Predicting Soil Organic Matter with Soil Color Value in Wisconsin Central Sands

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INTRODUCTION

- Soil organic matter (SOM) is a key soil property influencing soil quality, water retention, biodiversity, and additional ecosystem services (Adhikari et al., 2019).
- Laboratory analyses of SOM can be time-consuming and expensive (Stiglitz et al., 2016), creating a need for cost-effective and rapid field tests.
- A preliminary study of soils in Wisconsin Central Sands found significant, but weak correlations between SOM and dry soil Munsell value (Bryan et al., 2019).
- The research goal is to expand upon the study above to develop a relationship between SOM and dry soil Munsell value that can be useful to practitioners.

Hypothesis 1: A significant, inverse relationship will exist between SOM and dry Munsell value for soils in Wisconsin Central Sands.

Hypothesis 2: Grouping samples by mineral and organic horizons will improve the prediction accuracy of SOM by dry Munsell value for soils in Wisconsin Central Sands.

Figure 1. Measuring soil color in the field with the Chroma Meter to predict SOM.

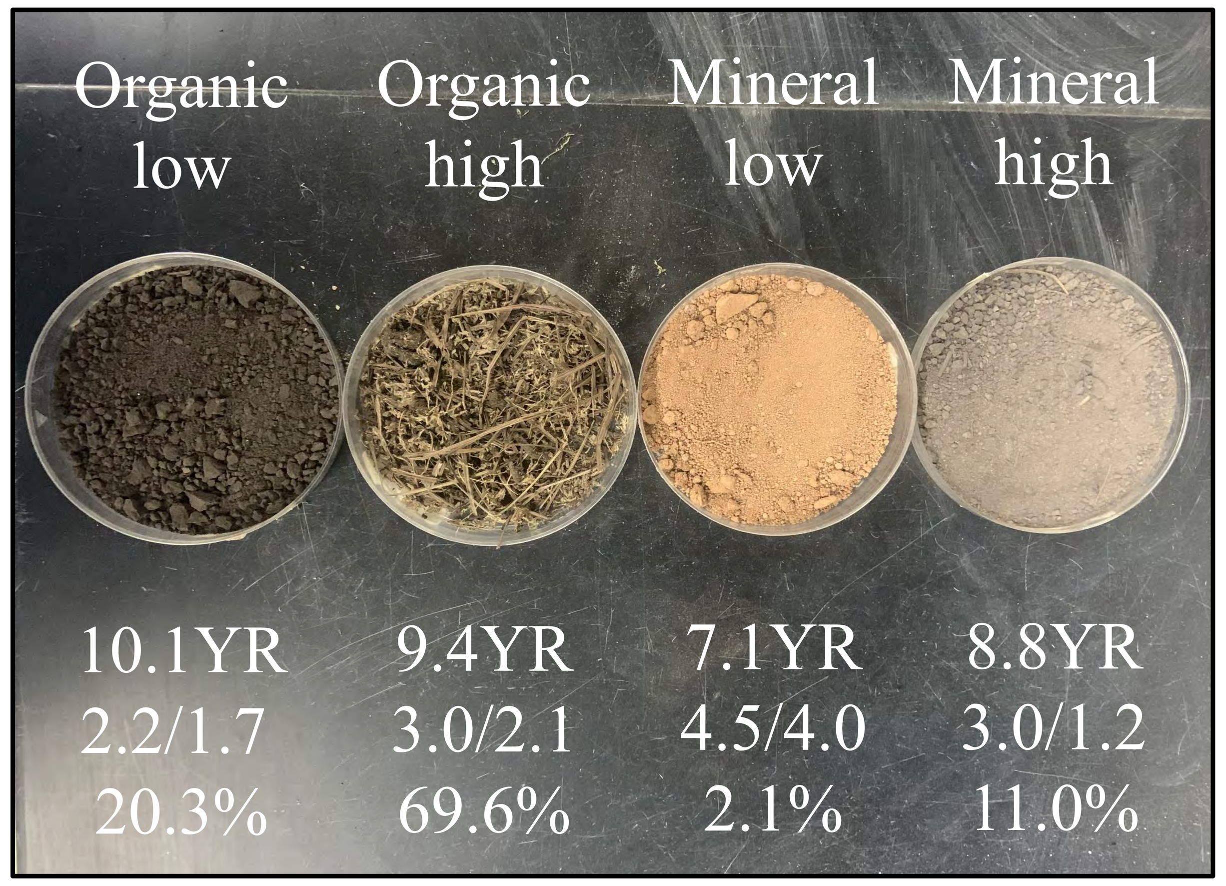

Figure 2. Colors and SOM% from representative soils of high and low SOM and high and low dry Munsell value.

METHODS

- Soil samples were obtained in Wisconsin Central Sands representing all soil and ecosystem types (92 pedons, 639 soil samples).
- Soil color was evaluated (3x per sample) by Chroma Meter (Konica Minolta CR-400) after drying, sieving, and grinding following Konen et al. (2003).
- SOM was determined by loss on ignition following Nelson et al. (1996).
- Regression analyses were conducted to test the stated hypotheses.

RESULTS and DISCUSSION

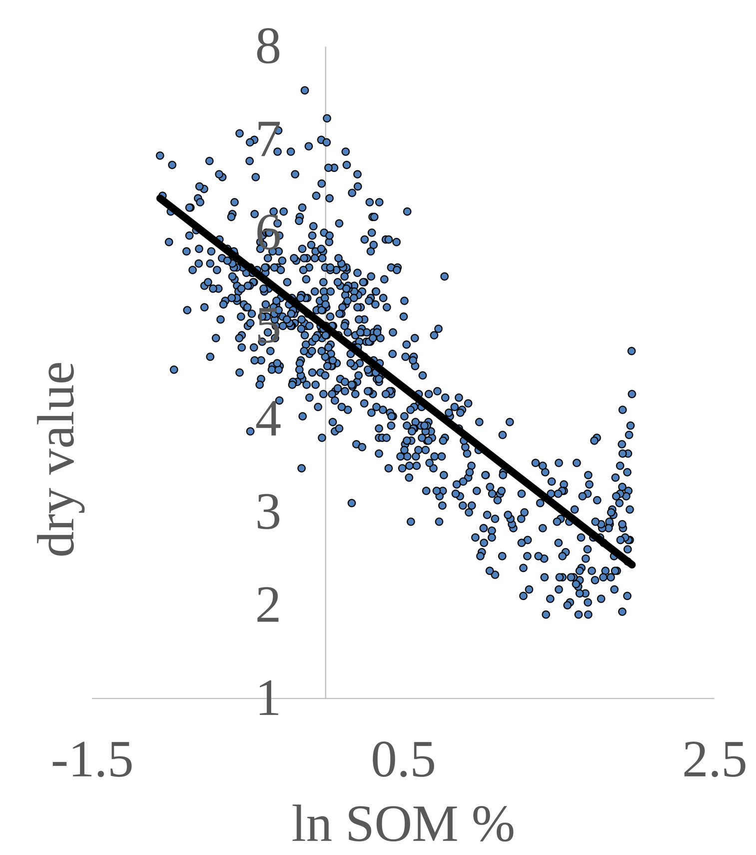

Figure 3. SOM and dry soil Munsell values for all soils (n=639)
$y = -1.2972x + 4.9938$
$R^2 = 0.67$; $P < 0.0001$

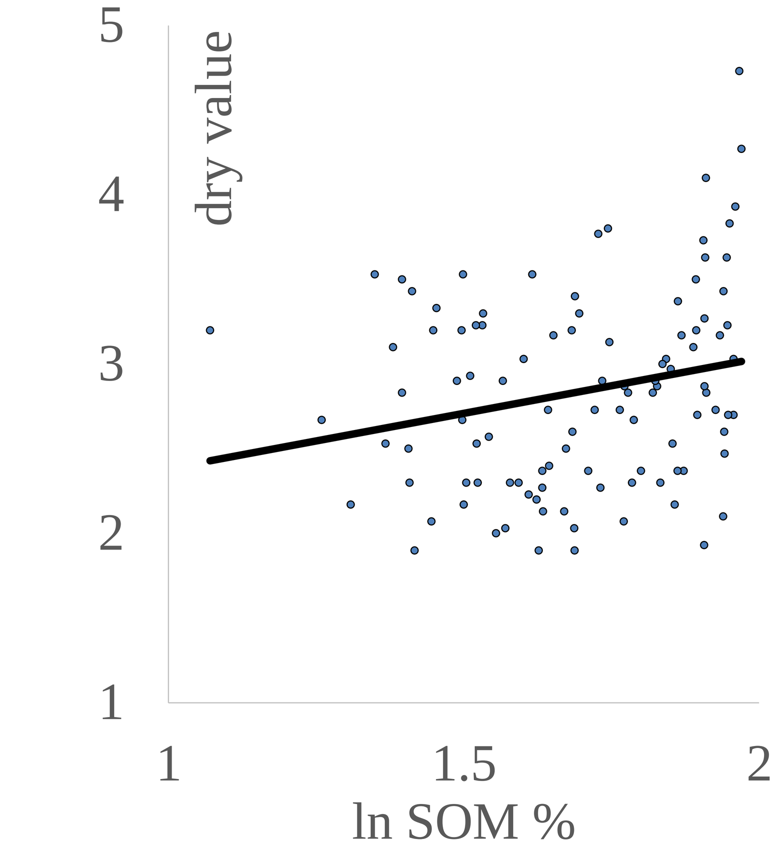

Figure 4. SOM and dry soil Munsell values for only organic soils (n=105)
$y = 0.6519x + 1.7298$
$R^2 = 0.05$; $P=0.0218$

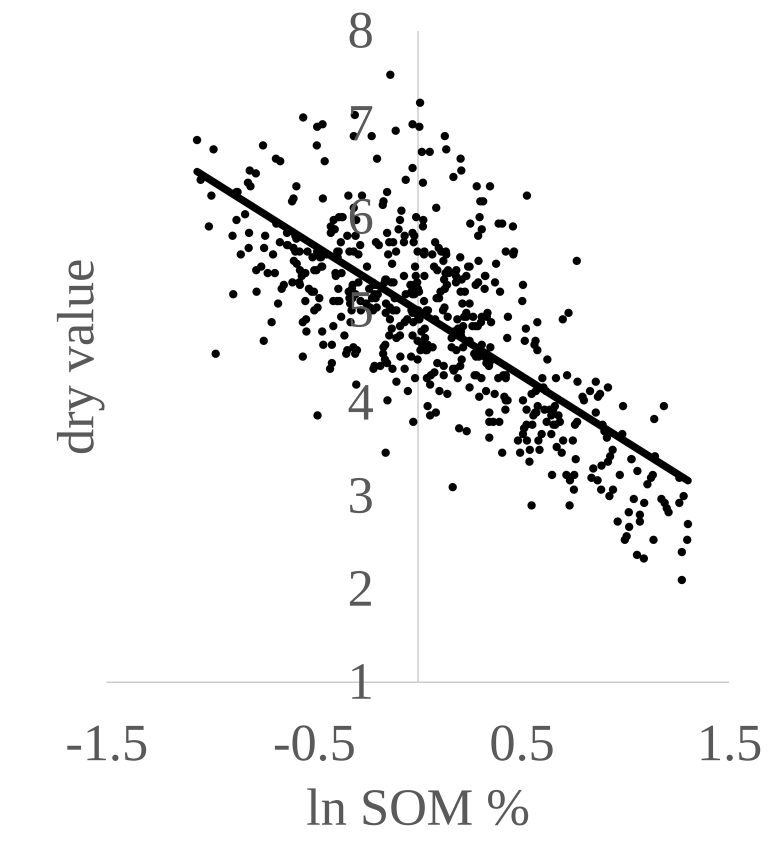

Figure 5. SOM and dry soil Munsell value for only mineral soils (n=534)
$y = -1.4058x + 4.9956$
$R^2 = 0.52$; $P < 0.0001$

Hypothesis 1:

- We found a significant, inverse relationship between SOM and dry Munsell value for all soils (Figure 3), confirming our hypothesis.
- This was expected because soils with greater SOM tend to be darker in color due to black humic acid coatings (Schulze et al., 1993).

Hypothesis 2:

- We found a weak relationship between SOM and dry Munsell value for organic horizons (SOM ≥ 20%) (Figure 4).
- This is because soil color of organic material is more dependent upon the degree of composition than SOM content (Franzmeier, 1988).
- We found a significant, inverse relationship between SOM and dry Munsell value for mineral horizons (SOM < 20%) (Figure 5).
- This relationship was weaker (R^2=0.52) than the relationship for all horizons (R^2=0.67) because data points from organic horizons that fit the line were excluded.

CONCLUSION

- Our results suggest that dry Munsell value is an accurate and practical method for estimating SOM of mineral soils in Wisconsin Central Sands.
- This method is not acceptable for organic soils in Wisconsin Central Sands.

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