THE EFFECT OF INCREASED NITROGEN DEPOSITION ON ECTOMYCORRHIZAS OF PINUS KOREIENSIS

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In boreal and temperate forests, trees are colonized by a community of ectomycorrhizal species, and are the main pathways of nutrient uptake for trees. China is experiencing intense air pollution caused in large part by anthropogenic emissions of reactive nitrogen. In simulation of increased N deposition into forests, increased N has been shown to increase net ecosystem productivity but have negative effects on root and soil microbial biomass. Increased N inputs have been shown to strongly effect the composition of the ectomycorrhizal community at a plot scale, and across geographical scales N deposition is one of the most important factors controlling the structure of the ectomycorrhizal community. At the experimental forest at Liangshui China a simulation of increased N deposition has been carried out for the last two years in a natural forest dominated by Pinus koreiensis and a Pinus koreiensis plantation. At this large scale investigation increased N deposition is simulated by the addition of ammonium sulphate at addition rates of 50, 150 and 300 Kg N ha-2 and a-1. The proposed project is an investigation of the effects of increased N deposition on the ectomycorrhizal community structure of Pinus koreiensis. The structure of the ectomycorrhizal community will be related to changes in soil chemical factors.

Prof. Douglas Godbold at BOKU will train the masters student in sampling and identification of ectomycorrhizas, and will cosupervise the master student. Douglas Godbold will oversee financial aspects of the project, and will be active in interpretation of the results and publication.

Prof. Wenbiao Duan will provide will co-supervise the master student and will organise the running of the project in China.

State of the art

In boreal and temperate forests, trees are colonized by a community of ectomycorrhizal species (Read et al, 2004), and are the main pathways of nutrient uptake for trees (Finlay 2008). Ectomycorrhizas acquire mineral nutrients particularly N and P from the soil solution but also by mobilizing organic forms (Finlay 2008).

China is experiencing intense air pollution caused in large part by anthropogenic emissions of reactive nitrogen. These emissions result in the deposition of atmospheric nitrogen (N) in terrestrial and aquatic ecosystems. Nitrogen deposition rates in the industrialized and agriculturally intensified regions of China are as high as the peak levels of deposition in northwestern Europe in the 1980s (Liu et al. 2013). In simulation of increased N deposition into forests, increased N has been shown to increase net ecosystem productivity but have negative effects on root and soil microbial biomass (Chen et al. 2015, Zak et al. 2017). Increased N inputs have been shown to strongly effect the composition of the ectomycorrhizal community at a plot scale, and across geographical scales N deposition is one of the most important factors controlling the structure of the ectomycorrhizal community (Suz et al 2014, Rosinger et al. 2018).

Estimation of EM community structure has historically been based on surveys of epigeous sporocarps (Peter et al., 2001a). Investigations of the EM belowground community on root tips was initially carried out using morphological identification of EM species on root tips (Agerer, 1997). This technique has subsequently evolved into presorting of EM root tips into morphotypes and subsequent identification to genus or species level using molecular methods. Surveys of sporocarps and investigations of root tips have shown that in general a few EM fungal taxa tend to dominate the EM community and a larger number of taxa tend to be less frequent (Horton & Bruns, 2001). However, estimates of above- and below ground EM community structure do not correspond (Peter et al., 2001b).

Background work

At the experimental forest at Liangshui a simulation of increased N deposition has been carried out for the last two years in a natural forest dominated by Pinus koreiensis and in a Pinus koreiensis plantation. At this large scale investigation increased N deposition is simulated by the addition of ammonium sulphate at addition rates of 50, 150 and 300 Kg N ha-2 a-1. The experimental design includes an elevation gradient representing 3 soil types. Each treatment is replicated 3 times. At the site a number of investigations are being carried out including estimation of soil carbon and forms, soil pH and rates of litter decomposition. These studies will provide background data for the planned investigation.

Planned project

In order to assess the ectomycorrhizal community structure, fine roots will be taken using a soil corer in May, July and September 2019. All clearly definable ectomycorrhizal root tips from each sample will be sorted into morphotypes based on the method described by Agerer (1997). The work will be carried out by a masters student to be recruited to the project. A number of candidates are currently available. Prof Douglas Godbold will train the masters student in the identification of ectomycorrhizas on roots. After morphotyping the roots tips will be frozen for subsequent DNA extraction and potential molecular identification. Before this is carried out the availability of reference sequences from China will first be determined.