Scale of Measurement Effects on Phosphorus in Runoff from Cropland

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January 19, 2006

Background

- P-based nutrient management planning is required for some farm operations
- The P Index is one tool for preparing P-based nutrient management plans
- The Wisconsin P Index concentration equations are based largely on plot scale research results showing relationships between soil P and runoff P concentrations

Rationale for Study

- Purpose of this study was to determine scale of measurement effects on P concentrations in runoff
- Pioneer Farm has a unique opportunity to compare plot and subwatershed scale measurements
- Natural runoff and simulated rain small plots in two USGS monitored subwatersheds
  - 17.8 acre (ac) corn field
  - 29.6 ac alfalfa field

Runoff Measurements

- Runoff volume
- Sediment
- Phosphorus
  - -Total P
  - -Dissolved P

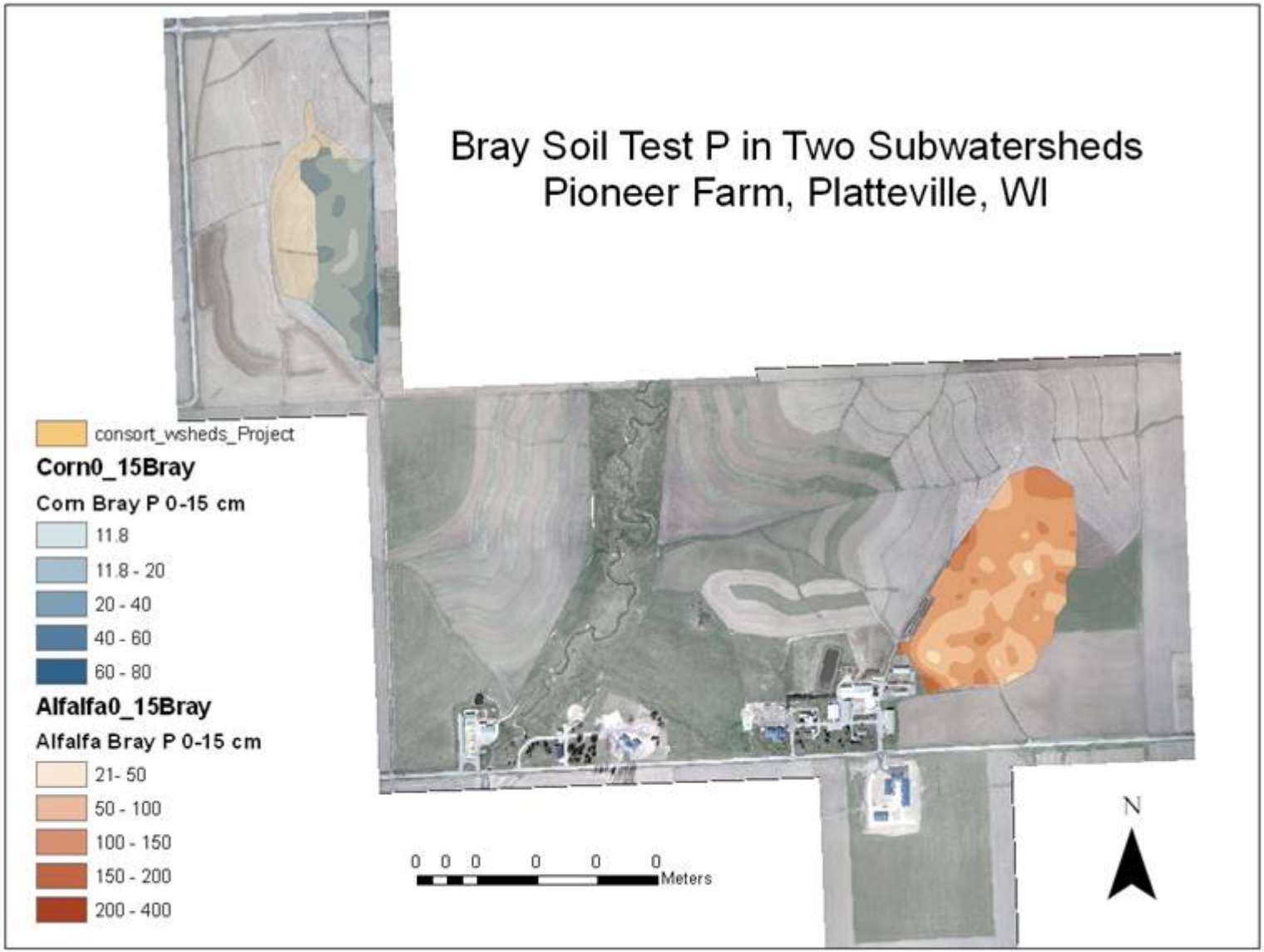
Natural Runoff Collection

Site Measurements

- Soil tests
  - Small plots (Bray P1, Mehlich III, deionized (DI) water extraction, total P)
  - Subwatershed intensive grid sampling (Bray P1, total P)

Soil Phosphorus Levels in Subwatersheds and Small Plots

Field	Depth (cm)	Bray soil test P	
		Subwatersheds	Small plots
		----------ppm----------	
Corn	0-2	49	31
	0-15	37	19
Alfalfa	0-2	133	141
	0-15	114	137


Bray Soil Test P in Two Subwatersheds
Pioneer Farm, Platteville, WI
consort_wsheds_Project
Corn0_15Bray
Corn Bray P 0-15 cm
11.8
11.8 - 20
20 - 40
40 - 60
60 - 80
Alfalfa0_15Bray
Alfalfa Bray P 0-15 cm
21- 50
50 - 100
100 - 150
150 - 200
200 - 400
0 0 0 0 0 0
Meters
N

Runoff Events in Both Scales

From June 2004 to June 2005

- 9 runoff events in the corn
  - -5 in the summer
  - -4 in the winter
- 7 runoff events in the alfalfa
  - -1 in the summer
  - -6 in the winter

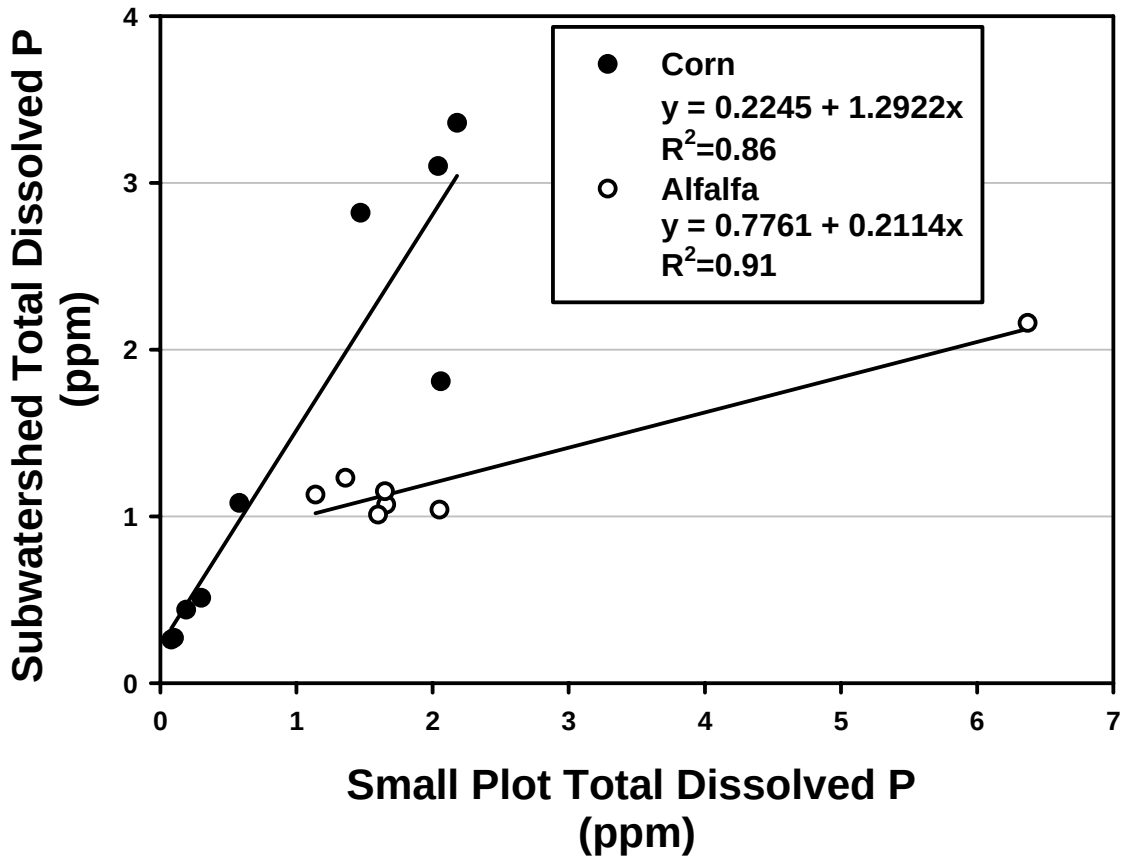
Runoff Volume Relationships

- Small plots had greater runoff volumes per unit area in all cases compared to subwatersheds, but the TDP (total dissolved P), TP (total P), and TS (total solids) concentrations follow similar trends
  - Volume relationships between small plot and subwatershed by event

    -Corn r^2=0.71 -Alfalfa r^2=0.72

Relationships between Corn and Alfalfa Subwatershed and Small Plot Total Dissolved P Concentrations in Runoff from June 2004 to June 2005 at the Pioneer Farm

- Bray P1 values influenced TDP concentrations at both scales



Total Dissolved Phosphorus and Sediment Concentrations in Annual Runoff from Corn Subwatersheds and Small Plots from June 2004 to June 2005 at the Pioneer Farm

Field	Season	n	Scale	TDP	TS
				ppm	ppm
Corn	Annual	9	Subwatershed	2.24	3920
			Small Plot	1.85	1100
	Winter	4	Subwatershed	3.32	440
			Small Plot	2.12	380
	Summer	5	Subwatershed	0.45	9670
			Small Plot	0.22	5390

Scale of Measurements Comparisons

- Total dissolved P (TDP) concentrations in runoff were similar at the small plot and subwatershed scales

- Crop and season effects on runoff TDP and TS concentrations were reflected at both scales of measurement

  - On an annual basis, the corn had higher runoff P and solid concentrations than the alfalfa

  - TDP concentrations and loads were greater in the winter than the summer at both scales

Pioneer Farm Climate Data for June 2004-April 2005

	Normal		Departure from Normal	
Season	Precipitation	Temperature	Precipitation	Temperature
	inch	°F	inch	°F
Summer	26.1	57.4	-7.09	2.00
Winter (Dec.-Mar.)	6.06	23.78	1.21	1.58

Conclusions

- Since P index equations for predicting runoff soluble P and sediment P concentrations are based on small plot measurements, the finding that these parameters are similar at plot and subwatershed scales lends support to use of plot scale data for the development of P indices

Acknowledgements

- University of Wisconsin Consortium for Extension and Research in Agriculture and Natural Resources
- College of Agriculture and Life Sciences, UW-Madison
- UW-Madison Graduate School
- UW-Platteville Pioneer Farm