Phosphorus Leaving Our Landscapes

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8th Annual Nutrient Management Conference

Jackpot Junction, Morton, MN

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Presentation Overview

- What is Discovery Farms?
- What's the Problem with Phosphorus?
- P Losses From 100 Site Years of Data Collection
- Case Study – Ag Fields vs. "Natural" Areas
- Three keys to reduce phosphorus losses

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Discovery Farms is a Farmer Led Water Quality Research and Educational Program

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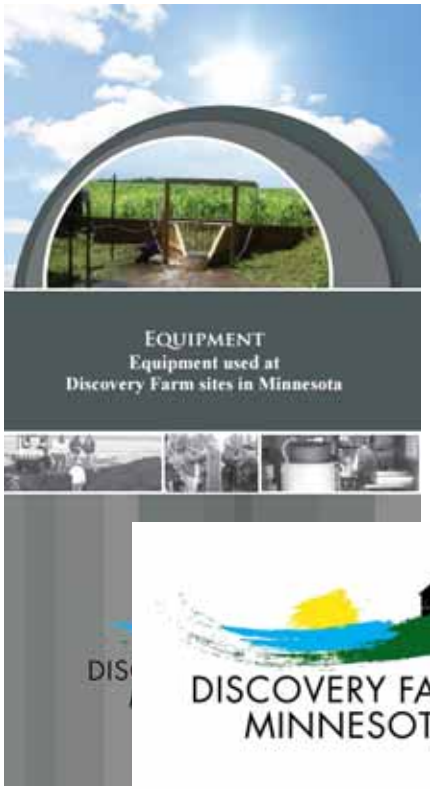
Discovery Farms Provides Credible Edge-of-Field Research



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MINNESOTA DEPARTMENT OF AGRICULTURE

CLEAN WATER LAND & LEGACY AMENDMENT

SOP
STANDARD OPERATING PROCEDURES

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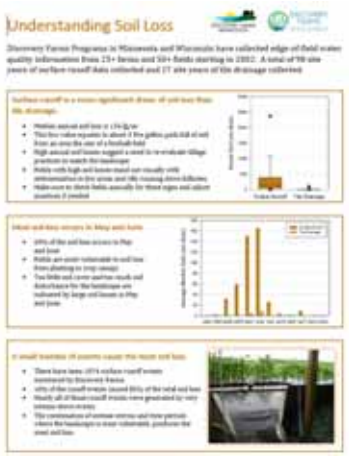
Discovery Farms Communicates Results

Field Days

Web:
DiscoveryFarmsMN.org
AgWaterExchange.com

Publications

Presentations



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Edge-of-Field Surface Runoff and Tile Drainage Data is Collected 365 Days a Year

Weather • Soil

Runoff • Sediment

Nitrogen • Phosphorus

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Collecting Data From a Variety of Farms and Landscapes in Minnesota

Dairy – Stearns and Wright County

Swine – Goodhue, Blue Earth, and Dodge County

Grain – Chisago, Renville, Wilkin, and Norman County

Beef – Rock County

Turkey – Kandiyohi County

Irrigation – Benton County

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Phosphorus is a nutrient that is needed for plant growth and is a natural part of aquatic ecosystems

Too much phosphorus in water can cause excessive algae growth

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Phosphorus is transported either attached to soil particles or dissolved in the water column

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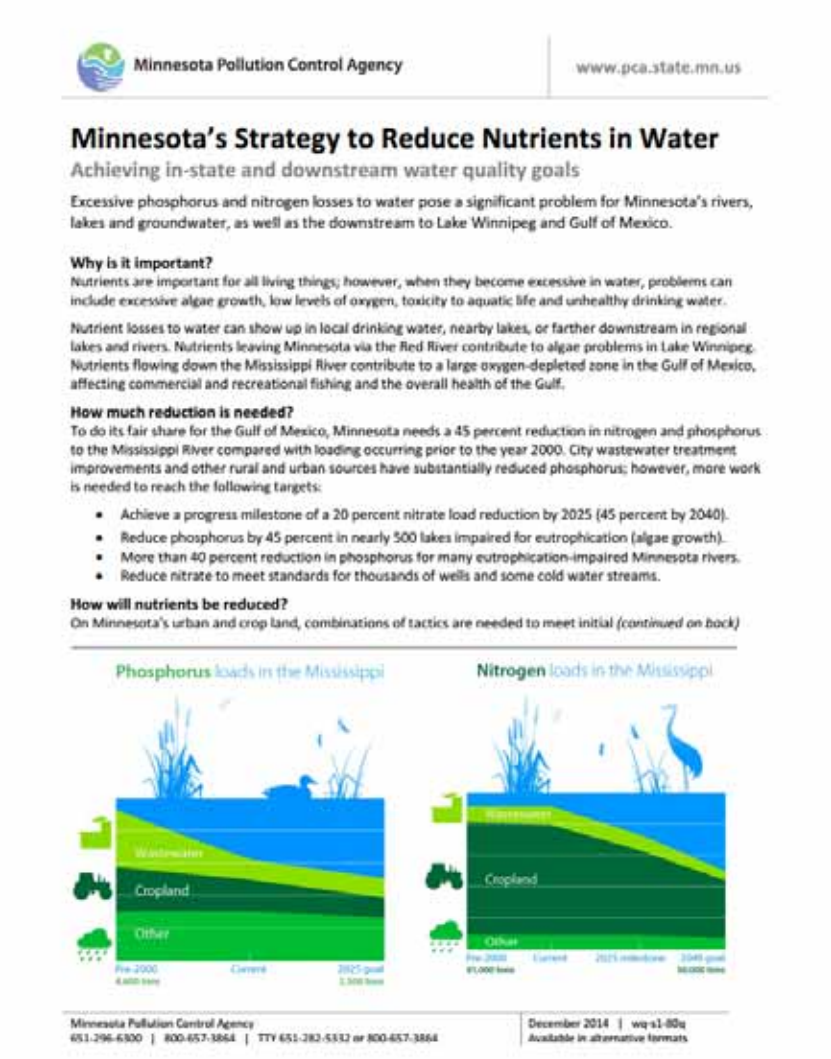
Pressure to Reduce Phosphorus Losses is Increasing



Minnesota Pollution Control Agency | www.pca.state.mn.us

Minnesota's Strategy to Reduce Nutrients in Water

Achieving in-state and downstream water quality goals

Excessive phosphorus and nitrogen losses to water pose a significant problem for Minnesota's rivers, lakes and groundwater, as well as the downstream to Lake Winnipeg and Gulf of Mexico.

Why is it important?

Nutrients are important for all living things; however, when they become excessive in water, problems can include excessive algae growth, low levels of oxygen, toxicity to aquatic life and unhealthy drinking water.

Nutrient losses to water can show up in local drinking water, nearby lakes, or farther downstream in regional lakes and rivers. Nutrients leaving Minnesota via the Red River contribute to algae problems in Lake Winnipeg. Nutrients flowing down the Mississippi River contribute to a large oxygen-depleted zone in the Gulf of Mexico, affecting commercial and recreational fishing and the overall health of the Gulf.

How much reduction is needed?

To do its fair share for the Gulf of Mexico, Minnesota needs a 45 percent reduction in nitrogen and phosphorus to the Mississippi River compared with loading occurring prior to the year 2000. City wastewater treatment improvements and other rural and urban sources have substantially reduced phosphorus; however, more work is needed to reach the following targets:

- Achieve a progress milestone of a 20 percent nitrate load reduction by 2025 (45 percent by 2040).
- Reduce phosphorus by 45 percent in nearly 500 lakes impaired for eutrophication (algae growth).
- More than 40 percent reduction in phosphorus for many eutrophication-impaired Minnesota rivers.
- Reduce nitrate to meet standards for thousands of wells and some cold water streams.

How will nutrients be reduced?

On Minnesota's urban and crop land, combinations of tactics are needed to meet initial *(continued on back)*

Minnesota Pollution Control Agency
651-296-6300 | 800-657-3864 | TTY 651-282-5332 or 800-657-3864

December 2014 | wq-s1-80g
Available in alternative formats

- 45% reduction to Mississippi River
- Do we know where the finish line is if we don't know the starting point?
- Perceptions seem to be getting worse

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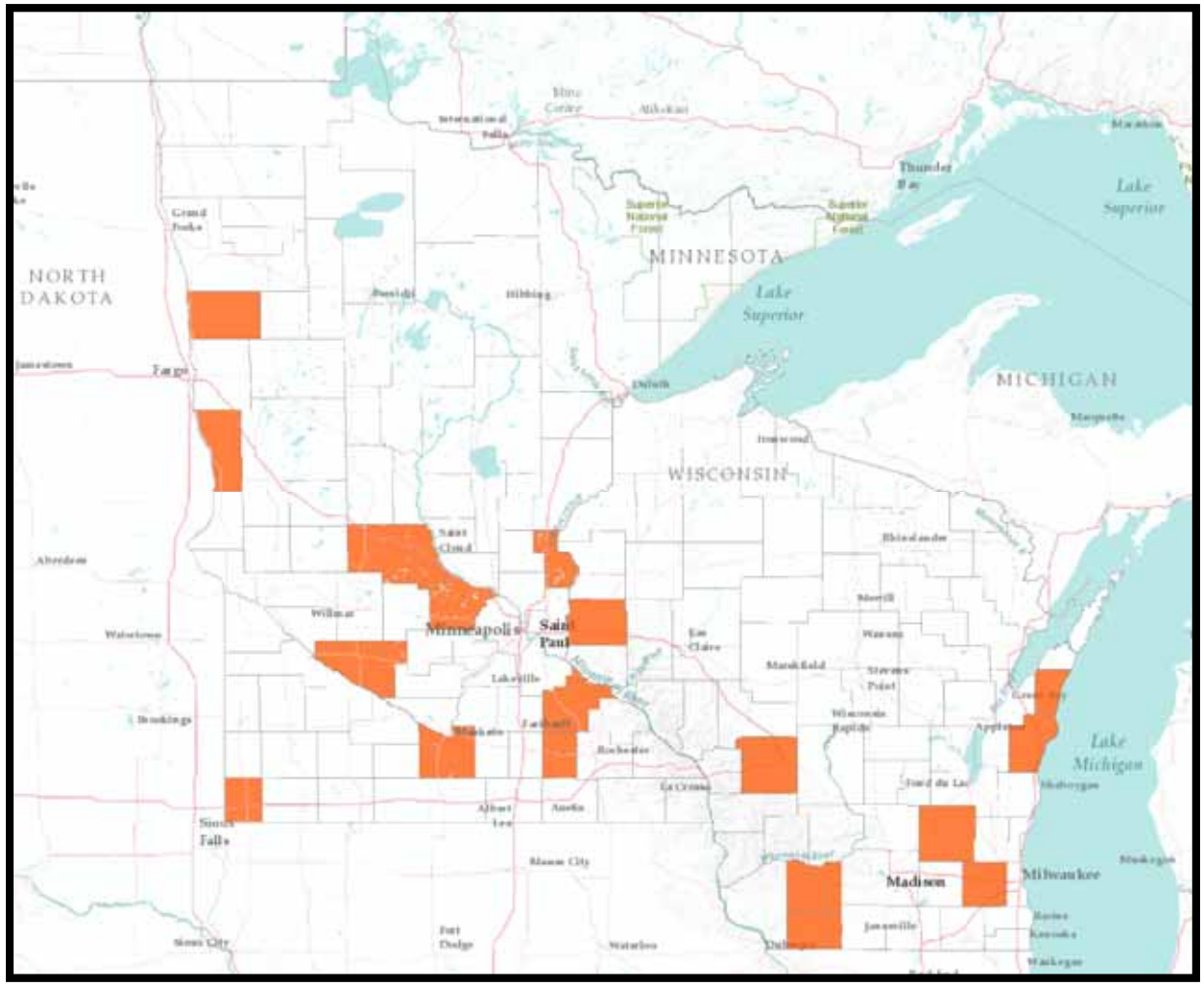
Phosphorus Loss in MN & WI - Large Dataset With Diverse Farm Systems and Locations



Surface Runoff:
110 site years
28 sites
21 farms

Tile Drainage:
50 site years
14 sites
11 farms

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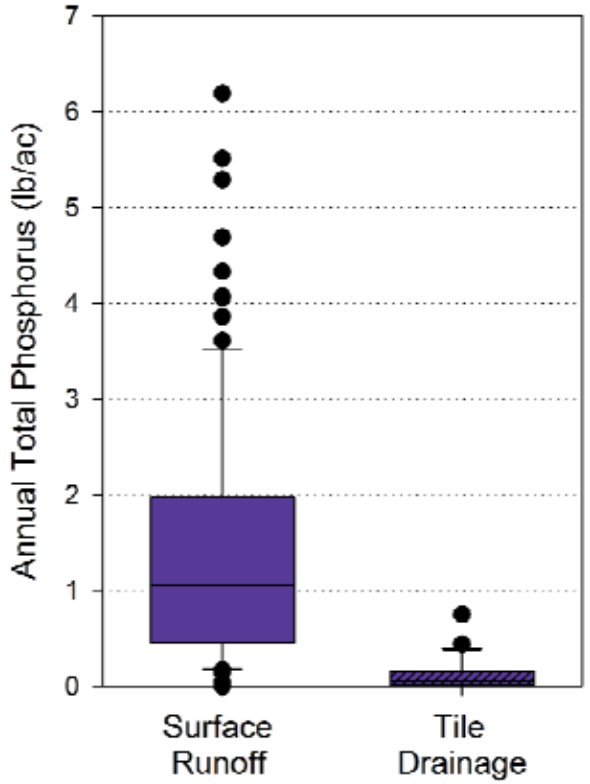
Phosphorus is Mainly Transported by Surface Runoff



Total Phosphorus Medians
Surface Runoff: 1.1 lb/ac
Tile Drainage: 0.1 lb/ac
Rank Sum p value <0.0001

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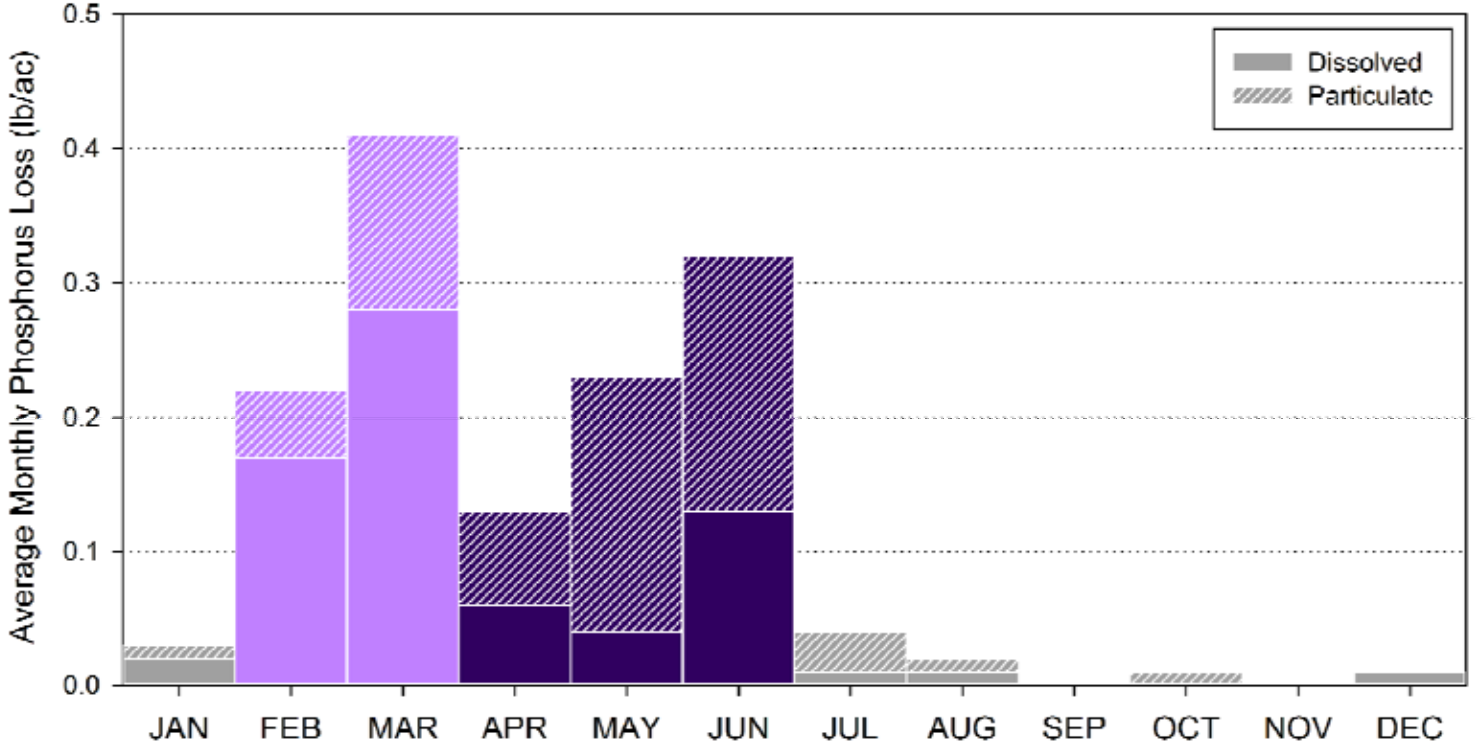
There are Two Time Periods for P Loss – Snowmelt and Spring Runoff



Feb/Mar: 44%
Apr/May/Jun: 48%

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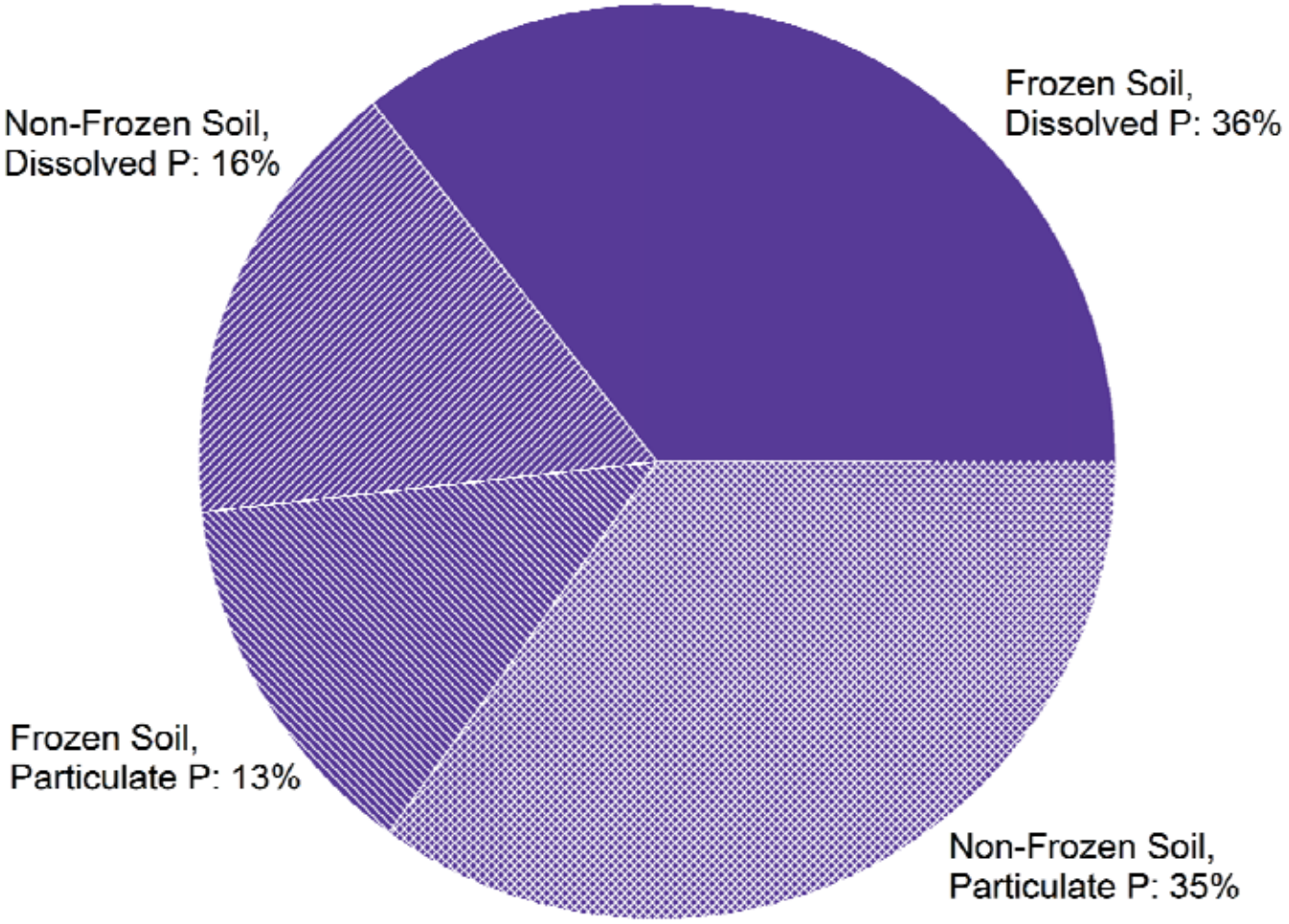
Snowmelt Runoff is Mostly Dissolved Phosphorus and Growing Season Runoff is Mostly Particulate Phosphorus



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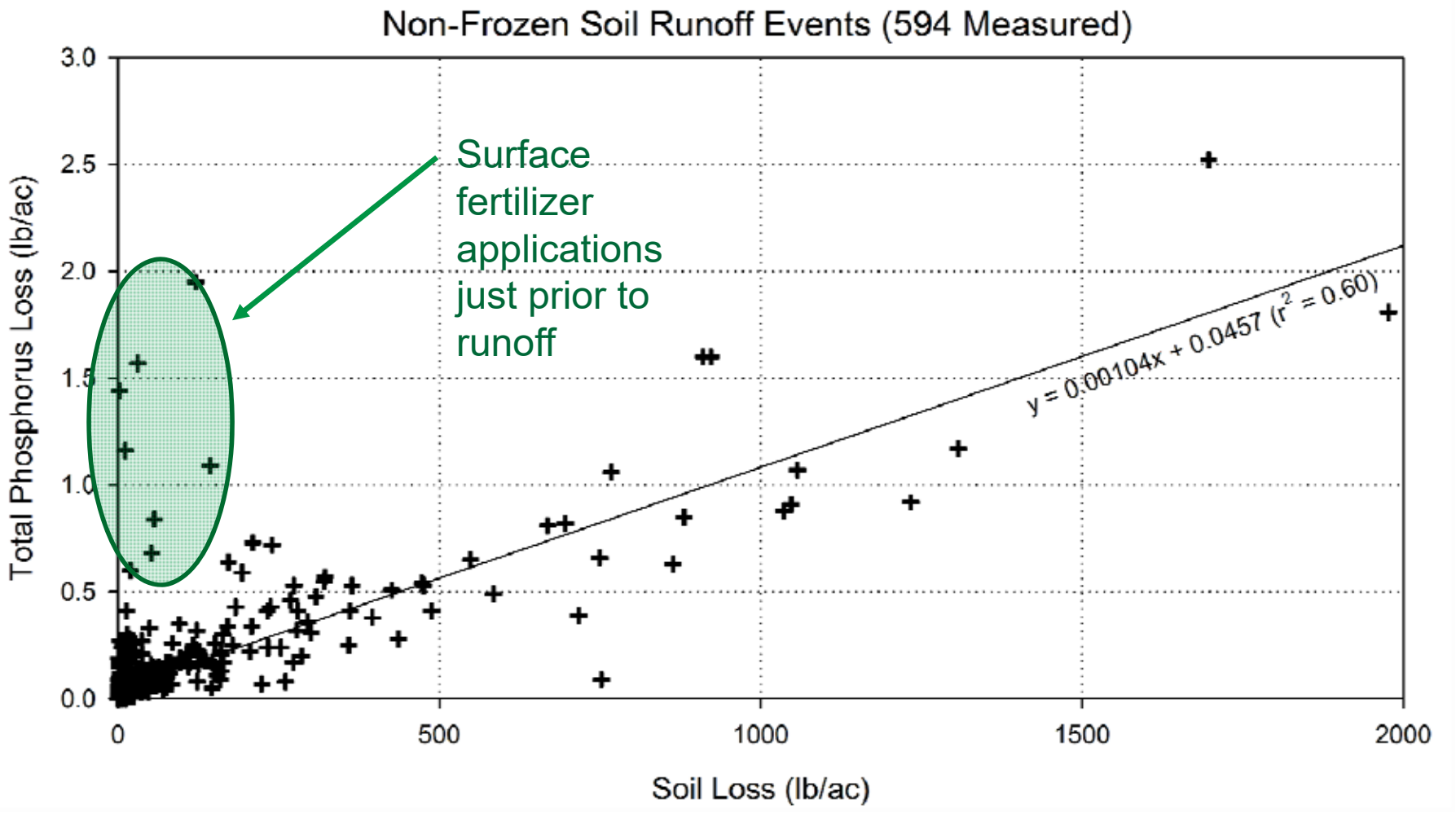
During the Growing Season Phosphorus Loss is Driven by Soil Loss



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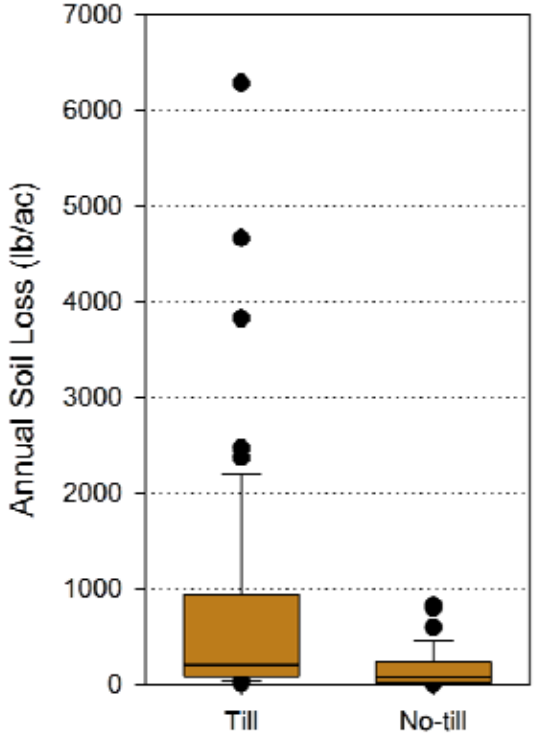
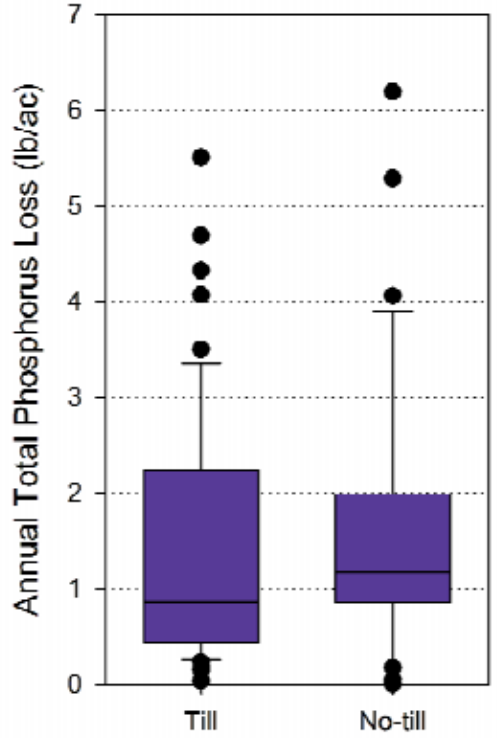
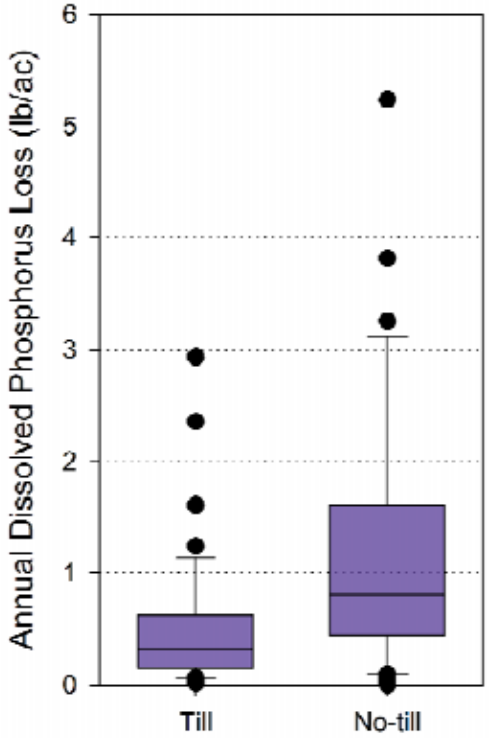
However, Reducing Soil Loss Does Not Always Reduce Phosphorus Loss For the Entire Year







Till median: 205 lb/ac
No-till median: 65 lb/ac
Rank sum p value: 0.001

Till median: 0.9 lb/ac
No-till median: 1.2 lb/ac
Rank sum p value: 0.294

Till median: 0.3 lb/ac
No-till median: 0.8 lb/ac
Rank sum p value: <0.001

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Till Count: 53; No-till Count: 37

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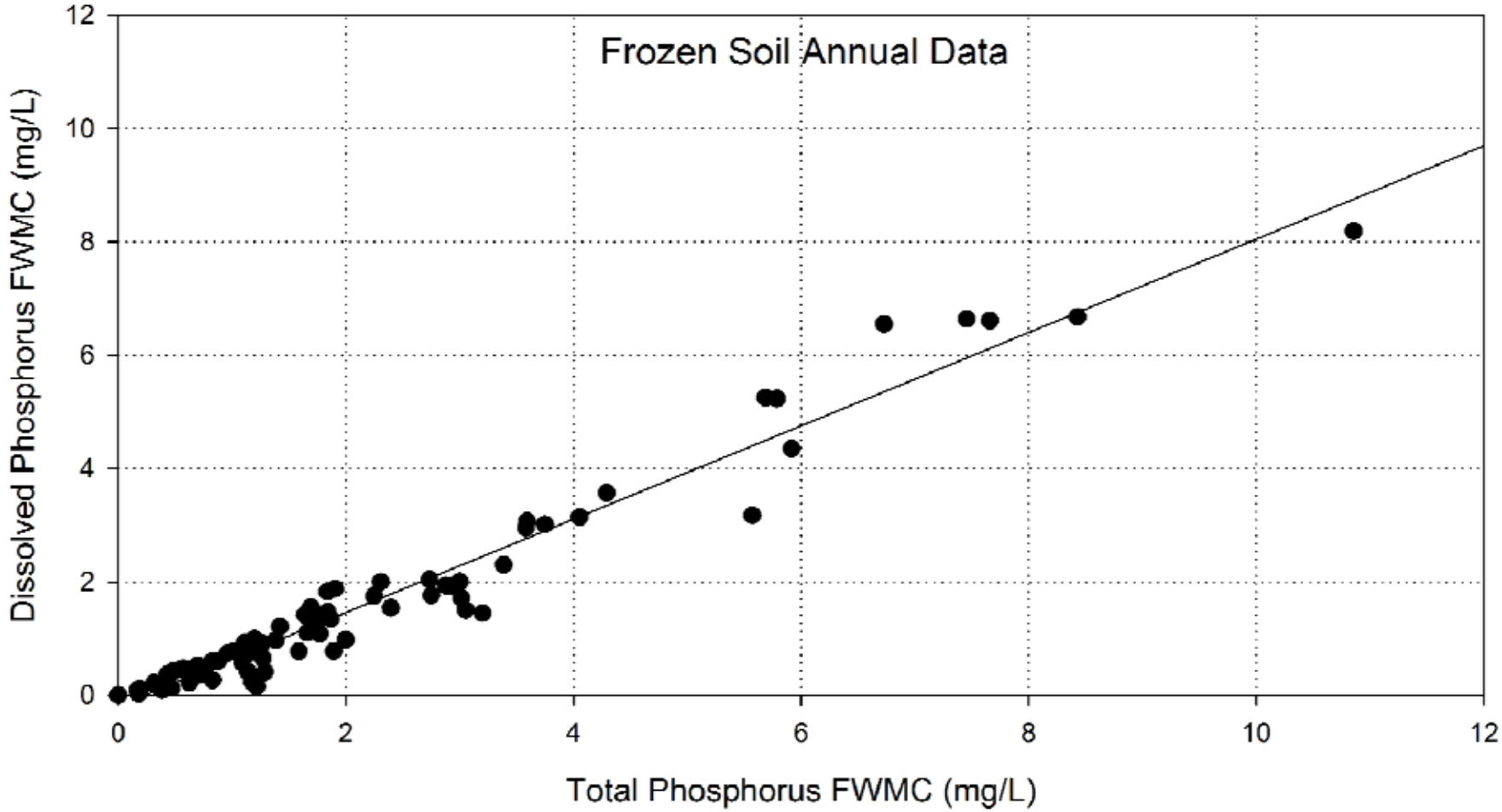
Most of the Dissolved Phosphorus Loss in Minnesota and Wisconsin Occurs in February and March.

Late winter manure application

No till fields with history of surface application of Phosphorus

High soil test values in top inch

80% of the Phosphorus Lost with Snowmelt is Dissolved



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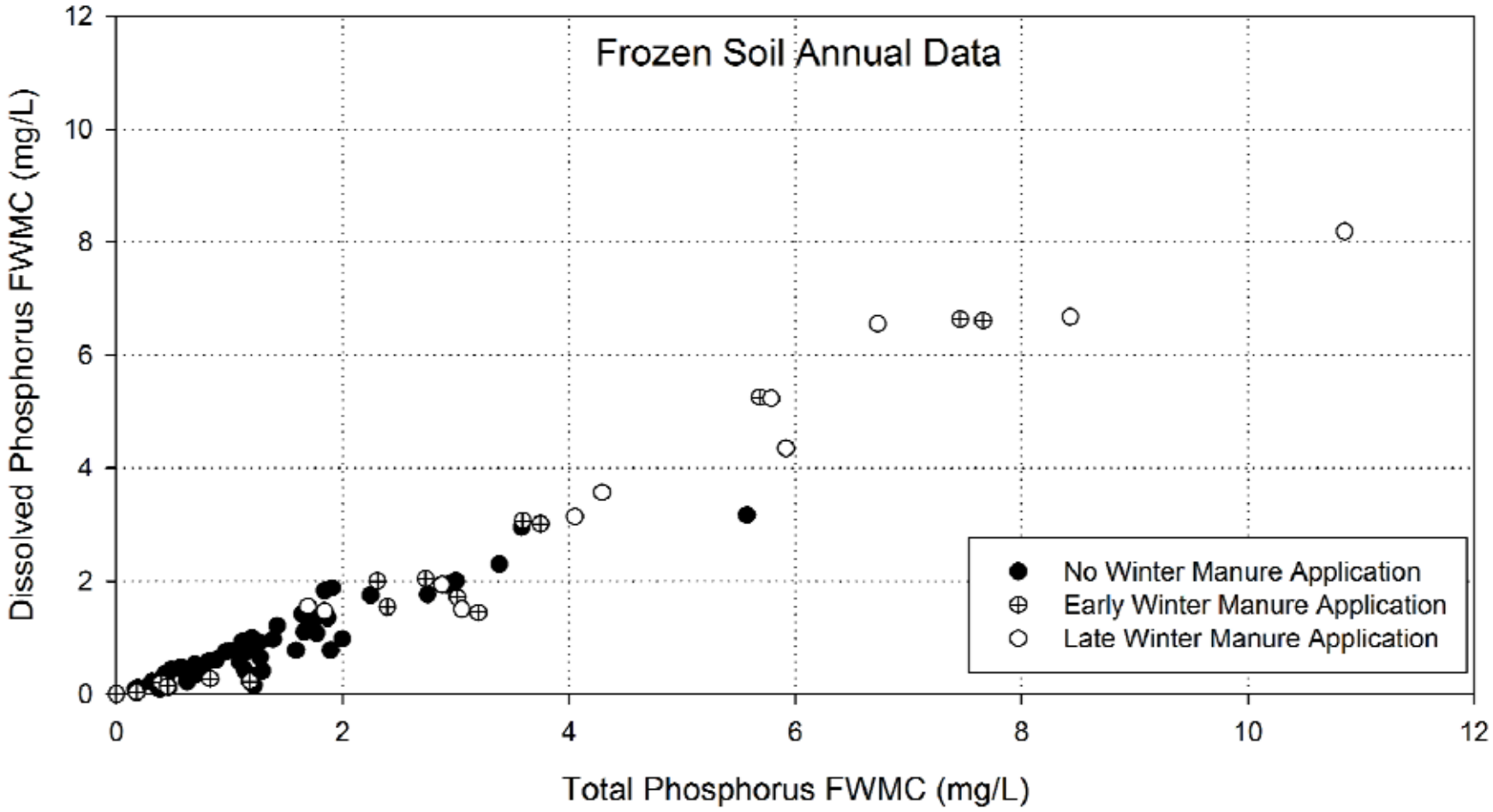
Winter Manure Application Can Increase Snowmelt TP and DP Concentrations



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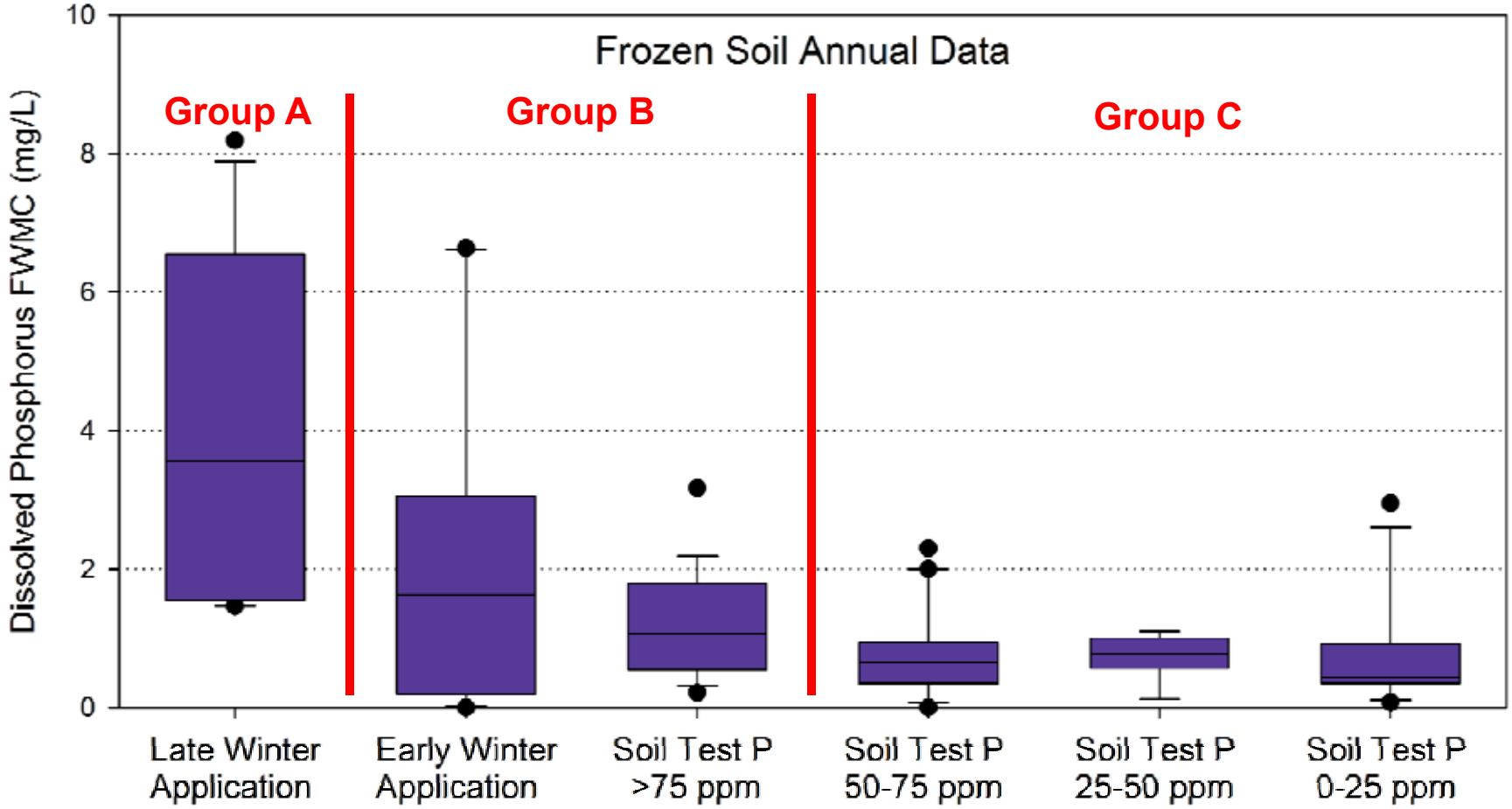
Soil Test P Impacts TP and DP Snowmelt Concentrations In Fields Without Winter Manure Application



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The Great Balancing Act

Minimize soil loss while incorporating P from manure and fertilizer

- Growing season – limit soil loss = limit TP loss
- Snowmelt/Frozen soils – significantly impacted by manure applications and soil test levels

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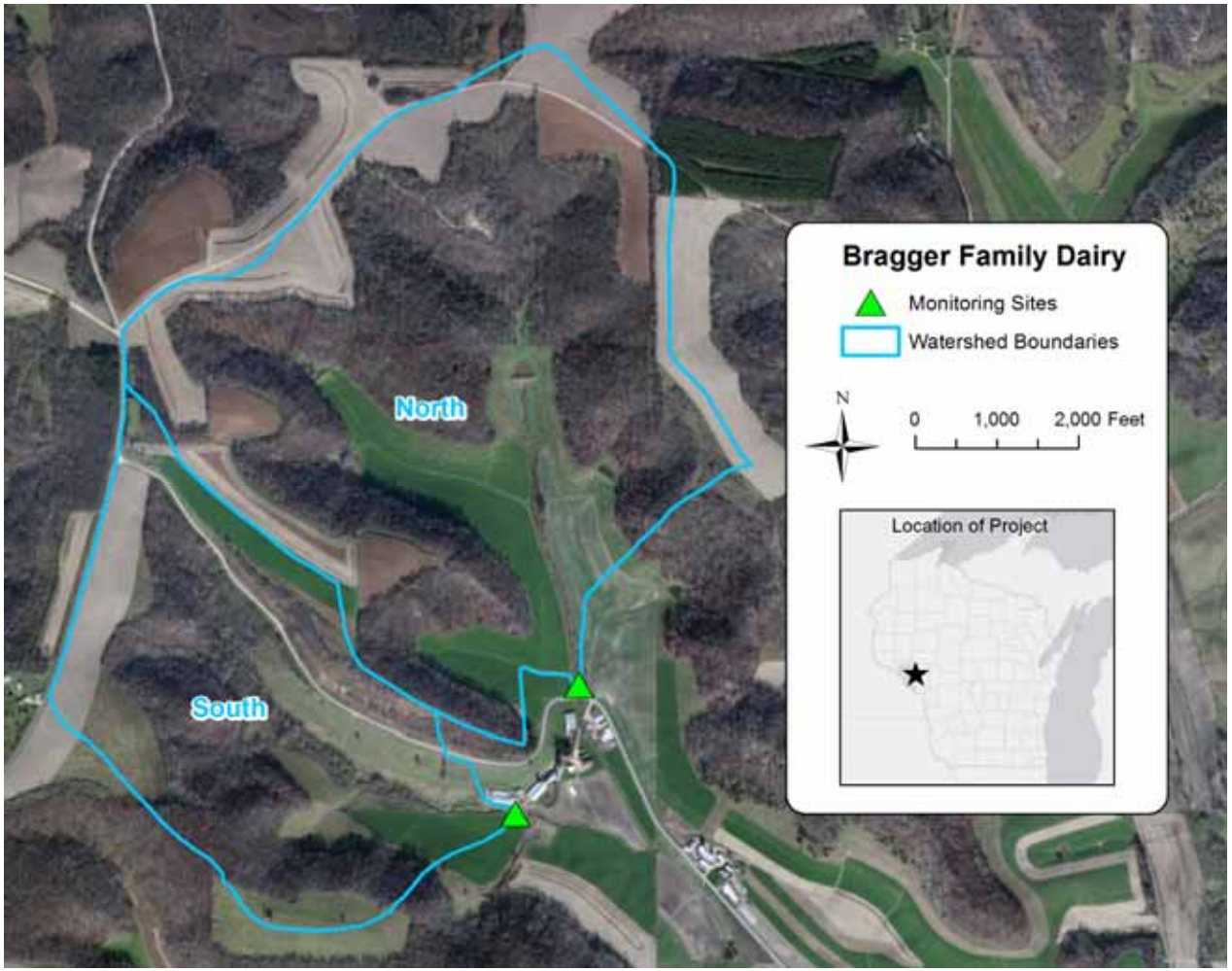
Case Study – How P Losses Compare Between Ag Fields and "Natural" Areas



Dairy and poultry
Farm hilltops and valleys
No-till practices
Corn, alfalfa, soybean
Surface Manure Application

25% average slopes
Silt-loam soils

North Basin ("Ag")
40% cropland
60% woodland & grassland

South Basin ("Natural")
18% cropland
82% woodland & grassland

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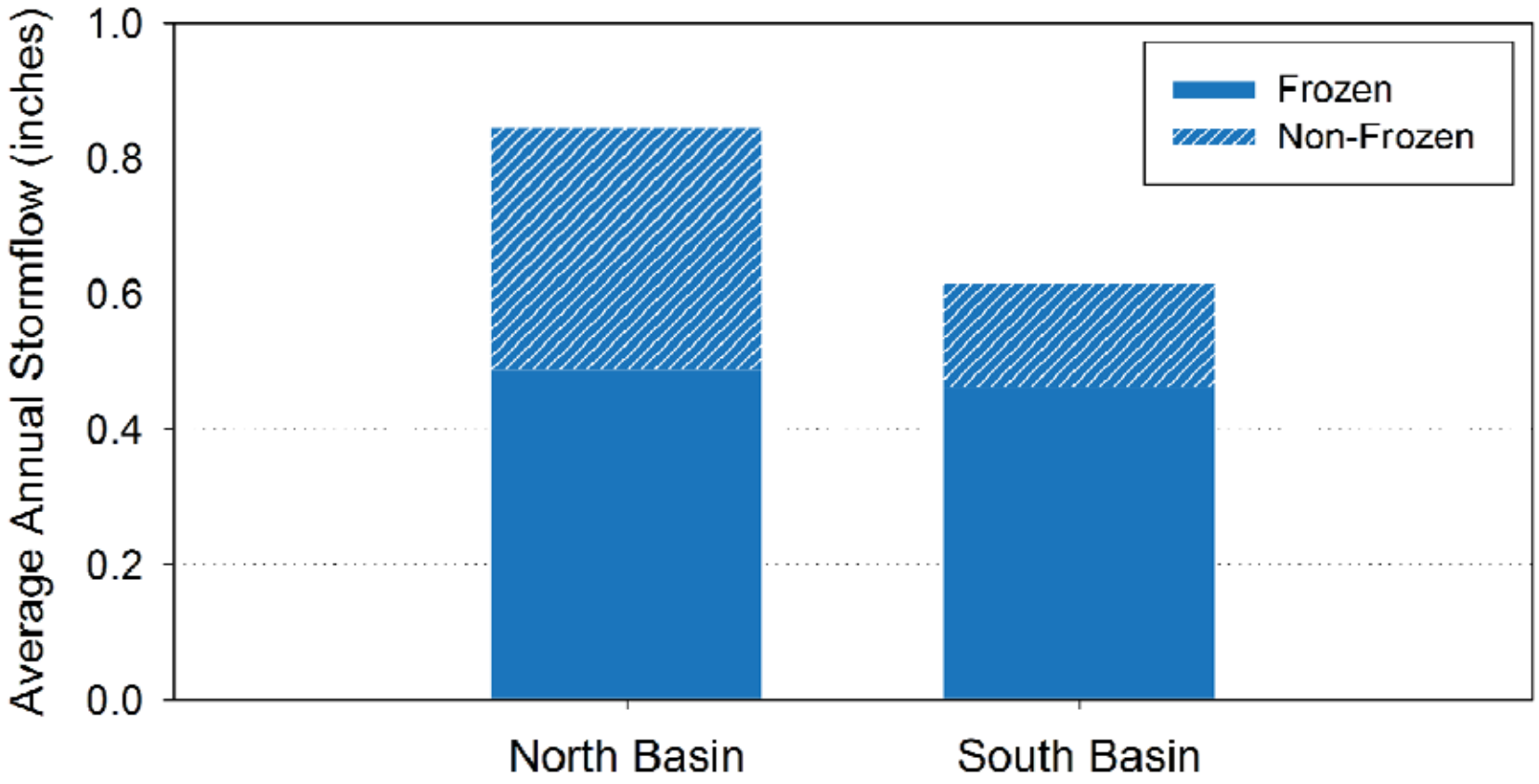
Runoff was Similar During Frozen Soils but Higher for the Ag Basin During the Growing Season



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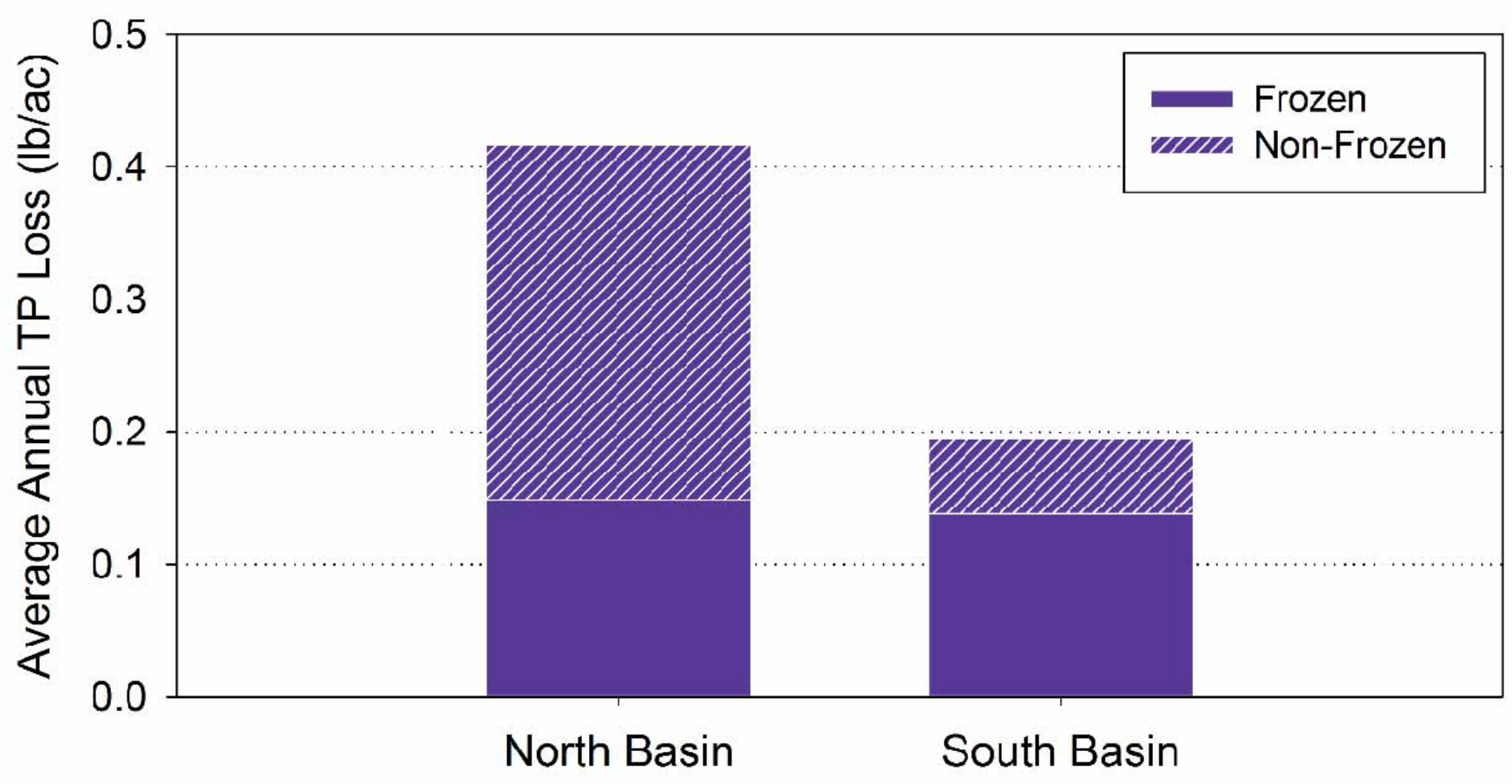
Phosphorus Loss was Similar During Frozen Ground but Higher for the Ag Basin During the Growing Season



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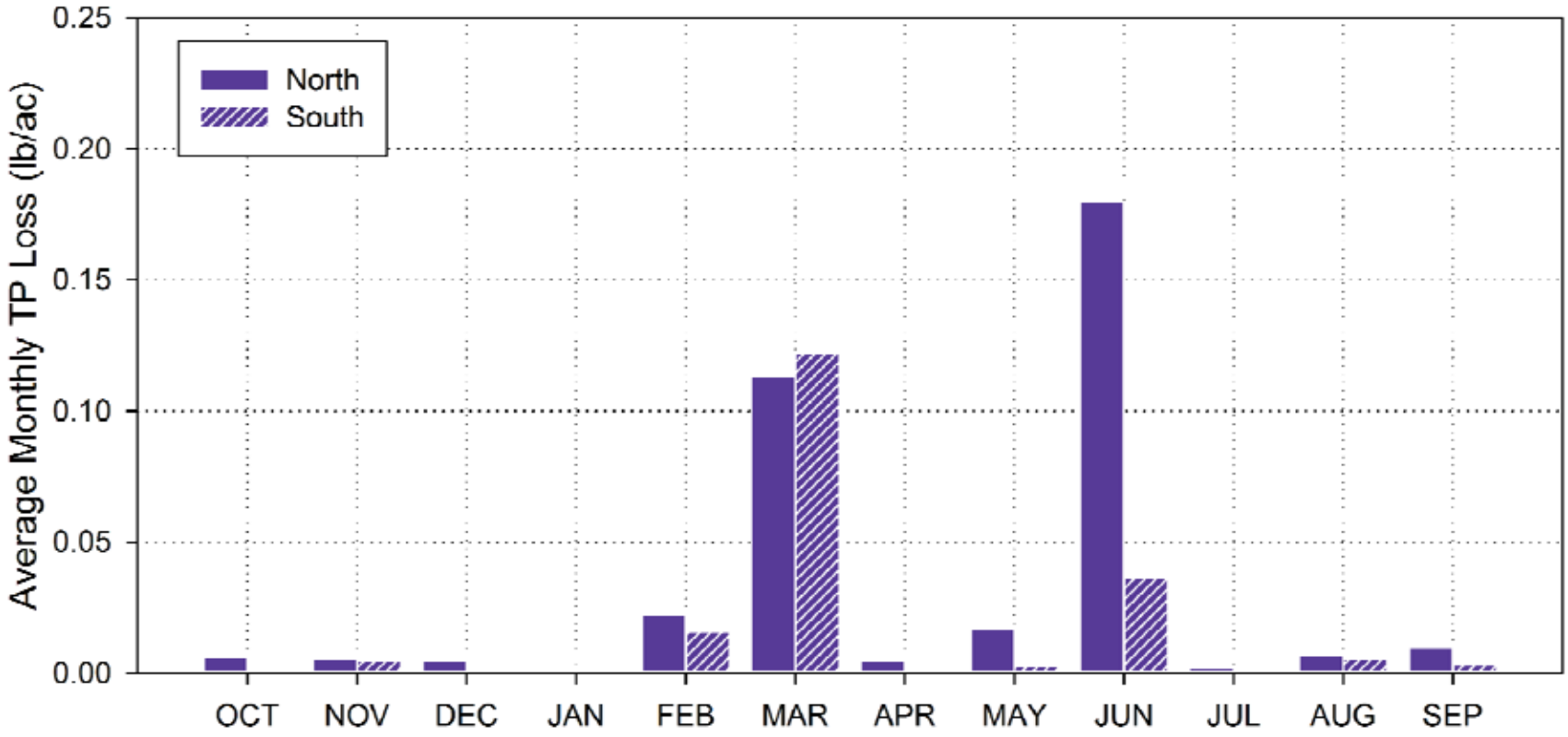
May and June Account for the Differences in Runoff and Total Phosphorus Loss



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What Can This Case Study Tell Us About Managing Phosphorus Losses?

During snowmelt – you get what you get – limited management options (excluding winter manure application)

Critical management time is from planting to crop canopy

What practices do you use to prevent losses during this period?

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Keys to Reducing Phosphorus Losses

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1. Control Soil Losses – Especially in May and June

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2. Carefully Manage Winter Manure Applications

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3. Watch Soil Test P Buildup – Especially on the Soil Surface (no-till)

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