Long-term N additions reduce the lability of soil carbon in temperate forest soils depending on tree species composition

CENTRE FOR FUNCTIONAL ECOLOGY

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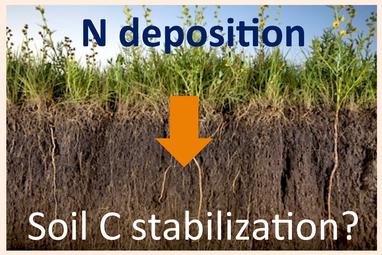
BACKGROUND, OBJECTIVE AND HYPOTHESES

The role and magnitude of effect of chronic nitrogen (N) input on forest soil carbon (C) pools and stabilization remains uncertain. Even more uncertain is to what extent different tree species may control the effect of the added N on the stabilization of C in soil.

AIM: To estimate the extent to which the lability of C is influenced by elevated N inputs and modulated by tree species composition

HYPOTHESES: 1) N addition enhances C storage in soil by reducing C lability
2) Different tree species may modulate the extent to which N addition decreases soil C lability



MATERIAL AND METHODS

- 14-years N addition experiment at the Catskill Mountains (NY) across plots with different dominant tree species:

Acer saccharum — Maple

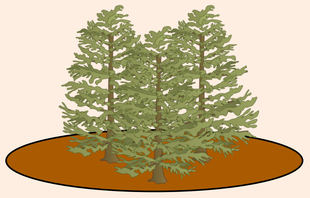
Tsuga canadensis — Hemlock

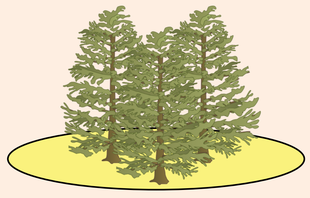
Fagus grandifolia — Beech

- A single-species, paired plot design (6 pairs for species):

Ambient
9 Kg N ha^{-1} year^{-1}

N-treated
9 + 50 Kg N ha^{-1} year^{-1}



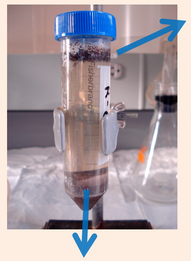


Quercus rubra — Oak

Betula alleghaniensis — Birch

- Two different approaches to estimate C lability:

Density fractionation

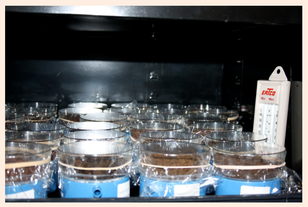


Light fraction (LF) has free organic matter -> **Labile C**

Heavy fraction (HF) has organic matter associated with minerals

Microbial fractionation

Incubations with measurements of heterotrophic respiration to estimate the **potentially mineralizable C (C_0)-> Labile C**



RESULTS & DISCUSSION

- Contrary to expectations, we found a slight increase in the LF mass, significant in the case of maple plots (Fig. 1).
- Significant and negative N effect on potentially mineralizable C of organic horizon samples in beech plots (Fig. 2), as well as on respiration rates at the beginning of the incubation in beech and oak plots (Fig. 3a-c).

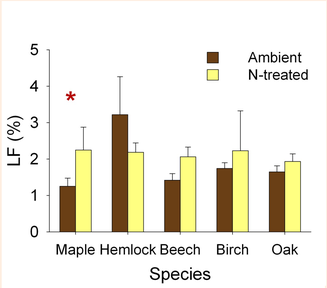


Fig.1 Light fraction mass

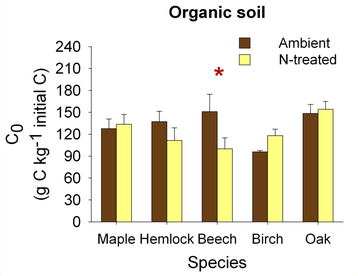


Fig.2 Potentially mineralizable carbon (C_0)

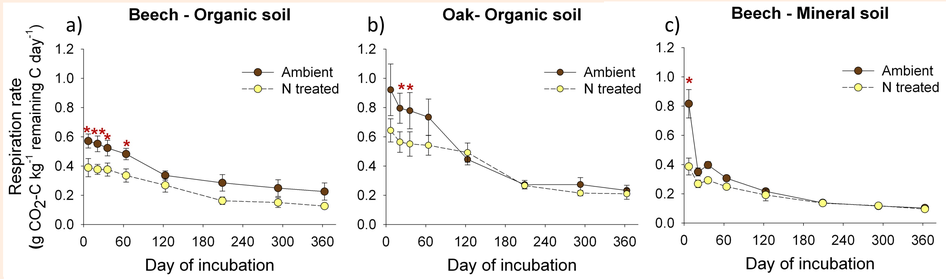


Fig.3 Heterotrophic respiration rate of the organic (a, b) and mineral (c) soils for stands of beech (a, c) and oak (b)

- Density fractionation did not fully correspond with the microbial accessibility to the organic matter (Fig. 4). Mechanisms other than organo-mineral associations (e.g. chemical stabilization, changes in the microbial community, etc.) could play a more important role in the stabilization of C in these soils.

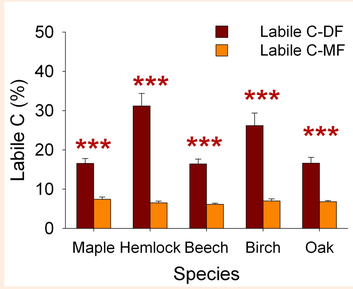


Fig.4 Labile C estimated from density and microbial fractionation

CONCLUSIONS

- Long-term N additions reduce organic matter decomposition and lability of soil C under some tree species but not others, highlighting the importance of considering tree species in future C budget models as important modulators of the ecosystem response to N input
- Caution should be used in interpreting estimates of labile C from different methods
- Using multiple methods is crucial to better understand soil C stability and the mechanisms that promote it

FUNDING

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