Sveriges lantbruksuniversitet
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PHD PROJECT

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Exploring the function and role of ectomycorrhizal decomposers

A major fraction of terrestrial carbon is stored in boreal forest soils, and in this system, fungi are the most important regulators of organic matter turnover. Mycorrhizal fungi, in symbiosis with their plant hosts, contribute to soil carbon accumulation through production of mycelium but can also directly and indirectly influence the decomposition of organic matter. Indirectly, through competition mycorrhizal fungi can restrict the access of saprotrophic fungi to deeper soil horizons and reduce the rate of decomposition. However, some ectomycorrhizal fungi have retained a capacity to produce potent oxidative enzymes and may, thereby, also be effective decomposers. In particular, manganese peroxidases use hydrogen peroxide and divalent manganese to produce trivalent manganese, which is highly reactive and oxidises organic compounds in an unspecific manner. Yet, unlike saprotrophic decomposition, ectomycorrhizal fungi do not require carbon from decomposition, but may instead utilize manganese peroxidases to increase access to organic nitrogen in infertile soils. It is still unknown how prevalent these enzymes are across ectomycorrhizal species, the function they have for ectomycorrhizal fungi, and the ecology of these potential "ectomycorrhizal decomposers".

The first objective of my research project is to study the ability of manganese peroxidases produced by ectomycorrhizal fungi to decompose soil organic matter and mine for nitrogen. My experimental setup will help to address the role of this potential guild of mycorrhizal decomposers in maintaining forest productivity on infertile soils. To generate hypotheses about which ectomycorrhizal species may have this functional capacity, my second project will assess co-occurrence of potential enzyme activity and fungal taxa. Ectomycorrhizal fungi that are found to co-occur with high potential enzyme activity will be investigated further to see if their presence correlates with lower carbon storage. By defining the ecological niche of this potential guild of ectomycorrhizal decomposers we can glean whether forest management impacts its presence. Lastly, I plan to use metatranscriptomics to improve our understanding of how these fungi, on a mycelium level scale, regulate their production of manganese peroxidases alongside other metabolic processes in response to their local environment. Overall, my project contributes to our knowledge on the role ectomycorrhizal fungi play in regulating carbon and nitrogen cycling in boreal forests.

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