The Wisconsin Phosphorus Index Characteristics and use

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Jan. 15, 2002
Aglime Conference

SUMMARY

Phosphorus that could cause problems in water occurs both in particles (PP) and dissolved in solution (SP) when it reaches surface water.

We consider movement of both particulate and dissolved P into water.

The PI is available in spreadsheet form to simplify calculations.

The numbers and relationships applied will be made more site-specific as we gain experience.

Objective

Decrease nonpoint source P inputs into water bodies efficiently and economically.

Characteristics of P index

- Accurately **rank fields** in order of their risk of supplying P to a water body

- Based on **best available science**, easily modified to reflect improvements

- **Easy** to use, interpret, and apply

- Helps user **understand factors** affecting P movement to water

- Direct user to **improved management practices** that effectively and economically lower the risk

- Should be applied over the **whole farm**

- Provide **maximum flexibility** to farmer, while decreasing P loading.

Total Risk Index for Phosphorus (PI):

PI = PP + SP + LP

PI = Total P index

PP = Particulate P

SP = Soluble P

LP = Leached P

PP: Depends on (1) erosion, (2) fraction of eroded particles delivered to stream, and (3) P concentration in the soil particles

Calculation:

Particulate P =

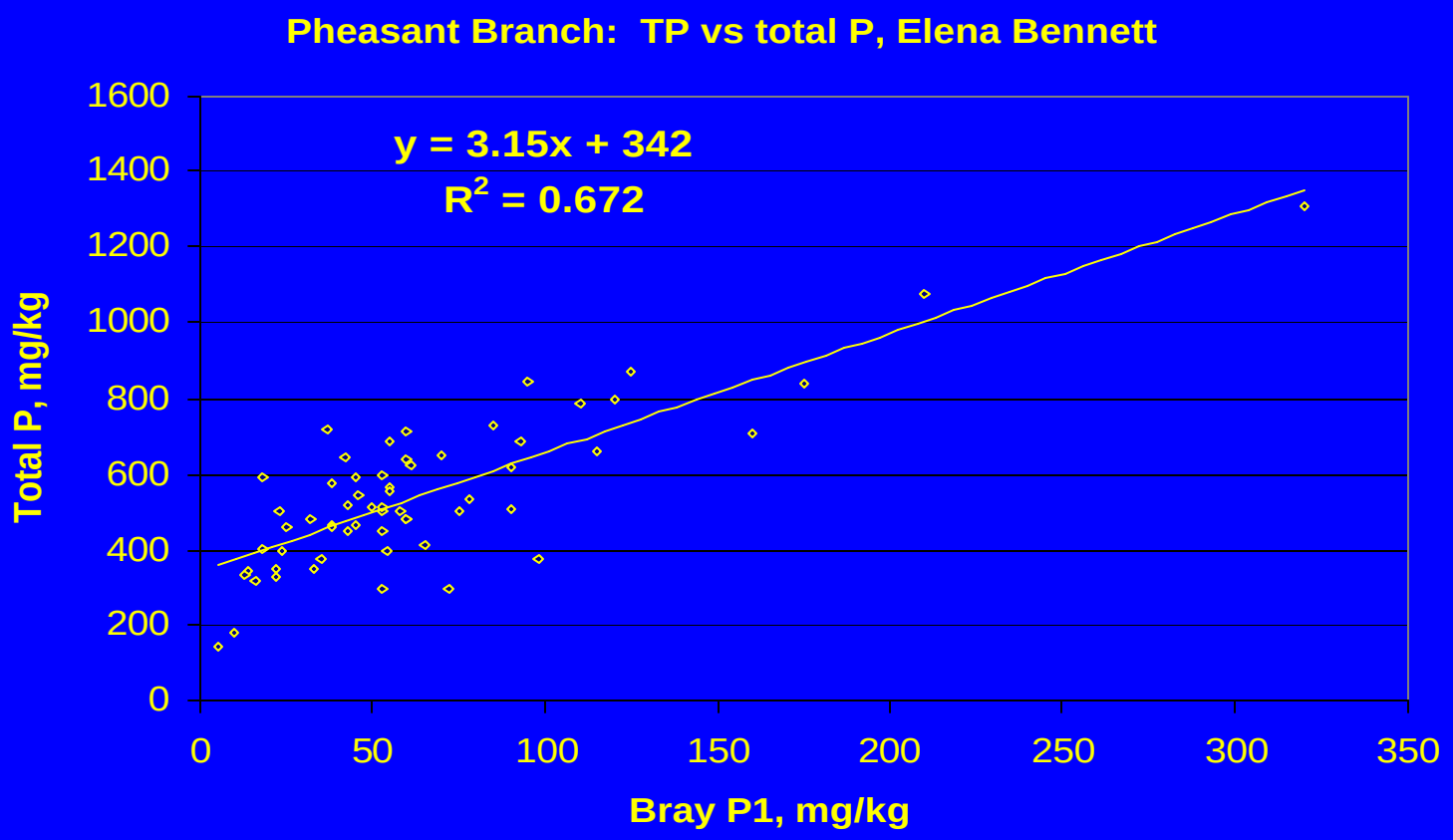
Rusle2 *

Sediment Delivery Ratio *

Enrichment Ratio *

BufferEffectiveness*

Soil particle P concentration (from Bray P1)



Also:

Meyer, Lyne, Avila, Barak, UW Madison, Plano silt loam:

Total P = 2.5 (Bray P1) + 875

Soluble P: Depends on amount of runoff, P concentration in the soil, and soluble P concentrations in P-containing amendments/fertilizers

Total of

SP from soil P

+ SP from unincorporated nutrients on unfrozen soil

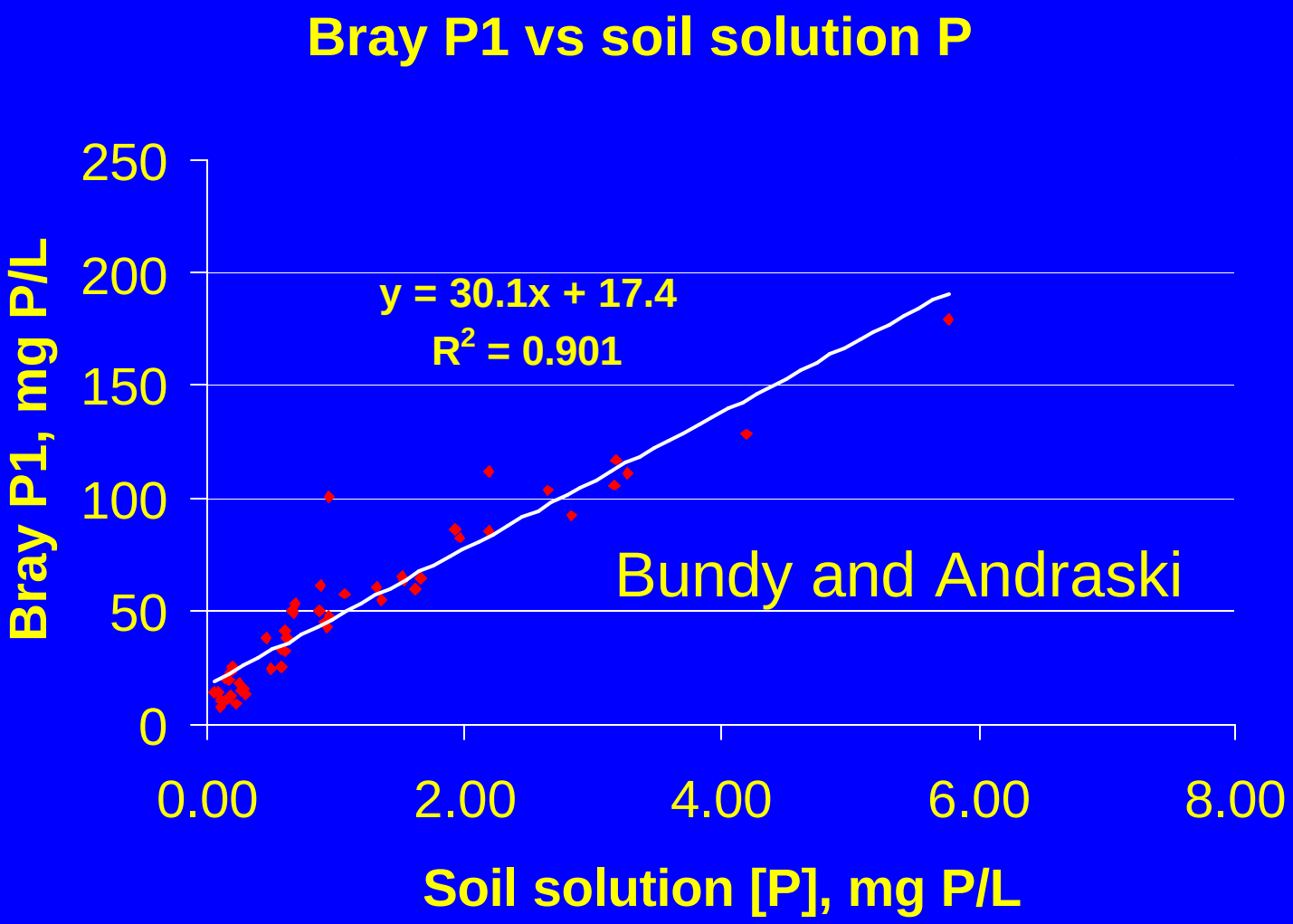
+ SP from unincorporated nutrients on frozen soil

(SP release from alfalfa?)

a. For no fertilizer or incorporated fertilizer:

Annual runoff volume *

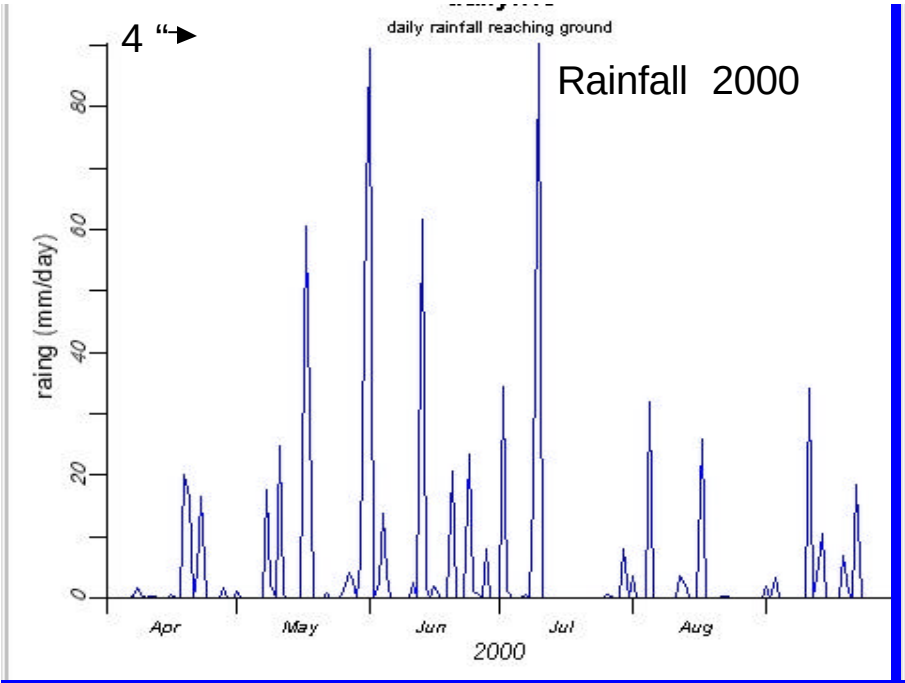
Soil solution [P] (from Bray P1)


Bray P1 vs soil solution P
Bray P1, mg P/L
250
200
150
100
50
0
y = 30.1x + 17.4
R2 = 0.901
Bundy and Andraski
0.00
2.00
4.00
6.00
8.00
Soil solution [P], mg P/L

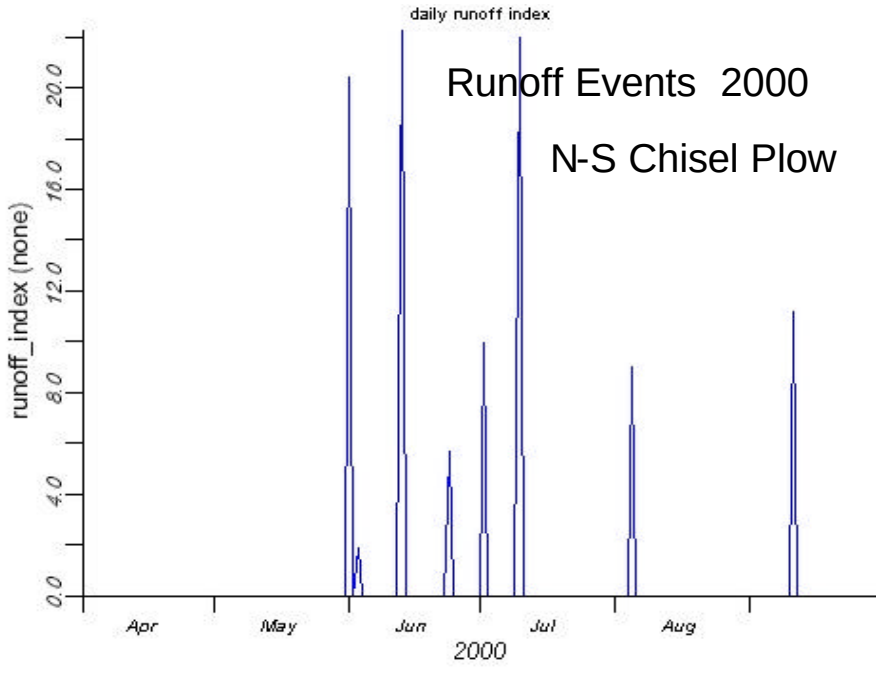
b. For surface-applied nutrients without incorporation:

Soluble P in manure (lb/A) /

average days between runoff-generating events



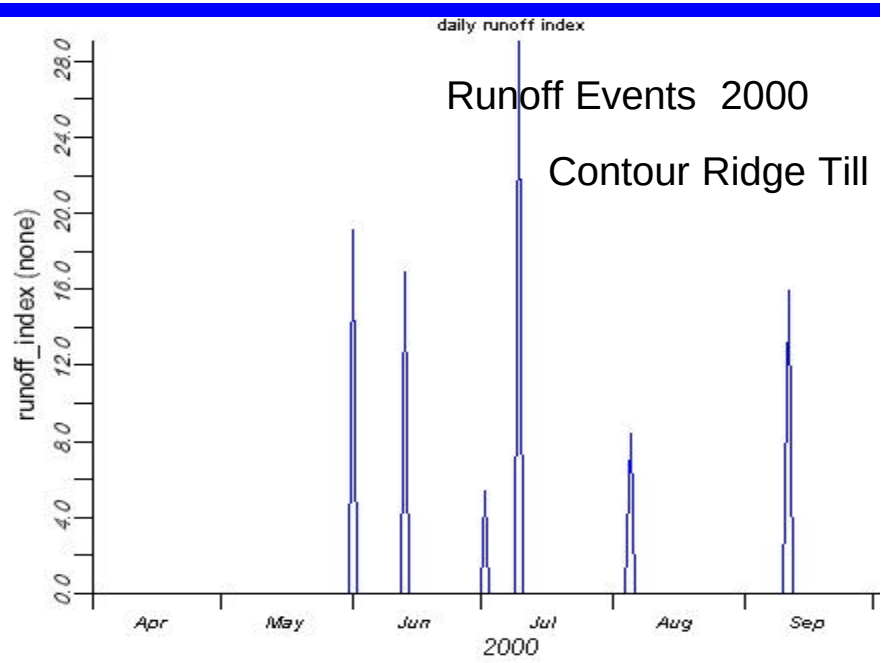
Rainfall 2000



Runoff Events 2000

N-S Chisel Plow

Arlington, Wisconsin



Runoff Events 2000

Contour Ridge Till

c. For snow-melt events with nutrients spread on frozen soil:

Soluble P in manure (lb/acre)*

Slope percentage(squared)/200

****NOT YET INCORPORATED INTO MODEL****

d. For loss of P from crop residue

SP = Soluble P in residue *

Runoff volume

****NOT YET INCORPORATED INTO MODEL****

LP = P lost through leaching

LP =

P concentration in soil solution/

(depth to tile * retention coefficient * recharge volume)

Preliminary Interpretation of risk associated with PI values:

0 – 2 Low risk: low probability of being a problem except for very sensitive water bodies

2 – 6 Intermediate risk: important for water bodies sensitive to P inputs

6 - 10 High risk: Likely excessive in most watersheds

>10 Very high risk: Excessive for almost any water body

Examples

Situation: Corn, silt loam soil, 100 ppm Bray P1, next to stream, 3% slope

1. No-till corn, 25 T/A dairy daily haul

Total = 4.01 Particulate = 0.18 Soluble = 3.76

2. Moldboard plow, corn, no manure

Total = 3.64 Particulate = 3.0 Soluble = 0.64

3. Moldboard plow, corn, 25 T/A dairy daily haul

Total = 5.59 Particulate = 3.0 Soluble = 2.59

4. No-till, corn, 25 T/A dairy daily haul, no feed supplement

Total = 1.61 Particulate = 0.18 Soluble = 1.43

5. No-till, corn, 25 T/A dairy daily haul, frozen ground

Total = 1.99 Particulate = 0.18 Soluble = 1.81

The Phosphorus Risk Index - Progressive Planning