Litter mixing enhances the formation of novel stable soil organic carbon but not its content in soil.

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Résumé

The decomposition of plant litter is one of the key processes influencing carbon (C) cycling and the capacity of ecosystems to store C in soils. As plant litters decompose, novel soil organic carbon (SOC) is formed, whether in the forms of stable 'mineral-associated organic matter' (MAOM) or more transient 'particulate organic matter' (POM). Simultaneously, native SOC mineralization can be accelerated (i.e., the 'priming effect'). However, despite most ecosystems on Earth host diverse plant communities producing complex litters mixtures, the influence of non-additive mixture effects (ME) on C stabilization and destabilization in soil has been entirely overlooked so far. We therefore investigated the decomposition of leaf and root litters from three plant species in isolation and in litter mixtures composed of two, three, four, and six litters up to near complete decomposition (after one year in standard highly favorable conditions). We measured the resultant gains and losses in SOC and its constituent pools (MAOM, POM) affect its overall balance in a microcosm litter decomposition experiment. Litters and soils were harvested after 10, 38, 156, and 367 days, and the ME was expressed relative to expectations derived from each mixture's constituent single litters' decomposition. After one year, the ME of litter C loss (+ 0.8%), litter-derived SOC (+ 9.5%) and litter-derived MAOM-C (+1.0%) were generally positive indicating that mixing litters concomitantly increased litter decomposition rate and the formation of novel SOC in the form of stabilized MAOM-C. The magnitude of the ME of both litter C loss and litter-derived SOC declined throughout the year (from 27.7 to 0.8% and 39.9 to 9.5%, respectively), highlighting the importance of early decomposition stages on the two processes. No ME was detected on the novel POM-C formation nor on the priming of native SOC and its constituent pools (POM and MAOM). However, overall, the ME of the C balance across SOC gains (formation) and losses (native SOC priming) at near complete decomposition was positive but non-significant. The same result was observed for the POM and MAOM pools of SOC taken separately. Taken together, our results suggest that whereas litter mixing may enhance the formation of novel litter-derived SOC, particularly in the form of stable MAOM-C, it does not significantly affect the net C balance across total SOC (nor MAOM-C) gains and losses int the soils incubated.

Mots-Clés: litter decomposition, litter mixtures, soil organic carbon formation, priming, mineral, associated organic matter, particulate organic matter.

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