Comparison of the soil quality of forested and pasture grazing lands on Spirit Creek Farm, Georgia

Zani Dembure, John Quinn, Brannon Andersen
Furman University, South Carolina, USA

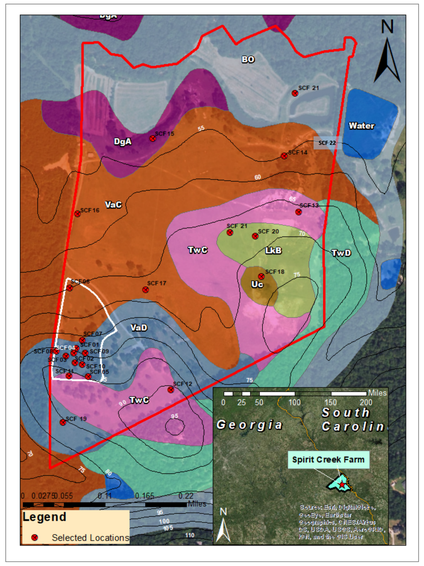
Introduction

Soil organic matter (SOM) is a medium that allows the progression of plant growth, regulates soil moisture, provides nutrients to root systems, and breaks down organic compounds to be used as storage of energy for the ecosystem (Franzluebbers et al., 2000; Lal, 2016). SOM contains soil organic carbon (SOC) and soil organic nitrogen (SON), and plays a key role in increasing soil fertility and productivity and may sequester greenhouse gasses (Franzluebbers and Stuedemann, 2009).

The purpose of this study was to compare forest and pasture soils on Spirit Creek Farm located near Augusta, GA. The data provide a baseline for forested soils that will be used for rotational grazing of hogs and pasture soils that are currently managed by intensive rotational grazing of cattle. The pasture has never been tilled for row crops, although one area of the pasture was used as a barrow pit. The objectives were to (1) compare SOC and SON pasture (grazed) and forest (ungrazed) soils and (2) determine the variation of SOC and SON concentrations across soil types.

Methods

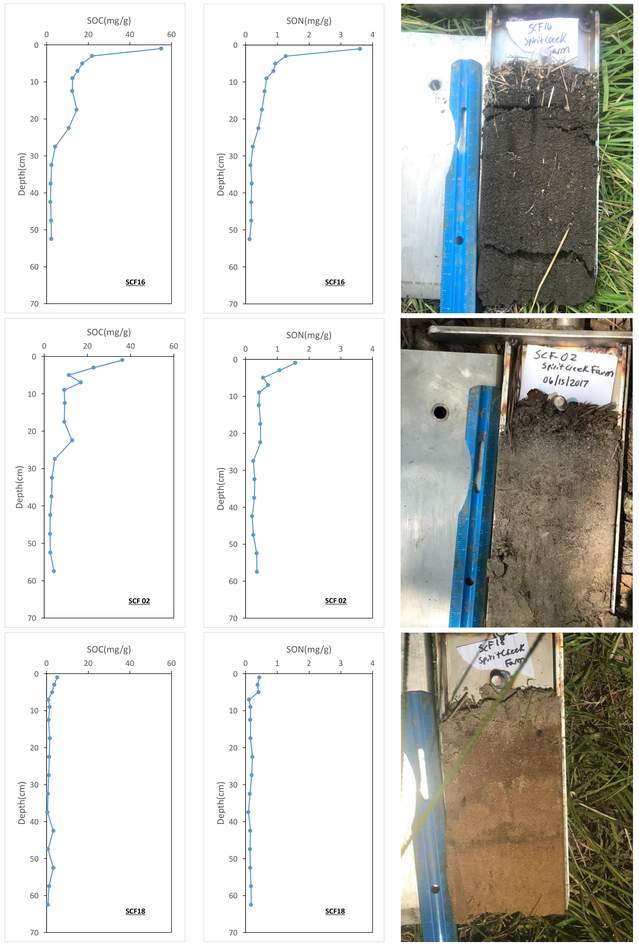
Samples locations were chosen using a doubly stratified random selection process. A 60 cm soil core and an 18 cm soil profile were collected at 22 locations. Bulk density samples were collected at four locations. Color, texture, and horizons were described for each profile. Each core was subdivided into as many as 16 subsamples for soil organic carbon (SOC) and soil organic nitrogen analysis (SON). Each subsample was disaggregated and passed through a 2 mm sieve to remove large roots. Samples were dried at 105°C and cooled in a desiccator before analysis. SOC and SON were measured using a LECO TruMac C/N Macrodeterminator with samples combusted at 1350°C.



Map of Spirit Creek Farm with soil sample locations and soil series. The red outline represents the boundary of the farm. The white outline represents the area that is forested and will be used for hog grazing. The rest of the farm is cattle pasture managed by intensive rotational grazing with no-till planting of fodder crops.

Soil series: BO- Bibb and Osier soils, DgA- Dogue fine sandy loam, 0 to 3 percent slopes, VaC- Vaucluse-Ailey complex, 5 to 8 percent slopes, VaD-Vaucluse-Ailey complex, 8 to 17 percent slopes, TwC- Troup fine sand, 5 to 10 percent slopes, LkB- Lakeland sand, 2 to 5 percent slopes, TwD- Troup fine sand, 10 to 17 percent slopes, and Uc- Udorthents, sandy and loamy.

Color variation among different soil samples.



Soil cores with SOC and SON concentrations and associated profiles for A) VaC soil series (SCF 16), B) VaD soil series (SCF 02), and C) Uc soil series (SCF 18).

"This material is based upon work that is supported by the National Institute of Food and Agriculture, U.S. Department of Agriculture, under award number 2015-38640-23780 through the Southern Sustainable Agriculture Research and Education program, under subaward number LS16-273. USDA is an equal opportunity employer and service provider. Any opinions, findings, conclusions, or recommendations expressed in this publication are those of the author(s) and do not necessarily reflect the view of the U.S. Department of Agriculture."

Results

Soils in all locations were sandy loams with colors in the upper 20 cm ranging from pinkish white (5YR 8/2) to black(7.5YR 2.5/1). Concentrations of SOC and SON showed rapid, often exponential, decrease with depth. SCF 14 and SCF 16 in the VaC soil series and SCF 15 in the DgA soil series, had the highest concentrations of SOC and SON. All soil cores from the forests had similar concentrations of SOC and SON, but all were from the VaD soil series. Currently, we are using bulk density to calculate stocks SOC and SON. The bulk density for the four selected samples are 1.35g/cm^3, 1.54g/cm^3, 1.61g/cm^3, and 1.71g/cm^3. SOC and SON stocks will be used to calculate stratification ratios for 0-10 cm/20-30 cm and 0-20 cm/20-40 cm. Stratification ratios of over 2 indicate better soil quality. In the southeastern U.S., stratification ratios of pastures are as high as 4.5 (Franzluebbers, 2010).

Different views of the non-grazed, forested areas.

Conclusion

The grazing in the pastures has led to significantly higher SOC and SON than in the forestlands. The sandy loam to sandy clay loam textures were able to contain the SOM and provide beneficial soil fertility and productivity to the farm. Due to the farm having never been plowed, the soil quality is likely better than most areas in the region. Further research will be done to calculate the stratification ratio, C to N ratio, and C and N stocks to have better measures of soil quality. Ultimately, the data from Spirit Creek Farm will be compared to Greenbrier Farms in the Piedmont of South Carolina. Both are managed the same way, but have very different soil textures (sandy loams versus clay loams).

References

Franzluebbers, A.J., 2010, Depth distribution of soil organic carbon as a signature of soil quality: 19th World Congress of Soil Science, Soil Solutions for a Changing World, p. 1-4.
Franzluebbers, A.J., Stuedemann, J.A., Schomberg, H.H., and Wilkinson, S.R., 2000, Soil organic C and N pools under long-term pasture management in the Southern Piedmont USA: Soil Biology and Biochemistry, v. 32, p. 469-478, doi: 10.1016/S0038-0717(99)00176-5.
Lal, R., 2016, Soil health and carbon management: Food and Energy Security, v. 5, p. 212-222, doi: 10.1002/fes3.96.