Genetic discovery to keep crops disease-free

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Curtin University researchers have found a way to breed disease-resistant wheat with no downside, potentially bringing multi-million dollar savings to Australia's agricultural industry.

According to John Curtin Distinguished Professor Richard Oliver, Director of the Australian Centre for Necrotrophic Fungal Pathogens (ACNFP) at Curtin, farmers can lose more than 0.35 tonnes per hectare in wheat yields to Yellow Spot, even after applying fungicide.

For an average-sized farm of 4000 hectares, this could mean an almost $500,000 loss to disease per year – or about $212 million worth of damage to the wider Australian agricultural industry.

Funded by the Grains Research & Development Corporation, Professor Oliver and his team, in conjunction with independent research provider Kalyx Australia, have demonstrated that by taking away disease-sensitivity genes from the wheat germplasm, pathogens find it difficult to latch onto wheat and cause damage.

"Our finding will help breeders produce crops in which disease losses are 60 to 80 per cent lower, and would be a real win for farmers – they will often be able to avoid using foliar fungicides," Professor Oliver said.

"Before now, breeding for resistance to Yellow (Tan) Spot and Septoria Nodorum Blotch was very time-consuming – no molecular markers were in use. The key has been to supply breeders with specific proteins (we call them effectors) that the fungi use to cause disease.

"For the first time, our technology allows for a steady and sustained improvement in disease resistance without affecting the farmer's pocket.

"Furthermore, breeders are able to devote more time and resources to breeding for yield, as well as for rust and frost resistance."

Using large wheat variety trials provided by Kalyx Australia, the team looked at yield loss of different cultivars (plants chosen for breeding because of desirable characteristics) when subjected to natural disease and stress pressures in the WA wheatbelt.

They compared cultivars with disease-sensitivity genes to cultivars that lacked these particular genes, and were able to show that the cultivars lacking the gene showed no yield loss and in some instances increased yields in the presence of disease.

From this, the team were able to conclude if a sensitivity gene was eliminated, there would be minimal associated risks and it would be a safe and straightforward strategy for improving disease resistance.

Professor Oliver said this research had never been done before as direct mapping for disease resistance had not led to useful molecular markers.

"Previously geneticists would infect plants that were progeny of crosses between relatively resistant and relatively susceptible parents before doing the QTL (quantitative disease-resistance gene) mapping. But as disease resistance is multifactorial due to the several effector reactions, the QTL mapping was always a bit fuzzy and was therefore never passed on," Professor Oliver said.

"Our research looks directly at the loci that recognise the pathogens, which can be readily identified using a process we developed earlier, thereby bypassing the need for QTL mapping."

More information: The paper, Absence of detectable yield penalty associated with insensitivity to Pleosporales necrotrophic effectors in wheat grown in the West Australian wheat belt, can be found at onlinelibrary.wiley.com/doi/10 … 1/ppa.12191/abstract

Provided by Curtin University