Fungi's genetic sabotage in wheat discovered

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Using molecular techniques, Agricultural Research Service (ARS) and collaborating scientists have shown how the subversion of a single gene in wheat by two fungal foes triggers a kind of cellular suicide in the grain crop's leaves.

Fortunately, the team has also developed DNA molecular markers that can be used to rapidly screen commercial cultivars for the gene, Tsn1, so it can be eliminated by selective breeding. This, in turn, would deprive the fungi of their primary means of killing off leaf tissue to feed and grow, explains Justin Faris, a plant geneticist with the ARS Cereal Crops Research Unit in Fargo, N.D.

The fungi—Pyrenophora tritici-repentis (also known as tan spot) and Stagonospora nodorum (leaf blotch)—are often partners in crime, occurring in the same crop fields and producing the same toxin, ToxA, to induce a Tsn1-controlled response in wheat called programmed cell death (PCD). Normally, PCD protects plants by confining invading pathogens in dead cells. However, the strategy doesn't work against the ToxA fungi because they're "necrotrophs," pathogens that feed on dead tissue.

To better understand this genetic trickery, Faris led a team of scientists from seven different research organizations in isolating, sequencing and cloning the DNA sequence for Tsn1 from cultivated wheat and its wild relatives. Based on their analysis, the researchers concluded that modern-day wheat inherited Tsn1 from goatgrass. They figure this happened after a goatgrass gene for the enzyme protein kinase fused with another

gene, NB-LRR, which probably conferred resistance to biotrophs, pathogens that feed on living tissue.

Interestingly, Tsn1 is controlled by wheat's circadian clock, and only initiates PCD in response to ToxA during daylight hours. At night, Tsn1 shuts down and "ignores" ToxA, suggesting the toxin may indirectly interfere with the plant's photosynthesis.

More information: The team, which includes researchers from North Dakota State University-Fargo and the Australian Centre for Necrotrophic Fungal Pathogens-Murdoch among others, reported its findings online this week in the *Proceedings of the National Academy of Sciences*.

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