University of Victoria | Graduate Studies

Notice of the Final Oral Examination for the Degree of Master of Science

of

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BSc (University of Guelph, 2013)

"Nitrogen Form Uptake Capacities by Arbuscular Mycorrhizae and Ectomycorrhizae"

Department of Biology

August 10, 2017
1:00 P.M.
Hickman Building
Room 120

Supervisory Committee:
Dr. Barbara Hawkins, Department of Biology, University of Victoria (Supervisor)
Dr. Real Roy, Department of Biology, UVic (Member)
Dr. J. Marty Kranabetter, BC Ministry of Forests (Outside Member)

External Examiner:
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Chair of Oral Examination:
Dr. Mihai Sima, Department of Computer and Electrical Engineering, UVic

Dr. David Capson, Dean, Faculty of Graduate Studies

Abstract

Plant growth and survival is affected by the nutrients available in the environment. Nitrogen (N) is most often the limiting nutrient in terrestrial ecosystems, particularly in temperate and boreal forests, such as those on Vancouver Island. To overcome the challenge of limited nutrient availability, plants have evolved symbiotic relationships with fungi, called mycorrhizae. While research on the importance of mycorrhizal symbioses for N uptake by plants continues to grow, we have a limited understanding of the mechanisms of N uptake and transfer by mycorrhizae. This knowledge is crucial to fully understand N uptake and assimilation by plants. This study aimed to determine the influence of soil N availability on conifer growth and foliar N content, and on the N form preferences and sporocarp N content of associated mycorrhizae. Inorganic and organic soil N production was determined for two sites near Port Renfrew British Columbia, under pure plantations of Douglas-fir (*Pseudotsuga menziesii* [Mirb.] Franco), Sitka spruce (*Picea sitchensis* [Bong.] Carr.), western redcedar (*Thuja plicata* Donn ex D. Don in Lamb) and western hemlock (*Tsuga heterophylla* [Raf.] Sarg.). Ammonium, nitrate and amino acid production contrasted between the sites, with relatively higher N production in San Juan compared to Fairy Lake. This indicated differences in soil N cycling, most likely due to differences in moisture and topography. In general, conifer species did not affect inorganic and organic soil N production. Growth of conifers increased with increasing N availability, and differed between species, with Douglas-fir and Sitka spruce having the greatest growth and western redcedar having the least growth. Foliar %N and **σ**15N were found to differ among the conifer species, and western redcedar had the lowest foliar N concentrations. While site quality was not reflected in foliar %N, foliar **σ** 15N was found to increase with increasing □15N of the forest floor. Ectomycorrhizal (ECM) sporocarps reflected site quality, with greater N concentrations but lower **σ** 15N values on the higher N site. Sporocarp 15N concentrations were higher than foliar 15N concentrations, suggesting N isotope fractionation by mycorrhizae. Finally, site N availability was not related to the rates of N form uptake by ECM genera. Both ECM and arbuscular mycorrhizae (AM) did not have substantial nitrate uptake, despite a greater supply of nitrate. Ammonium was found to be taken up at higher rates than nitrate in the ECM and AM roots, suggesting a preference for ammonium, possibly due to ammonium being energetically cheaper to metabolize and suppressing nitrate transporters in mycorrhizal fungi. Differences in proportions of N form uptake and sporocarp N content among ECM genera were seen, indicating potential niche formation based on functional traits such as N form uptake and mycelial morphology. Knowing how mycorrhizae respond to different N forms and rates of N supply will not only increase our knowledge of N dynamics in mycorrhizal symbioses, but will help predict the effects environmental changes, such as disturbance and N deposition, may have on these systems.