



PhD Studentship in
Molecular Biology of Plant-Endophyte Interactions
at AgResearch, New Zealand

Fungal effectors required for *Epichloë*-wheat interactions

This PhD studentship is based within the Plant-Fungal Interactions Team at AgResearch, New Zealand's agricultural crown research institute. The student will conduct research towards a PhD degree in a joint appointment with the Institute of Fundamental Sciences at Massey University (Palmerston North, New Zealand). The student will be based at AgResearch in Palmerston North and will be part of a large multidisciplinary team with extensive expertise in grass endophytes. The principal supervisors at AgResearch will be Linda Johnson and Christine Voisey, and at Massey University the main supervisor will be Rosie Bradshaw. Co-supervision will also be provided by Martijn Rep at the University of Amsterdam (The Netherlands).

Description of project:

Cool season grasses such as perennial ryegrass (*Lolium perenne*) have co-evolved with symbiotic fungal endophytes (genus *Epichloë*) that impart significant protection against biotic and abiotic stresses. These symbiotic associations have been extensively studied by the Plant-Fungal Interactions Team resulting in commercialization of protective endophytes such as AR1 and AR37 in perennial ryegrass. The research team has extended this expertise to identify biochemically useful endophytes in the wild grass relatives of modern cereals, with the intention of developing protective endophytes for use in cereals. Inoculation of *Epichloë* endophytes into wheat has been achieved; however the relationship between the endophyte and host is wholly or partly incompatible resulting in stunted plants or elimination of the endophyte. This PhD programme will study genes and proteins with possible roles in mediating compatibility or incompatibility with the host plant.



Pathogenic and symbiotic fungi manipulate host gene expression, protein function and physiological conditions to produce an environment favourable to the fungus by translocation of small secreted proteins (SSPs) termed “effectors” into host cells. Gene expression data (transcriptomics) obtained through our existing programme has identified a suite of genes that are differentially expressed between compatible and incompatible cereal-endophyte associations. These genes include host genes involved in defence, as well as a significant number of candidate effector genes from the fungal partner that we hypothesise mediate these and other responses necessary for compatibility. In accordance with other studies, we anticipate that many endophyte SSPs will localise to the nucleus or other subcellular compartments within host tissues, and that correct expression and localisation of these proteins are essential for host/endophyte compatibility and hyphal colonisation.

In order to identify putative effector genes involved in *Epichloë*-wheat interactions, the successful candidate will compare genome sequences of *E. bromicola* endophyte strains that infect wheat with greater or lesser compatibility, along with *Epichloë* species that do not form associations with cereal grasses at all. The full suite of genes predicted to encode secreted proteins will be identified in each genome, and candidate effector and avirulence genes identified on the basis of their expression in compatible or incompatible associations. To examine their role, if any, in host compatibility, candidate genes will be functionally analysed in a wheat-infecting *E. bromicola* strain by targeted gene deletion or through gene over-expression studies. The effects of gene manipulation will be assessed by inoculation of mutants into cereal hosts and analysis of endophyte infection, plant vigour, and host defence responses. Dominant effectors will be tested for host range to determine whether these proteins are able to mediate infection of new hosts.

The scholarship has a value of 30,000 NZD tax free p/a plus PhD registration fees (Currently approx. 7,000 NZD for international and domestic students) for up to 3 years. The successful applicants will have to satisfy Massey University academic and English language requirements for postgraduate studies.

To apply, please send (i) a cover letter outlining your suitability and interest in the position, (ii) a current curriculum vitae and names of three referees, and (iii) your academic transcripts online via: <https://careers.sciencenewzealand.org>. This position closes on 31 May 2015.