Phosphorus Losses From Corn Fields

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Overview

I. Introduction and Background.

II. Overall Research Goal.

III. Methods and Materials.

IV. Results and Discussion.

V. Conclusions.

Introduction and Background

- Water quality work over the past 30 years have been driven by the Clean Water Act (CWA, 1972).

- One major unresolved problem is nutrient nitrogen (N) and phosphorus (P) export from agriculture.

Lake 226, September 1973

Introduction and Background

This discussion will focus on the following:

1. The impact of residue level on soil loss.
2. The relationship between soil and phosphorus (P) loss.
3. The particle size TP mass distribution of sediment.

Overall Research Goal

To investigate the influence of agricultural management practices on the delivery of P in rainfall and snowmelt runoff from corn fields.

Methods and Materials

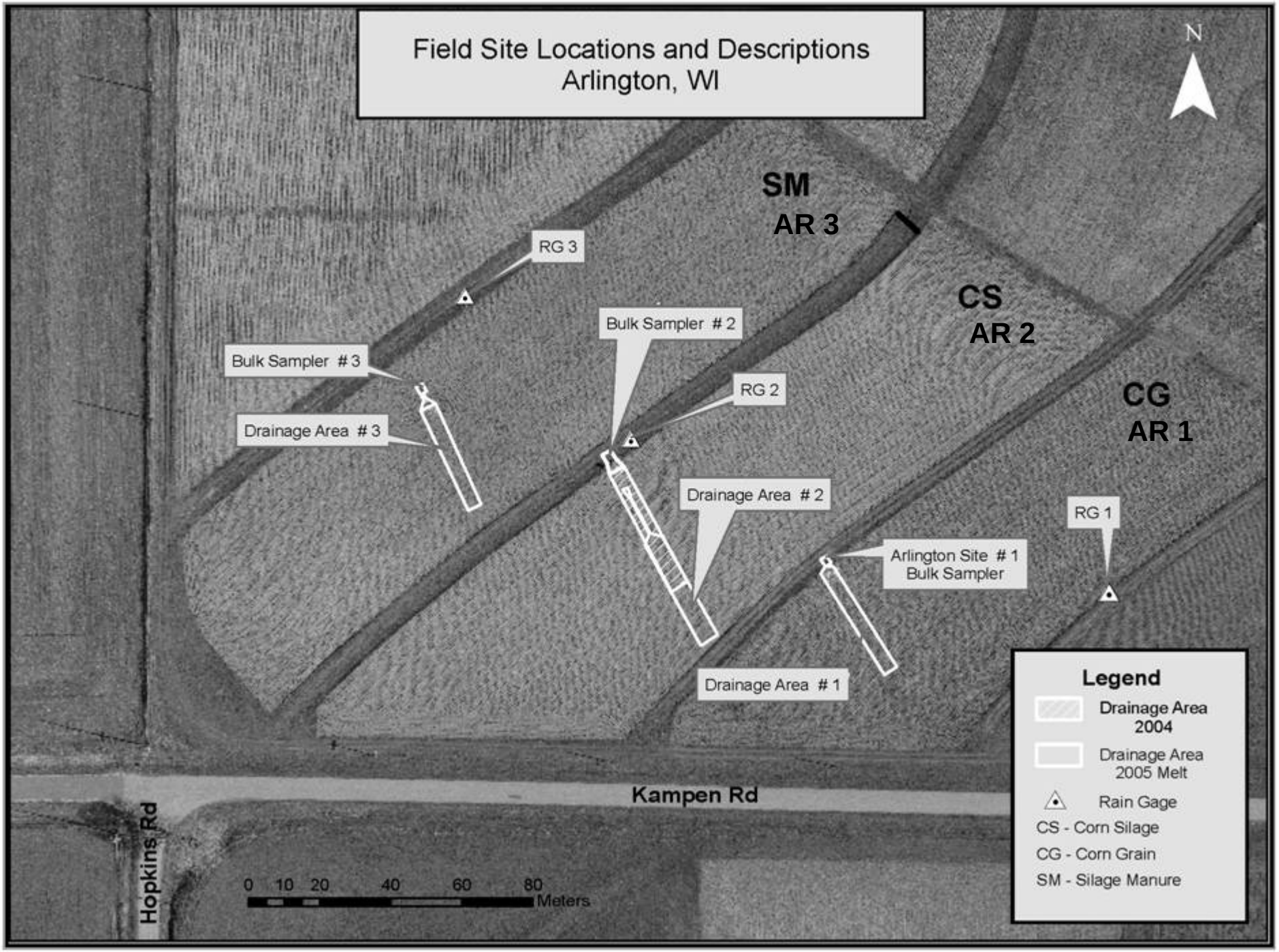
- Field treatments -

Field AR 1 - CG
Corn – Grain, No manure
Residue = 51%

Field AR 2 - CS
Corn – Silage, No manure
Residue = 10%

Field AR 3 – CS-M
Corn – Silage, Fall manure
9,400 gal. / ac. ~ 48 lb P / ac
Residue = 15%

Soils: Ripon series silt loams ~ 8% slope


Field Site Locations and Descriptions
Arlington, WI
N
SM
AR 3
CS
AR 2
CG
AR 1
RG 3
Bulk Sampler # 2
Bulk Sampler # 3
RG 2
Drainage Area # 3
Drainage Area # 2
RG 1
Arlington Site # 1
Bulk Sampler
Drainage Area # 1
Kampen Rd
Hopkins Rd
0 10 20 40 60 80
Meters
Legend
Drainage Area 2004
Drainage Area 2005 Melt
Rain Gage
CS - Corn Silage
CG - Corn Grain
SM - Silage Manure

Methods and Materials

- Bulk Sample Collection -

- Hydrologically isolated hill-slope tracts 15 ft x 120 ft.
- Inflow divided 1/24 at B1 and B2 (Pinson et al., 2004)
- Bucket No. 1 returned to lab and re-apportioned.

Methods and Materials

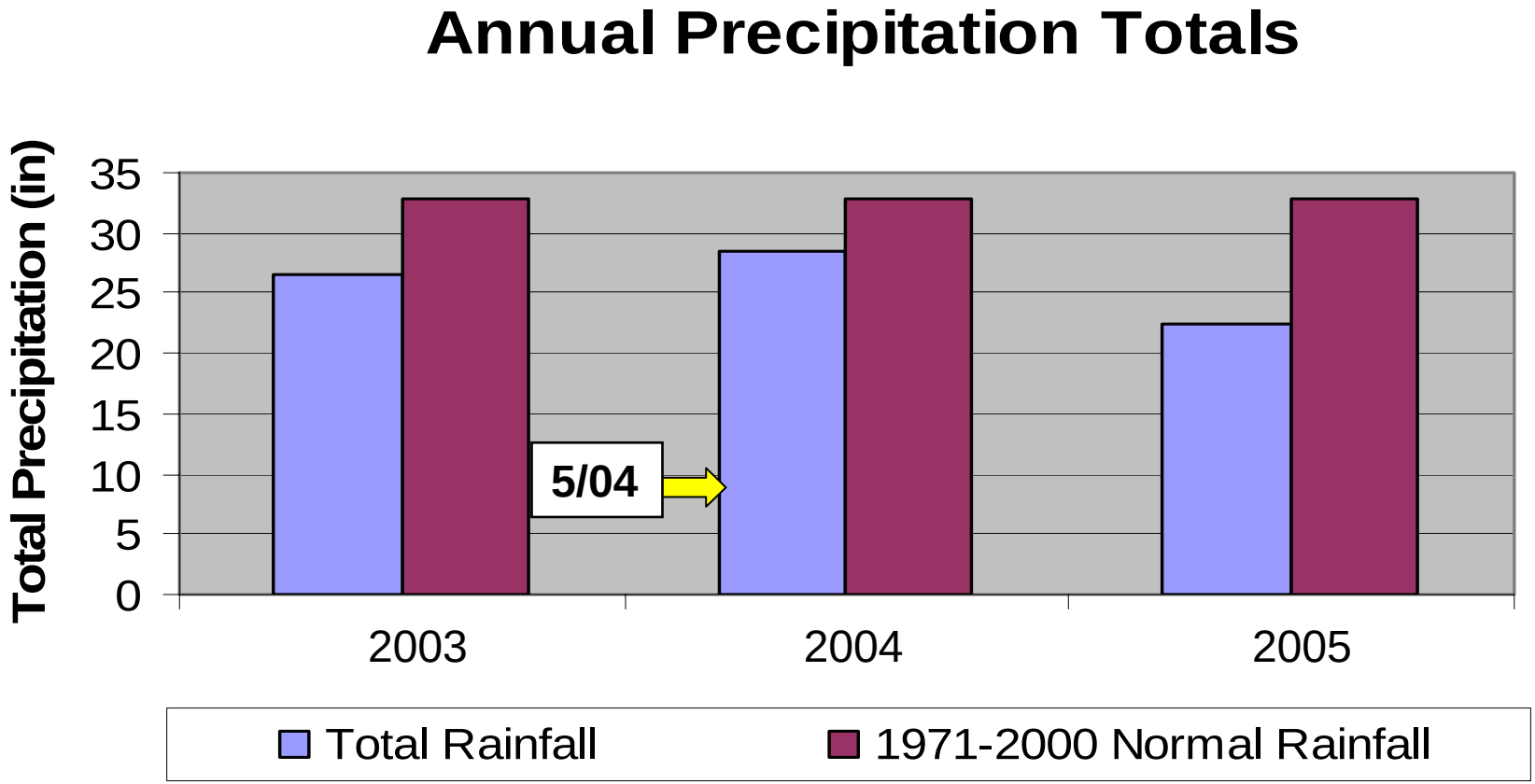
- Chemical and Particle Analysis -

Parameter	Method
Total solids (TS)	Total solids dried at 103-105º C for 24 h
Total Volatile Solids (VS)	Fixed and volatile solids ignited at 550º C for 1 h
Phosphorus (TP,TDP,DRP)	Molybdate-based colorimetric methods at wavelength of 880 nm
Particle Fractionation	Gravity settling – Pipette Method with 5 particle size classes

Results and Discussion

Results and Discussion

- Rainfall -

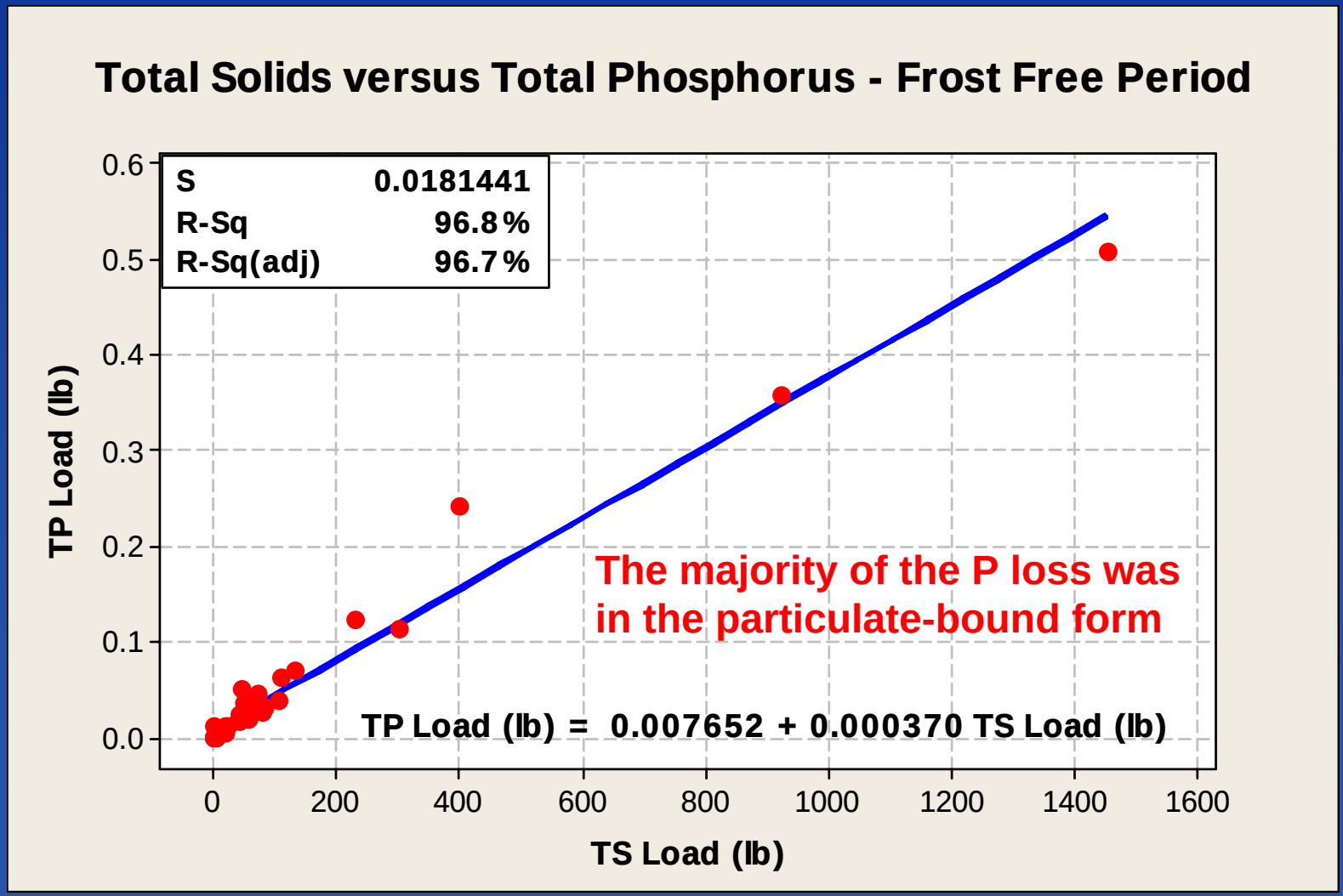


The median FF runoff coefficient

CG (0.04) < CS (0.13) = SM (0.14); $p < 0.01$

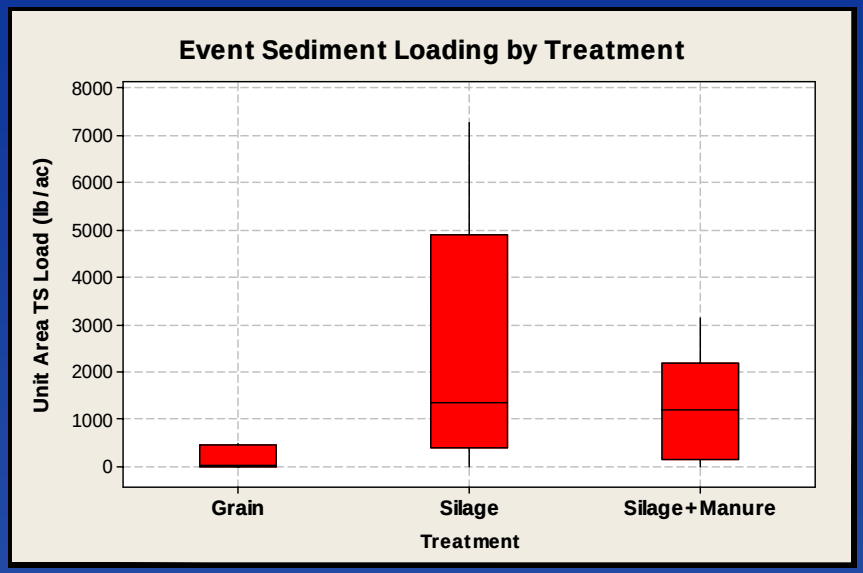
Results and Discussion

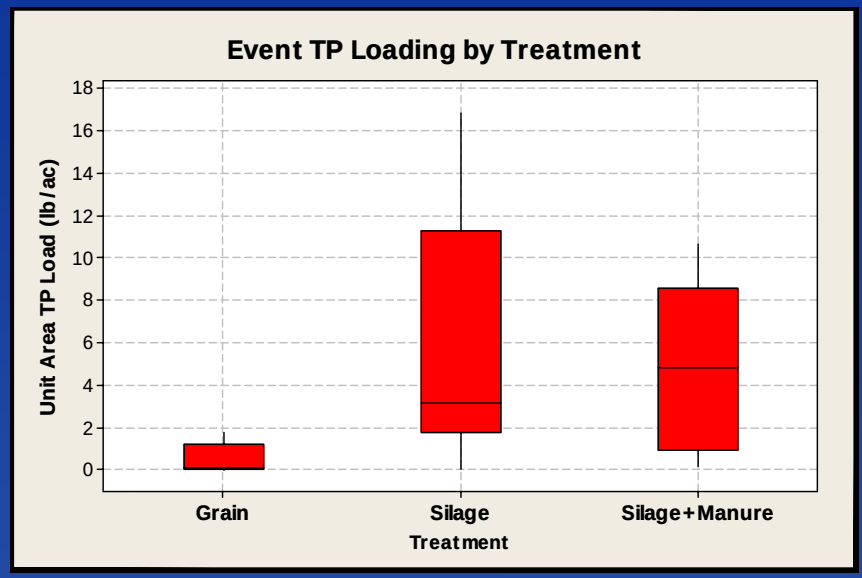
- Total Phosphorus and Solids -



Results and Discussion

- Sediment and Phosphorus Loss -

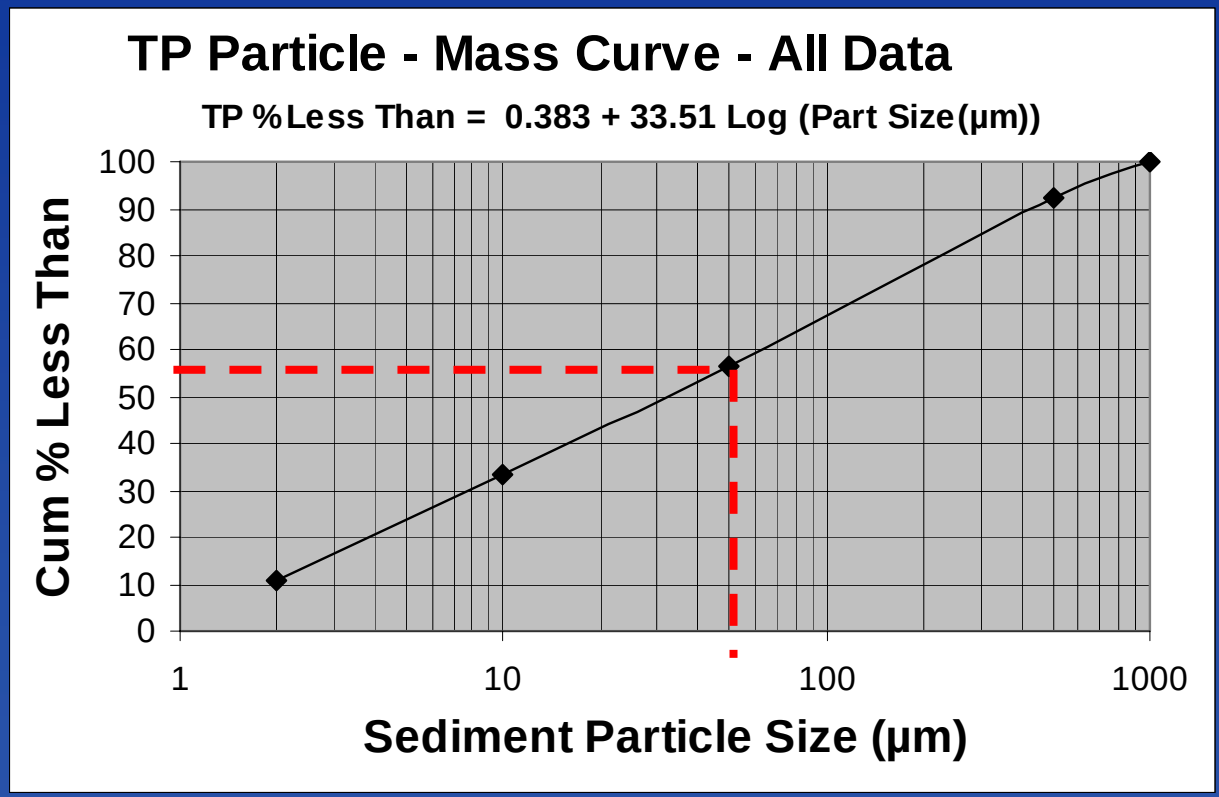




- The median event sediment loss for CG < CS = SM (33, 1,400 and 1,200 lb/ac).
- The median event total phosphorus loss for CG < CS = SM 0.14, 3.2 and 4.8 lb/ac).
- The **total annual** soil and TP loss for the adjacent no-till site were only 200 and 0.04 lb/ac/YR !!!

Results and Discussion

- Phosphorus by Particle Size -



About 57% of the TP mass is contained in the 50 µm and less particles.

Conclusions

- Particulate-bound P represents the greatest FM and FF loss and delivery mechanism from row crop corn management systems.
- Total P and sediment were closely correlated and residue level appeared to be the single largest factor driving soil loss.
- Greater than 97% of the annual sediment and TP loading occurred during the FF period.
- The majority of the P mass (~60 %) is associated with particles less than silt (50 µm) in size.

Conclusions

To Summarize ……

Minimizing soil loss from row crop corn production systems minimizes P export and reduces adverse water quality and soil productivity impacts.

Acknowledgement

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Measuring and Modeling the Source, Transport and Bioavailability of Phosphorus in Agricultural Watersheds


Questions ?