flow were measured for 11 years. Figure 3 shows the concentration and drain flow for each month, averaged over all 11 years. Concentration was consistently highest in June (12 mg/L) and drain flow is highest in March. Controlled drainage had the most impact during high flows in late winter and spring. Annual loads were determined by combining daily drain flow and concentration, and are shown in Figure 4. Controlled drainage reduced nitrate-N load by 37% on an annual basis, from an average of 26 lbs N/acre to 17 lbs N/acre.

Total and dissolved reactive phosphorus were measured for 5 years and were not significantly different under free and controlled drainage (Figure 5).

These results showed that controlled drainage is a reliable practice for reducing nitrate loads from subsurface drains, mainly due to the reduction in flow.

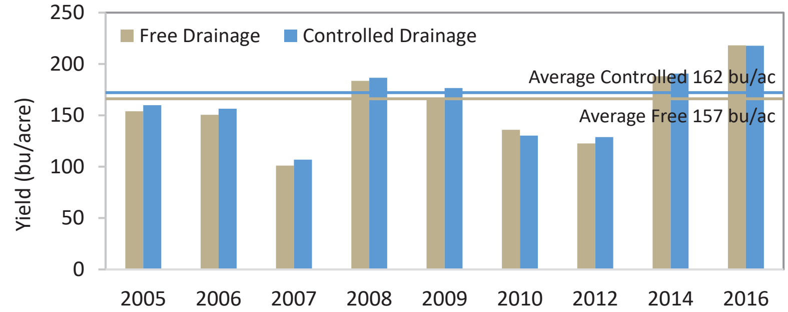

Figure 2. Corn yield was 2.3% higher on average under controlled drainage than free drainage.

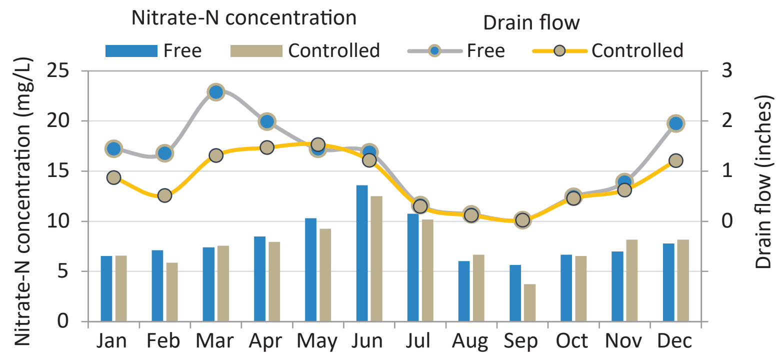

Figure 3. Nitrate-N concentration and drain flow by month, averaged over all 11 years. Depth of drain flow in inches is calculated by dividing flow volume by the area of the plot.

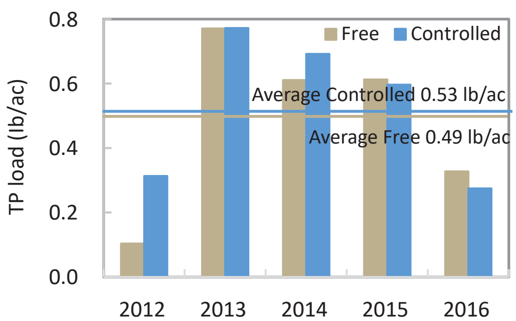

Figure 5. Total phosphorus loads were not significantly different under controlled and free drainage in 5 years of measurement.

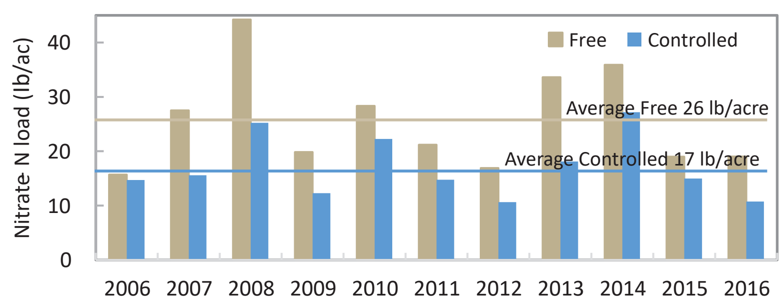

Figure 4. Nitrate-N loads were 9 lbs/acre (37%) lower under controlled drainage than free drainage over the 11 years of measurement.

PUBLISHED WORKS FROM THE SITE

Delbecq, B.A., Brown, J.P., Florax, R.J., Kladivko, E.J., Nistor, A.P. and Lowenberg-DeBoer, J.M., 2012. The impact of drainage water management technology on corn yields. Agronomy journal, 104(4), pp.1100-1109.

Saadat, S., Bowling, L., Frankenberger, J. and Brooks, K., 2017. Effects of controlled drainage on water table recession rate. Transactions of the ASABE, 60(3), p.813.

Saadat, S., Bowling, L., Frankenberger, J. and Kladivko, E., 2018. Estimating drain flow from measured water table depth in layered soils under free and controlled drainage. Journal of hydrology, 556, pp.339-348.

Saadat, S., Bowling, L., Frankenberger, J. and Kladivko, E., 2018. Nitrate and phosphorus transport through subsurface drains under free and controlled drainage. Water research, 142, pp.196-207.

Saadat, S., Frankenberger, J., Bowling, L. and Ale, S., 2020. Evaluation of surface ponding and runoff generation in a seasonally frozen drained agricultural field. Journal of Hydrology, 588, p.124985.

Data Access

Data from this site are available through the USDA National Ag Library Ag Data Commons repository (https://doi.org/10.15482/USDA.ADC/1521092) or the interactive website at Iowa State University with visualization and querying capabilities (https://drainagedata.org).

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TRANSFORMING DRAINAGE PROJECT

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