Open the gates! How fungi pass tree root walls.

Soil fungi and roots of temperate and boreal forest trees can form a beneficial interaction called ectomycorrhizal symbiosis (ECM). This interaction improves the trees' access to nutrients such as phosphorous and nitrogen, which are absorbed through the large belowground fungal network. In return, the fungus receives sugars derived from photosynthesis in the tree. This exchange favors the growth of both partners, making ECM symbiosis an ecologically and economically important partnership for our forests. During ECM establishment, fungal hyphae adhere to the root and surround it with a fungal mantle. Root cells in contact with the fungal sheath loosen from each other and hyphae grow in between them, forming the so-called Hartig Net (HN). The nutrient transfer between the partners occurs in the Hartig Net.

On a molecular level, ECM formation requires a coordinated molecular dialogue between compatible partners. Root cells are connected through the pectin-rich middle lamella, forming an impenetrable barrier to fungi and other organisms. It has been suggested that pectin is remodeled or broken down so that the contact between neighboring root cells is loosened and fungal hyphae can penetrate this space to form the Hartig Net. How the plant and the fungus both contribute to this "gate opening" cell wall release is yet to be understood. During the past decade, genomes of diverse ECM fungi have become available. Their analysis revealed that ECM fungi produce a number of cell wall degrading enzymes that are probably important for Hartig Net formation. Another fungal component that has been suggested to contribute to Hartig Net formation is fungal auxin, a plant growth hormone that may be involved in changes in root tip shape observed in ECM roots.

My research aims at revealing the molecular mechanisms that drive cell wall remodeling and root cell release during Hartig Net formation, as well as root growth alteration in the ECM partnership between *Populus* and the fungus *Laccaria bicolor*. In my lecture, I will present what my group has learned about pectin remodelling during the interaction of *Populus* with *L. bicolor* and how we have identified a fungal enzyme that is involved in pectin remodelling and required for Hartig Net formation. I will also explain our recent hypothesis that a decrease in cell wall bound tannins facilitates pectin remodeling and how we want to study this phenomenon further. We also study the effect of fungal auxin on Hartig Net formation. I will describe how we analyze and alter auxin production in *L. bicolor* and how we aim, in the future, to connect the effects of fungal auxin to pectin remodeling during Hartig Net formation. Fungal auxin is furthermore a likely contributor to the typical root growth retardation that is observed during ECM formation. I will talk about our efforts to generate an anatomical and a molecular map of *Populus* root tips to understand how ECM formation and fungal auxin impact cell division in the root tip. Taken together this research will both reveal fundamental mechanism of cell wall biology in plants, such as the impact of auxin and tannins on pectins, and also provide new insights into the requirements and respective contributions of plant and fungus to the establishment of the Hartig Net in ECM symbiosis. An increased understanding of ECM symbiosis can foster the development of new applications for ECM application in sustainable forestry.