Deciphering mechanisms of non-host resistance in tobacco to an important fungal pathogen of wheat

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Project description:
The air- and water-borne spores of plant pathogenic fungi are ubiquitous in nature and will often encounter many diverse plant species. However, plants remain immune to the vast majority of would-be invaders. This highly effective and broad-spectrum immunity, termed non-host resistance (NHR), is thought to be under polygenic control and is therefore highly durable. Despite the paramount importance of NHR to interactions between plants and microbes, in most cases the precise mechanisms involved are poorly understood.

The fungus Zymoseptoria tritici is only able to cause disease on leaves of wheat, and is the causal agent of Septoria tritici blotch (STB) disease, which is of global importance and currently one of the foremost threats and economic constraints to wheat production in the UK and Western Europe. This fungus colonises the intercellular space (apoplast) between host plant cells and likely relies on the functions of apoplastic small secreted proteins (effectors) to manipulate plant defences and enable infection. This infection strategy is shared by many other species of pathogenic fungi causing globally important plant diseases. What prevents Z. tritici (and fungi with similar lifestyles) from causing diseases on the non-host plant species they encounter remains virtually unknown.

We recently discovered a dozen of Z. tritici effectors that trigger strong, defence reactions in the form of cell death in Nicotiana benthamiana (tobacco), which is a non-host for this fungus. Most of these effectors required secretion into the apoplast to elicit cell death responses, and induction of cell death depended on the two plant regulatory receptor-like kinases BAK1 and SOBIR1. Because the latter are known to be required for defence signalling following activation of cell surface pattern recognition immune receptors we hypothesised that tobacco possesses numerous receptors that can recognise different Z. tritici apoplastic effectors and initiate defence signalling. We also hypothesised that these multiple, likely distinct receptors play an important role in NHR against Z. tritici.

The principal aim of this project is to identify the putative immune receptor(s) that facilitate recognition of Z. tritici effectors in tobacco, functionally characterise these proteins, and assess their contribution to the NHR phenomenon.

This is an excellent PhD opportunity for a student to work on an extremely important pathogen, with clear implications for global food security. This project will have a strong supervisory team comprising collaborative academics at Rothamsted Research and at the University of Bristol.