

Fungal endophytes for disease control in cereals

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Plant diseases and pests are responsible for significant crop losses worldwide both in terms of yield and quality. Conservative estimates lie at 20-40%. These losses are caused not only by direct inhibition of plant growth but also by insidious factors such as toxic specialised metabolites, termed mycotoxins, which result in reduced quality and safety of the consumable products. Although diseases are managed through a combination of technologies, ranging from farmer skills, the use of pesticides, disease resistance and biological control, there are many diseases for which effective methods for management are yet to be developed. The use of biological control as a means of controlling disease, and particularly the potential of endophytic microorganisms for control of diseases will be explored. Our studies have focussed on cereal diseases, especially *Fusarium* head blight and *Septoria tritici* blotch. Both diseases cause losses in cereals, with *Fusarium* head blight further resulting in the accumulation of several mycotoxins in the grain.

An ecological approach was used for identifying and isolating endophytic fungi in cereal crops, specifically in plants subject to disease pressure that do not show disease symptoms. The chief rationale is that an organism isolated from a particular environment is likely to be

a successful competitor with other microorganisms – including pathogens – in that environment. Therefore, it may represent an efficient means of identifying fungi which can be used as biological control agents (BCAs). A reason for concentrating on endophytic fungi is that, once they have successfully colonised the host tissues, they are less affected by external environmental conditions than phyllosphere or rhizosphere microbes and this may lead to increased stability in changing environments. A focus of biological control of *Fusarium* head blight is to determine whether this can lead to a reduction in mycotoxin levels in the harvested grain. We have studied this in barley, wheat and oats, primarily with an effective rhizosphere BCA, *Clonostachys rosea* IK732, and have shown that this organism can stimulate detoxification of trichothecene mycotoxins such as deoxynivalenol. A commercially successful biological control strategy is associated with the ability of the BCA to colonise the host tissue and outcompete pathogens. In the case of *Fusarium* diseases in cereals, several microbes have individually been shown to control disease under different conditions. Whether more effective control can be achieved by combining several microorganisms will be explored.