Impact of Controlled Drainage Management on Nitrogen and Phosphorus Concentrations in Subsurface Drainage Discharge in the Western Lake Erie Basin

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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.

Experimental Setup

Seven field sites across northwest Ohio were monitored for differences between controlled and conventional drainage between 2011-2014.

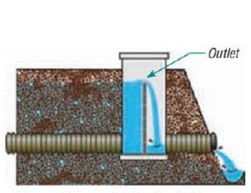


Figure 1. *The outlet is raised after harvest to reduce nitrate delivery.*

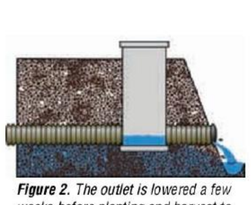


Figure 2. *The outlet is lowered a few weeks before planting and harvest to allow the field to drain more fully.*

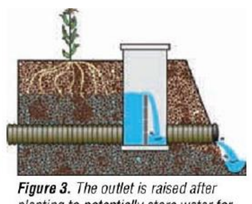


Figure 3. *The outlet is raised after planting to potentially store water for crops.*

Typical Controlled Drainage Management involves opening drains during planting and harvest periods and closing drains during winter and during the summer growing season to conserve water.

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-})

Research Question:

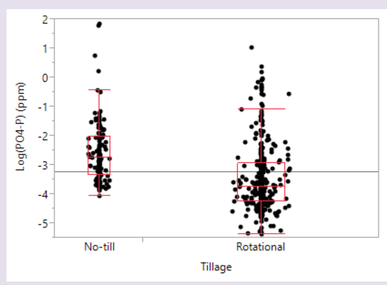
What site-specific factors influence dissolved NO_3 and dissolved PO_4 concentrations in drainage water?

Results and Discussion

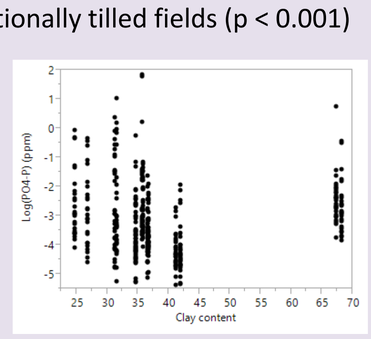
Climate, soil, and management factors including rainfall, discharge, soil texture, crop, tillage, drainage management and season were used to fit a predictive model for nutrient concentrations in drainage water across field sites.

Significant Factors Influencing Nutrient Concentrations in Subsurface Drains

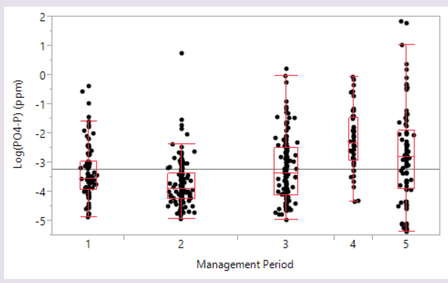
Dissolved PO_4



No-till fields have higher DRP conc. than rotationally tilled fields ($p < 0.001$)

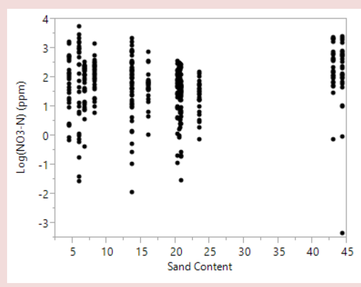


Higher clay content increases DRP concentrations ($p < 0.026$)

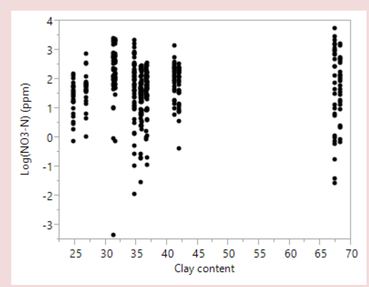


See highest DRP Conc. in Late Fall Period (4) ($p < 0.001$)

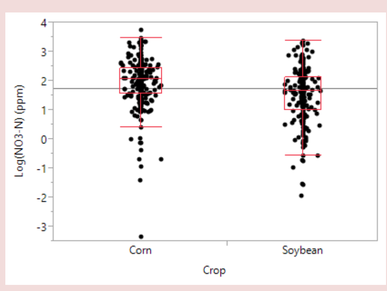
Dissolved NO_3



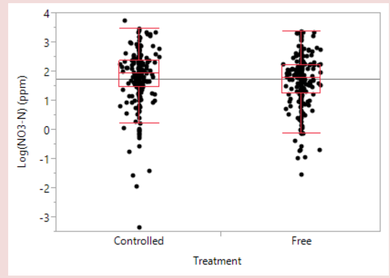
Higher sand content tends to increase NO3 conc. ($p < 0.001$)



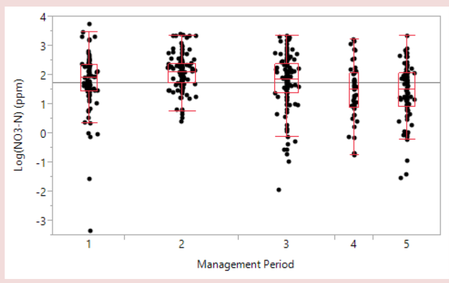
Higher clay content tends to increase NO3 conc. ($p < 0.001$)



Corn cropping years have higher NO3 conc. than soybean cropping years ($p < 0.001$)



Although looking at treatment alone does not yield a statistically significant result, when combined with other factors, conventional drainage has higher NO3 conc. than controlled drainage ($p < 0.016$)



See highest NO3 Conc. in Early Spring Period (1) ($p < 0.001$)

Conclusions

- Soil Texture and Season are significant for both nitrogen and phosphorus concentrations in drainage water
- Tillage becomes an important factor in P concentrations, but Crop and Drainage Management become important factors for N concentration

Acknowledgements

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