

***Epichloë* endophytes – from science to commercial impact**

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Epichloë species are filamentous fungal endophytes within the family Clavicipitaceae that form enduring symbioses with temperate grasses of the Pooideae. These plant-microbe associations are ecologically important constituents of many temperate grassland ecosystems. In New Zealand, selected asexual strains of *Epichloë* have been incorporated into elite grass cultivars where they predominantly confer protection against invertebrate pests. These novel grass-endophyte associations underpin sustainable pastoral farming practices in managed temperate grasslands in many countries such as in New Zealand, Australia, and the USA. For example, the commercialisation of endophyte strain AR37 in a wide range of ryegrass cultivars has been estimated to contribute NZ\$3.6 billion to the New Zealand economy. This has led to greater productivity and persistence of pastures, resulting in increased livestock productivity and improved health and welfare.

In New Zealand, a multidisciplinary science team at AgResearch has, and continues to, underpin the development of selected *Epichloë*-grass technology with many endophyte products now successfully marketed for pasture persistence and wild-life deterrence. The

team's success has relied on their diverse capability set in areas of science such as agronomy, animal science, entomology, plant biology, fungal genetics, mycology, seed science, toxicology, and natural product chemistry, along with the application of fundamental and applied science to study grass-endophyte symbioses.

In the pursuit of new agriculturally useful grass-endophyte associations, the team at AgResearch has furthered the understanding of the molecular interactions that govern genetic compatibility between endophyte strains and their grass hosts. This new knowledge has led to the development of novel endophyte associations in cereal crops (e.g. rye and wheat). Additionally, the AgResearch team has developed a gene editing platform to precisely custom design previous genetically intractable *Epichloë* strains to deliver the ideal combination of chemistry and subsequent conferment of bioactivity within the grass host using CRISPR-Cas9 technology. These scientific endeavours aim to broaden the biocontrol capability of *Epichloë* strains, particularly to mitigate climate related stresses in globally important agriculturally crops.