Soil Carbon in the Ecological Transition
International symposium
24 - 26 January 2024

# Land use determines the composition and stability of organic carbon in earthworm casts under tropical conditions.

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Abstract:

Environmental conditions play an important role in controlling the fate of organic carbon (OC) in earthworm casts, however, the mechanisms that lead to the destabilization of OC in different land use systems remains poorly understood. In this study, we investigated the impact of land use on the fate and composition of particulate organic matter (POM) and mineral-associated organic matter (MAOM) in earthworm casts under tropical conditions. We conducted a 400-day field exposure experiment in a woodland and meadow in northern Vietnam. Under natural rainfall conditions, this experiment compared soil aggregates without earthworm activity (reference soil) to earthworm casts. We analyzed the element content and carbon isotope and mid-infrared signatures of the two types of materials after 9 and 400 days of field exposure. The results showed that the casts were initially enriched in OC as compared to the reference soils, with the MAOM fraction accounting for over 90% of the earthworm induced OC accumulation. The POM fraction occluded in casts consisted of fresh plant material and disappeared during the 400 days of field exposure. Enrichment and composition of OC differed between woodland and meadow casts. POM and MAOM showed contrasting persistence in the two land use systems. While woodland casts showed highest potential to stabilize SOC, the actual amount of cast OC stabilized for more than 400 days was more important under meadow. Both systems showed contrasting processes affecting cast OC dynamics. Under woodland, cast OC destabilization was most probably related to microbial degradation, while in meadow, OM accumulation most probably related to root activity may be the dominant process. Our study highlights that the impact of earthworms on the origin, composition, and fate of cast OC in tropical environments is strongly influenced by land use.

Key words: Bioturbation; Land uses; Macrofauna; FTIR spectroscopy

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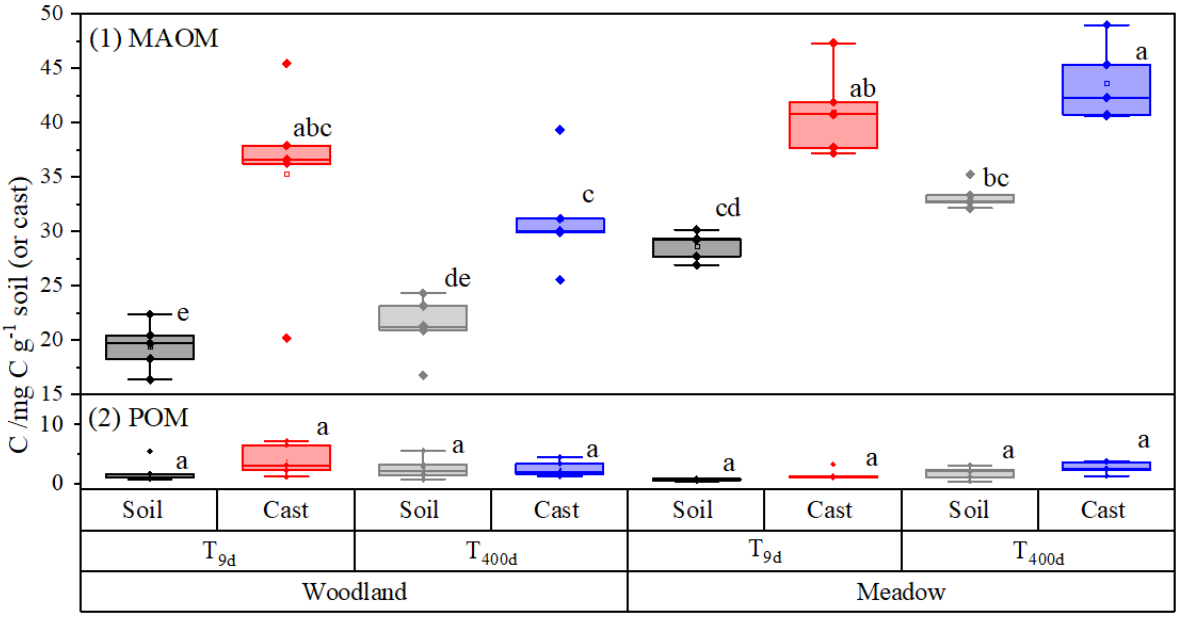


Fig. 1 The POM C and MAOM C in casts and reference soils under woodland and meadow at the two ageing stages ($T_{9d}$ and $T_{400d}$). Different letters indicate statistically significant differences between casts and reference soils during ageing under different land uses (***$p < 0.001$; **$p < 0.01$; *$p < 0.05$ and ns for $p > 0.05$, ANOVAs)