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Search continues for wheat with resistance to stripe rust

By Bob Johnson

In a test plot at the University of California, Davis, agronomy fields, more than 1,000 wheat-type plants from around the world are being screened for resistance to stripe rust.

Over the next five years, researchers will screen 5,000 wheat-type varieties in their search for additional sources of genetic resistance to this potentially devastating disease.

"The idea is to widen the search for sources of resistance that we don't know about yet," said Jorge Dubcovsky, UC wheat breeder.

Researchers at UC Davis, including doctoral student Josh Hegarty (top right), have planted more than 1,000 wheat-type plants, above, in their research for wheat varieties, that have resistance to stripe rust, which has caused yield losses in California.

Five years ago, an unexpected epidemic of stripe rust dropped the average winter wheat yields in 2006 to 30 percent below the yields two years before, even though many fields were not affected at all. The cash value of the wheat lost to the disease in 2005 and 2006 combined was in the range of $75 million.

Wheat yields quickly returned to record or near-record levels as a result of timely fungicide applications, variety screening and breeding for genetic resistance to stripe rust.

The latest wheat varieties already have multiple sources of resistance to wheat stripe rust.

"We are trying to use a cocktail of resistances to stripe rust, but we are running a risk because everybody is using the same resistances to stripe rust, which is a recipe for disaster. We have converted most of the varieties to resistant varieties," Dubcovsky said.

When the name of a wheat variety includes the number 515, that means it has been bred to include both the Yr5 and Yr15 genes, which provide resistance to stripe rust.

The new variety Patwin 515 is something of a landmark in breeding wheat for superior resistance to stripe rust.

"For the first time we are not putting resistance into a variety that is susceptible; we are taking a variety that is resistant and adding two more sources of resistance. Patwin is at the same level as Blanca Grande and Blanca Fuerte in yields. It has a very high protein level, good stripe rust resistance and medium septoria resistance," Dubcovsky said.

By a stroke of good breeding fortune, the gene that gives Patwin higher protein also gives it resistance to nematodes. Wheat is not susceptible to nematodes, but

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this resistance makes Patwin an attractive rotation crop to suppress nematodes before planting vegetables that are susceptible.

"Patwin has good resistance to nematodes, so it is a good rotation choice for tomatoes or carrots," Dubcovsky said.

While wheat varieties will soon come with the Yr5 and Yr15 genes to protect them against stripe rust, the search for additional sources of resistance is already yielding promising results, researchers said.

"Plants with the Yr48 gene aren't completely resistant, but they prevent the disease from spreading so we can stack it with the other sources of resistance," said Josh Hegarty, a UC Davis doctoral student working with wheat disease resistance.

This newly discovered gene slows down the rate at which stripe rust multiplies, which slows down the development of resistance and reduces the growth of the disease over the course of the season.

"The Yr48 gene doesn't let the disease sporulate as well, so the secondary infections aren't as bad," Hegarty said.

The attempt to stay ahead of stripe rust figures to be a major challenge for both wheat farming and wheat variety breeding for the foreseeable future.

"We need to have respect for this disease. It is an amazing organism that has been trying to destroy us since biblical times. Stripe rust destroyed my first variety, so for me, it's personal," Dubcovsky said.

A $25 million grant from the U.S. Department of Agriculture for public university wheat and barley breeding is helping to finance the extensive screening for sources of resistance to stripe rust. The state's wheat growers also make a substantial contribution to this breeding effort.

"We collect $1 a ton from the growers and the wheat commission decides how to use it for research and breeding. The primary way that we use the money is to support the breeding program at UC Davis," said Janice Cooper, California Wheat Commission executive director.

Breeding for resistance only works well in combination with grower practices to help manage stripe rust throughout the state.

"Every time we plant susceptible varieties, we give the disease a chance to produce trillions of spores to overcome resistance. Not only do you lose yield, but you are being a bad neighbor. We are starting to see symptoms on varieties that have been resistant," Dubcovsky said.

The wet winter and early spring of 2011 have made conditions good for stripe rust, as well as a number of other important wheat diseases.

"This has been a year that will teach us things about diseases, and about the lessons we need to learn. This was a wet year that made conditions good for stripe rust and septoria," Dubcovsky said.

One of the next breeding projects could be the development of more powerful genetic resistance to septoria.

"In some cases, septoria caused more damage than stripe rust, especially in the Sacramento Valley. We have identified molecular markers for resistance to septoria and hopefully we can do some breeding work with that if stripe rust gives us a break," Dubcovsky said.

In the meantime, susceptible varieties like Clear White, Joaquin and Blanca Grande should be avoided in areas of the Sacramento Valley where septoria has been an issue, he said.

The unusually strong rains combined with the heavy ground in some areas of the Sacramento Valley made for other wheat disease challenges.

"In some areas of the Sacramento Valley with heavy soils there was substantial loss to crown rot," said Kent Brittan, UC Cooperative Extension farm advisor in Yolo County.

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