Color, Organic Carbon, and Texture Relationships for A Horizons in Selected MLRA in Iowa, Illinois, Indiana, and Ohio

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Abstract

There are numerous studies that examine OC's relationship with soil color and texture. Just the numerical amount of these studies hint at OC's importance. This study was undertaken in order to try and quantify OC's relationship with soil color and texture across multiple MLRA. To accomplish this 424 mineral surface horizon samples from 9 MLRA's across 4 states were analyzed. When taken as a whole the data set exhibited weak relationships between OC and soil color and texture. Only when separated into different MLRA's did the relationship get stronger. The strongest relationship between color and OC occurred in MLRA 103 which is located in Iowa. Munsell Value (R^2=0.83 dry, 0.86 wet), Hunter Whiteness (R^2=0.52 dry, 0.69 wet), L* (R^2=0.83 dry, 0.86 wet) and Y (R^2=0.81 dry, 0.84 wet). The weakest relationship between OC and color was found in MLRA 111D. MLRA 111D can be found in Western Indiana. Munsell Value (R^2=0.00 dry, 0.02 wet), Hunter Whiteness (R^2=0.18 dry, 0.00 wet), L* (R^2=0.00 dry, 0.02 wet) and Y (R^2=0.00 dry, 0.02 wet). The strongest relationship (R^2=0.38) between OC and sand was in MLRA 110. The strongest relationship between silt (R^2=0.61), clay (R^2=0.70), and GMPD (R^2=0.74) occurred in MLRA 103. The weakest relationship between OC and sand (R^2=0.00) occurred in MLRA 95B. MLRA 95B also had the weakest relationship with GMPD (R^2=0.00). The weakest relationship with silt (R^2=0.00) was found in MLRA 111A. The weakest relationship with clay (R^2=0.00) occurred in MLRA 110. The predictive equations varied within this study which suggests that no universal equation that predicts OC based on color or soil texture exists or would even be close to adequate.

Introduction

424 mineral soil surface horizons from 9 MLRA across 4 states were quantitatively analyzed for organic carbon, color and texture. Surface samples were collected from forested and non-forested sites, with a majority coming from agricultural fields.

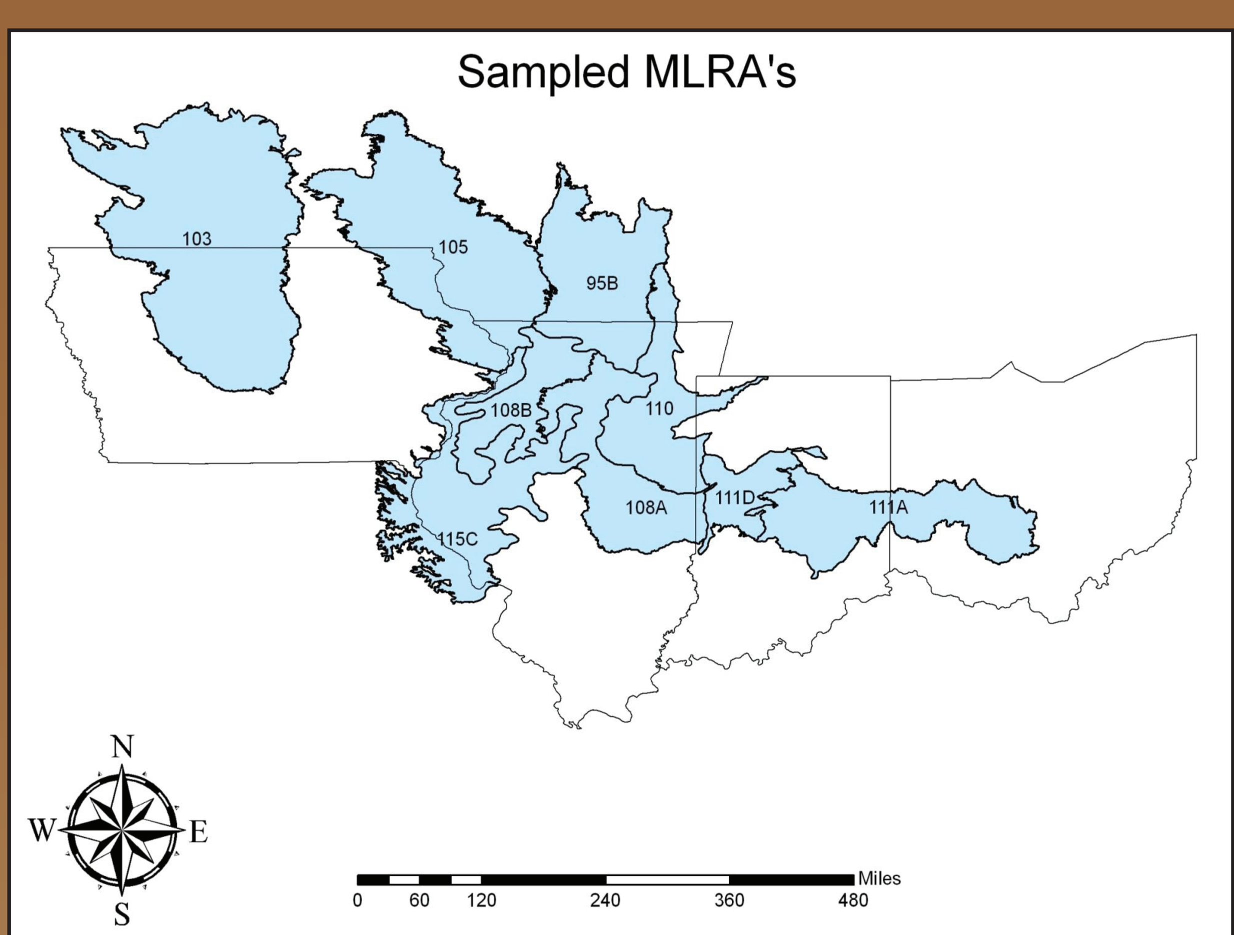

Figure 1. Location of sampled MLRA's

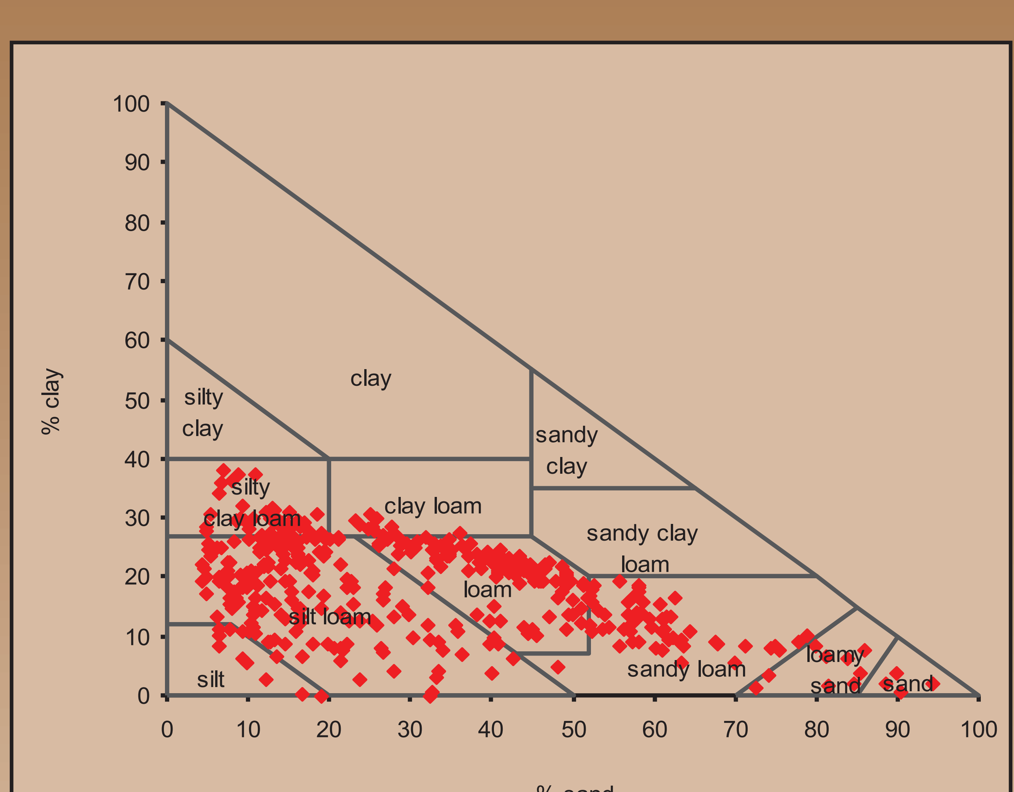

Figure 2. Textures of surface samples

Methods

- A Konica-Minolta Cm-2500d spectrophotometer was used to determine Munsell Hue, Value and Chroma as well as Hunter Whiteness index values and Y values
- Air-dry and moist color was determined for all samples. Samples were moistened and then the color measurement was taken when the sample no longer glistened.
- Elementar vario MAX CNS was used for the determination of carbon content.
- Particle size analysis was done using the pipette method (Soil Survey Staff, 2004)

Results & Discussion

Color and Organic Carbon

When the data set was taken as a whole weak relationships were observed between OC and color. When the data set was broken down into individual MLRA's the relationships got stronger. Whether in on large data set or broken down into MLRA's, OC had stronger relationships with color when the samples were wet for three of the four variables.

The strongest relationship between color and OC occurred in MLRA 103 which is located in Iowa. Munsell Value (R^2=0.83 dry, 0.86 wet), Hunter Whiteness (R^2=0.52 dry, 0.69 wet), L* (R^2=0.83 dry, 0.86wet) and Y (R^2=0.81 dry, 0.84 wet).

The weakest relationship was found in MLRA 111D. MLRA 111D can be found in Western Indiana. Munsell Value (R^2=0.00 dry, 0.02 wet), Hunter Whiteness (R^2=0.18 dry, 0.00 wet), L* (R^2=0.00 dry, 0.02 wet) and Y (R^2=0.00 dry, 0.02 wet).

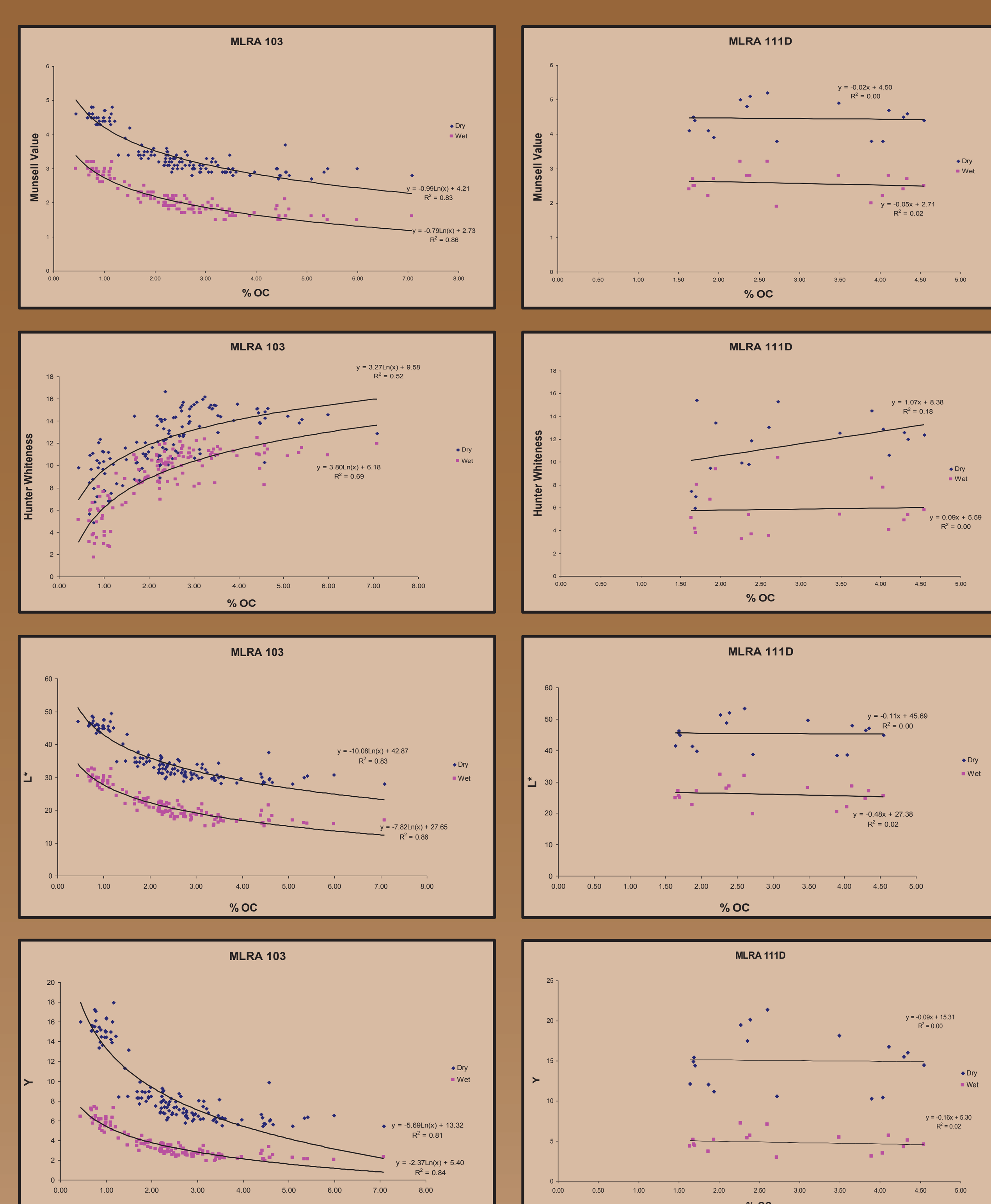

Figure 3. OC and Color Graphs

Table 1. Summary Table for OC and Color by MLRA

	MLRA	95B n=48	103 n=128	108A n=69	108B n=20	110 n=34	111A n=66	111D n=18	115C n=33	All n=424*
Munsell Value	Dry	0.54	0.83	0.05	0.30	0.05	0.44	0.00	0.02	0.22
	Wet	0.50	0.86	0.15	0.76	0.08	0.53	0.02	0.26	0.36
Hunter Whiteness	Dry	0.31	0.52	0.34	0.59	0.45	0.27	0.18	0.05	0.26
	Wet	0.49	0.69	0.26	0.35	0.21	0.61	0.00	0.04	0.28
L*	Dry	0.54	0.83	0.05	0.29	0.05	0.43	0.00	0.02	0.22
	Wet	0.50	0.86	0.15	0.77	0.10	0.52	0.02	0.25	0.36
Y	Dry	0.45	0.81	0.04	0.30	0.06	0.44	0.00	0.01	0.20
	Wet	0.37	0.84	0.14	0.77	0.12	0.51	0.02	0.19	0.32

* Total Includes 8 Samples from MLRA 105

Soil texture and Organic Carbon

Again when taken as a whole the data set exhibited a relatively weak relationship between OC and particle size until it was broken into separate MLRA's.

The strongest relationship (R^2=0.38) between OC and sand was in MLRA 110. The strongest relationship between silt (R^2=0.61), clay (R^2=0.70), and GMPD (R^2=0.74) occurred in MLRA 103.

The weakest relationship between OC and sand (R^2=0.00) occurred in MLRA's 95B. MLRA 95B also had the weakest relationship with GMPD (R^2=0.00). The weakest relationship with silt (R^2=0.00) was found in MLRA 111A. The weakest relationship with clay (R^2=0.00) occurred in MLRA 110.

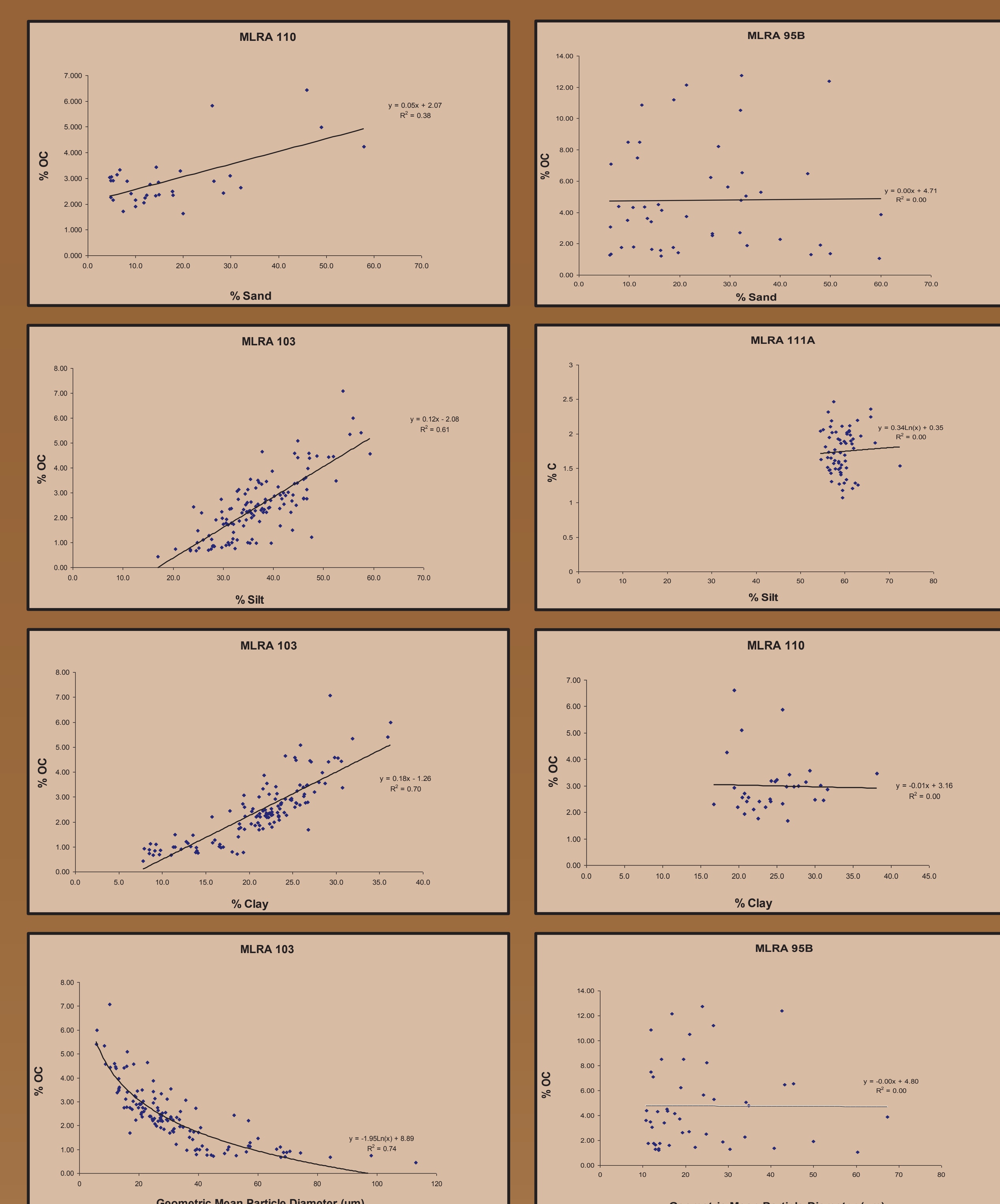

Figure 4. Particle Size and OC Graphs

Table 2. Summary Table for Particle Size and OC

MLRA	95B n=47	103 n=128	108A n=66	108B n=19	110 n=34	111A n=64	111D n=18	115C n=29	All n=410*
% Sand	0.00	0.14	0.01	0.25	0.38	0.09	0.01	0.36	0.03
% Silt	0.01	0.61	0.01	0.23	0.43	0.00	0.02	0.22	0.09
% Clay	0.10	0.70	0.03	0.06	0.00	0.04	0.29	0.48	0.05
GMPD (µm)	0.00	0.74	0.01	0.27	0.30	0.10	0.01	0.49	0.02

* Includes 5 samples from MLRA 105

Summary and Conclusions

In general the trends that were observed in this study were similar to previous OC and soil color and texture studies but the predictive equations different. The predictive equations also varied greatly between MLRA with in this study. This information suggests that no universal equation exists or would be adequate in predicting OC.

The relationships were a mixture of logarithmic and linear. Logarithmic relationships existed primarily between OC and soil color. While linear relationships were observed primarily between OC and particle size.

Future research should focus on smaller geographic units than MLRA.

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