Abstract

# Exploring ways to improve wheat productivity through the use of beneficial *Epichloë* endophytes

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A fifth of the calories consumed by humans come from wheat. In 2023, 789 million tonnes of wheat were produced worldwide. With an increasing human population, demand for wheat is expected to increase. With rising production costs and increased environmental instability, novel solutions are required to enhance productivity. Beneficial fungal endophytes belonging to the *Epichloë* genus may provide a solution. These endophytes are used as protection against insect herbivory in commercial pasture grasses throughout the world via animal safe secondary metabolites. Other benefits from *Epichloë* include resistance to fungal pathogens and increased resistance to abiotic stress such as drought. Asexual *Epichloë*, which are used in commercial forage grasses, grow intercellularly and are vertically transmitted (maternally inherited). Modern wheat could benefit from this technology by reducing the synthetic chemistry requirements for control of biotic stress. However, to date there are no *Epichloë* found naturally in symbiosis with modern wheat cultivars and establishing symbioses has been a challenge. Early work successfully involved Chinese spring-based wheat lines that contained alien chromosomes from wild grasses known to host *Epichloë* endophytes. One of the more successful associations was with TACBOW0011, which has a *Leymus racemosus* H chromosome substitution. However, there were several negative phenotypes associated with endophyte colonisation, which included stunting, delayed flowering, shrivelled seed, low germination and low endophyte transmission. Through traditional breeding methods, improvements in plant phenotypes compatible with *Epichloë* endophytes will be described. Progress includes improved plant height, reduced flowering delay, increased seed size and improved germination and endophyte transmission.

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