Monitoring Runoff and Sediment at the Platteville Pioneer Farm

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Pioneer Farm Location

5 miles south of Platteville, WI. Located in MLRA 105 – Northern Mississippi Loess Hills
Pioneer Farm Operations

- 330 acres tillable cropland
- contour strips, terraces

Beef Unit / Bull Test Station
Dairy Facility
Swine Center
Corn: 135 ac
Hay: 122 ac
Oats: 73 ac
Nutrient Sources

- Manure Sources
  - Swine
    - Compost
  - Beef
    - Pack manure, compost, lot runoff effluent
  - Dairy
    - Single stage lagoon, pack manure, compost

Use only N fertilizers
Current Manure Management

- Provide full or partial N need for corn
- Estimate manure nutrients
- Sample all manure at time of application
- Follow setback guidelines
- Apply to lowest P soils when possible
- Yearly soil testing
- Composting 100% of swine manure, some dairy and beef manure
Nutrient Application Restriction Areas

Legend

- **Surface Water Quality Management Area**
- **Application restrictions due to well proximity**
- **Waterways and grassed terraces**
Results of whole-farm mass balance

2002:
- N: 93 lb/acre
- P: 21 lb/acre
- K: 43 lb/acre

2003
- N: 96 lb/acre
- P: 8 lb/acre
- K: 24 lb/acre

Planned expansion of swine and dairy herds will increase future mass balances under current manure management strategies.
Pioneer Farm Soil Tests
1968-2003
Pioneer Farm Research Mission

**Mission:** Contribute to the vibrancy of Wisconsin’s agricultural and environmental health.

- Research addresses issues identified by stakeholders that include:
  - Producers
  - Regulatory agencies
  - University researchers and educators
  - Non-governmental organizations
Pioneer Farm Research Priorities

1. Baseline measurements: environmental & farm management
2. Water quality: soil conservation practices, erosion & sediment delivery
3. Nutrient management: focus on N & P
4. Manure Management composting, liquid/solid separation
5. Air quality odor monitoring

** Support of science-based public policies **
Topography and Runoff/Stream Sampling Sites

1. Stream
2. Sites
3. Sites
4. Sites
5. Sites
6. Sites
7. Sites
8. Sites
Typical Pioneer Farm Monitoring Station

- Raingage
- Solar Panel
- Gaging station
- Shaft-encoder stage sensor
- Plywood wingwall

H-Flume - flow measurement
Baseline Runoff Data

- Evaluate factors affecting runoff quality (sediment and P)
  - Relationships among runoff volume, sediment and P concentration
  - Effects of cropping systems
  - Snowmelt vs rainfall runoff
Runoff Volume vs. Suspended Sediment Loads – Site 3

\[ y = 0.5687x - 36.861 \]

\[ R^2 = 0.4588 \]
Runoff volume vs Total P Load – Site 3

\[ y = 0.0008x - 0.0394 \]

\[ R^2 = 0.6967 \]
Sediment Load vs. Total P Load – Single Use Watersheds

\[ y = 0.0011x + 0.0476 \]
\[ R^2 = 0.8407 \]
Effect of Cropping System on Annual Suspended Sediment Load

![Graph showing the effect of cropping systems on annual suspended sediment load. The graph has a y-axis labeled "Suspended sediment load (lb/acre/year)" with values ranging from 0 to 3. The x-axis is labeled "Crop and Years In" and shows different crops labeled H2, H3, C1, and C2. The bars represent the number of years (n) in each crop, with n=1 for H2 and H3, n=3 for C1, and n=2 for C2.]
Effect of Cropping System on Total P Load

![Chart showing the effect of different cropping systems on total P load.](chart.png)

- **Crop and Years In**
  - **H2**: n=1, TP load (lb P/acre/year) = 0.5
  - **H3**: n=1, TP load (lb P/acre/year) = 1
  - **C1**: n=3, TP load (lb P/acre/year) = 4
  - **C2**: n=2, TP load (lb P/acre/year) = 1.5

This chart illustrates the variation in total P load across different cropping systems and years.
Snowmelt Total and Dissolved P

Relationship of Total P to Dissolved P in all 2004 Snowmelt Samples

\[ y = 1.0215x - 0.2603 \]

\[ R^2 = 0.9901 \]
Impact of Winter Manure Applications

2004 Winter Runoff – 3 events

Received winter manure
Calibrating the P Index: Why use Pioneer Farm?

- PI has been determined for all fields
- Single-crop subwatersheds provide ideal conditions for measuring edge-of-field losses
- Have flexibility in management to test assumptions of the PI
Results of PI and Annual Loads

**** Provisional Data ****

channelized flow & gully erosion
Site 2 – June 2004
Is the PI a better predictor of runoff losses than Soil Test P?

**PI vs P load**

\[ y = 0.322x + 0.479 \]

\[ R^2 = 0.7472 \]

*** Provisional data and Site 2 – 2004 removed***
Phosphorus Index - Related Research

- Testing the relationship between soil test P and runoff concentrations at plot and subwatershed scales
- Evaluating the assumption that runoff P is consistent throughout the year
- Determining if a sediment P enrichment factor would better predict sediment P concentrations
- Determining the impact of acute P losses
Ongoing Research: Testing the relationship between STP and runoff P losses

Small Plot Scale

Watershed Scale

Simulated Runoff

Natural Runoff
Alfalfa watershed

Approx. watershed boundary

Small Runoff Plots

soil samples

Flume
### Winter runoff – Sites 2 and 8 (not manured)

<table>
<thead>
<tr>
<th>Season (2004 crop year)</th>
<th>Site 2 (1\textsuperscript{st} year corn)</th>
<th>Site 8 (1\textsuperscript{st} year hay)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Fall (harvest- Nov. 15)</strong></td>
<td>0.50 (n=4)</td>
<td>N/A</td>
</tr>
<tr>
<td><strong>Winter (snowmelt and winter precipitation)</strong></td>
<td>0.43 (n=20)</td>
<td>2.35 (n=23)</td>
</tr>
<tr>
<td><strong>Spring (April 1 – June 1)</strong></td>
<td>0.46 (n=13)</td>
<td>0.57 (n=6)</td>
</tr>
<tr>
<td><strong>Summer (June 1 - harvest)</strong></td>
<td>0.42 (n=8)</td>
<td>1.57 (n=2)</td>
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</tbody>
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---------- Average dissolved P concentration (mg/L) ----------
Evaluating Acute Losses

- Fall / Winter 2004-2005: Planned applications of solid and liquid dairy manure
Summary

- Large amounts of data have been collected
- Baseline data is beginning to answer questions about runoff sediment and P dynamics
- Data quality control and dissemination is a priority
- Goal is to provide sound basis for nutrient management – related public policy, leading to more widespread adoption of BMPs
Questions?