

Endophyte Mediated Plant-Herbivore Interactions or Cross Resistance to Fungi and Insect Herbivores

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Abstract

Endophytic fungi are generally considered to be plant mutualists that protect the host plant from pathogens and herbivores. Defensive mutualism appears to hold true particularly for seed-transmitted, alkaloid producing, grass endophytes. However, we propose that the mutualistic nature of plant-endophyte interactions via enhanced plant resistance to pathogens and herbivores should be reconsidered when focusing on woody plants.

We compared phenotypic and genetic frequency correlations for two endophytic fungal genera (*Fusicladium* and *Melanconium*) and birch rust (*Melampsoridium betulinum*) with the performance of six invertebrate herbivores growing on the same half sib progenies of mountain birch *Betula pubescens* Ehrh. ssp. *czerepanovii* (N. I. Orlova) Hämet-Ahti in two environments over a 3-year period. We found little support for causal association between fungal frequencies and performance of herbivore species. Instead, genetic correlations, particularly between autumnal moth (*Epirrita autumnata*) and birch rust, suggest that herbivore performance may be affected by (1) genetic differences in birch quality for fungi and herbivores, or (2) genetic differences in responses to environmental conditions. Genetic analysis of *Venturia ditricha* (anamorph *Fusicladium betulae*) revealed that (1) birch genotypes and environment influence the probability of infection by particular endophyte genotypes, (2) genetic variation correlated negatively with infection frequencies of the fungus, and (3) the susceptibility of the birch to a particular endophyte genotype may change when environmental conditions are changed (environment-host genotype interaction).

Furthermore, statistical perusal of endophyte literature revealed clear contrasts between grass and tree endophytes. Grass endophytes appear to provide support for the hypothesis of defensive mutualism, whereas variability appears to be the nature of the tree endophyte mediated plant herbivore interactions.

We propose that: (1) the performance of endophytes, pathogens, and herbivores may be responses to genetically determined plant qualities rather than interconnected associations; (2) the observed genetic correlation structure may have importance for evolution of birch resistance to fungi and herbivores (e.g., negative correlation between birch resistance to rust fungus and autumnal moth may constrain birch population from reaching optimal species-specific resistance); this should be considered also in forest tree improvement attempting to overcome pests and pathogens; and (3) more knowledge about multispecies coevolution is necessary to fully understand bilateral interactions between plants and the organisms living on them.

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