Epichloë endophytes – underpinning sustainable food production from pastoral systems

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The world faces an incredible challenge to produce food in an environmentally sustainable manner. In the next 25 years, almost as much protein must be produced as has been produced in the last 2,000 years. Ruminant animal protein sources are key contributors to essential amino acids and human micronutrient needs. This must be achieved while using less land, having a smaller environmental footprint and while providing greater care for production animals; and this must be accomplished in the face of a more volatile climate. Grazing systems are a significant contributor to global food security, with 10-15% dairy products and more than 30% of red meat produced from grazing animals, and there is a growing consumer trend for 'grass-fed' or 'pasture-raised' animal products. In New Zealand, almost all dairy and red meat are produced from pasture.

The symbiotic relationship between asexual *Epichloë* endophytes and improved pasture grass species has been critical in developing sustainable animal production systems in many parts of the world, where insect attack would otherwise limit productivity. This need is likely to grow with climate change, as the habitat for these insects grow to regions previously unsuitable, and as consumers demand fewer chemical interventions. Advances in endophyte selection have reduced some of the negative effects on animal health and welfare and further developments will continue to improve their function in grazing systems. Furthermore, advances in genetic technologies may allow the development of endophytes that produce chemicals that confer productivity or sustainability benefits for production systems. With a world in need of more food sustainably produced, advanced genetic manipulation of endophytes with novel traits should be a focus of future research and development.

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