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Digging into the "Gadgil effect": a contrived field experiment to unravel how the competitive balance between fungal guilds affects forest carbon cycling

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In forest soils ectomycorrhizal (EM) and saprotrophic (ST) fungi interact and compete for nutrients. This competitive interaction may result in suppression of organic matter decomposition, a phenomenon known as the "Gadgil-effect". However, the mechanism by which ST and EM fungi interact in C-cycling remains controversial and poorly understood. Our novel double-controlled experiment, aims to unravel the interactions between ST and EM fungi under different forest and soil conditions to unravel the mechanism behind the Gadgil effect.

In late-summer 2023, we installed an experiment in forests in southern and eastern England on sandy and clayey soils, experiencing N deposition or N limitation. Plots (2x2m) were excavated (1m) to exclude EM fungi, with control plots allowing for new roots and EM ingress complete exclusion. Several measurements were made in the soil including litter decomposition, CO_2 evolution and fungal community analysis.

Decomposition rates varied between substrates introduced in litter-bags and trenching treatments. Soil respiration and fungal communities also varied with notable differences between the two study locations.

Our findings suggest that the competitive dynamics between EM and ST fungi may be impacted by existing root-stored carbohydrates supporting EM fungi post-root severance or might not align with the expected "Gadgil-effect". Notably, the variation between locations indicates the significant role of local environmental conditions, such as soil and forest type along with nitrogen availability, in modulating soil carbon-cycling.

Our experiment is providing new insights into the complex interactions between EM and ST fungi under varying environmental conditions and their collective impact on organic matter decomposition.