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Abstract:

The exotic disease known as citrus leprosis is caused by Citrus Leprosis Virus (CILV), a Brevipalpus mite-transmitted rhabdovirus. Infecting mainly oranges and mandarins, the virus has the potential to impact citrus production both in commercial and residential settings. CILV is currently an important disease in South America, has recently appeared on citrus in Central America and Mexico, but has not been detected in the US since its virtual disappearance from Florida in the late 1920's corresponding to the adoption of sulfur sprays for mite control. The mite vectors, which have unusually broad host ranges, persist in Florida and are present in other major US citrus production areas. The 2 types of virus particles that cause leprosis are localized to the nucleus or cytoplasm; the virus is not systemic in the infected plant. Primary diagnosis is by observation of symptoms, which include stem and fruit lesions that may coalesce, accompanied by chlorotic and necrotic leaf spots. Electron microscopy and light microscopy can confirm the presence of the virus particles and inclusion bodies respectively, and recently developed molecular diagnostic methods are in use in Brazil. Exclusion and early detection with eradication are superior to disease management methods which employ miticides for vector control and selective pruning to remove infected tissues.

Detection in the U.S.:

Citrus leprosis is currently an devastating viral disease of citrus in Argentina, Panama, Brazil, and other areas of South America. Although reported to have nearly destroyed the citrus industry in Florida prior to 1925, the disease has not been detected since. No occurrence of the disease has been reported over the past 40 years in Florida and recent surveys in 2001-2002 did not detect the disease (Rodriguez and Childers, 03). The vector, however, is found throughout the world, with reports of detection on every continent (www.eppp.org). Florida's climate is conducive for re-establishment of the pathogen, increasing the chance of yet another disease impacting citrus production in the state and possibly other parts of the U.S. such as Texas and California.

Biology of the pathogen:

The causal agent of leprosis is a naked bullet-shaped virus that has recently been molecularly characterized. Two different types of leprosis viruses exist. One virus occurs in the cytoplasm and the other resides primarily in the nucleus of infected cells. The virus particles, with some difference in shape, can often be observed by electron microscopy of lesions from naturally infected citrus and from mechanically inoculated *Chenopodium quinoa* (universal virus host) plants. The cytoplasmic one has been characterized and sequenced and diagnostic probes are available. Leprosis primarily affects oranges, but mandarins can also be affected. The host range outside of citrus remains unclear. Leprosis virus can be mechanically transmitted to some herbaceous plants, producing local necrotic lesions. However, attempts to re-infect citrus with extracts from affected herbaceous plants have failed. It has been reported that leprosis symptoms appeared on citrus seedlings fed on by *Brevipalpus* mites collected from Spanish needle plants, but its status as a weed host has not been determined. Field symptoms produced by leprosis are similar to coffee ring spot and the virus particles associated with the two diseases have similar shapes, but no direct relationship has been established. (Excerpted from Chung and Bransky, UF Fact Sheet PP-226)

Vectors of the disease:

Leprosis has been transmitted experimentally by several species of *Brevipalpus* mites (*B. phoenicis*, *B. californicus*, and *B. obovatus*). The vector is present in all citrus-producing areas of the U.S. Leprosis has been very difficult to transmit to citrus by grafting due to the frequent rapid death of affected tissue after grafting. Transmission occurs only when symptomatic areas of the inoculum tissue are in contact with the receptor plant. Symptoms develop only in immediately adjacent tissues of the receptor plants. (Excerpted from Chung and Bransky, UF Fact Sheet PP-226)

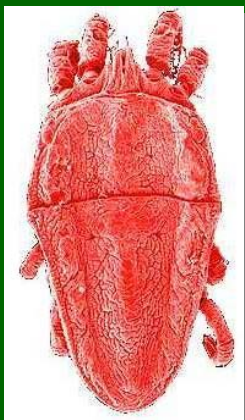
Symptoms:

Leprosis symptoms can be found on leaves, fruit and twigs. Lesions are usually chlorotic at first and then may become necrotic in the center. There may be concentric patterns present and gum impregnation in mature lesions. Stem lesions may coalesce, produce bark scaling, and results in premature fruit drop, leaf abscission, and twig dieback when severe. A similar disease called zonate chlorosis occurs in Brazil, but is less severe. Zonate chlorosis produces larger chlorotic patterns that may cover a large part of affected leaves, but lacks the necrotic characteristics of leprosis. (Excerpted from Chung and Bransky, UF Fact Sheet PP-226)

Diagnosis:

Symptoms of leprosis are easily visible on leaves, fruit, and twigs in the field and serve as the primary means of diagnosis. Confirmation can be done by electron microscopy of infected tissue to observe bullet-like virus particles. In 2003, a reverse transcription-polymerase chain reaction (RT-PCR) method was developed and tested on multiple cultivars and species (Plant Dis. D-2003-0829-02R, 2003. Online, Guerra, M.S. Thesis, University of Florida). Although local lesions have been observed in mechanically inoculated herbaceous hosts, these are not diagnostic. Control of mite populations greatly limits the spread and development of leprosis. Pruning the affected trees may reduce the inoculum sources. (Excerpted from Chung and Bransky, UF Fact Sheet PP-226)

Citrus leprosis vector, *Brevipalpus obovatus*.
Image: University of Queensland



Brevipalpus phoenicis Image: Extension Entomology IFPM Program, University of Hawaii



Citrus leprosis vector, *Brevipalpus phoenicis*.
Image: Oliveira, UNESP-FCAVJ



Brevipalpus phoenicis Image: USDA Systematic Entomology Laboratory



Citrus leprosis symptoms on a leaf.
Photo: R. Bransky



Abscised fruit on the ground beneath an affected tree. Photos: R. Bransky



Mature and immature citrus leprosis affected fruit.
Photos: R. Bransky



Stem lesions caused by citrus leprosis. Photos R. Bransky

Citrus Diseases Exotic to Florida: Citrus Leprosis¹

K.-R. Chung and R. H. Bransky²

Citrus is susceptible to a large number of diseases caused by plant pathogens. Economic losses due to these diseases can be severe, but fortunately, not all pathogens attacking citrus are present in Florida. Major citrus diseases currently present in Florida include Alternaria brown spot, light citrus canker, grove spot, tantronic, Phytophthora-infused diseases (foot and root rot, brown eye, postharvest fruit drop (PFD), scale, and trunks), Azela necrotic dieback disease called citrus greening (Citrus greening), has recently been found in Florida. Efforts to suppress citrus canker and greening are ongoing in Florida. Any exotic disease of citrus, if introduced, will increase production costs and decrease profitability for Florida growers. Exotic diseases could affect the viability of the industry and the varieties that could be profitably grown.

One approach to reduce the risk of exotic citrus disease not yet present in a state is to: 1) provide a basis for evaluating exotic pathogens that may pose potential risks to Florida citrus, and 2) create a decision-making framework to prevent their introduction and spread. This paper will discuss citrus leprosis.

Why Are We Concerned About Citrus Leprosis?

Leprosis is a virus-induced disease causing chlorotic lesions on citrus leaves, fruit, and twigs. Leprosis is currently a highly important citrus disease in Brazil and other areas of South America. A new outbreak of leprosis has recently been reported in Panama. Prior to 1925, leprosis was once a serious disease of citrus in Florida, but it has not been observed here since. The causal agent of leprosis is characterized for several species of Brevipalpus mites. It is not known why leprosis disappeared in Florida. Improved mite control procedures may have at least partly responsible for the disappearance of the disease from Florida. A great deal of uncertainty exists about the epidemiology of leprosis and its potential to reappear in Florida.

The Causal Agent of Citrus Leprosis

The causal agent of leprosis is a naked bullet-shaped virus that has recently been molecularly characterized. Two different types of leprosis viruses exist. One virus occurs in the cytoplasm and the other resides primarily in the nucleus of infected

¹ The knowledge of Plant Dis. PP-226, one of a series of the Plant Pathology Department, Florida Cooperative Extension Service, Institute of Food and Agricultural Sciences, University of Florida, Gainesville, Fla., and Florida Home Yard (H-226) is the property of the University of Florida. This publication is available in Spanish, Spanish, and Chinese. For more information, contact the Extension Specialist, Citrus Canker, Citrus Leprosis, Citrus Greening, Citrus Trunk Disease, Citrus Alternaria Brown Spot, Citrus Grovespot, Citrus Tantronic, Citrus Foot and Root Rot, Citrus Dieback, Citrus Scale, and Citrus Trunk Disease, University of Florida, Citrus Research and Education Center, Lake Alfred, FL 33859. This article is written based on the research of the University of Florida Citrus Pathogen Team headed by Dr. M. L. Garcia and R. H. Bransky, and has been reviewed by D. R. Anderson, Florida, and has been approved for publication by the state director, Gainesville, Fla.

² The author of Plant Dis. PP-226, one of a series of the Plant Pathology Department, Florida Cooperative Extension Service, Institute of Food and Agricultural Sciences, University of Florida, Gainesville, Fla., and Florida Home Yard (H-226) is the property of the University of Florida. This publication is available in Spanish, Spanish, and Chinese. For more information, contact the Extension Specialist, Citrus Canker, Citrus Leprosis, Citrus Greening, Citrus Trunk Disease, Citrus Alternaria Brown Spot, Citrus Grovespot, Citrus Tantronic, Citrus Foot and Root Rot, Citrus Dieback, Citrus Scale, and Citrus Trunk Disease, University of Florida, Citrus Research and Education Center, Lake Alfred, FL 33859. This article is written based on the research of the University of Florida Citrus Pathogen Team headed by Dr. M. L. Garcia and R. H. Bransky, and has been reviewed by D. R. Anderson, Florida, and has been approved for publication by the state director, Gainesville, Fla.