Can Permanganate Oxidizable Carbon Differentiate Ecological Sites in Wisconsin?

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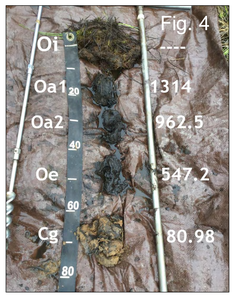
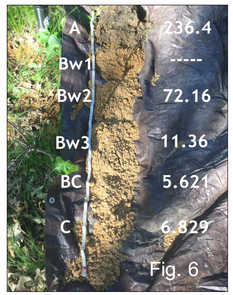
Introduction

- Ecological site descriptions (ESDs) are distinct ecosystems that differ in their vegetation and soil properties (USDA-NRCS, 2021).
- ESDs are dynamic due to human disturbance, climate, and other factors.
- Soil organic matter is an important soil property that differs with ESDs
- However, total SOM changes may occur slowly and the dynamic nature of ESDs may not be well captured by assessing total SOM.
- Permanganate Oxidizable Carbon (POXC) is a reactive pool of total SOM that is more responsive to disturbance and management (Culman et al., 2012).
- We hypothesize that differentiation among ESDs will be stronger with POXC than with total SOM.

Figures 1-6: Across the top (L->R) show the plant cover for the Acidic Poor Fen, Sandy Floodplain, and Sandy Outwash Uplands. Across the bottom (L->R) are example pedons for the above we analyzed showing horizon labels and POXC values in ppm.

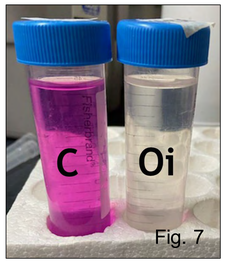


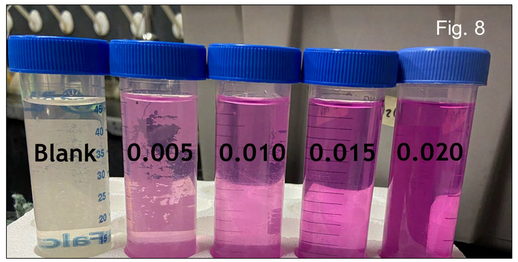


Methods

- Pedons from three ESDs in central WI were investigated: Acidic Poor Fen (n=29), Sandy Floodplain (n=28), and Sandy Outwash Upland (n=33).
- Total SOM (n=90) and POXC (n=69) were determined on soil samples from each horizon from the pedons.
- Soil was ground to pass 2mm sieve prior to analysis of total SOM and POXC
- Total SOM was determined by the loss on ignition method at 450C for 6 hours (Sparks, 1996).

Figures 7 and 8. Comparison of high POXC (Oi) and low (C) (left image) and KMNO4 in standard curve (right image).





- POXC analyses were conducted following methods of Weil et al. (2003). 2.5g soil, 18mL H2O, and 2mL 0.2M KMnO4 were mixed on a shaker table for 2 minutes and then placed in the dark for 10 minutes to settle. An aliquot (0.5mL) was pipetted into 49.5mL of DI water. Absorbance was measured at 550nm. Greater absorbance values relate to less oxidized KMnO4 and less labile carbon in the sample. Absorbance values were converted to POXC using a standard curve (KMnO4 concentrations of 0.005M, 0.01M, 0.015M, and 0.02M).
- Analysis of Variance tests were conducted on the total SOM and POXC to test if ESDs were significantly different.
- Tukey-Kramer mean separation tests were used to test significant differences among the ESDs.
- The F and p values were compared to test our hypothesis that POXC would be better differentiate ESDs compared to total SOM.

Results and Discussion

Figures 9 and 10. ANOVAs for total SOM (L) and POXC (R) for ESDs.

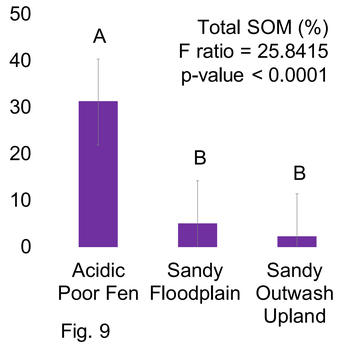


Fig. 9

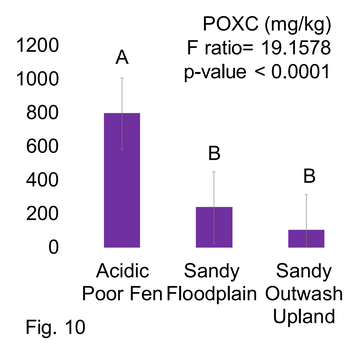


Fig. 10

- Significant differences were observed for both total SOM and POXC for these ESDs.
- Acidic Poor fen had significantly greater total SOM and POXC compared to Sandy Floodplains and Sandy Outwash Uplands.
- This result was expected since wetter sites tend to have slower decomposition and greater organic matter.
- The ANOVA F-ratio was greater for total SOM compared to POXC indicating that POXC was not a better separator for ESDs compared to total SOM.

Conclusion

- These results do not provide support for our hypothesis that POXC will better differentiate these ESDs compared to total SOM.
- More data is needed from additional ESDs to further investigate this hypothesis.

References

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