Controlled Drainage Reduces Nitrogen and Phosphorus Loading in the Lake Erie Watershed

Lindsay A. Pease[1], Norman R. Fausey[2], and Jay F. Martin[1]

1. The Ohio State University, Columbus, OH; 2. USDA Agricultural Research Service, Columbus, OH

Introduction and Rationale

Water Management is a primary tool for climate adaptation and helps to ensure sustained production and environmental services even with increasing weather variability.

Reducing the loss of Nitrogen and Phosphorus fertilizer through subsurface drainage systems is an important step in minimizing future algal blooms in the Gulf of Mexico and the Great Lakes.

One practice which can reduce water loss and nutrient loading is **Controlled Drainage**, a management strategy which allows greater control of field water levels and reduction in the volume of water lost through subsurface drains.

Research Questions:

1. How much does controlled drainage reduce subsurface drain flow in Northwest Ohio?
2. How much does controlled drainage reduce N and P loading in Northwest Ohio?

Experimental Setup

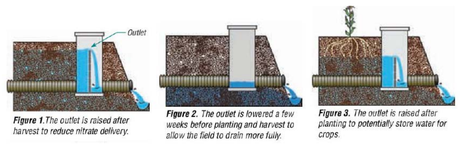


Figure 1. *The outlet is raised after harvest to reduce nitrate delivery.*

Figure 2. *The outlet is lowered a few weeks before planting and harvest to allow the field to drain more fully.*

Figure 3. *The outlet is raised after planting to potentially store water for crops.*

Three field layouts of showing controlled drainage area (blue) and conventional drainage area (red)

Subsurface Drain Flow Monitoring and Nutrient Sampling

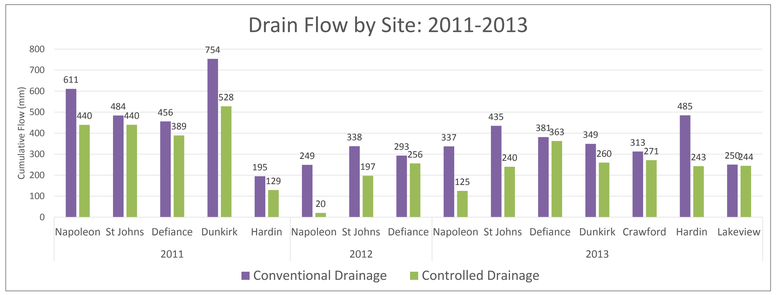
Water levels inside the control structure were downloaded to calculate flow rate

V-notch weirs were placed in each structure to improve the accuracy of the flow rate calculation at low flows

Grab Samples were taken from inside the controlled and conventional drainage structures and were analyzed for dissolved nitrate (NO_3^-) and dissolved phosphate (PO_4^{3-})

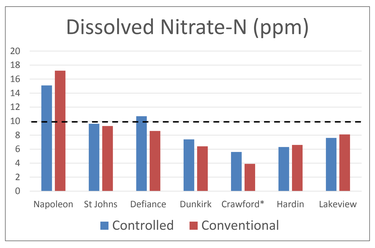
Results and Discussion

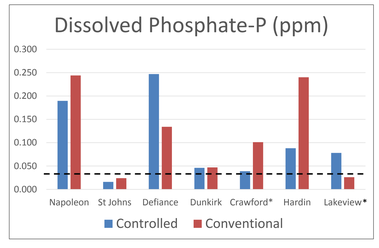
Subsurface Drain Flow Reduction



Controlled drainage reduced subsurface drain flow at all sites. The average reduction across all sites and years was 31% with a standard deviation of 24%.

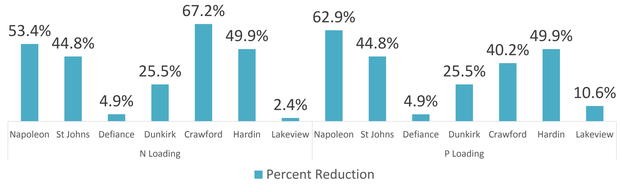
Nutrient Concentrations





Looking across all data, N and P concentrations in drainage water were not statistically different between controlled and conventional drainage. Statistically significant differences were observed at the Crawford and Lakeview sites.

Reductions in Nutrient Loading by Site (2013)



Results and Discussion (continued)

Nutrient Loading

Controlled Drainage reduced N and P loading at all sites in the Lake Erie Watershed. Reductions in flow resulted in a decrease in the mass of nutrients discharged from controlled drainage compared to conventional drainage.

Conclusions

Overall, controlled drainage was a successful management practice for reducing water loss from subsurface drains.

Nutrient concentrations varied between sites but did not show a statistically significant difference from the use of controlled drainage.

Reduction in water loss from subsurface drains led to a reduction in nutrient loading from fields to streams and waterways.

Acknowledgements

Thanks to Sarah Hess, Phil Levison, Eric Fischer, Paxton McDonald, Marie Schrecengost, Molly Roup, Dr. Larry Brown, Vinayak Shedekar, Stephan Gunn, Ehsan Ghane, Yuhui Shang, Mark Wahl, and the Martin Lab group for their help collecting and analyzing this data.

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This research is part of a regional collaborative project supported by the USDA-NIFA, Award No. 2011-68002-30190 "Cropping Systems Coordinated Agricultural Project (CAP): Climate Change, Mitigation, and Adaptation in Corn-based Cropping Systems" sustainablecorn.org

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