The 'nose' knows: Using citrus odor for early detection of HLB

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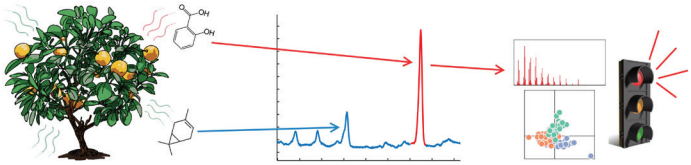
What is the technique?

Citrus trees emit volatile organic compounds (VOCs), or odors, that are the end products of plant metabolism. Researchers can measure the VOCs emitted by a plant and create an "odorprint". Pathogens, such as the bacterium CLas that causes huanglongbing (HLB), affect plant metabolism and alter the odor profile of the plant. Thus, the odor profile of an HLB-infected tree is different from a healthy one. Because VOCs are emitted by the citrus tree as a whole, this method of detecting the bacterium can reveal infected trees earlier than PCR, a biochemical test that only reveals the disease if the specific plant part collected (leaf, twig or root) has the bacterium in it.



Citrus trees emit volatile compounds, or odors. HLB changes these odors.

We measure a tree's odor profile, or "odorprint", and look for changes made by HLB.

Using machine learning, we diagnose HLB infection based on a tree's "odorprint".

Methods to measure VOCs

The Davis laboratory has developed two volatile-based methods to detect HLB in citrus trees. Both methods provide a way to screen entire orchards, tree by tree.

Fig. 1. Mobile gas chromatograph-spectrometer on the back of a tractor.

The first method brings the laboratory to the field: a mobile GC-DMS (gas chromatograph-differential mobility spectrometer) unit is parked next to a tree (Fig. 1). The unit collects tree odors for 3 minutes. Ten minutes later, the GC-DMS unit provides a picture of the volatile profile, which is used to diagnose HLB in that tree.

For the second method (Fig. 2), samples are collected in the field and returned to the laboratory. A Tic-Tac sized device called a Twister® is hung in the tree canopy for 2 hours. Twisters® are like odor sponges and absorb the chemicals released by the tree. Afterwards, the Twisters™ are collected and placed into vials, returned to the laboratory and tested using a GC-MS (gas chromatograph-mass spectrometer), which provides the volatile profile.

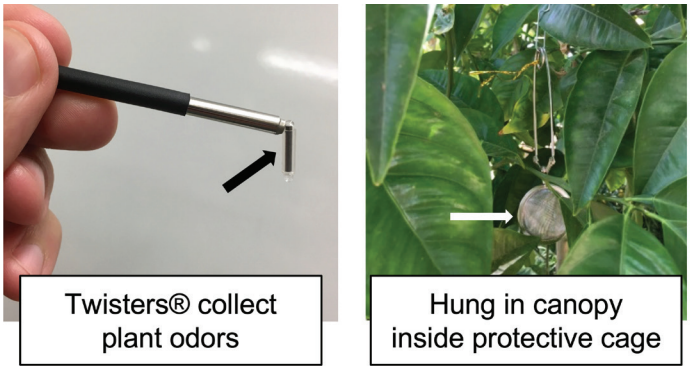


Fig 2. Twister® absorbs tree volatiles. They are hung in the tree canopy for 2 hours and analyzed in the laboratory.

Once the odor profile is outlined by either GC-DMS or GC-MS, the Davis Lab uses machine learning algorithms that were developed over many years to describe the tree's odor profile and determine if HLB is present.

The volatile profiling methods have been successful in detecting HLB infected trees and also differentiating trees that have citrus tristeza virus from those infected citrus stubborn (another bacterial disease) or HLB.

Who is working on the Project?

Dr. Cristina Davis, chair and professor in Mechanical & Aerospace Engineering at UC Davis, and her laboratory, led by Mitchell McCartney, are developing this method of early detection of HLB- infected trees.

What are the challenges and opportunities?

Dr. Davis has spun off a company from this research. XTB Laboratories is currently raising capital from investors to begin offering a commercial test. Visit xtblabs.com or more information.

As for potential opportunities, these technologies are also being used to determine whether new treatments are successful in either curing or preventing HLB infections.

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