CALIFORNIA DEPARTMENT OF FOOD & AGRICULTURE

California Pest Rating Proposal for

Citrus leprosis virus C
Leprosis of citrus

Current Pest Rating: none

Proposed Pest Rating: A

Domain: Virus; Group: Positive sense ssRNA viruses;
Family: Kitaviridae; Genus: Cilevirus

Comment Period: 10/05/2021 through 11/19/2021

Initiating Event:

This pathogen has not been through the pest rating process. The risk to California from Citrus leprosis virus C is described herein and a permanent pest rating is proposed.

History & Status:

Background: Citrus leprosis syndrome is a damaging disease that is currently found in Mexico, Brazil, and other countries in South and Central America. It is caused by a heterogenic group of RNA viruses endemic to the Western Hemisphere (Roy et al., 2015). Five well-defined viruses are currently known to be associated with citrus leprosis. Leprosis can reduce citrus yields and fruit quality, cause premature fruit drop, and in some instances kill trees. Leprosis is spread by brevipalpid flat mites, mainly *Brevipalpus californicus*. Although citrus leprosis has not been detected here, the mites are already common and widespread in California (CDFA PDR database).

Recent studies have shown that multiple virus species in the genera *Dichorhavirus*, *Higrevirus*, and *Cilevirus* cause citrus leprosis symptoms. There are two types of leprosis: C-type (genera *Cilevirus* and *Higrevirus*, positive-sense RNA viruses) and N-type (genus *Dichorhavirus*, negative-sense RNA). The types refer to the part of the plant cell where the virus is found. C-type is in the cytoplasm, and N-type is in the nucleus. The C-type is considered more aggressive and is more widespread than the N-type (Bastianel et al., 2010). In 2012, the species name “Citrus leprosis virus C” (CiLV-C) was accepted by the International Committee on Taxonomy of Viruses (ICTV), and it was defined as the type member of genus *Cilevirus* (Locali-Fabris et al., 2012).

In the 1860s, leprosis was found in Florida and citrus production was drastically reduced. By the 1950s it was reported only on the east coast of Florida and in small isolated areas. Leprosis has not been reported in Florida since 1968. It is unclear why the disease disappeared from Florida, but it could have been from increased use of miticides and cold winter temperatures causing a decline in mites, resulting in reduced inoculum and transmission (Childers et al., 2003). Based on the viral sequence of a sample collected in Florida in 1948, the virus is a distinct Dichorhavirus, named as CiLV-N0 (Roy et al., 2020; Hartung et al., 2015).

Currently there are no known systemic plant hosts for CiLV-C. The lack of a natural systemic plant host is atypical for plant viruses, raising the question of whether these two completely unrelated virus groups are actually mite viruses that have convergently evolved a unique approach for mite-to-mite transmission using plants. Kitajima and Alberti (2014) showed CiLV-C particles persistently present in mites, between membranes of adjacent cells, particularly at the basal parts of the midgut epithelium and neighbor cells. However, TEM of thin sections was unable to find intracellular viral particles and viroplasms of CiLV-C in mites, indicating that CiLV-C may not be replicating inside the mite cells (Roy et al., 2015).

Hosts: The natural hosts of this virus are almost all in the family Rutaceae, including *Cintroncirus, Citrus* spp., *C. aurantium*, *C. deliciosa*, *C. paradisi*, *C. reshni*, *C. reticulata, C. sinensis*, *Fortunella* spp., *Glycosmis* spp., *Poncirus trifolata*, and x *Citrofortunella macrocarpa.* The first non-citrus natural host identified was *Swinglea glutinosa* in Colombia (León et al., 2008). This plant is in the family Rutaceae, native to southeast Asia, and used as an ornamental and as a hedgerow near citrus orchards. Experimentally, *Chenopodium quinoa*, *C. amaranticolor*, *Gomphrena globosa*, *H. rosa-sinensis, Malvaviscus arboreus, Grevillea robusta, Phaseolus vulgaris*, and *Solanum violaefolium* have been reported as hosts for CiLV-C. In 2012, Nunes et al. reported leprosis symptoms in *Commelina benghalensis* (tropical spiderwort), a perennial weed native to tropical Asia and Africa. This plant is commonly found in citrus groves in Brazil. The presence of the virus was confirmed with RT-PCR. This work shows that other plants or weeds growing in and around citrus orchards may be susceptible to the virus and may host the brevipalpids. Garita et al. (2014), in an expanded experimental host range study of CiLV-C, tested 140 plant species from 43 families, and 40 species belonging to 18 families produced either localized chlorotic and/or necrotic lesions on leaves identified as positive for CiLV-C.

Symptoms: Symptom development differs between citrus hosts and varieties (Cook et al., 2019; Peng et al., 2013). Citrus leprosis appears as necrotic lesions encircled by chlorotic halos on leaves and immature fruit. On leaves, lesions are mainly chlorotic but as fruits mature, the lesions tend to turn black. Cortical lesions are observed on twigs and later develop into crusty scabs. These symptoms develop at the feeding sites of viruliferous brevipalpid flat mites. In Brazil, the disease is characterized by necrotic or chlorotic spots in leaves, branches, and fruit, which progressively leads to the early drop of leaves and fruit, branch dieback, and, occasionally, to death (primarily of the youngest citrus trees) (Hartung and Leon, 2020).

Transmission: Leprosis does not seem to be able to move systemically in the host plant. Movement in latently infected planting material is not likely to be a major pathway because of its non-systemic

infection. The main means of movement and dispersal of the virus is via the vector mites of the genus *Brevipalpus*, which colonize most species of *Citrus* and many other plant species (Hartung and Leon, 2020).

Damage Potential: Sweet orange (*C. sinensis*), grapefruit (*C. paradisi*), and mandarin (*C. reticulata*) are susceptible to CiLV-C infection, but lemons (*C. limon*) are immune (Bastianel et al., 2010). Citrus leprosis syndrome is an economically important disease of citrus in South and Central America and Mexico. Losses incurred due to citrus leprosis are related to leaf and fruit drop and the reduction in market value of symptomatic fruit. Leprosis is considered the viral disease with the greatest economic impact in Brazil, partially due to the cost of mite control (Bastianel et al., 2010), with yield reduction in the infected orchards and the costs to prevent or manage infection foci. Citrus leprosis is a disease of quarantine significance to California.

Worldwide Distribution: Central America: *Belize, Costa Rica, El Salvador, Guatemala, Honduras, Nicaragua, Panama*. North America: *Mexico.* South America: *Argentina, Bolivia, Brazil, Colombia, Paraguay, Uruguay, Venezuela* (Hartung and Leon, 2020).

Official Control: Citrus leprosis virus is on the EPPO's A1 list for Bahrain, the European Plant Protection Organization, the European Union, Jordan, and Turkey. It is a quarantine pest for Israel, Mexico, Morocco, and Tunisia, a regulated, non-quarantine pest in Egypt, and on the alert list for the North American Plant Protection Organization (Hartung and Leon, 2020). It is on the Harmful Organisms list for Albania, Costa Rica, Ecuador, Georgia, Guatemala, Honduras, Israel, Japan, Republic of Korea, Mexico, Morocco, Nicaragua, New Zealand, Oman, Panama, Peru, Taiwan, Thailand, and United Arab Emirates (USDA PCIT, 2021). The USDA maintains Federal Foreign Quarantines against citrus nursery stock (319.19) and citrus fruits (319.28) for citrus canker and other diseases. CDFA has a State Exterior Quarantine against citrus pests, and this includes any plant disease pest of citrus which does not occur or is not generally established in California (https://www.cdfa.ca.gov/countyag/postings/files/301_9.pdf).

California Distribution: None

California Interceptions: None

The risk Citrus leprosis virus would pose to California is evaluated below.

Consequences of Introduction:

1) **Climate/Host Interaction:** The mite vector of leprosis is already widespread in California. The virus is likely to survive wherever its hosts can be grown, which is limited to the warmer parts of the state that currently have citrus.

   Evaluate if the pest would have suitable hosts and climate to establish in California.

Score: **2**
- Low (1) Not likely to establish in California; or likely to establish in very limited areas.
- Medium (2) may be able to establish in a larger but limited part of California.
- High (3) likely to establish a widespread distribution in California.

2) **Known Pest Host Range:** The host range is mainly members of the family Rutaceae, and mostly citrus, although plants in other families (e.g., *Dieffenbachia*) are confirmed natural hosts. There are many other experimental hosts that can become symptomatic and harbor viruliferous mites.

Evaluate the host range of the pest.

Score: 2
- Low (1) has a very limited host range.
- Medium (2) has a moderate host range.
- High (3) has a wide host range.

3) **Pest Reproductive Potential:** The virus is not systemic in its plant hosts but can be persistent in the mite vectors. It is not readily spread by mechanical transmission. Mite feeding causes localized, non-systemic infections in citrus and other hosts. Disease incidence and severity is highly correlated with feeding from viruliferous mites.

Evaluate the natural and artificial dispersal potential of the pest.

Score: 3
- Low (1) does not have high reproductive or dispersal potential.
- Medium (2) has either high reproductive or dispersal potential.
- High (3) has both high reproduction and dispersal potential.

4) **Economic Impact:** Citrus leprosis is a disease of quarantine importance, posing a threat to the citrus industry in California. Trees can be killed because of expanding lesions that girdle tree limbs and cause leaf and fruit drop as well as unmarketable fruit. Premature fruit drop results in greatly reduced yields. Mites must be continually controlled to prevent disease spread, and this is mainly done with pesticides.

Evaluate the economic impact of the pest to California using the criteria below.

Economic Impact: A, B, C, D, E

A. The pest could lower crop yield.
B. The pest could lower crop value (includes increasing crop production costs).
C. The pest could trigger the loss of markets (includes quarantines).
D. The pest could negatively change normal cultural practices.
E. The pest can vector, or is vectored, by another pestiferous organism.
F. The organism is injurious or poisonous to agriculturally important animals.
G. The organism can interfere with the delivery or supply of water for agricultural uses.

Economic Impact Score: 3
- Low (1) causes 0 or 1 of these impacts.
- Medium (2) causes 2 of these impacts.
- High (3) causes 3 or more of these impacts.

5) **Environmental Impact:** In Central and South America, CiLV-C has been detected in landscape plants and ornamentals that have naturalized in and around orchards. They could serve as reservoirs for the virus or for viruliferous mites and could trigger the need for treatments. As this pathogen is under Federal regulation, any detection would have a significant regulatory response, likely involving miticides and eradication of infected hosts, regardless if the detection is in commercial or residential orchards

Evaluate the environmental impact of the pest to California using the criteria below

Environmental Impact: D, E
A. The pest could have a significant environmental impact such as lowering biodiversity, disrupting natural communities, or changing ecosystem processes.
B. The pest could directly affect threatened or endangered species.
C. The pest could impact threatened or endangered species by disrupting critical habitats.
D. The pest could trigger additional official or private treatment programs.
E. The pest significantly impacts cultural practices, home/urban gardening or ornamental plantings.

Environmental Impact Score: 3
- Low (1) causes none of the above to occur.
- Medium (2) causes one of the above to occur**.**
- **High (3) causes two or more of the above to occur.**

Consequences of Introduction to California for Citrus leprosis virus C*:* High

Add up the total score and include it here. **13**
-Low = 5-8 points
-Medium = 9-12 points
-**High = 13-15 points**

6) **Post Entry Distribution and Survey Information**: Evaluate the known distribution in California. Only official records identified by a taxonomic expert and supported by voucher specimens deposited in natural history collections should be considered. Pest incursions that have been eradicated, are under eradication, or have been delimited with no further detections should not be included.

Evaluation is 'not established'.
Score: 0

-Not established (0) Pest never detected in California or known only from incursions.
-Low (-1) Pest has a localized distribution in California or is established in one suitable climate/host area (region).
-Medium (-2) Pest is widespread in California but not fully established in the endangered area, or pest established in two contiguous suitable climate/host areas.
-High (-3) Pest has fully established in the endangered area, or pest is reported in more than two contiguous or non-contiguous suitable climate/host areas.

7) **The final score is** the consequences of introduction score minus the post entry distribution and survey information score: (Score)

Final Score: *Score of Consequences of Introduction – Score of Post Entry Distribution and Survey Information* ***= 13***

Uncertainty:

Increased understanding of the diversity of viruses causing leprosis disease may lead to a reevaluation of the nomenclature.

Conclusion and Rating Justification:

Based on the evidence provided above the proposed rating for Citrus leprosis virus C is A.

References:

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Responsible Party:

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*Comment Period: 10/05/2021 through 11/19/2021

*NOTE:

You must be registered and logged in to post a comment. If you have registered and have not received the registration confirmation, please contact us at permits[@]cdfa.ca.gov.

Comment Format:

- Comments should refer to the appropriate California Pest Rating Proposal Form subsection(s) being commented on, as shown below.

  Example Comment:

  Consequences of Introduction: 1. Climate/Host Interaction: [Your comment that relates to "Climate/Host Interaction" here.]

- Posted comments will not be able to be viewed immediately.
- Comments may not be posted if they:

  Contain inappropriate language which is not germane to the pest rating proposal;

  Contains defamatory, false, inaccurate, abusive, obscene, pornographic, sexually oriented, threatening, racially offensive, discriminatory or illegal material;

  Violates agency regulations prohibiting sexual harassment or other forms of discrimination;

  Violates agency regulations prohibiting workplace violence, including threats.

- Comments may be edited prior to posting to ensure they are entirely germane.
- Posted comments shall be those which have been approved in content and posted to the website to be viewed, not just submitted.

Proposed Pest Rating: A