Sustained effects of chronic nitrogen addition on the capacity of fungi to degrade lignocellulose

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Introduction

- Chronic nitrogen (N) deposition due to agriculture and industry has been shown to affect rates of organic matter decomposition[1].

-White-rot fungi belonging to the phylum Basidiomycota are the primary decomposers of lignin, a recalcitrant plant polymer, and their ability to decompose lignin may be suppressed under chronic N deposition[2, 3].

-We examined fungal degradation responses to chronic N deposition and the presence of N in an i*n vivo* simulated N deposition gradient.

Figure 1. White-rot basidiomycete *Irpex lacteus* decomposing wood and in culture.

Methods

Study Site: Chronic N Amendment Study at Harvard Forest Long Term Ecological Research (LTER) site (Petersham, MA), a simulated N deposition study since 1988.

1. Cultured basidiomycete fungal species from soil and wood in control (ambient N); N50 (50 kg N ha^{-1} y^{-1}); & N150 (150 kg N ha^{-1} y^{-1}) plots.

2. Measured decay rates and enzyme activities of decomposing oak litter in “home” and “away” environments.

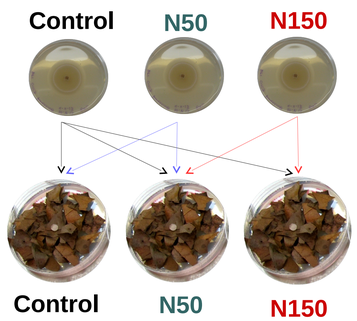
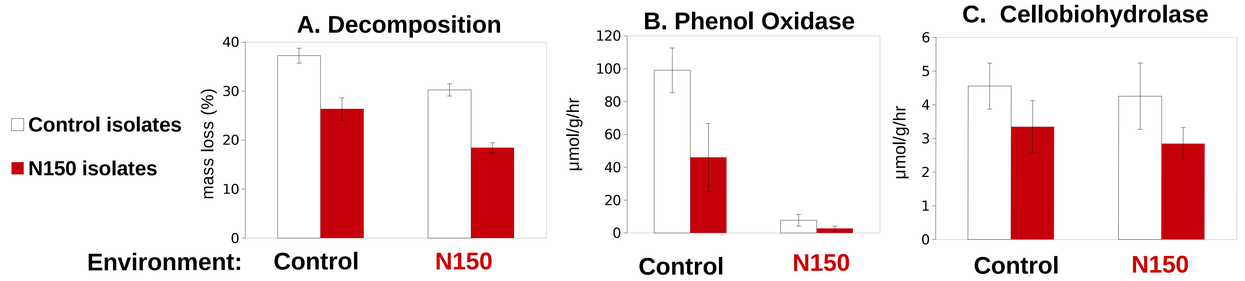


Figure 2. Experimental design to measure decomposition capacity in simulated N deposition environments representative of field conditions.

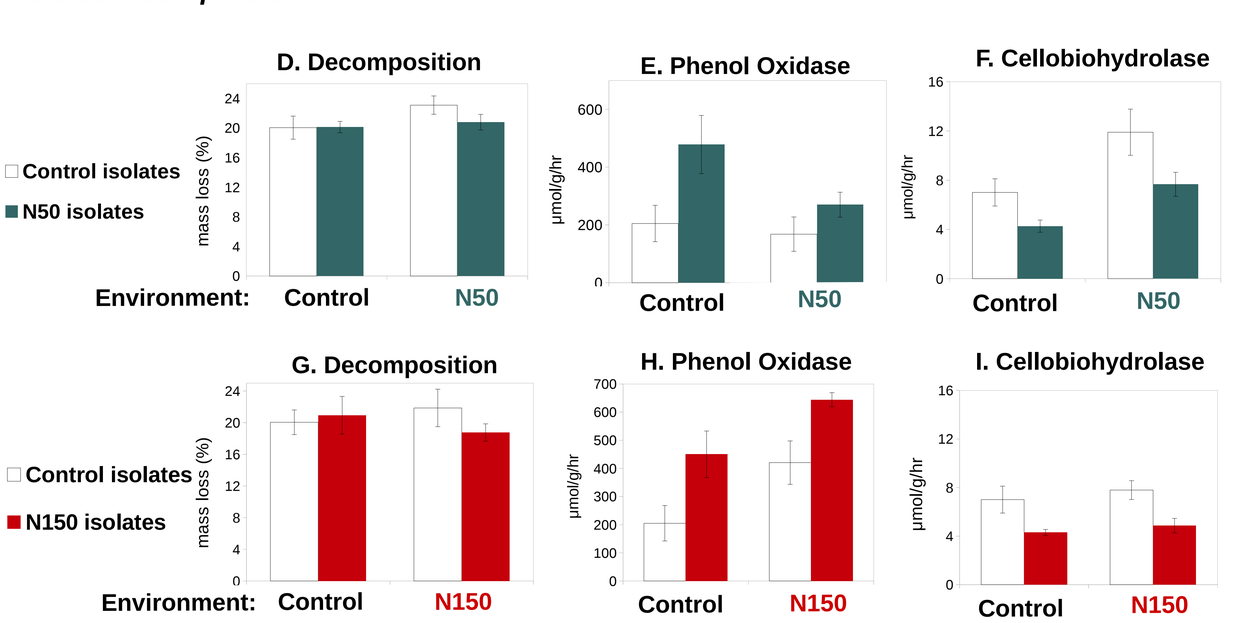
Results

Irpex lacteus



Litter decay **(A)**, phenol oxidase activity **(B)**, and cellobiohydrolase activity **(C)** were reduced for Irpex lacteus isolated from soils exposed to 25+ years of chronic N additions. This result was apparent for both control and N amended lab environments.

Stereum complicatum



Decay was not significantly different for either control or N isolates in their “home” or “away” environment **(D, G)**. Phenol oxidase activity increased **(E, H)** and cellobiohydrolase activity decreased **(F, I)** for isolates exposed to 25+ years of N additions.

Conclusions

1. Chronic N addition has both immediate and long lasting, non-plastic effects on fungal decomposition capacity and enzyme activity.

2. Decomposition capacities and enzyme activities respond to simulated N deposition in a species specific manner.

3. Nitrogen addition for *S. complicatum* has diverging effects on enzyme activities, which may explain the absence of change in decomposition rate.

Future directions

1. Replicate method for other basidiomycetes abundant in our study site.

2. Estimate lignin and cellulose degradation rates.

3. Measure lignocellulolytic gene expression.

4. Estimate fungal biomass to account for enzyme efficiency.

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Literature cited

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