



Super resistance to tackle biggest disease

CSIRO Plant Industry has identified 'DNA markers' that flag the location of four important stem rust resistance genes in wheat and is now planning to breed a new super stem rust-resistant wheat at least four times more effective than existing varieties.

The Australian wheat industry is heavily dependent on rust-resistant wheat varieties to prevent losses in production estimated at \$300 million per year. But new rust strains mean wheat breeders are always on the lookout for new sources of rust resistance.

Three of the genes, Sr26, Sr31 and SrR, have not been widely used in breeding programs to introduce rust resistance in Australia as the genes are closely associated with negative characteristics.

Sr26 is used in Australia but mainly in feed wheats as it is associated with reduced yield. Sr31 and SrR are widely used across the world to confer rust resistance but not in Australia because an associated negative characteristic that causes the dough of the wheat to become sticky.



Dr Rohit Mago at CSIRO Plant Industry has identified DNA markers for four stem rust resistance genes – speeding up the delivery of a super-rust resistant wheat variety.

DNA markers

A DNA marker is a bit like a bookmark that identifies the location of an important sentence in a book. If the bookmark isn't there you would have to read the whole book to see if the sentence was

there or not. In a similar way a DNA marker lets breeders quickly know whether an important gene is present or not.

Using the DNA markers wheat breeders can easily look at a plant's DNA to identify if the rust resistance genes are present. This saves time because breeders no longer need to expose a plant to rust to assess how it performs. Instead they simply take a sample of the plant and look to see if the DNA marker for the resistance gene is present or not.

Finding useful genes

The four stem rust resistance genes that CSIRO Plant Industry has identified DNA markers for are called Sr24, Sr26, Sr31 and SrR. All four genes provide significant resistance to stem rust and Sr24 is already widely used in Australian wheat breeding programs to confer rust resistance.

CSIRO Plant Industry is continuing to look for more rust resistance genes and aims to develop DNA markers that flag their location too.

Removing negative characteristics

CSIRO has developed DNA markers for new versions of SrR, Sr31 and Sr26 that should lack all negative characteristics.

Researchers at the University of Adelaide and in the USA have developed the new versions from shortened wheat chromosomes that contain the desired genes but the negative characteristics have been 'cut-out'.

With DNA markers locating these resistance genes exactly it will be easier for breeders to breed new wheat varieties that have the useful resistance genes only and exclude the unwanted negative characteristics.

CSIRO Plant Industry is also looking to 'clone' the rust resistance genes. If the genes can be cloned then the individual gene can be inserted, via genetic modification, into a new wheat, thereby introducing the rust resistance without any negative characteristics. This would result in a genetically modified (GM) wheat resistant to rust. This aspect of the research would only progress towards a GM wheat with support from the grains industry and approval from the Office of the Gene Technology Regulator.

'Stacking' resistance genes

CSIRO Plant Industry has already conventionally developed wheat breeding lines where each line contains a different combination of two of the four 'marked' genes.

By the end of 2006 CSIRO Plant Industry hopes to have developed a wheat line with all four rust resistance genes.

'Stacking' genes like this means that if a strain of rust comes along that cannot be controlled by one of the resistance genes then there are still three other resistance genes in place ready to fight it. It is very unlikely that a rust that can overcome all four resistance genes at once will develop.



CSIRO is tackling stem rust, the biggest disease threat to the Australian wheat industry, by 'stacking' rust resistance genes.

The DNA markers for the new rust resistance genes CSIRO Plant Industry has identified perform an important role when stacking genes as breeders can't rely on testing the plant for resistance by exposing it to rust as any one of the genes could provide initial resistance but they want to know that all desired genes are present.

Once all four rust resistance genes have been introduced into a wheat breeding line

CSIRO Plant Industry will do further quality testing and if all goes well plans to deliver a new super rust-resistant wheat variety within the next four years.

Scientific reference

Mago, R., et al (2005). *Development of PCR markers for the selection of wheat stem rust resistance genes Sr24 and Sr26 in diverse wheat germplasm*. *Theoretical and Applied Genetics*, Vol: 111, Issue: 3

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