

## Characterizing the Defense Hierarchy of *Populus trichocarpa*

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Plants host a diverse array of non-pathogenic microorganisms that can affect plant disease severity either by interacting directly with pathogens or by modulating the plant defense response. Our ongoing project seeks to characterize the contribution of fungal and bacterial endophytes, and an endophytic, eriophyid mite, to rust disease severity in the model tree, *Populus trichocarpa*. Fungal endophytes antagonize the leaf rust pathogen (*Melampsora*) whereas the mite competes with the rust pathogen; both interactions result in lower rust disease severity. To date, we have identified a QTL and individual genes (using GWAS) that are associated with genetic resistance to the mite. In particular, a gene involved in cutin/suberin production in response to wounding is found in resistant tree hosts. We are in the process of validating the GWAS result for mite resistance, while simultaneously using GWAS to identify genes associated with endophyte antagonism of the rust pathogen. Next, using a combination of field and greenhouse inoculation experiments, we have found that rust pathogen antagonism by fungal endophytes can be preempted by host genes for resistance that suppress pathogen development in the first place, and 2) rust pathogen antagonism by endophytes can secondarily be preempted by competitive exclusion of the rust by the mite. Overall, these results point to a *Populus* defense hierarchy with resistance genes on top, followed by pathogen competition, and finally pathogen antagonism. Our ongoing efforts seek to test the role of bacterial endophytes in the *Populus* defense hierarchy.