Priority effects of foliar fungal endophytes in leaf litter decomposition

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INTRODUCTION

Leaf litter decomposition is a key ecological process in forest ecosystems, driving carbon cycling and nutrient turnover. This process is largely carried out by microbial communities—particularly fungi—which break down plant material, releasing carbon dioxide (CO_2) and transforming organic matter into more stable forms such as soil carbon or biomass [1]. The structure of these microbial communities is shaped by both stochastic (random) and deterministic factors [2].

One important deterministic process is priority effects, where the order and timing of species arrival influence community composition and interactions through either facilitation or competitive exclusion [3]. To explore this, we used leaf litter as a model system to investigate the priority effects of foliar endophytic fungi (FEF) in leaf litter communities.

In deciduous forests, trees shed their leaves each fall, forming a litter layer that becomes a hotspot of microbial activity on the forest floor (Fig. 1). FEF reside in living leaves and can persist after abscission, giving them early access to decomposing substrates [4]. Some FEF may continue growing as saprotrophs, potentially influencing which fungi colonize later and how quickly litter breaks down [5,6]. This early colonization may shape fungal community structure and alter the rate of carbon turnover in terrestrial ecosystems.

RESEARCH QUESTION

Do fungal endophytes impose priority effects in leaf litter communites?

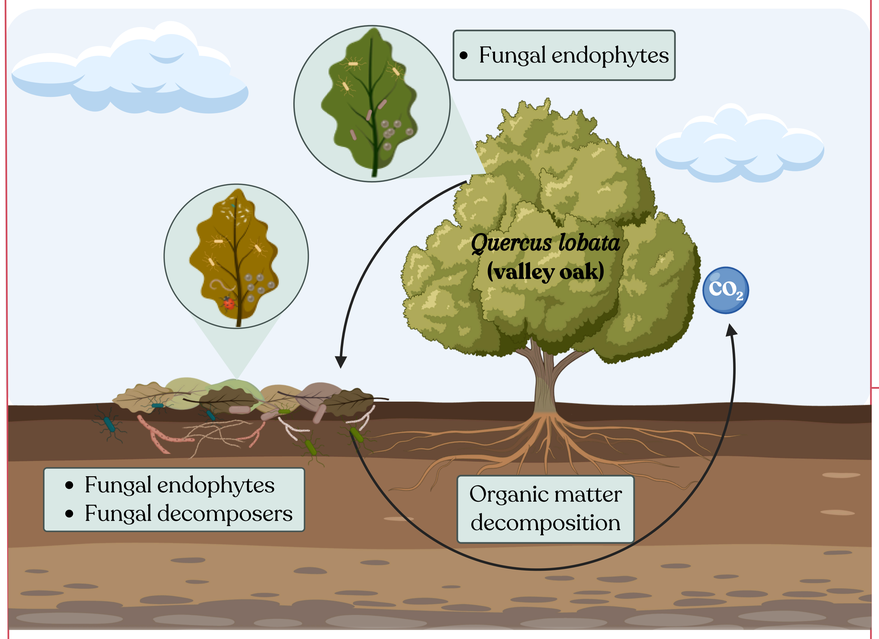


Figure 1. Diversity and ecological interactions of FEF transition from green leaves to leaf litter, shaping leaf litter decomposition and the carbon cycle.

CONCLUSION

- FEF imposed weak priority effects, as FEF communities overlapped with those of external fungi.
- FEF persisted in litter, supporting their transition from endophytes to saprotrophs.
- Mass loss was similar across treatments.
- Community composition shifted over time only in the external fungi treatment, with strong site effects across all treatments.

SIGNIFICANCE

This research deepens our understanding of fungal community assembly and the role of fungal endophytes in leaf litter decomposition. It also highlights the broader importance of microbial communities in driving ecosystem processes and terrestrial carbon cycling.

METHODOLOGY

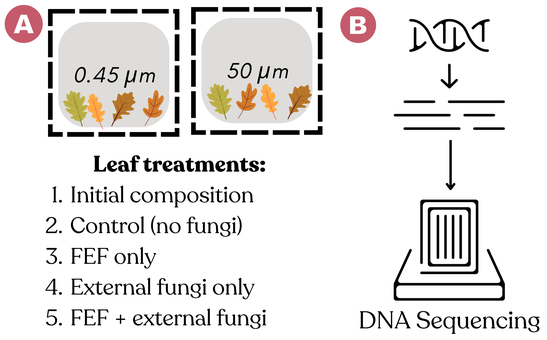


Figure 2. Field experiments at Big Chico Creek Ecological Reserve used valley oak leaf litter from three sites. (**A**) Leaves were assigned to five treatments using nylon mesh: 50 µm to allow and 0.45 µm to exclude external fungal colonization. Packets were collected at five time points. (**B**) DNA was extracted, fungal internal transcriber region (ITS1) was amplified, and sequenced via high-throughput Illumina sequencing.

RESULTS

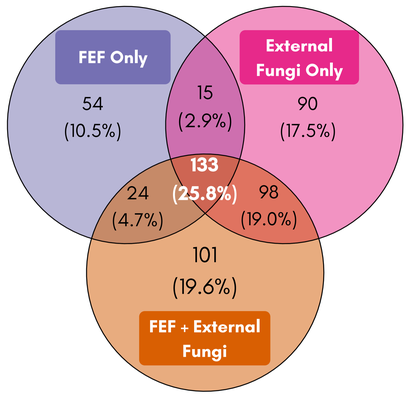


Figure 3. Operational taxonomic units (OTU) distribution across fungal treatments. A total of 133 OTUs were shared across all treatments.

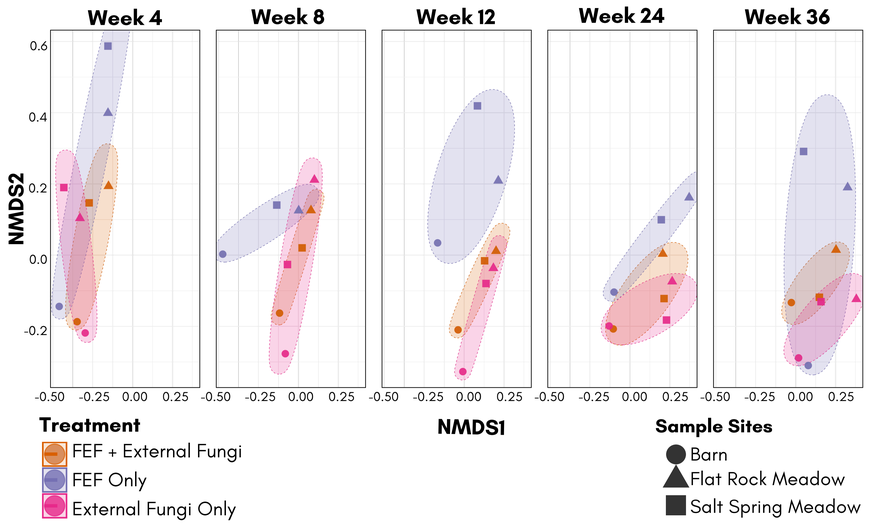


Figure 4. Non-metric multidimensional scaling (NMDS) ordination based on Bray Curtis dissimilarity differed significantly by site ($p < 0.001$), with temporal shifts observed only in the external fungi-only treatment ($p < 0.05$). Pairwise PERMANOVA revealed significant differences between FEF only and other treatments at Barn ($p < 0.05$), but not at other sites.

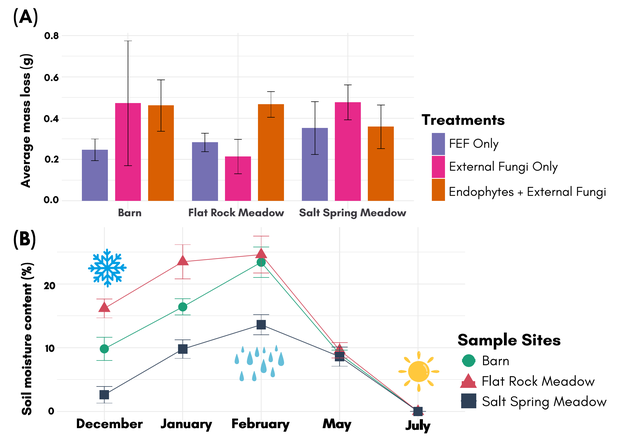


Figure 5. (**A**) Average mass loss by treatment showed no significant effects across site, time, or interactions ($p > 0.05$). (**B**) Soil moisture varied significantly by site, time, and their interaction ($p < 0.001$).

CITATIONS AND MORE INFORMATION
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