Study characterizes genetic resistance to wheat disease

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P. Stephen Baenziger. Credit: Craig Chandler/University Communications

A new study co-authored by University of Nebraska-Lincoln researchers has unearthed the genetic roots of resistance to a wheat disease that has recently devastated crop yields from southern Africa through the Middle East.

Though reports of stem rust date back to biblical plagues and ancient

Greece, plant breeders successfully combated the disease by introducing rust-resistant cultivars in the mid-20th century. Stem rust epidemics largely faded until 1999, when a mutated strain—Ug99—emerged in the east African country of Uganda.

Ug99 and its recent variants have toppled nearly all previously resistant genes. The rare holdouts include Sr2, found in an especially hardy wheat variety named Gage that was co-released by the University of Nebraska and the U.S. Department of Agriculture in 1963.

The recently published study isolated and examined DNA sequences of Gage to ascertain why it enjoys greater resistance to stem rust, including Ug99, than other cultivars featuring the Sr2 gene. The authors concluded that Gage's rust-resistance during adulthood likely owes to a combination of Sr2 and an additional gene, which the team believes also contributes to the wheat's resistance in the seedling stage of its development.

The researchers have narrowed down the location and potential identity of this additional gene, which they said they hope to soon verify through further study.

"It so happens that the source of Sr2 that was used to create Gage—the variety Hope—actually had a number of other stem rust resistance genes in it," said P. Stephen Baenziger, a co-author and the Nebraska Wheat Growers Presidential Chair at UNL. "Our results would say that it looks like Gage got the lucky straw, so to speak, from Hope.

"If it's a two-gene resistance, then it should be more durable. Let's say you have a mutation that allows something to become virulent to your gene one in a million times. When you have two genes, the idea would be that a mutation that overcomes both genes happens only once in a million multiplied by a million."

Drawing a genetic map to that level of resistance could prove extremely valuable against Ug99, which has raced down the Nile River valley to threaten some of the most fertile areas of the Middle East and west Asia.

The wealthiest African farmers fight Ug99 with fungicides, which introduce foreign chemicals into the environment. Yet most farmers in the affected regions cannot afford these fungicides, leaving them little defense against the ravages of the mutated strain, according to Baenziger.

"It's already crossed over into the Arabian Peninsula. It's spreading now toward Pakistan, Afghanistan and India, which are the real breadbaskets for that part of Asia," Baenziger said.

"It's important to understand the resistance to stem rust, because with the mutations that are coming out of Africa, we're losing genes all the time. But Sr2 is still resistant to it, and now that we can associate parts of the genome with the resistance, we're making good progress."

The team's study appeared in the January-February edition of the journal *Crop Science*.

Provided by University of Nebraska-Lincoln