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A 'time bomb' for world wheat crop

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Katharine Kimball / For The Times

Oregon State scientist Mary Verhoeven is among those working to develop wheat varieties resistant to a strain of "stem rust" that a colleague calls "a time bomb."

The Ug99 fungus, called stem rust, could wipe out more than 80% of the world's wheat as it spreads from Africa, scientists fear. The race is on to breed resistant plants before it reaches the U.S.

By Karen Kaplan
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The spores arrived from Kenya on dried, infected leaves ensconced in layers of envelopes.

Working inside a bio-secure greenhouse outfitted with motion detectors and surveillance cameras, government scientists at the Cereal Disease Laboratory in St. Paul, Minn., suspended the fungal spores in a light mineral oil and sprayed them onto thousands of healthy wheat plants. After two weeks, the stalks were covered with deadly reddish blisters characteristic of the scourge known as Ug99.

Photos: New threat

Grain scourge

Nearly all the plants were goners.

Crop scientists fear the Ug99 fungus could wipe out more than 80% of worldwide wheat crops as it spreads from eastern Africa. It has already jumped the Red Sea and traveled as far as Iran. Experts say it is poised to enter the breadbasket of northern India and Pakistan, and the wind will inevitably carry it to Russia, China and even North America -- if it doesn't hitch a ride with people first.

"It's a time bomb," said Jim Peterson, a professor of wheat breeding and genetics at Oregon State University in Corvallis. "It moves in the air, it can move in clothing on an airplane. We know it's going to be here. It's a matter of how long it's going to take."

Though most Americans have never heard of it, Ug99 -- a type of fungus called stem rust because it produces reddish-brown flakes on plant stalks -- is the No. 1 threat to the world's most widely grown crop.

The International Maize and Wheat Improvement Center in Mexico estimates that 19% of the world's wheat, which provides food for 1 billion people in Asia and Africa, is in imminent danger. American plant breeders say $10 billion worth of wheat would be destroyed if the fungus suddenly made its way to U.S. fields.

Fear that the fungus will cause widespread damage has caused short-term price spikes on world wheat markets. Famine has been averted thus far, but experts say it's only a matter of time.

"A significant humanitarian crisis is inevitable," said Rick Ward, the coordinator of the Durable Rust Resistance in Wheat project at Cornell University in Ithaca, N.Y.

The solution is to develop new wheat varieties that are immune to Ug99. That's much easier said than done.

After several years of feverish work, scientists have identified a mere half-dozen genes that are immediately useful for protecting wheat from Ug99. Incorporating them into crops using conventional breeding techniques is a nine- to 12-year process that has only just begun. And that process will have to be repeated for each of the thousands of wheat varieties that is specially adapted to a particular region and climate.

"All the seed needs to change in the next few years," said Ronnie Coffman, a plant breeder who heads the Durable Rust Resistance in Wheat project. "It's really an enormous undertaking."

Ancient adversary

Farmers have been battling stem rust for as long as they have grown wheat. The fungus' ancestors infected wild grasses for millions of years before people began cultivating them for food, said Jorge Dubcovsky, professor of genetics and plant breeding at UC Davis.

"The pathogen keeps mutating and evolving," he said. "It's one of our biblical pests. This is not a small enemy."

When a spore lands on a green wheat plant, it forms a pustule that invades the outer layers of the stalk. The pustule hijacks the plant's water and nutrients and diverts them to produce new rust spores instead of grain. Within two weeks of an initial attack, there can be millions of pustules in a 2.5-acre patch of land.

Wheat plants that can recognize a specific chemical produced by stem rust can mount a defense against the fungus. But the rust is able to mutate, evade the plant's immune system and resume its spread.

Stem rust destroyed more than 20% of U.S. wheat crops several times between 1917 and 1935, and losses reached nearly 9% twice in the 1950s. The last major outbreak, in 1962, destroyed 5.2% of the U.S. crop, according to Peterson, who chairs the National Wheat Improvement Committee.

The fungus was kept at bay for years by breeders who slowly and methodically incorporated different combinations of six major stem rust resistance genes into various varieties of wheat. The breeders thought it unlikely that the rust could overcome clusters of those genes at the same time.

After several outbreak-free decades, it seemed that stem rust had been defeated for good. Scientists switched to other topics, and the hunt for new resistance genes practically slowed to a crawl.

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