A high frequency change, which is both inducible and reversible, results in altered colony morphology of a fungal symbiont (*Neotyphodium lolii*) and dwarfing of its grass host (*Lolium perenne)*

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Wayne Roydon Simpson
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Abstract

Fungal endophytes of the genus *Neotyphodium* form stable symbiotic associations, with grasses, that are symptomless and generally considered to be mutualistic. The benefits that these fungi confer to their grass hosts are exploited in pastoral agriculture systems. The production of a range of secondary metabolites, specifically alkaloids including peramine and ergovaline can give their host plants an ecological advantage in certain environments. *Neotyphodium* endophytes are asexual and have lost the ability to transfer horizontally between hosts making seed transmission a vital feature of the association.

This thesis reports the occurrence of phenotypically different perennial ryegrass plants (*Lolium perenne*) in a population infected with *Neotyphodium lolii*. Here we show that the change in the plants is directly attributable to a variant endophyte that they host. Isolation of the variant endophyte reveals a change in colony growth compared to the wild-type resident endophyte in the population, which has a white and cottony phenotype. Colonies of the variant endophyte are smaller than wild-type colonies and mucoid, with hyphal filaments forming aggregates. Evidence shows that the switch between colony morphologies occurs at a very high frequency, is reversible, and appears to be environmentally induced. This suggests that the switching phenomenon involves gene regulation rather than mutation. When endophyte-free plants are infected, with either white and cottony (wild-type) or mucoid (variant) fungal colonies, they assume a morphology consistent with the state of the fungus at the time of inoculation, that is normal or dwarfed, respectively. In addition, re-isolation of endophyte from either normal or dwarfed plants always yields white and cottony or mucoid colonies, respectively, suggesting that the host environment stabilizes the state of the fungus. Proteomic profiling revealed differences in protein expression between plants infected with either the wild-type or mucoid fungus. Furthermore, host plants containing the mucoid fungus have never flowered or produced seed. Thus, if this change in the fungal symbiont occurs in a competitive natural environment the mucoid fungus and its host plant may not persist beyond the first generation. This thesis provides insights into the plastic nature of fungal endophyte/grass symbiota and discusses possible mechanisms for the observed morphological switching in culture and host dwarfing.

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