Breakthrough in plant-fungi relationship

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Professor Barry Scott and Dr Murray Cox

(PhysOrg.com) -- Massey biologists have uncovered for the first time the complete set of gene messages that define the symbiotic interaction between a fungal endophyte and its grass host.

Institute of Molecular BioSciences head Professor Barry Scott conducted the research with Dr Carla Eaton and Dr Murray Cox. It may have implications for future research into understanding plant disease and pasture growth.

They looked at perennial ryegrass, which has a fungus living inside it in a symbiotic relationship. “We focused on a particular gene in the fungus responsible for signal transduction,” Professor Scott says. “We knocked out that gene and reintroduced the modified fungus into the plant, and the results were dramatic.”

The plant's whole development was altered. “It was seriously stunted; it didn’t grow very well. At the base of the grass there is usually a band of red pigments, but they were gone, and the fungus just grew out of control; the symbiosis had completely broken down,” Professor Scott says.

To make sense of these developmental changes, the team used a relatively new process, known as high-throughput sequencing. They were able to rapidly sequence the transcriptomes (sets of gene molecules that can be influenced externally and reflect which genes are active at any given time) of both the fungal endophyte and the grass host.

“We sent ribonucleic acid (RNA) from plants containing the normal fungus and the modified fungus to a company called Cofactor Genomics in the United States,” Professor Scott says. “They sent us back a vast amount of data; around 40 million sequences per sample.”

Being able to obtain that amount of data would have been impossible just a few years ago, Dr Cox says. “Five years ago a large dataset would have been a few thousand reads, and now we’re dealing with millions of reads; that’s how much it has changed,” he says.

The result is a spreadsheet that lists all the plant and fungal genes that show a statistically significant change between grass infected with the modified and normal fungus. This was matched against the genome sequence of the fungus to find which reads were fungal and which came from the grass.

Just over 1000 of the fungal genes had changed significantly. Professor Scott says the resulting data represents the first complete transcriptome of a plant-fungal symbiosis. “We now have a key insight into what’s important in terms of symbiosis, and how it can quickly turn into a pathogenic relationship if things are altered slightly. It’s a really fine

balance. If you change the relationship subtly it is enough to tip it over the edge. The fungus becomes a pathogen."

The research will be published in the August issue of the international journal *Plant Physiology*.

Provided by Massey University