NC STATE UNIVERSITY College of Agriculture and Life Sciences

Department of Crop and Soil Sciences

Measuring Soil Organic Carbon from Different Agronomic Systems in North Carolina Soils

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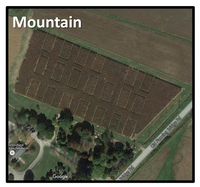
Soil Organic Carbon

- Soil organic carbon (SOC) is beneficial to soil health.
- Various agronomic practices can increase SOC, but their effects may not be realized in North Carolina soils.
- There is no "standard" measurement of SOC, but some procedures used to measure SOC may be more sensitive to changes than others.

Research Objectives

1. Compare results of SOC analyses to derive predictive conversions between SOC determined by each procedure.
2. Determine if conventional procedures for measuring SOC can detect differences in SOC from different agronomic systems on NC soils.

Locations in North Carolina



25 years (1990)
Involved no-till, disk tillage, organic and chemical management, and cover crops

31 years (1984)
Included 9 tillage treatments ranging from no-till to moldboard plowing

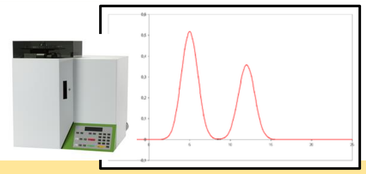
31 years (1984)
Included 4 tillage treatments as no-till, 0.5X, 1X, and 2X disk tillage per year

16 years (1999)
Included conventional no-till and disk tillage as well as organic management with tillage

Procedures for Measuring Soil Organic Carbon

Approximately 470 cm^3 of soil was collected using a 2.2-cm-diameter soil probe to a depth of 15 cm. Soils were ground and homogenized to pass a 2-mm mesh before analysis.

Automated Gas Chromatography (AGC)

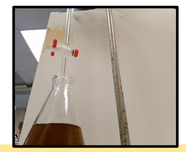


SOC Calculation

$$\frac{g\ C\ detected}{g\ soil}$$

0.025 g dried soil → Thermal digestion (2 minutes) → SOC oxidation → Gas chromatography

Walkley –Black (WB)

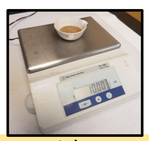


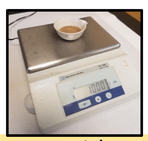
SOC Calculation

$$\frac{(meq\ K_2Cr_2O_7\ -\ meq\ FeSO_4)(0.003)}{g\ soil}$$

1 g dried soil → Oxidant ($K_2Cr_2O_7$) Heat (H_2SO_4) → SOC oxidation → Filtered solution → Titration ($FeSO_4$)

Mass Loss on Ignition (LOI)





SOC Calculation

$$\frac{g\ SOM\ \times\ 0.58}{g\ soil}$$

10 g dried soil → Ceramic Crucible → Mass with organic matter (SOM) → Muffle furnace (120 minutes) → SOM oxidation → Mass without SOM

Results

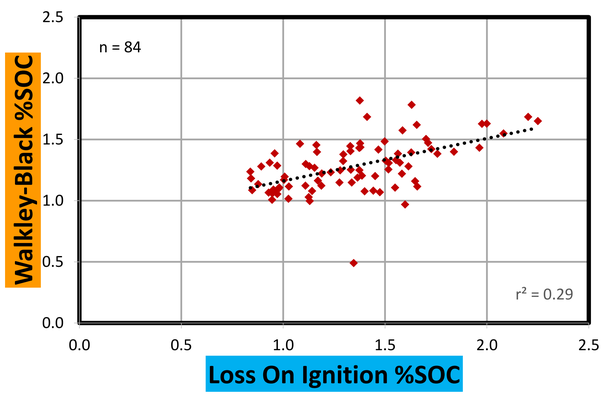
Soil Organic Carbon (average %)

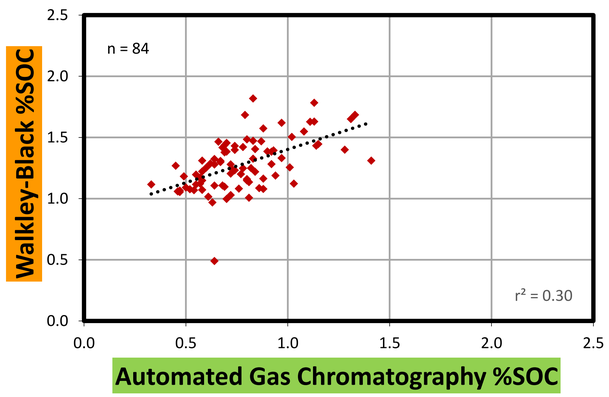
Independent analyses of treatments were conducted for each trial and each procedure using the Scheffe comparison with a 95% confidence interval.

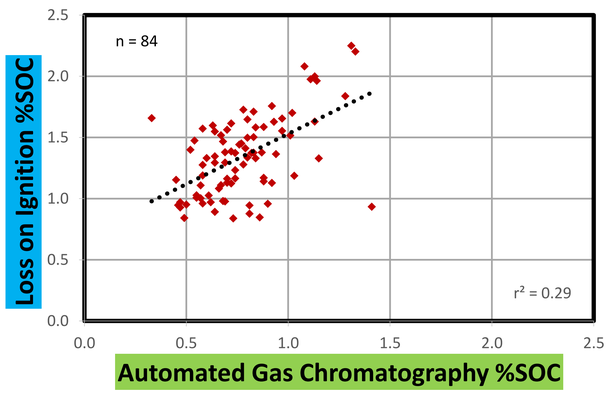
Management	AGC		WB		LOI	
Mountain						
No-till organic	1.23	a	1.64	a	2.01	a
No-till chemical	0.88	b	1.46	ab	1.63	b
Tillage organic	0.93	ab	1.39	ab	1.73	ab
Tillage chemical	0.73	b	1.27	b	1.53	b
Tillage fallow	0.88	b	1.50	ab	1.64	b
Piedmont – 9 tillage						
No-till chemical	0.75	ab	1.19	a	1.26	bc
In-row subsoiling	0.95	a	1.40	a	1.69	a
Disk, spring	0.53	b	1.08	a	1.38	abc
Chisel, fall	0.79	ab	1.24	a	1.36	abc
Chisel, spring	0.81	ab	1.37	a	1.49	ab
Chisel, disk, fall	0.71	ab	1.22	a	1.23	bc
Chisel, disk, spring	0.65	ab	1.21	a	1.34	abc
Moldboard, fall	0.53	b	1.09	a	1.27	bc
Moldboard, spring	0.55	b	1.16	a	1.02	c
Piedmont – 4 tillage						
No-till chemical	0.71	a	1.17	a	1.16	a
Alternating till/no-till	0.71	a	1.35	a	1.20	a
Disk, spring	0.67	a	1.27	a	1.16	a
Double disking	0.59	a	1.23	a	1.02	a
Coastal Plain						
No-till, chemical	0.82	a	1.32	a	0.99	a
Tillage, chemical	0.90	a	1.07	b	0.99	a
Tillage, organic 1	1.10	a	1.33	a	1.03	a
Tillage, organic 2	0.90	a	1.19	ab	1.19	a

- There was not more SOC from no-till soils compared to tilled soils in any trial.
- SOC determined by AGC was typically less than both WB and LOI.
- No procedure exhibited greater differentiation of SOC from these soils.

Correlations Between SOC Analyses







- Correlations between SOC analyses had positive trends, but results from one procedure were not predictive of results from another procedure ($r^2 \leq 30$).
- Independent analyses for individual trials also resulted in low r^2 values for correlations (data not shown).
- Average error for regressions (RMSE) ranged from 0.21-0.28 %SOC, which is equivalent to 16-26% of the range of measured SOC.

Conclusions

- Conversions between measured SOC for different procedures could be off by as much as 0.28 %SOC, and may not be reliable predictors of SOC results.
- Interpretations of SOC content should be relative to a specific procedure and should not be compared to different procedures.
- After many years of consistent management, differences in SOC content among no-till and tillage were not present in any trial based on the SOC procedures used.

Acknowledgements

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