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Final Transmission

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Final transmission

Plant pathologists work to stop plant diseases and the insects that spread them

The food we eat is under attack by some of nature's tiniest threats. But several plant pathologists at Kansas State University are fighting back both in the field and in the lab.

Anna Whitfield, an associate professor of plant pathology; Dorith Rotenberg, research associate professor in plant pathology; and Bill Bockus, professor of plant pathology, are beginning the second year in a two-year study investigating the diversity of wheat-infecting viruses across the state of Kansas. Kansas is one of the nation's largest wheat producers.

The 2011 wheat season was considered one of the state's worst, with the U.S. Department of Agriculture estimating a 23 percent loss from 2010. But in tandem with brutal combinations of high winds, scorching temperatures and minimal rainfall, researchers found that wheat was also battling a much smaller opponent: viruses.

From April through May 2011, Whitfield, Rotenberg and Bockus — along with Erick De Wolf, associate professor of plant pathology; John Appel, plant pathologist at the Kansas Department of Agriculture, and several student researchers — collected more than 700 samples from 15 wheat variety trials and several commercial fields throughout the state. Samples were analyzed at the university using a process called enzyme-linked immunosorbent assay, or ELISA for short. ELISA uses antibodies to detect viral proteins that may be in the plant tissue.

"We saw that the viruses were very prevalent, very abundant and distributed all over the state last year," Rotenberg said. "We found that more than half of the samples were infected. A portion of those, about 33 percent, were not visually showing symptoms but were infected. Many samples were also infected with more than one virus."

As a result, the team found that 2011's wheat yield was significantly reduced because of viruses — with wheat streak mosaic virus and barley yellow dwarf virus the most prevalent.

The high virus rate could be linked to the warmer and dryer weather causing aphids and other virus vectors to be active during the entire winter. These vector insects could have come into contact with the virus-carrying vegetation and transmitted viruses to 2010's fall wheat crop.

The team is currently collecting and analyzing samples from the same regions in an effort to find whether the viruses differ by region and how they changed from the 2011 year. Heartland Plant Innovations Inc., a Manhattan, Kan.-based company, is supporting the study.

In addition to the wheat virus study, Whitfield and Rotenberg are looking at insect-plant interactions. The focus is how pest insects like thrips and planthoppers spread diseases — such as tomato spotted wilt virus — without getting sick from the disease they carry. By identifying the genes that keep the insect immune, researchers could turn the gene off, ending insects' immunity and consequently reducing the spread of diseases.

"The long-term goal is to either make the insects not able to acquire and transmit the virus or to make the insect susceptible to the virus it's carrying and transmitting," Whitfield said.

Another way to control viruses is by turning the plant against the insect feeding on it.

Whitfield and Rotenberg are developing and testing transgenic tomato plants. The plants have been engineered to express viral proteins. Once a pest insect ingests a part of the plant, the protein will compete with the virus for uptake and potentially prevent the virus from entering the insect.

Another option includes the plant expressing small pieces of nucleic acid matching insect immune response genes. After feeding, the matching nucleic acid goes to work, breaking down the insect's gene that gives it immunity and making the insect susceptible to the disease it would spread to the plant.

"This option opens up new environmentally friendly control strategies for an enormous number of insects we really haven't had that option for," Whitfield said. "Generally, this is about protecting the food supply. That's crucial."

— Greg Tammen

Dorith Rotenberg, Forrest Chumley, Anna Whitfield and Rob Berard (from left to right)