Canines can detect trees infected with the bacterium that causes huanglongbing

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What is the technique?

Canines have a highly sensitive scent detection capability that is significantly better (parts per trillion) than most laboratory instruments and they can be trained to "alert" (either sit or lay) when they detect specific 'smells' (known as scent signatures). Most people are familiar with their ability to detect bombs, drugs, and plant material at airports. However, canines are also used to detect human pests, such as bed bugs, and agricultural pests, such as stink bugs, date palm weevils and imported fire ants. With regard to agricultural pathogens, canines have been shown to detect with greater than 98% accuracy the fungal pathogen that causes laurel wilt disease in avocado, the bacterium that causes citrus canker disease in citrus, and plum pox virus in peach orchards.

Canine checking trees at Lindcove Research and Extension Center, Exeter, CA

Researchers have been training and evaluating the efficacy of canines for detecting "*Candidatus* Liberibacter asiaticus" (CLas), the bacterium that causes huanglongbing (HLB), for 5 years in Florida, and CLas detection efforts with canines have recently begun in California. Dogs have been trained in both the laboratory environment and in the field. Researchers have demonstrated that well-trained canines can detect CLas over 95% of the time in commercial trees and over 92% of the time in residential trees. Researchers did not observe any differences in canine performance between citrus species and varieties. The training that the canines receive is very specific to CLas. When they are taken into citrus orchards infected with citrus tristeza virus, viroids, the fungal pathogen *Phytophthora*, or the bacterium that causes citrus stubborn, the CLas-trained canines do not respond to these diseases.

The canines provide a significant opportunity to be used as an Early Detection Technology (EDT) in California. In a field study using potted citrus in Florida, dogs could detect CLas in some of the trees as early as 2 weeks after CLas-infected psyllids fed on the trees. In contrast, it can take 1-2 years for CLas to distribute itself in a mature citrus tree sufficiently for the bacterium to be present in sampled leaves, which are then tested and shown to be infected using laboratory techniques, such as Polymerase Chain Reaction (PCR). Using canines to detect early infections could significantly help reduce disease spread in California, where HLB is currently limited to southern areas of the state and identify areas where increased psyllid control measures are needed

Canine Maci in the Rio Grande Valley of Texas.
Watch video of Maci in action at *https://ucanr.edu/p/65353*

Who is working on the project?

Dr. Tim Gottwald, Research Leader and Epidemiologist at the USDA, U.S. Horticultural Research Laboratory in Fort Pierce, Florida, and additional collaborators with F1K9, LLC, USDA, North Carolina State University, Texas A&M University and the California Department of Food and Agriculture.

What are the challenges and opportunities?

The volatile scent signature associated with CLas-infection settles from the canopy and simultaneously emanates from root infections pooling at the base of the tree. The detector dog interrogates the tree holistically by alerting in seconds on the scent signature regardless of its origin (i.e., a single leaf, root, stem or the entire tree if systemically infected). Conversely, other detection technologies, like PCR, are reliant on selecting and processing a small amount of tissue from large trees and often miss incipient infections because infected tissue is so rare in newly infected trees. Early detection via dogs is devoid of these sampling issues. Therefore, it is difficult to confirm CLas detections by dogs using currently available molecular or chemical detection methods. Dogs have been tested in hot and cold temperatures and with wind speeds up to 20 MPH with no perceptible degradation in detection.

Human scouts require several minutes per tree to visually examine it for symptoms, then they must collect tissue which must be transported to a diagnostic lab for processing

and analysis, which is time consuming and labor-intensive. Whereas, in a residential environment dogs can assess all trees in even large yards in a couple of minutes. The major limitation to the number of trees a dog can assess per day is access to these residential properties and the time required to relocate from property to property. In commercial groves a team of two dogs and one handler can survey a 10 acre planting (~1500 trees) in 1-2 hours depending on the number of infected trees; each positive alert requires rewarding the dog and tagging the infected tree. Dogs usually work 30 min then rest 30 min and can work 6-8 hours a day.

Utilizing dogs, *C*Las can be detected early in a region, when it is in just a few trees. If these few early infected trees are removed, the establishment and spread of the disease could be greatly reduced.

Like every detection instrument, dogs need to be periodically recalibrated. This is done by resensitizing them to known *C*Las-positive trees or specially prepared 'scent pads' that contain the scent signature of *C*Las to ensure they maintain > 98% accuracy of detection before being redeployed.

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