Genome sequence could reveal 'Achilles' heels' of important wheat disease

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Research published in *PLoS Genetics* today provides insights into how an important fungal disease is able to evade wheat's defences. The researchers hope that the study, which reveals the fungus' complete genome sequence, will enable them to breed resistant crop plants or improve the use of pesticides.

The genome sequence was produced by an international consortium of researchers including scientists at Rothamsted Research in the UK. The scientists, who were funded by the Biotechnology and Biological Sciences Research Council (BBSRC) and others, are already using the fungus' genome sequence to find ways to control the disease in order to help meet the challenges of ensuring global food security.

The consortium has sequenced the genome of a fungus called Mycosphaerella graminicola which causes leaf blotch disease in wheat. The disease kills cells in the plants leaves leaving large dead blotches which are unable to absorb energy from the sun. This significantly reduces yields and takes a serious toll on wheat crops globally and in the UK; annually a 5-15% reduction in grain yield is incurred in each wheat field solely as a result these infections.

Professor Kim Hammond-Kosack of Rothamsted Research who led the study in the UK said "M. graminicola attacks wheat plants by stealth. There is normally a period of about a week between when a plant first becomes infected and when the characteristic blotches of the disease appear on its leaves. During this time it appears that the plant fails to

recognise it has become infected and so is unable to activate its defences to fight back. Studying the fungus' genome will help us to understand how the pathogen is able to go undetected and maybe reveal a chink in its armour that we can exploit."

The genome sequence reveals that M. graminicola has very few genes which produce enzymes able to break-down plant cell walls compared with other fungi which specialise in infecting plants. Plants often use the presence of the sugars and proteins released when a cell is broken down as cue for turning on their immune responses, so the researchers think that the unusually low numbers of genes producing enzymes for breaking down plant cells may be crucial to the fungus' stealth approach.

The team from Rothamsted have already started on work using the genome to look for potential weaknesses in the fungus' defences. Collaborating with researchers at Wageningen University in the Netherlands they have identified a protein in the fungus which is important in keeping it hidden. This research was published recently in Plant Physiology.

Dr Jason Rudd who worked on the project at Rothamsted Research said "We were able to use the information in the genome sequence almost immediately to look for a potential Achilles' heel. We singled out a protein which helps keep the fungus camouflaged and protects it from the plant's defences. When we generated a mutant strain of the fungus which didn't contain the gene for this protein, the infected wheat plants produced strong immune responses and didn't develop the characteristic leaf blotches. Our next step is to use these and similar findings to help farmers combat this disease out in the field in order to reduce wheat losses."

Professor Maurice Moloney, Director and Chief Executive of Rothamsted Research commented "Rothamsted Research is proud to be

part of the team that has sequenced and analysed the M. graminicola genome. This fungal pathogen causes one of the most pernicious plant diseases and accounts for significant losses annually in wheat yields throughout the world. This work illustrates the power of sequencing the genomes of plant pathogens in identifying key targets for efficient plant protection."

Professor Douglas Kell, Chief Executive of the Biotechnology and Biological Sciences Research Council, said "Genome sequencing is an important tool in the fight to ensure global food security. Determining the sequence of a destructive crop disease like this is now so quick and affordable that it can be viewed as a research tool rather than a project in itself. This is especially true when the complementary talents of researchers in different countries can be brought to bear. As in this project, this information can be put to immediate use in finding new ways to combat plant disease."

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