Using insect viruses to combat the Asian citrus psyllid

Research by Dr. Bryce Falk, University of California, Davis
Article written by Bryce Falk, Elizabeth Grafton-Cardwell, Peggy G. Lemaux, & Lukasz Stelinski.
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Insects have viruses just like people have viruses. In fact, viruses are the most abundant microbes on our planet. Most viruses are discovered only when they cause disease in their hosts. An example is the human immunodeficiency virus (HIV), the pathogen that causes AIDS. This virus is not new, but has existed for thousands of years in its natural host, most likely non-human primates, where it did not cause disease. It remained undiscovered until it shifted to humans and caused disease. Bryce Falk's research is focused on finding and identifying viruses in the Asian citrus psyllid (*Diaphorina citri*; *D. citri*). These viruses, or genetically altered versions of them, could be potential tools to combat the Asian citrus psyllid to limit spread of the bacterium (*Candidatus* Liberibacter asiaticus; *C*Las) that causes huanglongbing (HLB) disease of citrus.

What is the technique?

Falk's lab has collected viruses (as ribonucleic acid, RNA) from Asian citrus psyllids all around the world - including China, Pakistan, Taiwan, Brazil, Florida, Puerto Rico, Texas, Hawaii, Arizona and California. His lab collects RNA, rather than DNA, because most insect viruses have RNA as their genetic material and even those viruses with DNA genomes must make RNA during infection. The RNA from the virus is non-infectious and can be safely imported into the United States for analysis. RNA can also be used for sequencing of the genes in order to devise strategies to use PCR-based (polymerase chain reaction) techniques to find new viruses. Falks's lab has collected 6 viruses from Asian citrus psyllids, and are evaluating various strategies to use one or more in the battle against HLB. The first strategy is to use the virus, as is, to sicken? psyllids and attempt to disrupt *C*Las transmission. His lab is studying the viruses separately and in combinations to assess whether they work better affecting *C*Las when alone or co-infecting the psyllid. The second strategy is to genetically modify several of the viruses so that they will induce traits in the psyllid that make it less likely to transmit *C*Las.

Five Asian Citrus Psyllid Viruses

Three circled in orange cause disease

Bunyavirus *Picorna-like virus* *Associated C virus* *Densovirus* *Reovirus*

These viruses include a picorna-like virus, an associated C virus, and a denso virus. Currently they are putting these viruses into cell culture systems to understand their genetics and how they work. Similar efforts with viruses are underway for mosquitoes that spread diseases, such as malaria. Thus, this project is timely and takes advantage of new opportunities to target the Asian citrus psyllid. Understanding the psyllid genes that interact with the viruses could provide a clue as to how psyllids resist viruses, which then could against them by altering the genetics of the insect or the virus.

Who is working on the Project?

Bryce Falk, Professor of Plant Pathology at UC Davis, and his laboratory are studying the viruses, developing insect cell culture lines to grow the viruses, and determining if they could be used to reduce psyllid populations or negatively impact psyllid transmission of *C*Las. This work is done within the UC Davis biosafety 3P Contained Research Facility (crf.ucdavis.edu) where they maintain four populations of the Asian citrus psyllid collected from various parts of the world. They maintain the viruses on cell cultures made up of other insects, such as fruit flies, moths or plant insects, and in *D. citri*.

What are the challenges and opportunities?

Much research needs to be done to understand the genetic make-up of the viruses and how they act in the psyllid. If a virus naturally competes with the HLB bacterium in the psyllid or could be modified to compete with the bacterium, or in some other way reduce the psyllid's ability to transmit the bacterium, then it could be used to slow the spread of HLB.

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Designed by Barbara Alonso, University of California, Berkeley