

Evaluating Bray P1 on High pH, Calcareous Soils

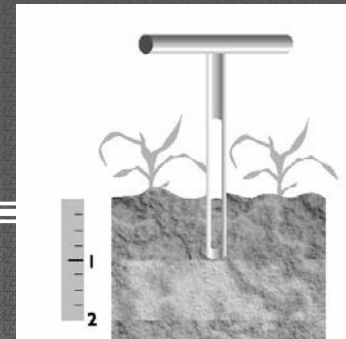
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Outline

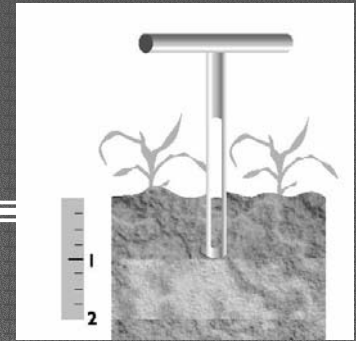
- Background on Soil Test P
- Experimental Approach
- Soil Description
- Results
- Conclusions

Background – Soil Test P (STP)



- STP – used to determine plant available P
- Bray P1, Mehlich 3, Olsen – common STP methods in Midwest
- Bray P1 is **required** in Wisconsin

Background - Soil P Tests



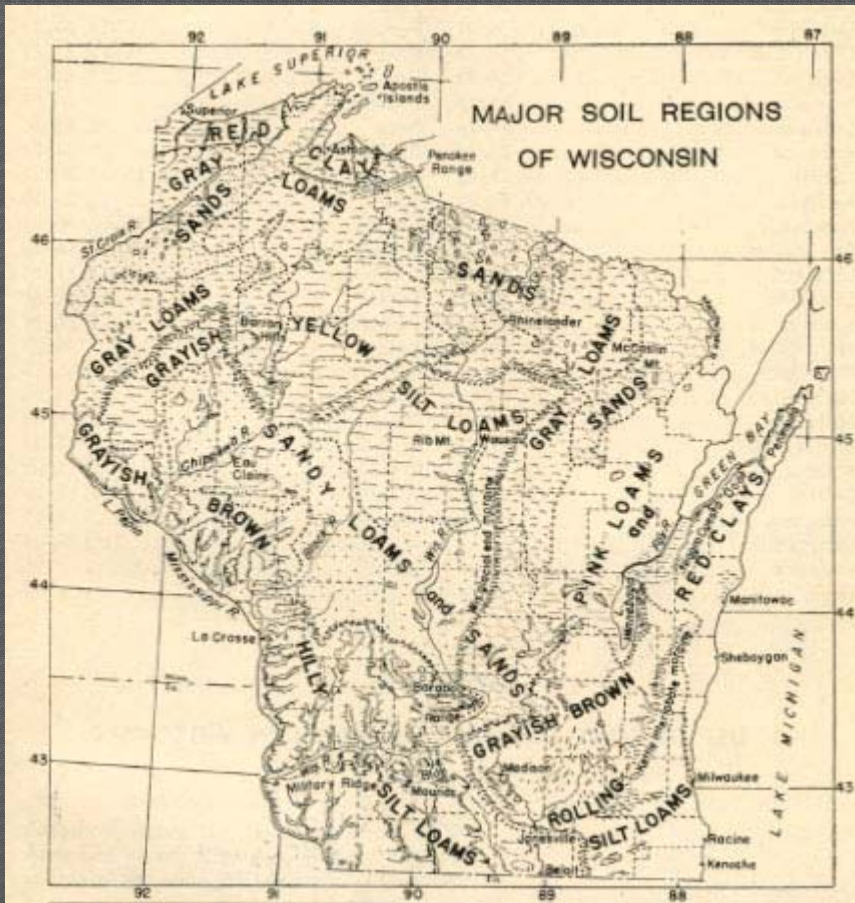
Extractant	Type of Soil	Composition
Bray P1 (BP1)	Acid soils (pH<7)	0.03N NH_4F , 0.025N HCl
Mehlich 3 (M3)	Acid and calcareous soils Also cation extraction	0.2N CH_3COOH , 0.25N NH_4NO_3 , 0.015N NH_4F , 0.013N HNO_3 , 0.001M EDTA
Olsen	Calcareous soils (> 2% CaCO_3)	0.5 M NaHCO_3 , pH 8.5

References: Frank et al., 1998; Mehlich, 1984; Olsen, et al., 1954

Background - Bray P1 performance

- On acid soils: BP1/M3/Olsen all well correlated
- Numerous studies note poor Bray P1 performance on high pH and/or calcareous soils:
 - Hooker, et al., 1980; Mallarino and Blackmer, 1992; Mallarino, 1997; Mallarino, 2003; Fixen and Grove, 1990; Herman, et al., 2004; Randall and Grava, 1971
 - pH > 7.4 or calcium carbonate > 4%
- Lower P extracted attributed to:
 - 1-neutralization of acid by CO_3^{2-}
 - 2-reduction of F^- activity by precipitation with Ca^{2+}

Background - Wisconsin Eastern Red Soils (ERS)



Eastern Red Soils

Northeast Wisconsin
pH range=5.5-8.5
Calcareous?

Effectiveness of BP1?

Experimental Approach

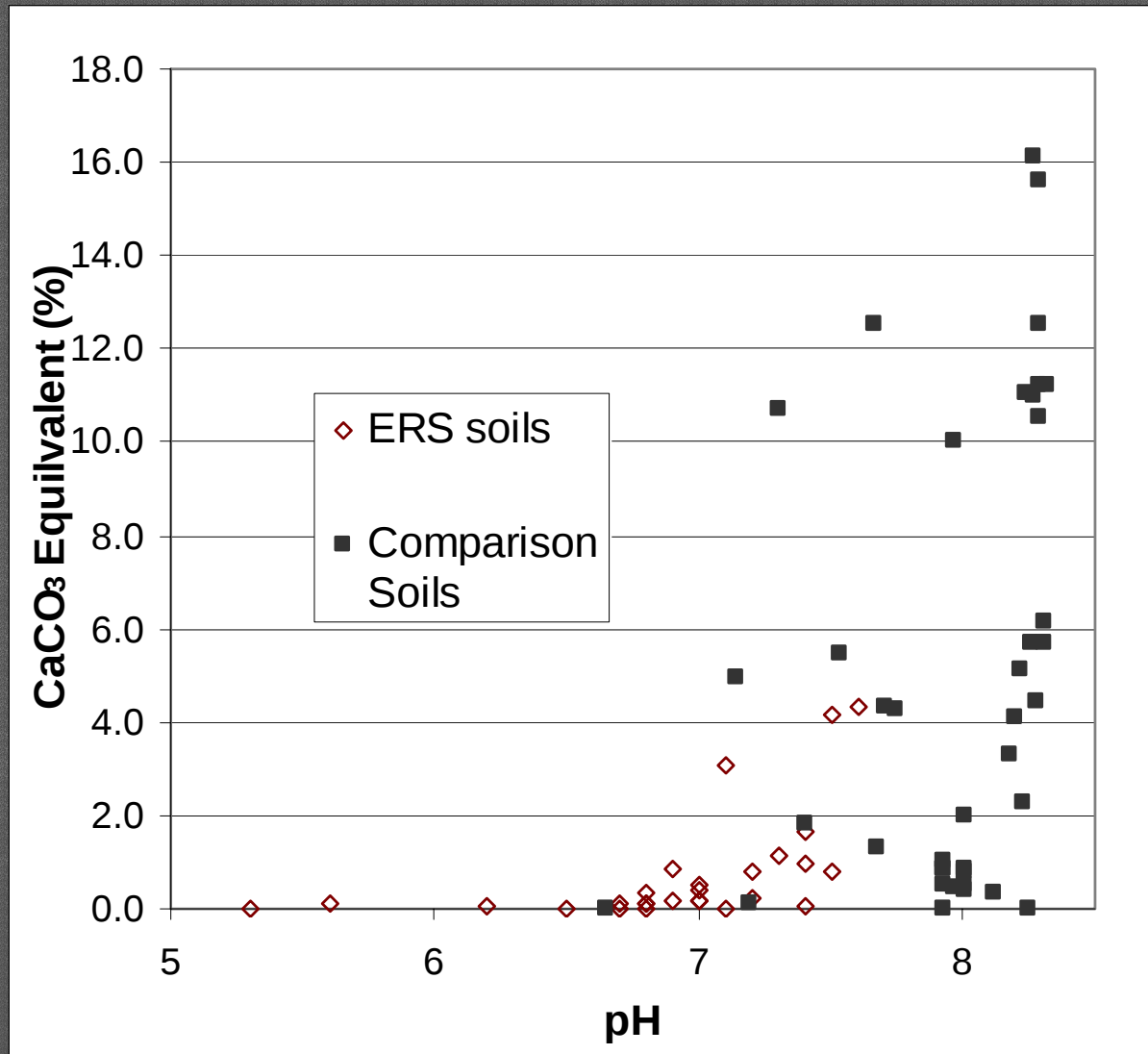
- Soils:
 - Existing soil samples from ERS
 - Comparisons with other high pH/high carbonate soils
- Analyses:
 - Bray P1, Mehlich 3, Olsen
 - pH, carbonate

Soil Descriptions — ERS and Comparison Soils

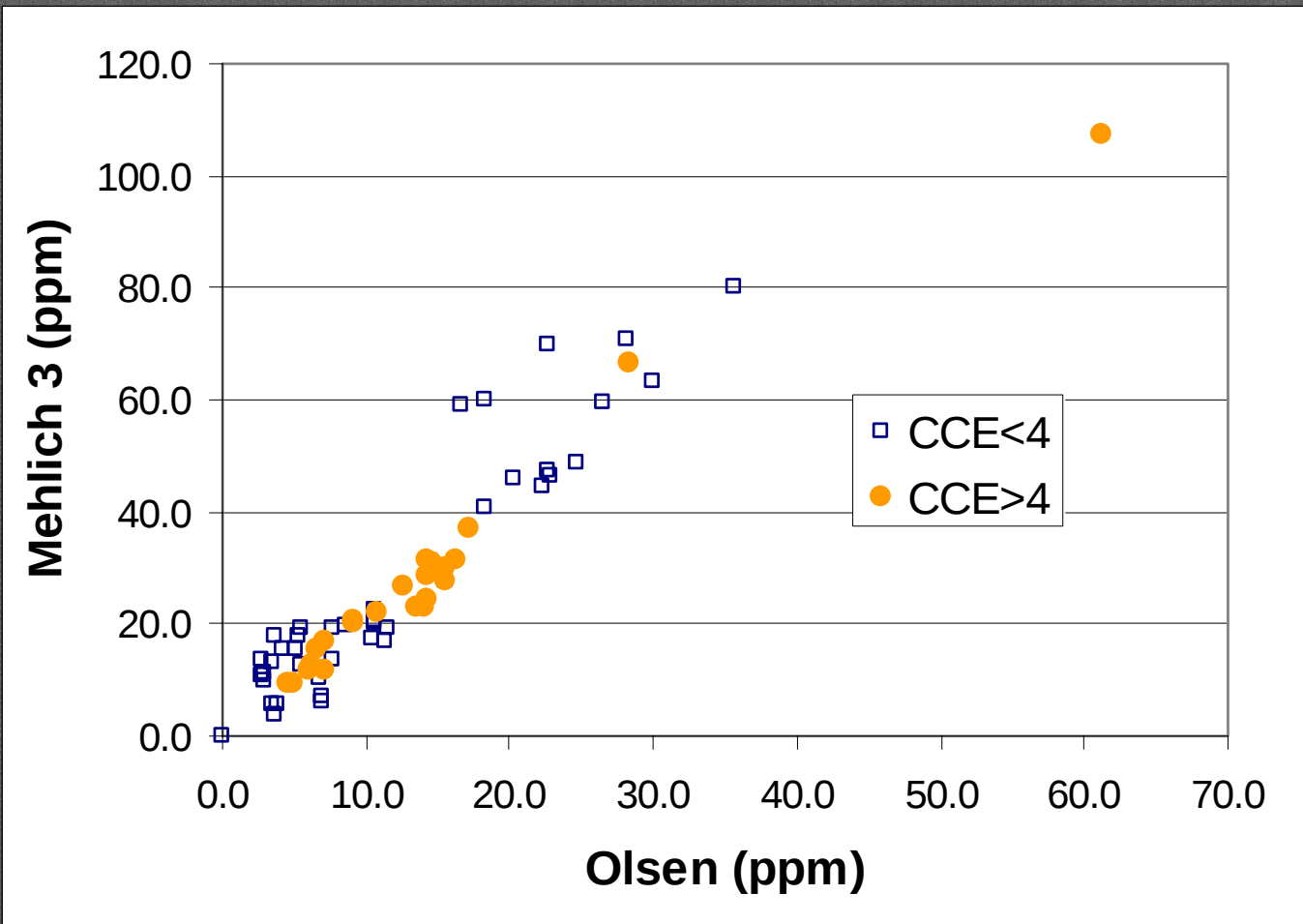
Location	Number of samples	pH range	CCE ^a (%)
ERS			
WI	27	5.3-7.6	0.0-4.3
Comparison Soils			
Iowa	9	7.1-7.8	0.1-12.5
Kansas	29	7.9-8.3	0.0-16.1
Rountree (WI)	2	6.7-8.3	0.0

^a Calcium carbonate equivalent

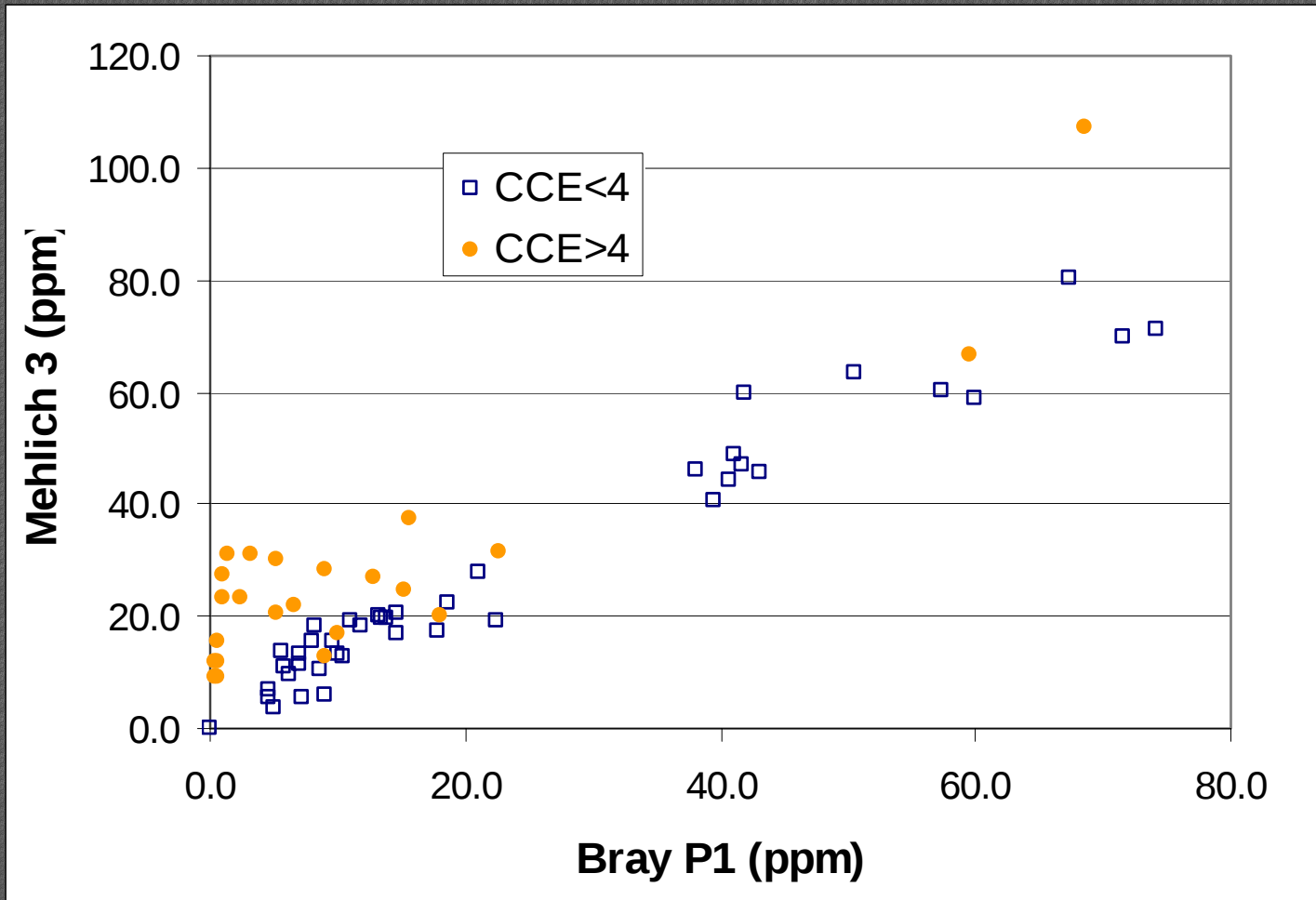
Results — ERS and Comparison Soils: pH and carbonate



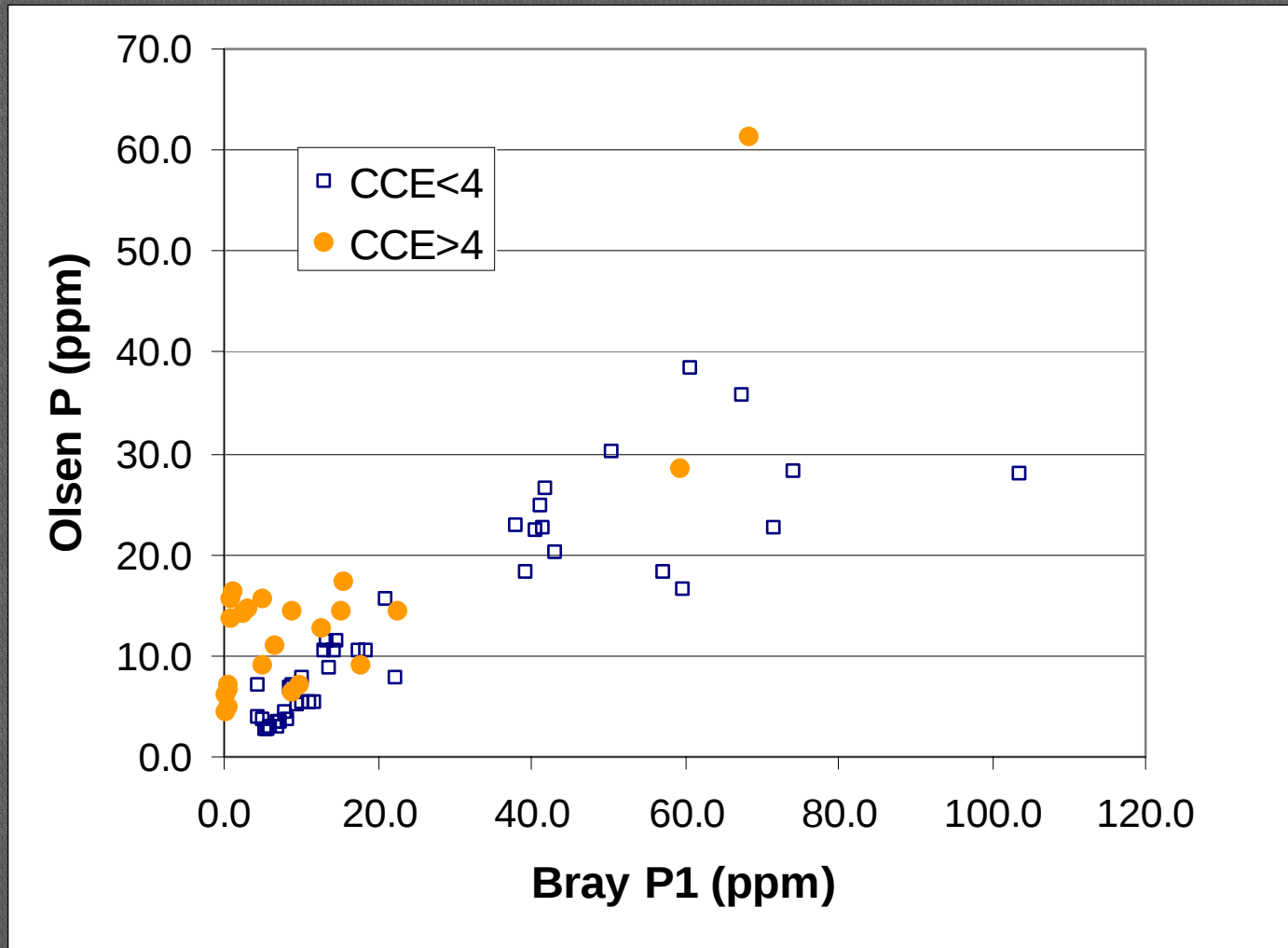
Results — ERS and Comparison Soils: M3 vs. Olsen



Results — ERS and Comparison Soils: BP1 vs. M3



Results — ERS and Comparison Soils: BP1 vs. Olsen



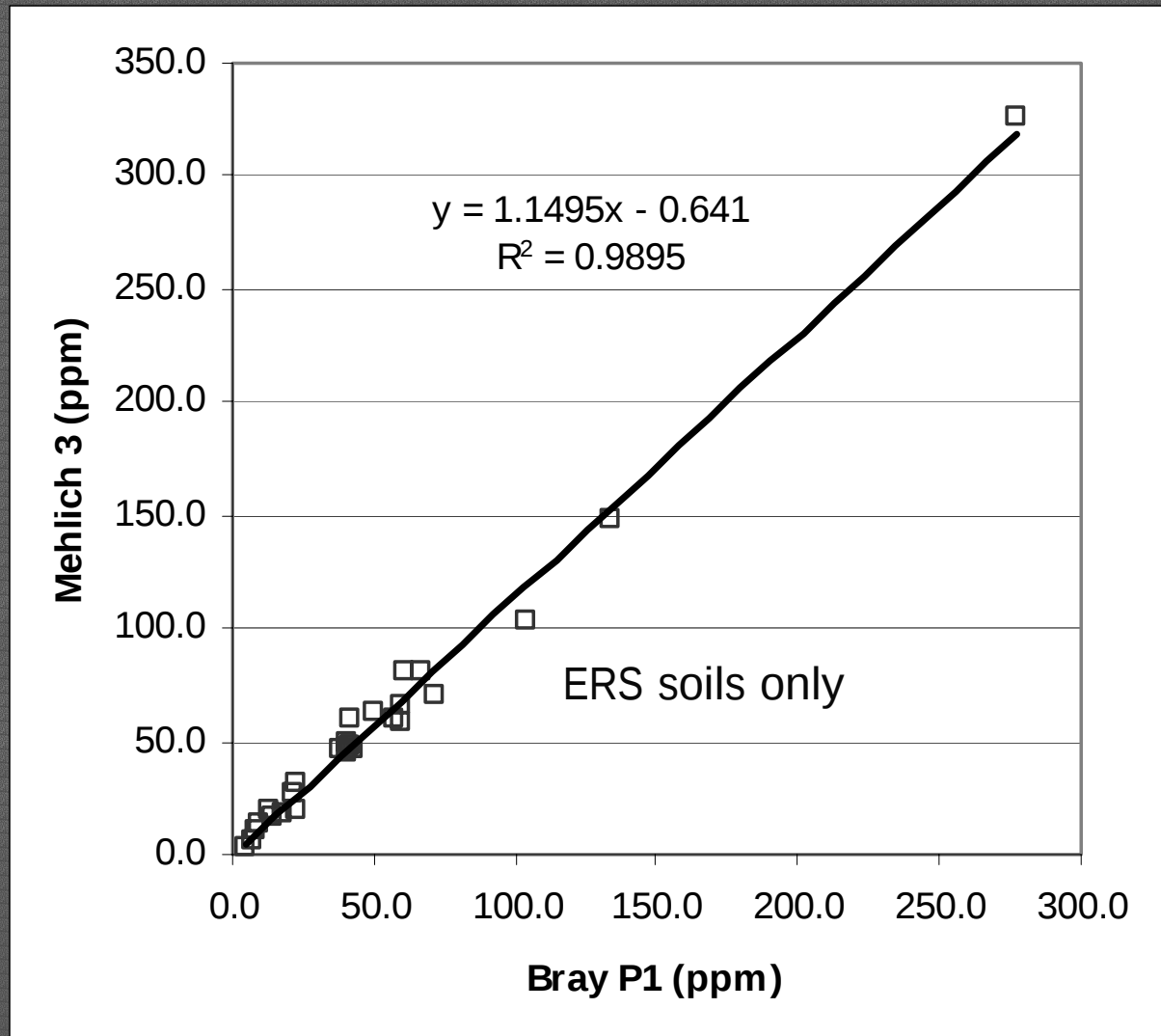
Results — ERS and Comparison Soils:

Correlation Table — r^2 values

R^2 values for each pair of soil P tests

	Soils with CCE<4	All Soils
BP1/M3	0.96	0.83
BP1/Olsen	0.77	0.66
M3/Olsen	0.89	0.88

Results — ERS soils only: BP1 vs. M3



Conclusions

- Bray P1 inadequately measures soil P on highly calcareous soils
- High soil pH does not necessarily imply high levels of inorganic carbon
- ERS soils do not contain enough carbonate to affect Bray P1 performance
- BP1 gives valid estimate of available P in ERS

Continuing Work

Analyzing more soils: samples from 25-30 more ERS farms collected this fall

Thank you!

Acknowledgments

- Antonio Mallarino – Iowa state soils
- Dale Leikam – Kansas State soils
- Cindy Styles – Rountree soils

- Aaron Kittell – sample analysis
- Dan Ebeling – analytical and instrumental expertise

- Laura Ward-Good – existing ERS soil information
- Larry Bundy – advisor

Appendix - All soils: pH vs BP1

