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Unlocking Plant-Microbial Interactions in Deep Mollisols in the Midwestern US: Linking Depth Gradients in Roots, Microbial Activity, and Soil Carbon in Agroecosystems

Background/Objective

Deeply rooted perennial plants may help build soil carbon (C) stocks, but most research has focused on shallow soils, resulting in gaps in our understanding of how the balance between decomposition and C inputs shift and drive soil C accumulation with depth. To address this challenge, researchers assessed the distribution and assimilation of ^{13}C-labeled simple carbon in meter-deep pits under mature perennial miscanthus stands.

Approach

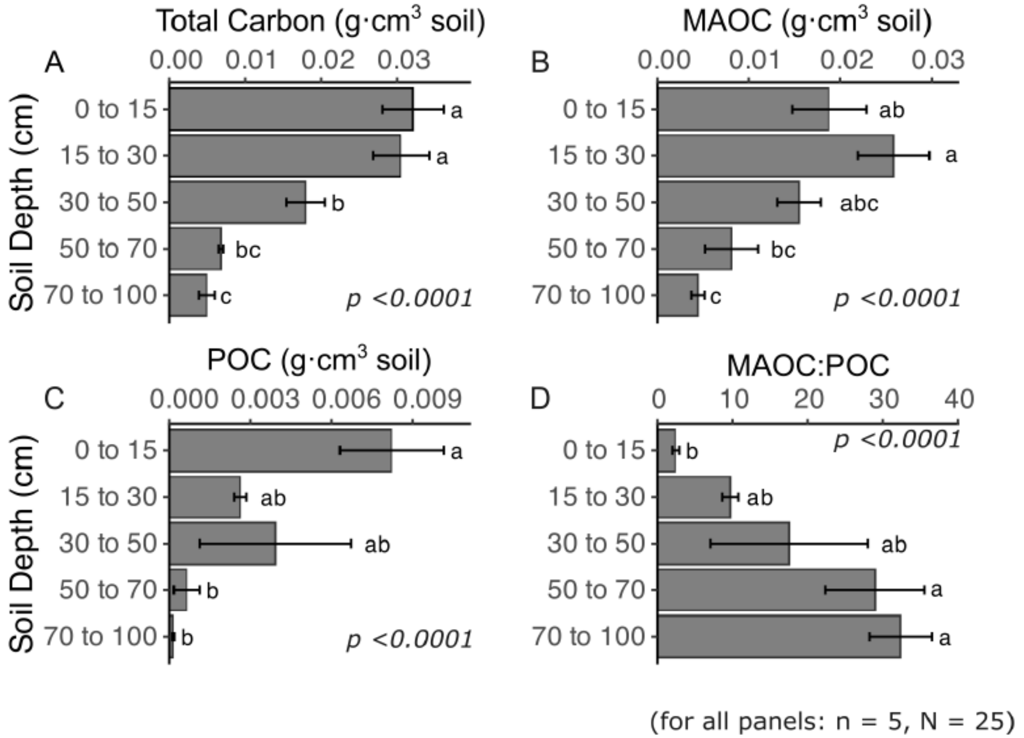
Researchers dug five quantitative soil pits under mature miscanthus plots in Urbana, IL, separated and quantified fine root biomass by depth, quantified soil C, microbial respiration, and potential nitrogen mineralization and nitrification, and traced ^{13}C-labeled glucose to the soils to determine the fate of simple C inputs with depth.

Results

Fine root biomass, total soil C, mineral-associated organic C (MAOC), particulate organic C (POC), and microbial activity declined with depth. POC declined more rapidly than MAOC, resulting in an increase in MAOC:POC with depth. Incorporation of simple ^{13}C inputs into MAOC were similar across depths. However, these inputs led to net MAOC losses in shallow soils and either small loses or gains in deeper soils.

Significance/Impacts

This work suggests that depth gradients in soil C stocks represent a balance between inputs, decomposition, and microbial necromass production and that increase in root C inputs by deep-rooted plants may have the potential to build stable MAOC.



Distribution of (A) total carbon, (B) MAOC, (C) POC, and (D) MAOC:POC with depth. Error bars show standard error. Within each panel, groups represented by different letters are significantly different (p<0.05, Tukey-Kramer HSD).

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