Collaborative Edge-of-Field Research to protect Michigan Water Quality

Ehsan Ghane
Assistant Professor and Extension Specialist

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History of Drainage

- First comprehensive drain law of Michigan was passed in 1839.  
  (Miller and Simons 1918)

- U.S. Swamp Land Acts of 1849 and 1850 provided federal funding
Installing

Digging the second spading.

Digging the third spading to put the tile good and deep.

Laying the tile.

The ditch should be straight, without any dents or crooks in the line of tile.

Tile Drainage. James King (1918)
MSU Farms

• August 1955
MSU Farms

- August 1955
Michigan Drainage (miles installed)

1898 to 1912 (15 years)
58 miles of tile per year

1913 to 1917 (5 years)
212 miles of tile per year

Data from "Drainage in Michigan" by Miller and Simons (1918)
LP Michigan

- 2.3 million acres
  Agricultural subsurface drainage

- 29% total cropland is drained
  2007 estimate
Nutrient loss pathways:
- Surface runoff
- Subsurface drainage flow
Finding: Soluble Reactive Phosphorus

- From early 2000s soluble reactive P loads into Western Lake Erie has increased dramatically.
- Majority of the SRP load increase was due to
  - increased P availability in the field.
  - increased transport efficiency.
- Increase in reduced tillage (lower erosion).
- Increased drainage, closer lateral spacing. (Jarvie and colleagues 2017)
Soluble Reactive Phosphorus Variation

• No significant (meaningful) variation in SRP concentration across seasons.

• Majority of SRP load was lost during non-growing season, winter and early spring. (Pease and colleagues 2017)
What is Controlled Drainage?

• Managing the outlet level of the drainage system
  – Purpose is to reduce nutrient delivery to surface water

• Works for both Nitrogen and Phosphorus
Conventional Drainage
Controlled Drainage
After Harvest and fall field operations
Why controlled drainage?

- No land is taken out of production
- Low maintenance and requires management
- Reduces nutrient loss (Ross and colleagues 2016)
  - Average nitrate load is 48%
  - Average soluble Reactive P load reduction is 57% (scarce: only 2 studies).
- Potential to improves crop yield with proper management and timely rainfall
MI: Blissfield Site

- Evaluate Controlled Drain
- P concentration over time
  - Non-growing season
  - Growing season
MI: Palmyra Site

- Evaluate Controlled Drain
- P concentration over time
  - Non-growing season
  - Growing season
Saturated Buffer
Saturated Buffer

- Main purpose is to reduce nutrient delivery
- Targets NO₃⁻
  - Potentially P
- Built-in controlled drainage
Top view of a Saturated Buffer
Saturated Buffer Sampling

- Transects of observation wells
MI: Clayton SB Site

- Evaluate Saturated Buffer
- P concentration over time
  - Non-growing season
  - Growing season
Project Goals

- Controlled drainage nutrient load reduction (primarily P)
- Crop yield benefit from controlled drainage
- Saturated buffer nutrient load reduction (primarily P)