Using interference RNA to manage Asian citrus psyllids

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Revised August 3, 2017. http://ucanr.edu/sites/scienceforcitrushealth/

What is the technique?

Insecticides are one of the main tools used to manage the Asian citrus psyllid. Their overuse has led to the evolution of insecticide resistance in some populations of Asian citrus psyllids, rendering them less susceptible to insecticide treatment. This is particularly concerning for the neonicotinoid class of insecticides, since these are the main tools currently being used to protect young trees from psyllids carrying CLas, the bacteria that causes huanglongbing. If this problem is not properly managed, insecticides could become less effective in killing psyllids in the field.

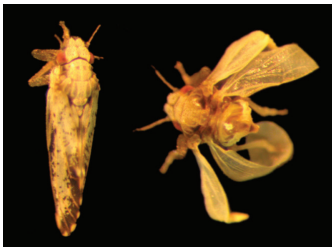
Researchers are developing a way to render field populations of psyllids more susceptible to insecticides, using a technique called RNA interference, or RNAi. RNAi can be used to precisely target and shut down important genes in Asian citrus psyllids to manage the insect's response to insecticides.

Using RNAi to prevent insecticide degradation

Insecticide resistance to the group of pesticides called neonicotinoids happens when insects increase certain enzymes (encoded by CYP4 genes) that break down the pesticide.

RNAi can be used to shut down the making of gene products, like the enzymes that degrade insecticides, and so make insecticides more effective against Asian citrus psyllids and so reverse insecticide resistance.

Silencing the above-mentioned CYP4 genes, by feeding newly emerged Asian citrus psyllids with dsRNA (double stranded RNA) molecules, inhibits expression of the Cyp4 gene rendered them more susceptible to insecticides. In the laboratory, they were able to completely reverse insecticide resistance of psyllids collected from farms whose psyllids were showing resistance.



Psyllid with normal functioning wings (left) and malformed wings (right)

Killiny's group also used RNAi to combat Asian citrus psyllids directly. First, they identified several key genes important in the life history of Asian citrus psyllid, such as those responsible for normally functioning wings and flight muscles. They developed specific dsRNAs, which when fed to immature psyllids, resulted in adults that emerged with malformed wings and were incapable of flight (see above). Thus the resulting psyllids cannot transmit the bacteria causing huanglongbing.

Who is working on the Project?

Lukasz Stelinski, an associate professor at the University of Florida, is leading efforts on insecticide resistance research for Asian citrus psyllid in Florida. Nabil Killiny, an assistant professor with University of Florida, is leading the efforts to develop RNAi-based management tools for Asian citrus psyllid.

What are the challenges and opportunities?

An important challenge for the practical use of dsRNA for pest control is to figure a way to get the dsRNAs into the insect in the field. Killiny and others are working on inserting dsRNAs into citrus plants, so the Asian citrus psyllid would ingest them during feeding. Delivery of dsRNA through transgenic plants has been achieved with other insect pests and thus should be possible to do for Asian citrus psyllid.

Another potentially feasible way to deliver dsRNA is to incorporate dsRNA into transgenic bacteria that are not harmful to humans and then spraying the transgenic bacteria onto citrus trees. However, a practical limitation of the RNAi approach is that large quantities of dsRNA are needed and are expensive to produce. Also, research is needed to develop formulations that prevent breakdown of dsRNA under field conditions.

Funding source: *This project is funded by the Citrus Research and Development Foundation.*

United States Department of Agriculture National Institute of Food and Agriculture

The **Science for Citrus Health** project is funded by two grants from United States Department of Agriculture's National Institute of Food and Agriculture.

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