Changes in Soil Organic Carbon and Nitrogen in Response to Rotational Grazing in the Piedmont of the Southeastern United States

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S. Abstract

Grazing on perennial legumes can potentially improve soil quality by increasing soil organic carbon (SOC) and soil organic nitrogen (SON) storage. Previous studies of long-term grazing to improve soil quality have tested pasturelands under conventional tillage methods and found mixed results, typically showing no change or lower SOC and SON concentrations in soils from pasturelands than from tilled soils. In 2002, the Greenbrier Farms in Pickens County, South Carolina, began a rotational grazing system based on the idea of increasing animal activity to improve soil quality. The objectives of this study were: (1) to compare SON and SOC concentrations at Greenbrier Farms with soils from non-grazing farms, and (2) to determine if the SON/SOC ratio was a useful indicator of soil quality. The SON/SOC ratio was measured at both Greenbrier Farms and at two farms in the Piedmont region of South Carolina, one of which was a non-grazing farm. The SON/SOC ratio was higher at Greenbrier Farms than at the non-grazing farm. Higher SOC concentrations were measured in the upper 15 cm of the soil profile at Greenbrier Farms than at the non-grazing farm. The SON/SOC ratios at Greenbrier Farms were higher than at the non-grazing farm in the upper 15 cm of the soil profile. Therefore, rotational grazing may increase SON concentrations, thereby lowering C/N ratios.

II. Introduction

The southern Piedmont of the United States is characterized by an abundance of pedotextures which are recognized as an important link with the capability of storing large quantities of both organic matter and nutrients. Historical tillage practices have been responsible for the degradation of these soils through periods of inactivity and variability in climate and crop management. Degraded soils are characterized by a decrease in soil organic matter, a decrease in soil quality, and a decrease in crop productivity. A hypothesis has been made that rotational grazing has the potential to improve soil quality by increasing animal activity that can improve soil quality through increased aggregation and organic matter release. We hypothesized that soils from 12 Aprils Dairy Farm and Greenbrier Farms would have higher SON and SOC concentrations in the upper 15 cm of the soil profile than soils from the non-grazing farm. We also measured the SON/SOC ratio as an indicator of soil quality.

III. Methodology

In 2011, 10 soil cores were collected from Greenbrier Farms, and in 2012 10 soil cores were collected from 12 Aprils Dairy. Core locations were selected using a doubly stratified random scheme. Consecutively numbered cores were taken from the top 15 cm of each of the five selected management treatments (Figure 1), which were also separated into four cm strata. The equation for the strata depths used to core soil was

\[
BD = 1.71 \cdot \exp(-0.013 \cdot SOC)
\]

IV. Results and Discussion

12 Aprils Dairy Soil Destination

- SON concentrations and soil storage were higher in the upper 15 cm, but SOC decreased rapidly and decreased at lower depths. Both Greenbrier Farms and 12 Aprils Dairy Farms showed higher SON and SOC concentrations in the upper 15 cm of soil.

- The SON/SOC ratio was higher at Greenbrier Farms than at 12 Aprils Dairy Farms in the upper 15 cm of soil.

- The SON/SOC ratios at Greenbrier Farms were higher than at 12 Aprils Dairy Farms in the upper 15 cm of soil.

- Higher SOC concentrations were measured in the upper 15 cm of the soil profile at Greenbrier Farms than at the non-grazing farm.

- The SON/SOC ratios at Greenbrier Farms were higher than at the non-grazing farm in the upper 15 cm of the soil profile.

V. Conclusion

- Soil quality indicators, such as SON and SOC, were higher at Greenbrier Farms than at 12 Aprils Dairy Farm. It was hypothesized that the SON/SOC ratio was a useful indicator of soil quality, and this hypothesis was supported by the results of this study. The SON/SOC ratio was measured at both Greenbrier Farms and at two farms in the Piedmont region of South Carolina, one of which was a non-grazing farm. The SON/SOC ratio was higher at Greenbrier Farms than at the non-grazing farm. Higher SOC concentrations were measured in the upper 15 cm of the soil profile at Greenbrier Farms than at the non-grazing farm. The SON/SOC ratios at Greenbrier Farms were higher than at the non-grazing farm in the upper 15 cm of the soil profile. Therefore, rotational grazing may increase SON concentrations, thereby lowering C/N ratios.

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VII. References