Questions and Answers: Emergence of the Ug99 lineage of the wheat stem-rust pathogen through somatic hybridisation – *Nature Communications*

Compiled by Kate Langford

What was the discovery?

We discovered the origins of the Ug99 strain of wheat stem rust, a particularly devastating disease of wheat.

It turns out that this strain is the result of a process called somatic hybridisation, which enables fungi to fuse their cells together and exchange genetic material.

We found that half of Ug99's genetic material came from a strain that has been in Southern Africa for more than 100 years and is also found in Australia.

Why is this discovery important?

As the saying goes, 'the more you know your enemy, the more equipped you are to fight against it'.

Knowing how these pathogens came about means we can better predict how they are likely to change in the future.

This discovery also means that we can better identify the resistance genes, which can be bred into wheat varieties to give crops long-lasting protection against rust.

What is wheat rust and what is Ug99?

Rust is a common fungal disease of plants that many people will be familiar with from their own gardens.

In agriculture, rust diseases destroy over $1 billion worth of crops each year across the world.

The spores of the fungus attach themselves to the stems and leaves of wheat plants and essentially suck the nutrients from the plant. The plants then fall over. They either die or produce grain that is very small, giving farmers a much lower yield.

Ug99 is considered the most threatening of all wheat rusts, as it has managed to overcome most of the resistance genes that have been bred into wheat varieties. It was discovered in Uganda in 1999, hence its name.

So far, Ug99 has caused devastating epidemics in Africa and the Middle East. It is estimated that 80% of the world's wheat varieties are susceptible to Ug99. An outbreak in Australia could cost up to $1,4 billion.

Should we be worried? How likely is it that Australia will be affected?

Yes and no.

Yes, because now that we know how these rusts hybridise in nature, we know that it could happen again and lead to the emergence of a new strain that we're not prepared for.

And no, because the reality in Australia is that these events are not that frequent.

We're lucky to be relatively isolated in Australia, and so far, we only have one type of stem rust here. So, the opportunity to hybridise with something different does not exist. If hybridisation did occur, the resulting pathogen is likely to be genetically pretty close to what we already have.

The more dangerous situation would be if a pathogen came into Australia from another country. This means that maintaining biosecurity in Australia is very important to avoid these risks.

How did the discovery come about?

When we did this research, I was working at the University of Minnesota and sequencing the genome of Ug99.

At the same time, Dr Peter Dodds from CSIRO (who I have collaborated with for many years and who happens to be my husband) was sequencing another wheat rust strain called Pgt21, which came to Australia in the 1950s, probably from South Africa.

We compared results and found that the two pathogens share an almost identical nucleus and therefore half of their DNA. We knew then that the pathogen couldn't come from a sexual cross (like you and I do) or it would have a mixture of DNA, as we do from both our mother and father.

We knew we had uncovered the first proof of somatic hybridisation in wheat rust, which scientists had speculated since the 1960s could occur.

Who are the collaborators on the project?

This research has been a joint collaboration with scientists from CSIRO, the University of Minnesota, the University of the Free State, and the Australian National University, funded by 2Blades and USDA.