Soil organic carbon stability in forests: distinct effects of tree species identity and traits.

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Rising atmospheric CO_2 concentrations have increased interest in the potential for forest ecosystems and soils to act as carbon (C) sinks. While many studies provide evidence for an effect of tree species identity on soil C stocks, little is known about *if* and *how* tree species influence the stability of C in soil.

We thus investigated the effects of eleven different tree species and their traits (including tree tissue chemistry, magnitude of organic matter inputs to the soil and their turnover, descriptors of the soil microbial community, and soil physico-chemical properties) on five indices of soil organic matter (SOM) stability (including heterotrophic respiration, C in aggregate-occluded particulate organic matter (POM) and mineral-associated SOM, and bulk soil δ^{15}N and Δ^{14}C).

Our results show that the stability of SOM varied independently of the amount of C in soil and that this stability was regulated by tree species and their traits, mainly via the composition of roots. Stability of SOM appeared to be greater (as indicated by higher δ^{15}N and reduced respiration) beneath species with higher concentrations of nitrogen and lower amounts of acid-insoluble compounds in their roots, while SOM stability appeared to be lower (as indicated by higher respiration and lower proportions of C in aggregate-occluded POM) beneath species with higher tissue calcium contents. Some of our stability indices (C in mineral-associated SOM and bulk soil Δ^{14}C), though, were negligibly dependent on tree species traits, likely reflecting an insensitivity of some SOM pools to decadal-scale shifts in ecological factors. Strategies aiming to increase soil C stocks may thus focus on particulate C pools, which can more easily be manipulated and are most sensitive to climate change.