PHOSPHORUS LOSS FROM TILE DRAINS: SHOULD WE BE CONCERNED?

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General consensus is that tile drainage will reduce erosion and surface P losses, but increase N leaching losses.

Discovery Farms has intensely monitored four farm sites that have tile drainage and extremely high soil test phosphorus values.

The question is – how much P are losing, what is causing it, and what are our options for mitigation?
COWS & TILE DRAINAGE IN WI

U.S. Census of Agriculture, 2007

U.S. Census of Agriculture, 1992
STUDY OBJECTIVES

- Quantify P losses from tile drained fields
- Evaluate factors that influence P loss
FOUR DISCOVERY FARMS SITES

CP1: Chisel plowed, continuous corn
- Kewaunee Co., STP=80 ppm, slope 2-6%

CP2: Chisel plowed field, continuous corn
- Kewaunee Co., STP=56 ppm, slope 2-6%

NT: No-till field, corn-soybean rotation
- Waukesha Co., STP=85 ppm, slope 1-3%

GP: Grazed pasture
- Manitowoc Co., STP=108 ppm, slope 2-6%
LOCATIONS – IN OR CLOSE TO LAKE MICHIGAN WATERSHED

F. Hole, 1976

http://techalive.mtu.edu/meec/module01/images/MichiganWatershedAtlas.gif
Methods of Data Collection, Sample Processing, and Data Analysis for Edge-of-Field, Streamgaging, Subsurface-Tile, and Meteorological Stations at Discovery Farms and Pioneer Farm in Wisconsin, 2001–7

http://pubs.usgs.gov/of/2008/1015/
Dissolved P = P in water
Particulate P = P in sediment (in water)
Total P = DP + TP
Flux = lb/ac/yr
Concentration = mg/L or ppm
Flow-weighted concentration
  - Averaging concentrations over time
  - e.g.: 1,000 L with 1 ppm and 100 L with 50 ppm
  - Flow weighted = 5.5 ppm
<table>
<thead>
<tr>
<th>Site</th>
<th>2005</th>
<th>2006</th>
<th>2007</th>
<th>2008</th>
<th>2009</th>
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<tbody>
<tr>
<td></td>
<td>Tile</td>
<td>Surface</td>
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<td>Surface</td>
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<tr>
<td>CP1</td>
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<td>1.47</td>
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<td>1.17</td>
<td>1.47</td>
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<td>0.49</td>
<td>2.27</td>
<td>0.53</td>
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<tr>
<td>GP</td>
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<td>1.25</td>
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<tr>
<td>Location</td>
<td>Bray P1 equiv.</td>
<td>Tile FW-TP</td>
<td>Tile TP</td>
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<td>---------------</td>
<td>------------</td>
<td>---------</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>mg kg⁻¹</td>
<td>mg L⁻¹</td>
<td>lb ac⁻¹ yr⁻¹</td>
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<td>1.11</td>
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</table>
WHEN DO WE LOSE P IN TILES?

Tile TP (kg ha\(^{-1}\))

- 0.0
- 0.5
- 1.0
- 1.5
- 2.0

Drainage (cm)

- 0
- 5
- 10
- 15
- 20

Month

- Oct
- Nov
- Dec
- Jan
- Feb
- March
- April
- May
- June
- July
- Aug
- Sept

Drainage (cm)

- 2005
- 2006
- 2007
- 2008

Tile TP (kg ha\(^{-1}\))
DRAINFLOW VS P LOSS

R² Table

<table>
<thead>
<tr>
<th>Site</th>
<th>TP</th>
<th>DRP</th>
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</thead>
<tbody>
<tr>
<td>CP1</td>
<td>0.69</td>
<td>0.80</td>
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<tr>
<td>CP2</td>
<td>0.67</td>
<td>0.80</td>
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<td>NT</td>
<td>0.16</td>
<td>0.17</td>
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<tr>
<td>GP</td>
<td>0.78</td>
<td>0.80</td>
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The application on 4/1/08 was the only “clear” evidence of manure having a large impact on tile losses across all sites.
EVENT P CONCENTRATIONS: ALL SITES

$y = 0.29x + 0.28$

$R^2 = 0.66$
CONCLUSIONS

- Tile drainage can represent between 17 and 52% of the total P loss from a field.
- Total flow explains most of the variation in P loss.
- Manure applications were not found to consistently affect P loss from drains.
- Since there is a significant relationship between overland flow and tile flow, a simple model may be effective in accounting for these losses.
We need to exploring both management options (e.g. different manure applications) and engineering options (e.g. controlled drainage, tile filters) to determine if any reductions can be obtained.

The best management option is to apply manure at appropriate times, not when tiles are flowing.
BEST THING TO DO IS CHECK TILE DRAINS

http://www.nocafos.org/news.htm

“Frothy-ness” is evidence of organic carbon loss – most likely from manure