

# Preparation for Citrus Variegated Chlorosis: Diagnostics and the NPDN

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## Abstract:

The National Plant Diagnostic Network (NPDN) has been involved in detection and diagnosis of many new plant diseases, including preparation for the exotic disease known as citrus variegated chlorosis (CVC), caused by a particular strain of the xylem-limited sharpshooter-transmitted bacterium, *Xylella fastidiosa*. Most citrus cultivars grown in the US are susceptible to the disease, increasing its potential impact on citrus production both in commercial and residential settings. While presently impossible to diagnose in the field, the pathogen can be detected in the lab by light microscopy and culture on selective media. Serological and molecular methods of detection are also available, but like the microscopic and cultural methods, do not always reliably distinguish between CVC and other *Xylella* diseases already in the US. Disease management methods are limited, so exclusion and early detection are our only options, increasing the importance of rapid and accurate diagnosis, and encouraging collaboration between university, government, and private diagnosticians.

## Detection in the U.S.:

Citrus variegated chlorosis has been confirmed in Brazil, Argentina, and Paraguay, but has not been detected outside of South America. However, the vector is found in Florida and all of the citrus cultivars grown in the state are known to be susceptible to the pathogen. Introduction of the pathogen would be devastating to U.S. citrus production, so the best possible control is to keep the pathogen out through port inspections, certification programs, and public education.

## Biology of the pathogen:

CVC is caused by the xylem-inhabiting bacterium, *Xylella fastidiosa*. Similar strains of *X. fastidiosa* cause Pierce's disease of grape, phony peach, and leaf scorch diseases of almond, coffee, oak, plum and sycamore. These strains can be distinguished by host range and other physiological characteristics. The exact origin of the CVC pathogen is unknown, but it could likely have been transmitted into citrus from another host by sharpshooter vectors and from that point has continued to spread by propagation and insect vectors. Studies have shown that the CVC strain is apparently closely related to the bacterium causing coffee leaf scorch, and inoculation of coffee with the CVC bacterium causes coffee leaf scorch symptoms. The CVC pathogen has been the subject of intensive research in Brazil and its genome has recently been completely sequenced. Identification of the bacterial genes associated with CVC pathogenicity will help characterize relationships among different *X. fastidiosa* strains. Excerpted from Chung and Brilansky, UF Fact Sheet PP-137

## Vectors of the disease:

CVC can be graft-transmitted or vectored by sharpshooters. At least 11 species of sharpshooters are known to vector CVC in Brazil. Two sharpshooter species common in Florida have been shown to be capable of transmitting CVC under experimental conditions. Recently, transmission of CVC through citrus seed from infected trees has been reported. In Brazil, spread of CVC incidence was primarily due to the movement of infected nursery stock into many new locations. Tree-to-tree spread, resulting in clumped patterns of new infections, was due to limited sharpshooter movement within citrus plantings. Symptom severity and disease incidence is greatest in the warmer citrus growing areas in Brazil. Despite the fact that sharpshooters can feed on various plants, the role of non-citrus hosts as a pathogen reservoir remains unknown. (Excerpted from Chung and Brilansky, UF Fact Sheet PP-137)

## Symptoms:

When young trees are infected, CVC causes severe leaf chlorosis between veins resembling nutritional deficiencies. Leaves on affected trees frequently have brown gummy lesions on the lower side corresponding to yellow areas on the upper leaf surface. Affected trees may exhibit reduced vigor and growth, and show abnormal flowering and fruit set. Affected fruits are often small and hard with high acids, which are not suitable for juice processing or fresh market. As with other *Xylella*-induced diseases, symptoms are most pronounced in older tissues. Symptoms may appear initially on only one limb or branch and then spread to the whole tree. If the affected limb is pruned out, the remaining part of the canopy may remain symptomless for some time. In Brazil, if 30% of trees in a grove are infected, the recommendation is to remove the entire grove. (Excerpted from Chung and Brilansky, UF Fact Sheet PP-137)

## Diagnosis:

Field diagnosis of CVC is difficult, since symptoms caused by CVC are variable and can be confused with other health conditions (diseases, nutritional deficiencies). However, the causal bacterium can be identified by light and electron microscopy and can be cultured on appropriate media. Serological tests are available for rapid diagnosis. Molecular assays based on DNA hybridization or PCR approaches also are available. Since a number of *Xylella* diseases already exist in Florida, and the Pierce's disease agent has been isolated from citrus in Florida and California, molecular methods that specifically distinguish CVC from other *Xylella* strains will be useful. (Excerpted from Chung and Brilansky, UF Fact Sheet PP-137)

CVC symptoms on shoots and branches. Photo: USDA



Smaller fruit, from CVC affected trees, compared to normal, healthy fruit. Photo: Brazil

Smaller, poorly ripened fruit from a CVC affected tree, compared to healthy rut. Photos: www.invasives.org

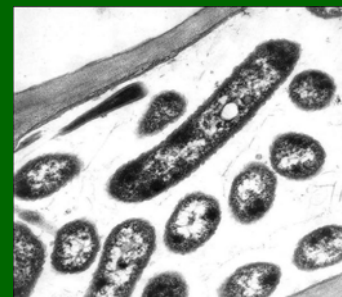
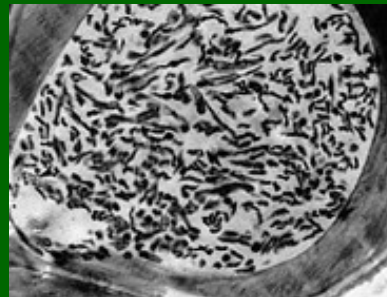
A range of leaf symptoms of CVC. Photo: Watson



Leaf discoloration caused by CVC. Photo: Brilansky



A vector of CVC, a sharpshooter. Photo: Garnsey



Micrographs of CVC bacteria obstructing the xylem. Photos: www.fundecitrus.com