

## ENDOPHYTE ENHANCEMENT OF SPRUCE AND EASTERN WHITE PINE SEEDLINGS TO IMPROVE TOLERANCE TO INSECTS AND DISEASE

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Research over the past two decades has focused on endophytic fungi isolated from the needles of conifer trees, forming mutualistic associations with their hosts. We have identified native strains of endophytic fungi that produce secondary metabolites which act antagonistically towards certain forest pests, namely eastern spruce budworm (*Choristoneura fumiferana*) and white pine blister rust (*Chronatium ribicola*). Spruce budworm, which is the most significant insect pest in Canada and parts of the United States, defoliates balsam fir and white spruce and to a lesser extent red spruce and black spruce. In 2017, 7 million ha of forests in the Province of Québec experienced defoliation from the current outbreak. White spruce is the most widely planted tree species in Canada and was the subject of early studies on potentially useful foliar endophytes. Research was initiated in 1998 to determine if white spruce seedlings could be inoculated with selected endophyte strains. Field tests were established to study the persistence of the endophytes in trees, to understand the transmission of the endophyte, and to provide trees for challenging experiments with the spruce budworm. Challenging studies with spruce budworm have demonstrated a reduction of spruce budworm survival through to adulthood and a reduction of defoliation in the range of 10–30 percent. Based on positive results of this work, research was initiated in 2008 to test the same approach on white pine blister rust, a devastating non-native disease affecting all five-needle pines in North America. Through screening many strains, endophytes have been selected which produce potent anti-fungal secondary metabolites and inoculation procedures have been developed. Lab assays using the disease pathogen and secondary metabolites at relevant concentrations have demonstrated inhibition of the disease and field testing is underway. Twenty years of research has demonstrated that selected endophytes can play a role in improving tolerance of planted trees to pests as one component of integrated pest management. J.D. Irving, Limited has implemented endophyte enhancement in nursery seedling production at a large scale since 2008.

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