RESEARCH SNAPSHOTS

ESTABLISHED ORCHARDS

Controlling psyllid gut cell death to prevent Huanglongbing

Research by Dr. Michelle Cilia-Heck, USDA-Boyce Thomson Institute

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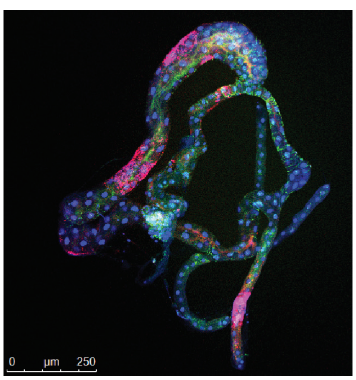
What is the technique?

Plant pathogens can have devastating effects on plant health and can severely limit food production in agricultural crops. In the case of the devastating disease, huanglongbing (HLB), the tiny Asian citrus psyllid is the vector that picks up the bacterial pathogen (Candidatus liberibacter asiaticus - CLas) and transmits it to the next citrus tree during feeding. HLB is spread easily by psyllids. The focus of this research is determining if this transmission can be interrupted. Can the psyllid be prevented from picking up (acquiring) the pathogen when it feeds on an infected plant? And/or can the psyllid be prevented from transmitting the pathogen to a healthy plant?

How does targeting cell death help?

The first step in this research is determining how CLas affects the Asian citrus psyllid vector. Plant pathogens transmitted by insects are not always benign 'tag alongs' in the vector. They can have negative or positive effects on vector health and function. Also, vectors often respond to the pathogens with defense mechanisms, even if they are not targets of infection. Cilia-Heck found that Asian citrus psyllids do respond to the CLas bacterium that causes HLB.



Dissected gut from the Asian citrus psyllid. The gut cells are stained in blue and the CLas can be visualized in green.

Cilia-Heck's group found that CLas causes cell death, or apoptosis, in the gut cells of the psyllid vector. Apoptosis, is a natural process of programmed cell death in multicellular organisms and its purpose is to get rid of unneeded or abnormal cells. Cells can initiate the process of cell death on their own, following stress or they can initiate the process when they receive signals from other cells. Though it's a normal process, cell death can be shifted out of balance toward 'too much or too little' cell death and so affect the normal functions of the organism.

Recent viral research suggests programmed cell death is a defensive mechanism that insects use to cope with viruses, which viruses in turn exploit to be successfully transmitted among hosts. The same may be taking place with the CLas - Asian citrus psyllid interaction. The psyllid's gut cell death response may benefit the bacteria by allowing the bacteria to exit the gut and then enter the insects' blood stream (hemolymph), ultimately reaching the insect's mouthparts so that CLas can be passed on when the psyllid feeds on a new host plant.

Understanding how and why programmed cell death is triggered by CLas in the psyllid's gut and whether this contributes to successful transmission among plants could have important implications for managing HLB. If the bacterial proteins that bind to the gut of the Asian citrus psyllid could be identified, then methods could be developed to impede the CLas bacteria's ability to bind to gut cells, cause cell death and move into the insect's blood stream.

Who is working on the Project?

Michelle Cilia-Heck, a USDA researcher at the Boyce Thomson Institute, and her research team are exploring various ways to manage HLB by disrupting transmission by psyllids.

For more information see: [Ghanim, M. et al. Morphological abnormalities and cell death in the Asian citrus psyllid (Diaphorina citri) midgut associated with Candidatus Liberibacter asiaticus. Sci. Rep. 6, 33418; doi: 10.1038/srep33418 (2016)].

What are the challenges and opportunities?

Practical application of this new discovery requires finding specific proteins that bind to the gut and methods to alter or 'silence' them so that the bacteria can not bind to them, cause cell death and make their way into the blood stream of the insect. Development of this approach is estimated to take 3-5 years.

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USDA NIFA United States Department of Agriculture National Institute of Food and Agriculture

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