Aggressive plant fungus threatens wheat production

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This is a close up photo of yellow rust on wheat leaf. Credit: Andrew Davis, John Innes Centre

The spread of exotic and aggressive strains of a plant fungus is presenting a serious threat to wheat production in the UK, according to research published in *Genome Biology*. The research uses a new surveillance technique that could be applied internationally to respond to the spread of a wide variety of plant diseases.

Wheat is a critical staple and provides 20% of the calories and over 25% of the protein consumed by humans. 'Yellow rust' caused by the fungus *Puccinia striiformis f. sp. tritici* (PST) is one of the plant's major diseases and is widespread across the major wheat-producing areas of the world. Infections lead to significant reductions in both grain quality and yield, with some rare events leading to the loss of an entire crop. New fungus strains have recently emerged that adapt to warmer temperatures, are more aggressive and have overcome many of the major defensive genes in wheat.

Lead author Diane Saunders of the John Innes Centre and The Genome Analysis Centre (TGAC), UK, said: "Increased virulence, globalization, and climate change, are all increasing the scale and frequency of emerging plant diseases, and threatening global food security.

"Our research shows that in the UK we have a newly emerging population of wheat rust fungus that could be the result of an influx of more exotic and aggressive strains that are displacing the previous population. By continuing to use these new surveillance techniques, not only can we track and respond to the ongoing threat of wheat rust, but our technology opens the door for tracking other plant pathogens, including ash dieback."

Researchers from the John Innes Centre, The Sainsbury Laboratory, TGAC and the National Institute of Agricultural Botany sequenced genetic material from 39 PST-infected samples of wheat collected from 17 UK counties in 2013.

By comparing the fungal RNA with fungal genetic information from previously prevalent populations between 1978 and 2011, they showed that there has been a rapid and dramatic shift in the PST population that could have serious implications for wheat production in the UK.

The 2013 PST samples showed more genetic variation and diversity, reflecting an increase in the evolutionary potential in the UK pathogen population that could enhance their ability to overcome disease resistance in wheat.

Of the samples, 11 were also genetically similar to a PST strain called "Warrior". The strain emerged in 2011 as a serious threat to European wheat production due to its virulence on an array of previously resistant wheat varieties. This indicates that a diverse PST population containing the "Warrior" strain is now prevalent across the UK.

This new diagnostic technique, called "field pathogenomics", could be applied internationally to respond to the spread of a wide variety of plant diseases. By rapidly pinpointing a fungus's genetic make-up from field samples, the technique is able to confirm outbreaks on particular wheat varieties and provides an efficient means of confirming whether previously resistant wheat varieties have been broken by virulent strains of the pathogen. This is in contrast to current techniques which can be lengthy, costly and are only able to sample a relatively small proportion of the fungal population.

The data collection and analysis took just a few months to produce from sample collections from the field, demonstrating the potential for the method to reduce delays and transform current disease surveillance systems. The highly detailed information that is generated could help inform disease incidence predictions and agricultural practices.

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