Movement on the resistance front exposes wheat killers

Necrotrophic diseases of wheat, such as yellow spot and *Stagonospora nodorum* (also known as Septoria and glume blotch), kill plant host cells and cost Australian growers at least $170 million per year.

But recent research offers a way to improve wheat resistance breeding.

The GRDC supported Australian Centre for Necrotrophic Fungal Pathogens (ACNFP) at WA's Murdoch University has established major research programs to define mechanisms of pathogenicity and plant disease resistance.

Professor Richard Oliver, ACNFP Director and GRDC Western Region Panel Deputy Chair, along with his team at Murdoch, has discovered how a special class of toxins produced by the pathogen, known as host specific toxins (HSTs), are critical to the virulence of this disease in wheat.

Unlocking the way HSTs are involved in causing disease has improved understanding of wheat resistance and susceptibility to necrotrophic fungal diseases.

Richard explained that HSTs are molecules toxic only to the host of the disease and are mostly harmless to other plants.

Further, only specific genotypes, or forms of the host, are sensitive to the toxin.

Richard and his team have demonstrated that the pathogen *Stagonospora nodorum*, cause of glume and *S. nodorum* blotch of wheat, interacts with its host via a specific and complex set of HSTs which are encoded on separate genes.

Genetic analysis of the host has shown that, in most cases, sensitivity to the toxin is a dominant trait in the host plant.

According to Richard, studying resistance to *Stagonospora nodorum* has been complex, due to differing plant resistance and susceptibility at the seedling, adult and glume stages.

But the team has identified several HST genes carried by necrotrophic fungal pathogens.

Professor Richard Oliver, ACNFP Director and GRDC Western Region Panel Deputy Chair, has discovered how host specific toxins are critical to the virulence of necrotrophic fungal diseases of wheat.

"One HST in the wheat pathogen, *Pyrenophora tritici-repentis*, which causes yellow leaf or tan spot, is known as ToxA and is identical to a gene in the genome of *Stagonospora nodorum*," Richard said.

Evidence suggests the gene has been laterally transferred from *Stagonospora nodorum* to *P. tritici repentis* in the recent past.

"It appears that *P. tritici* is the recipient and *Stagonospora nodorum* the donor, due to a process known as lateral gene transfer, which is consistent with the finding that yellow spot was unknown as a wheat pathogen before the 1940s.

"We therefore have a theory to explain how new diseases arise and a way of improving disease resistance in wheat," Richard said.

"Isolated HSTs can be used to test wheat varieties for their sensitivity to disease and provide wheat breeders with a new tool to determine which varieties are resistant to necrotrophic fungal pathogens."

Richard said growers would then have new varieties more resistant to some of the major diseases affecting wheat crops.

Further, they could choose to immediately avoid susceptible varieties. Richard estimated this would save growers $30 million a year and more in the future.

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