A trait-based framework reveals mechanisms underlying fungal responses to nitrogen deposition

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Background

Increased rates of nitrogen (N) deposition are expected to decrease leaf litter decomposition rates in temperate forests. Changes in the community of decomposer fungi are likely responsible for reduced decomposition, but specific mechanisms remain unclear. We used an *in situ* litter decay experiment to examine the effects of N deposition on fungal-mediated litter decay.

Methods

•Leaf litter bags were allowed to decompose for two years in a forest stand exposed to 24 years of simulated N deposition.

•RNA and DNA were extracted from litter, and the fungal ITS2 region was sequenced by 454 sequencing.

•Extracellular enzyme activities were measured using standard methods:

- Beta-glucosidase (BG)
- Cellobiohydrolase (CBH)
- Phenol oxidase (PPO, ABTS)
- Peroxidase (PER, TMB)
- Leucine aminopeptidase (LAP)
- N-acetylglucosaminidase (NAG)
- Acid-phophatase (PHOS)

•**Treatment abbreviations**

- **Control**: ambient N deposition
- **N50**: 50 kg N ha^{-1} yr^{-1}
- **N150**: 150 kg N ha^{-1} yr^{-1}

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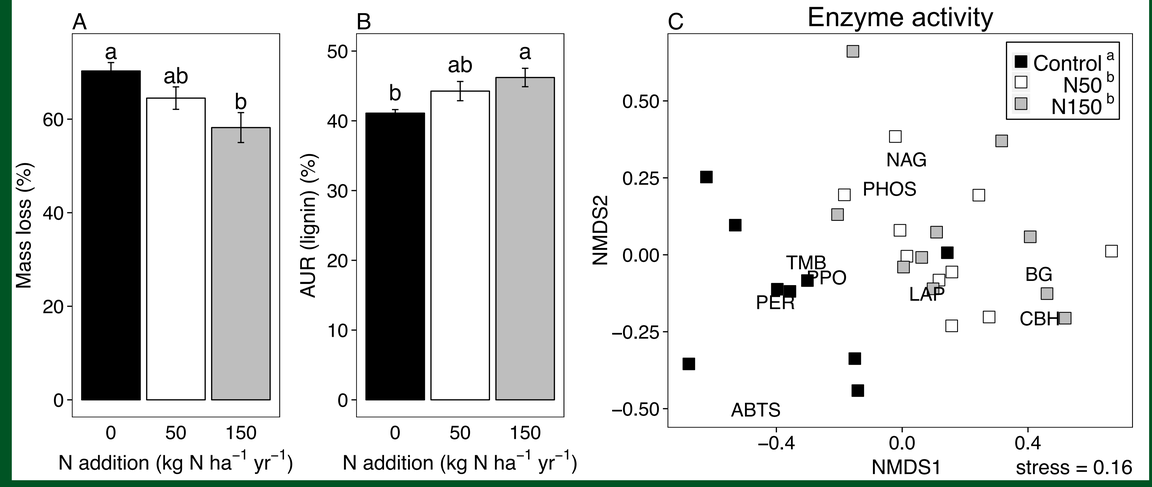
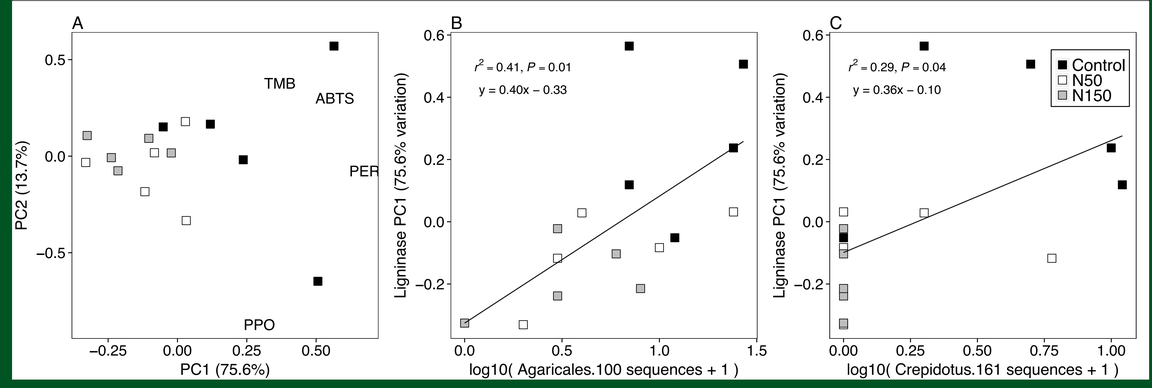
Results

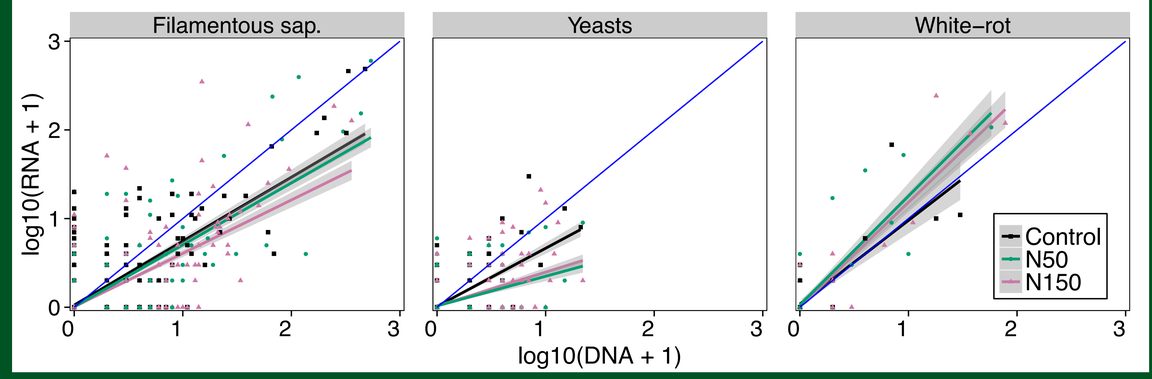
Nitrogen slows decomposition of leaf litter – especially lignin



Decreased relative abundance of particular species reduces lignin decompostion



Nitrogen decreases activity of yeasts and filamentous saprotrophs



Nitrogen favors fungi with traits that increase soil carbon storage

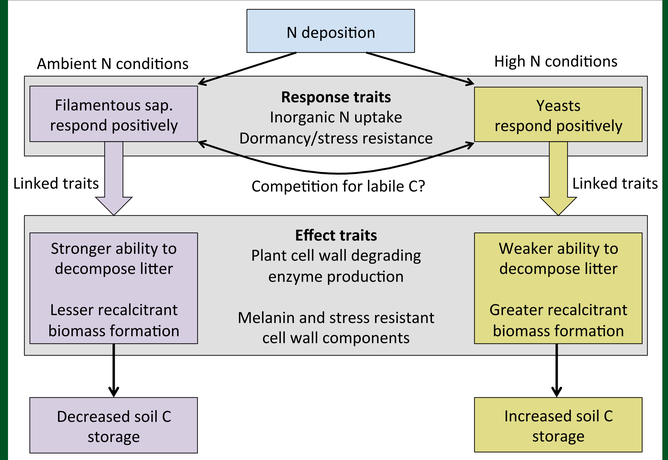


Figure adapted from Treseder & Lennon 2015, *Microbiology and Molecular Biology Reviews.*

Summary

Nitrogen increased lignin relative abundance and decreased litter mass loss.

Decreased relative abundance of only a few species explained a large reduction in enzymes that decompose lignin.

Nitrogen reduced activity of yeasts and filamentous saprotophs, and may favor dormancy as a competitive strategy.

Nitrogen deposition favors fungi with key traits like high inorganic N uptake rates or dormancy as a means of persistence, both of which are enriched in yeasts. These traits are linked with traits, such as low production of decomposition enzymes, that increase soil carbon stocks.

Acknowledgements

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