Causes and consequences of chemotypic diversity of *Epichloe* species, protective fungal endophytes of grasses.

Christopher L. Schardl
September 26, 2023.

Epichloe species are seed-borne fungal symbionts (endophytes) of grasses in subfamily Poöideae (cool-season grasses), such as species of *Hordeum* (barleys), *Festuca* (fescues) *Poa* (bluegrasses), *Achnatherum, Brachyelytrum, Brachypodium, Bromus, Elymus, Melica* and others. These endophytes are best known for their production of several classes of alkaloids, each with several chemical species, which are active against invertebrates, vertebrates or both. Their pathways and genes for ergot alkaloids, indole-diterpenes, aminopyrrolizidines and pyrrolopyrazines are now largely known, and there is substantial chemotypic diversity both among and within *Epichloe* species. Phylogenomic comparisons of *Epichloe* species have revealed several genetic processes contributing to their alkaloid diversification, including gene duplication, functional divergence, trans-species polymorphism, intra-allelic recombination and (most frequently) gene loss or partial gene loss. Evidence will be presented that the endophytes and their alkaloids sometimes constitute a significant metabolic load for the plant, so that some alkaloids or even the endophytes themselves can be selectively disfavored under some environmental and ecological circumstances. Therefore, herbivory and perhaps other stresses (such as drought) may be key to the long-term persistence of these symbiotic systems, and diversity of these symbionts constitutes a hidden but important dimension of biodiversity.