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Wheat Warning—New Rust Could Spread Like Wildfire

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As the world's population continues to grow, so does its appetite for cereal grains, which include such dietary staples as wheat. This growing demand has driven agricultural scientists to develop higher yielding grain varieties. However, wheat growers face a challenging threat to bountiful yields with the emergence of a new and virulent fungal pathogen. It stands poised to hammer wheat yields globally, according to data released this month in Nairobi, Kenya, at an international symposium convened to address the blight.

The new pathogen goes by the name of Ug99, for the nation—Uganda—and the year in which its emergence was formally recognized. This variant of the *Puccinia graminis* fungus, a type of black-stem rust, has been popping up in fields throughout East Africa. Rusts take their common name from the fact that the pathogens tend to have a vivid red or orange hue. At the end of a growing season, black-stem rusts sprout dark spores that can survive over winter.

SEEDY INFECTION. This photo, taken Sept. 6 at the Njoro Agricultural Research Station in Kenya, shows a seed head of wheat heavily infected with Ug99. CIMMYT

At the Nairobi meeting, officials with the International Center for Agricultural Research in Dry Areas and the International Maize and Wheat Improvement Center—an organization best known by its Spanish acronym, CIMMYT—summed up much of what they know about the Ug99 rust. For instance, the centers' scientists noted that most wheat currently being grown around the world has either established susceptibility to the new pathogen or unknown susceptibility. At present, CIMMYT officials reported, "only 0.3 percent of the more than 44 million hectares planted to known varieties [of wheat] is moderately resistant to Ug99."

In monitored test plots of wheat, Ug99 reduced grain yields by as much as 71 percent. Its virulence indicates Ug99 "has broken down the sources of resistance that have provided effective protection [for wheat against black-stem rusts] for over 30 years," the CIMMYT researchers said.

If not quashed soon, Ug99 infections might bloom into global crop epidemics within the next 15 years. In Africa alone, CIMMYT projected, grain-yield losses from such blights could approach $1 billion in value. Such events would increase the price of wheat on global markets and contribute to regional food shortages. These risks are especially grave for developing nations where reliance on wheat is high and budgets for fungicides are almost nonexistent, CIMMYT noted.

At the meeting, CIMMYT officials circulated a new report on Ug99's threat. They also announced plans to upgrade or develop new research centers in the heart of East Africa. These facilities will be screening local wheat cultivars for newly mutated genes that might confer resistance to Ug99 and then launching efforts to breed new lines of wheat carrying those genes.

Although wheat growers around the world had recently come to view stem rust as a thing of the past, the new CIMMYT report says, "new data show that such an assumption is no longer—and probably never was—warranted."

Pesticides are not the answer

East Africa has long been a breeding ground for new and virulent stem rusts—probably because the

area has a mild climate and farmers plant wheat year-round.

Ordinarily, stem-rust spores move only short distances, one stem infecting another as they brush against each other. However, Ug99 makes five distinct types of spores. Of these, the one known as the urediniospore is especially infectious and unique in its ability to ride air currents. Winds can carry these spores for hundreds or even thousands of miles.

Until recently, the threat of such long-range rust spread was largely discounted because scientists believed that ultraviolet light from the sun would kill spores that got swept into high-altitude wind currents and then hitchhiked there for days. To the contrary, recent studies have shown that fungal spores have survived wind transport from Africa to at least as far as the Caribbean (SN: 10/06/01, p. 218).

Although large-scale commercial growers typically use fungicides to deal with rusts, these chemicals are costly. Spraying can run to more than $100 per hectare (0.4 acre), CIMMYT notes.

That's well outside the budget of farmers in developing countries. Therefore, the new report argues, ignoring these small growers' needs for Ug99-resistant cultivars risks launching frequent and potentially uncontrollable black-stem rust epidemics from untreated fields.

SPOTTED. These wheat stems are infected with spores of the fungal blight Ug99.
CIMMYT

Epidemic pending?

Until a half-century ago, many popular wheat varieties were vulnerable to many variants of *P. graminis*. Mention of their sighting would trigger terror in the hearts of farmers, since an infection could rapidly render a healthy field of wheat into "a black tangle of broken stems and shriveled grain," the CIMMYT report says.

These fungal blights periodically triggered disastrous epidemics until breeders began intense efforts to select and breed wheat lines with genes resistant to black-stem disease. Indeed, CIMMYT and its predecessor organization, created in 1943, owe their origins to global campaigns aimed at countering this wheat rust.

The success of those breeding efforts "has led to complacency throughout the wheat community," observes Norman E. Borlaug, the 91-year-old Nobel prize winner credited with launching the "green revolution." It harnessed intensive plant-breeding programs to improve the yields of wheat, maize, and other plants that serve as dietary staples in developing countries.

Although Ug99 appears confined to Africa at this time, CIMMYT reports that epidemics of less-virulent wheat-stem rusts have occurred in Turkey, Australia, Paraguay, and the U.S. Midwest. These outbreaks indicate that commonly planted wheat cultivars are vulnerable to Ug99 and other *P. graminis* variants, according to CIMMYT.

In his preface to the new CIMMYT report, Borlaug observes that breeders around the world have acknowledged that "resistance to stem rust was no longer a leading breeding objective." And that's what makes the recent outbreak of Ug99 in East Africa so troubling, he says.

Borlaug pointed out that, like wildfires, the spread of stem rust relies on favorable climate conditions, air movement, fuel (in this case, susceptible wheat), ignition points, and complacency. "Once started, both [wildfires and rust epidemics] are difficult to stop," he says.

That's why Borlaug argues that mobilization against this blight is imperative. "The prospect of a stem-rust epidemic in wheat in Africa, Asia, and the Americas is real and must be stopped before it causes

untold damage and human suffering," he warns.

At the meeting in Nairobi, CIMMYT thanked Borlaug for "bringing this problem to the attention of the international community" and vowed it would indeed be launching a new Global Rust Initiative.

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