

Recovery Plan for Citrus Leprosis

April 3013

Presented to the National Plant
Disease Recovery System



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Introduction

- first reported from Florida in the early 1900's
- First called scaly bark because of stem lesions and bark scaling
- Also named nail head rust because of the typical lesions on the fruits and stems
- In 1926, the disease was called leprosis by Fawcett and Lee

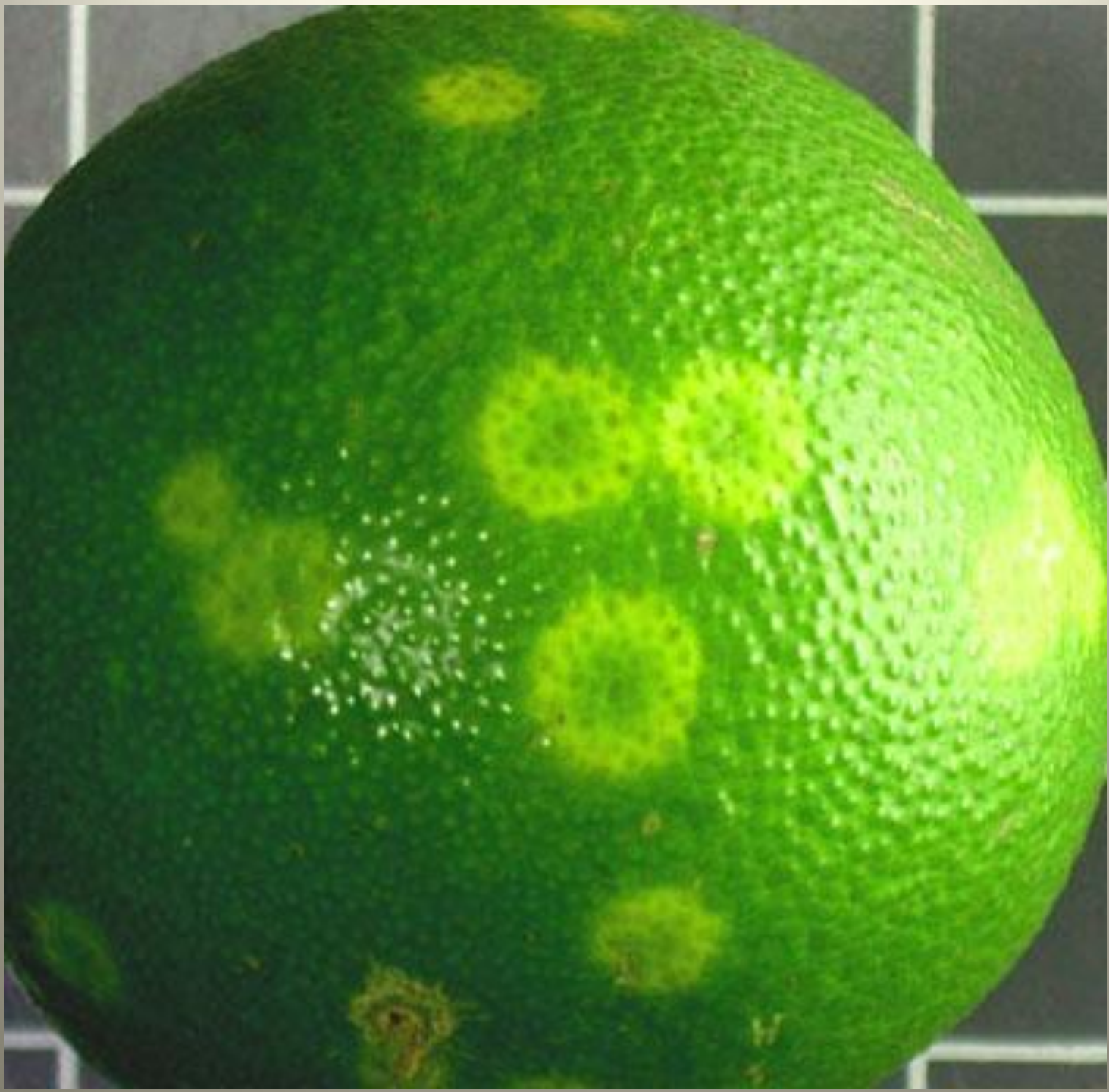
- Disappeared in Florida in the 1960's: why?
- A freeze, intensive sulfur application reducing the vector populations and thus completely eliminating virus inoculum

Symptoms

- Chlorotic leaf lesions becoming brown with or without necrotic centers
- On leaves and twigs may become flat or slightly raised necrotic areas on twigs and leaves
- On fruit lesions flat or depressed lesions with concentric patterns and gumming
- With abundant lesions abscission of fruit and leaves can occur

- Twig dieback may happen due to extensive lesion development
- Lesions on large limbs may coalesce and cause dieback; may resemble bark scaling similar to citrus psorosis

















YP2	Valencia Orange Leaves	El Yopal Casanare
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Host Range

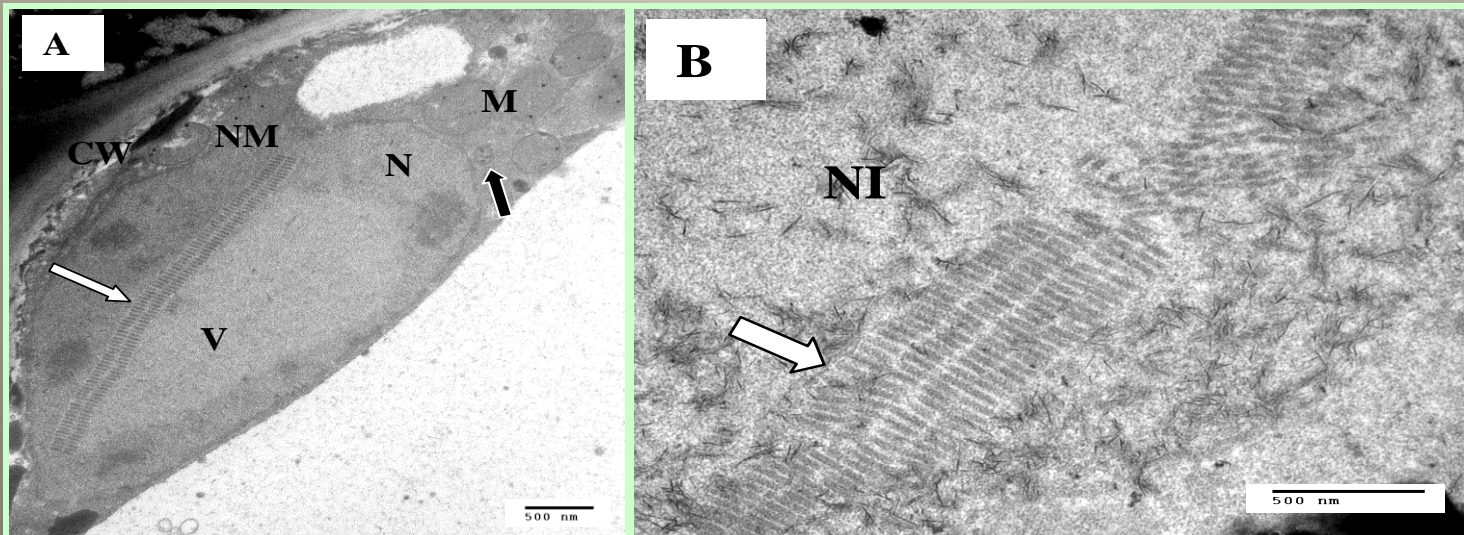
- Primarily on sweet orange
- Mandarins and sour orange are susceptible but other citrus cultivars may not show symptoms
- Transmissible to noncitrus species via mechanical transmission e.g. Gomphrena, Chenopodium with local lesions

Geographical Distribution

- Previously found in Florida but apparently was eliminated
- South America: Brazil, Argentina, Colombia, Venezuela, Bolivia, Paraguay, Uruguay
- Central America: Panama, Guatemala, Costa Rica, Nicaragua, El Salvador, Belize
- Mexico in 2005: now detected in 3 areas

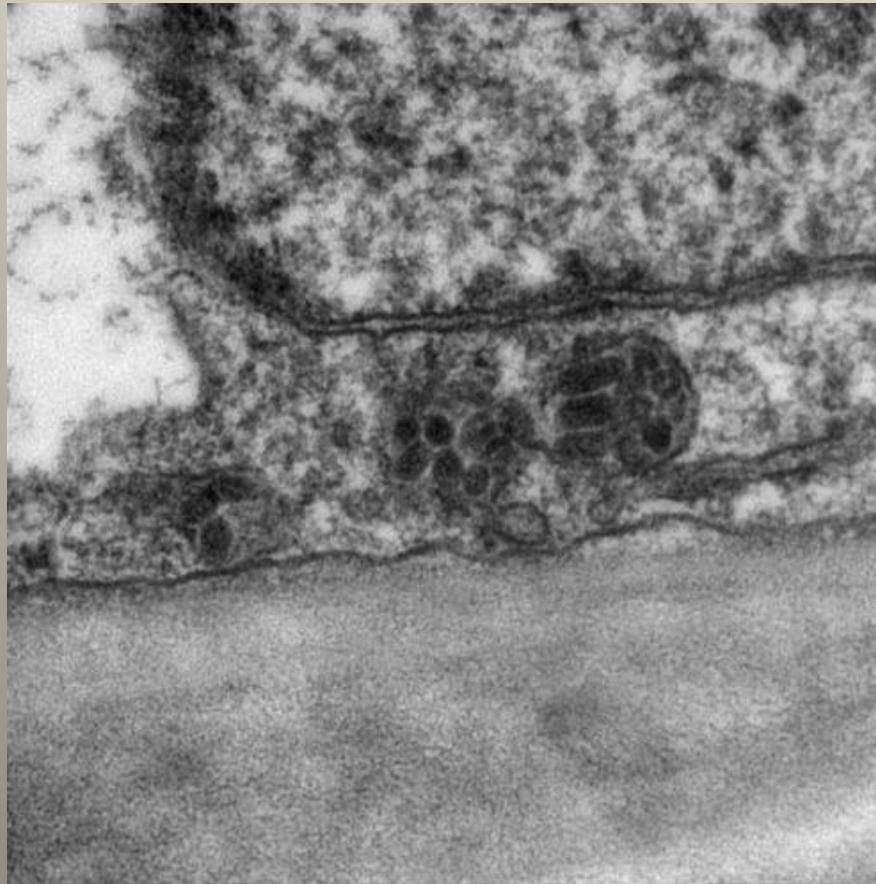
Types of Leprosis (Virions)

- In 1975 Kitajima found short rod virions 35-40 x 120-130 nm in the nuclei of symptomatic leaf tissues
- Virus tentatively identified as a naked rhabdovirus (CiLV-N)



Cytoplasmic Citrus Leprosis: CiLV-C

- Other particles also seen: 50-55 x 120-130 nm in the endoplasmic reticulum in the cytoplasm



Movement or Spread

- 1999: reported in Venezuela
- 2000: it had reached Panama and Costa Rica in Central America; virus on the move
- 2005: CiLV-C reported in Mexico and in Colombia

CiLV-C Detection

- 2004-2008: Molecular characterization and development of a rapid diagnostic methods for CiLV-C from Panama
- 2006: Complete nucleotide sequence for CiLV-C from Brazil
- 2008: CiLV-C on the move in Central America

CiLV-C

CiLV-C is a bipartite positive sense RNA virus.

Isolates from Brazil and Panama have been sequenced

A rapid diagnostic method using PCR can be used to detect the cytoplasmic-type of leprosis and distinguish from the nuclear type

Antibody detection systems have been developed

Transmission (CiLV-C and CiLV-N)

- Graft transmitted with difficulty from symptomatic tissue (cleft grafts)
- Transmitted by Brevipalpus flat mites. *B. phoenicis* larvae transmit after 24 h access period: nymphs and adults are less efficient ?
- No transovarial mite transmission found
- Spreads to new areas with infected trees and mites

Brevipalpus yothersi (synonym of
B. phoenicis)



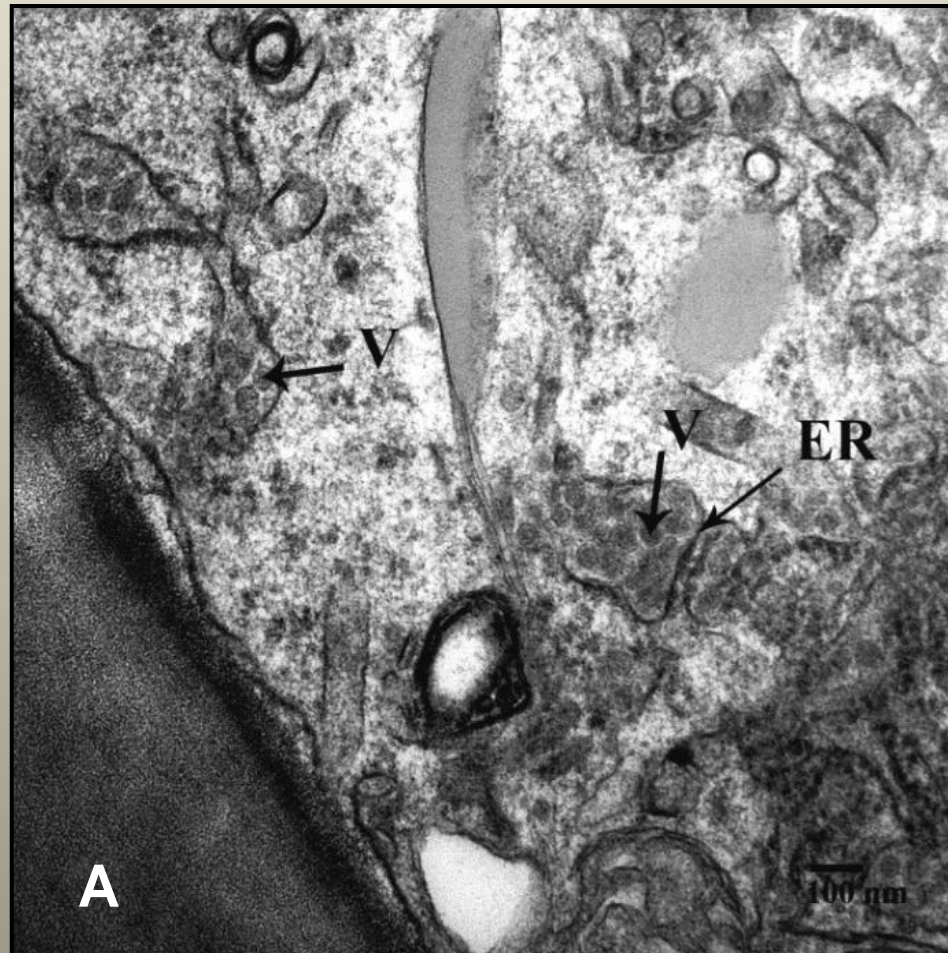
Hosts of the Mite

- *B. phoenicis*:
- reported over 65 hosts in 1958, but in 2004 there may be 1,000 hosts. Hosts from Florida include: Gardenia, grapefruit, hibiscus, holly, ligustrum, lemon, lime, orange, pecan, and viburnum.

B. californicus Host Plants

- *Acacia, Acer, Acineta, Allamanda, Anguloa, Anthurium, Antidesma, Aphelandra, Bletia, Brassia, Callicarpa, Callistemon, Calycanthus, Catasetum, Citrus, Clausena, Clerodendrum, Cocos, Codiaeum, Columnea, Cordia, Cupressus, Crescentia, Croton, Dendrobium, Dodonaea, Dolichos, Epidendrum, Euphorbia, Ficus, Flacourtia, Flaveria, Gardenia, Gongor, Hibiscus, Houletia, Howea, Ilex, Jacaranda, Ligustrum, Liquidambar, Lycaste, Magnolia, Malus, Melia, Odontoglossum, Peristeria, Persea, Pilea, Podocarpus, Poinsettia, Rhododendron, Sida, Solanum, Stantropea, Tabebuia, Thea, Thunbergia, Trevesia, Trichophila, Vitis, Wisteria.*

Newly Discovered CiLV-C from Colombia in 2012



New CiLV-C2 from Colombia

CiLV-C2 Summary

- High-throughput sRNA sequencing identified an unknown new bipartite, positive sense single stranded RNA virus
- The structure of CiLV-C2 genome resembled that of CiLV-C except that it contained a long 3' UTR and an extra ORF (p7) in RNA2.
- RNA1 and RNA2 of the CiLV-C2 had only 58% and 49% nucleotide identities with CiLV-C type
- Phylogenetic analysis revealed close relatedness with CiLV-C and placed the new virus as 2nd member of Cilevirus genus

Detection

- CiLV-C2 specific primer pair was designed for RT-PCR & successfully identified and differentiated from CiLV-C type
- Continuing developing antibodies (polyclonal & monoclonal) to expressed viral proteins for detection

Nuclear Leprosis: CiLV-N

- Nuclear CiLV (virions in nucleus CiLV-N)
- Deep sequencing done and sequences analyzed
- Identification pending
- Also Hibiscus green spot virus sequenced in Hawaii also detected in rough lemon citrus with symptoms similar to leprosis
- Currently 4 different viruses causing leprosis symptoms

Economic Impact

- No hard economic figures on fruit lost, lost markets, tree decline
- Leprosis has been a serious disease of citrus in Brazil and Argentina since 1930s
- Cost to live with leprosis: 21% increase in production cost; 12 extra acaricide sprays per yr.
- Est. \$75-100 million is spent on controlling the mites in Brazil (35% chemical costs)
- The disease has spread into Central America

Recovery Plan

- Strict quarantine measures should remain in place at all ports of entry for production citrus, ornamental citrus, and any ornamental plants or weeds that are a host to the leprosis viruses or its mite vectors, especially those originating from South America. Studies should be considered to identify all hosts and the specific mite species that are vectors.
- Develop and deploy molecular and serological tests that distinguish among the various forms of *Citrus leprosis virus*

- Monitor citrus groves and commercial nurseries, including distributors that market to homeowners for symptoms of leprosis
- Test acaracide products and treatment schedules to validate control programs for Florida, Texas and California
- Education is needed for all plant pathologists, plant health professionals, extension agents, nursery growers, retailers etc to raise awareness of potentially invasive citrus leprosis.

- Understand the epidemiology of the disease, especially the roles and interactions of mite vectors with the virus and with citrus and other hosts.
- Active pursuit of methods to manage this disease upon introduction is essential in order to avoid the economic consequences experienced by other countries.

References

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