Research examines virus infection's differing effects on plants, insects

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(PhysOrg.com) -- Tomato spotted wilt virus can be deadly for many important plants, but have little effect on the plants' small insect hosts. Research by a Kansas State University plant pathologist and two students is examining why.

Dorith Rotenberg, research assistant professor in plant pathology, has been examining the phenomenon since late 2006. Derek Schneweis, doctoral student in plant pathology, Monument, Colo., has been assisting Rotenberg in her research. Joshua Ames, sophomore in biology, Lenexa, Kan., joined the project in summer 2011 with a research assistantship funded by the National Science Foundation through the university's Ecological Genomics Institute. The focus of the research is the western flower thrips, a small insect that is the primary vector, or carrier, for tomato spotted wilt virus. Any plant infected with the virus must be removed or destroyed to prevent further spread.

"The vector acquires the virus from infected plants and then moves the virus plant to plant through croplands and greenhouses," Rotenberg said. "So it is really important for us to understand the basic biology of exactly how that vector acquires and replicates the virus inside its tissues without causing disease to itself."

Tomato spotted wilt virus is classified as a persistently propagative virus, which allows the virus to replicate inside the plant and insect. Thrips spreads the disease to plants by feeding on the leafy surfaces. The virus enters through the digestive tract of the insect and then replicates inside

epithelial cells, which absorb nutrients. Instead of impairing the insect as it does the plant, the virus and insect appear to have co-evolved in such a way that the infection does not lead to disease, Rotenberg said. Eventually the virus ends up in the insect's salivary glands where it can be transmitted to different plants.

One aspect of the research project involves understanding the molecular basis for how the insect is able to regulate the infection. Ames is examining the subset of insect genes that are known to be involved in defense against infection.

"We are the first to characterize these genes in western flower thrips," Rotenberg said. "We have come across several different genes that are known to be involved in insect innate immunity, which is the insect's defense system that responds quickly to pathogen invasion to limit the damage caused by infection. This system has been well characterized in other insects, including fruit flies and mosquitoes, and their genomes have provided invaluable information for our studies. Sequencing and analysis of the thrips genome is still in its infancy and we're the lab leading that charge."

The thrips transcriptome, the collection of RNA molecules, is another area of examination. Proteins encoded by RNA molecules in other insects provide clues of how thrips genes function and if particular genes play a role in defense against disease. Ames is examining the different types of genes involved in an insect's response to viral, bacterial and fungal infections. He is measuring expressions of these genes in response to tomato spotted wilt virus at different developmental stages of thrips.

"We're thinking that if we can monitor and quantify expression levels of these genes, we may be able to determine if the products of these genes are active against the virus," Rotenberg said.

In November 2011 the i5k initiative, an international effort to sequence the genomes of 5,000 arthropods, announced that the western flower thrips was chosen as one of the top 50 to be sequenced in the next year. The sequencing will take place at the Human Genome Sequencing Center at Baylor Medical College in Waco, Texas and be done for free. The western flower thrips was selected based on Rotenberg's research.

"Kansas State University is getting its name out there for this particular insect and its genome," she said. "It's really important to us because thrips causes enormous economic losses to crops as direct pests and as carriers of a major plant pathogen for which there are very limited strategies for control."

Currently, Ames and Schneweis are contributing research efforts to identification of gene targets for thrips control.

The project was funded by a targeted excellence grant through the university's Arthropod Genomics Center. The project has since worked from the ground up in acquiring the first partial transcriptome of the western flower thrips. Along the way, Rotenberg has developed and made available sequence resource tools for other scientists interested in thrips biology.

Rotenberg says projects in the university's Plant Virus Vector Interactions laboratory, of which she is co-director, support many undergraduate researchers. Discovering new results and learning how to present research has been beneficial for Ames, who presented a poster about his thrips sequence analysis at the recent Ecological Genomics Symposium in Kansas City, Mo.

Ames is particularly appreciative of the scholarship and grant opportunities available for undergraduate researchers.

"You're doing something you like and learning instead of working a boring part-time job somewhere that you only do for money," he said. "That's kind of a nice perk of doing it. It expands your mind. When you walk around you look at things a little differently."

Provided by Kansas State University