OBJECTIVES

(1) Determine the effect of various forage and pasture management strategies on the stratification of soil organic C and N with soil depth

(2) Identify the most dynamic soil C and N components that respond to management

RATIONAL

Soil quality is a concept based on the premise that management can deteriorate, stabilize, or improve soil ecosystem functions.

Soil organic matter is a key component of soil quality that sustains many key soil functions by providing the energy, substrate, and biological diversity to support biological activity, which affects (1) aggregation (prevented for habitat space, oxygen supply, and preventing soil erosion), (2) infiltration (important for leaching, runoff, and crop water uptake), and (3) decomposition (important for nutrient cycling and detoxification of amendments).

Degree of stratification of soil organic C and N pools with soil depth, expressed as a ratio, could indicate soil quality or soil ecosystem function. Stratification ratios would allow a wide diversity of soils to be compared on the same assessment scale because of an internal normalization procedure that accounts for inherent soil differences.

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Grass-based agricultural systems may improve soil quality and this could be recognized by high stratification ratios.

MATERIALS and METHODS

Soil organic C and N by dry combustion (Leco CNS 2000) Particulate organic C and N collected on 0.05 mm screen following dispersion and analysis with dry combustion. Non-particulate organic C and N from non-combustible C: (a) ashing at 550°C for 24 days, (b) 0.1 M HCl for 24 days, and (d) 1 M K2CO3 for 24 days

Soil microbial biomass C, C mineralization, and AOM fluxes (in situ 24 days) were measured using the fumigation-incubation method.

Analyses

Sensitivity of soil properties to stratification was evaluated by comparing F-values (ratio of known to unknown variability). Highest F-values indicate the greatest sensitivity.

RESULTS

Management comparisons 1

Soil organic C Particulate organic C Soil microbial biomass C Potential C mineralization

Concentration at 0-5-cm depth divided by the concentration at 12.0-20-cm depth (Mgt 1-4) and 0-2 / 4-6 cm (Mgt 5)

Stratification calculation

Sensitivity of soil properties to stratification was evaluated by comparing F-values (ratio of known to unknown variability). Highest F-values indicate the greatest sensitivity.

SUMMARY

Stratification of soil properties with depth is a consequence of conservation management that supplies organic residues at the soil surface resulting in:

- protection of the soil surface from erosion
- concentration of substrates to enhance biodiversity
- development of biologically supported physico-chemical processes (e.g., aggregation, nutrient cycling)

Land management with cattle grazing resulted in stratification ratios that were high or higher than:

- conservation-tilage cropland
- haying to remove grass without animal traffic
- natural forestland

Soil organic C and N pools became quickly stratified under pastures following conversion from degraded cropland

Many soil properties became stratified under pasture management strategies. Total, particulate, and microbial biomass C pools were equally sensitive to management-controlled changes in stratification.

Prediction of optimum soil quality with stratification ratios is still premature, but the average soil organic C stratification ratio of 5 under the various pasture systems evaluated here might be a reasonable target.

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