

CALIFORNIA DEPARTMENT OF

California Pest Rating Profile for

Candidatus Phytoplasma aurantifolia Zreik et al. 1995

Lime witches' broom phytoplasma

Pest Rating: A

Kingdom: Bacteria, Phylum: Firmicutes, Class: Mollicutes, Order: Acholeplasmatales, Family: Acholeplasmataceae

Comment Period: 04/04/2025 through 05/19/2025

Initiating Event:

This pathogen has not been through the pest rating process. The risk to California from *Candidatus* Phytoplasma aurantifolia is assessed herein, and a permanent rating is proposed.

History & Status:

Background:

Phytoplasmas (formerly known as Mycoplasma-like organisms) are phloem-limited pleomorphic bacteria lacking a cell wall which are mainly transmitted by leafhoppers but may also be moved with plant propagative materials. They cause characteristic symptoms including witches' brooms (stem proliferation from a single point), virescence (when floral parts that typically develop other colors instead remain green), phyllody (development of vegetative tissues instead of flowers), big buds (bulbous enlarged flower buds), sterility, chlorosis, stunting, changes in leaf morphology, and a general decline of the plant. Yellowing symptoms by clogging phloem tissue sieve tubes and interfering with the transportation of photosynthate out of the leaves. They can also produce biologically active toxic substances, causing the death of the leaves, inflorescences, and vegetative buds of their hosts. Brooms can be a symptom of phytoplasma infection; they are a dense mass of shoots growing from a single point, with the resulting structure resembling a broom or a bird's nest. Phytoplasmas infect a wide variety of vascular plant species and occur worldwide.

Species descriptions of bacteria belonging to the class Mollicutes typically require an accompanying culture of the organism. However, because phytoplasmas are very difficult to isolate in culture and



maintain in vitro, lineages within this group are generally referred to as '*Candidatus* Phytoplasma species' (Davis and Sinclair, 1998).

Phytoplasmas in the 16SrII group are classified into 21 subgroups. *Candidatus* Phytoplasma aurantifolia is classified in the peanut witches' broom group, taxonomic subgroup 16SrII-B of the classification based on the 16S rRNA gene sequence (Zreik et al., 1995; Yang et al., 2016). Witches' broom disease of lime (WBDL) is a lethal disease that was first observed in the Sultanate of Oman and the United Arab Emirates in the late 1970s where it was found to be widespread in coastal areas infecting acid lime (*Citrus aurantifolia*) (Bové, 1986; Bové et al., 1988).

Hosts: The primary host of lime witches' broom phytoplasma is *Citrus aurantifolia*, commonly known as acid lime, key lime, Mexican lime, or West Indian lime. The fruit is small, round, and has a thin yellow-green rind and flesh.

While *C. aurantifolia* is the main natural host, the phytoplasma can also be graft-transmitted to other *Citrus* species and hybrids, albeit at low frequency and with slower symptom development. Additional hosts include *Citroncirus webberi* (citrange), *Citrus aurantium* (sour orange), *Citrus jambhiri* (rough lemon), *Citrus limetta* (sweet lemon), *Citrus limettioides* (Palestine sweet lime), *Citrus limonia* (mandarin lime), *Citrus macrophylla* (alemow), *Citrus medica* (citron), *Citrus reticulata* (mandarin), *Citrus × tangelo* (tangelo), and *Citrus trifoliata* (trifoliate orange) (Garnier et al., 1991; Azadvar et al., 2023; CABI, 2025).

Dodder (*Cuscuta* spp.) has been used to transmit this phytoplasma to *Catharanthus roseus*, a widely used indicator plant for phytoplasmas (EPPO, 2025).

Symptoms: On acid lime, witches' broom symptoms manifest as small chlorotic leaves, dense shoot proliferations, and twig dieback, progressively affecting the entire tree. Over time, normal leaves and shoots are completely replaced, and the tree ceases to flower or bear fruit. Symptoms typically begin on one or a few branches and spread throughout the tree over several years, leading to tree death within 4–8 years (Al-Subhi et al., 2021). The incidence of WBDL symptoms appears relatively low on other *Citrus* species (Salehi et al., 2022).

Transmission: Phytoplasmas are introduced into sieve cells by phytoplasma-carrying sap-feeding insects of the order Hemiptera, by grafting infected scions, and through parasitic plants such as dodder. *Hishimonus phycitis* is the primary vector of *Ca. Phytoplasma aurantifolia* and several other phytoplasma diseases (Hemmati et al., 2021). This leafhopper belongs to the tribe Opsiini, subfamily Deltocephalinae, in the family Cicadellidae, suborder Auchenorrhyncha (Da Graça et al., 2007). Notably, *Hishimonus phycitis* has not been found in California.

WBDL has spread naturally in Oman, presumably via vectors. Internationally, infected planting material is considered a more likely pathway for long-distance spread. The sudden emergence of WBDL in Oman, where limes have been cultivated for centuries, suggests the disease was introduced from elsewhere.



The Asian citrus psyllid (*Diaphorina citri*), a known vector of Huanglongbing, can experimentally transmit *Ca. Phytoplasma aurantifolia* at a lower efficiency in a no-choice assay (Queiroz et al., 2016). *Diaphorina citri* is present in California and is under official control. It is also a vector of Huanglongbing, which is classified as transient, actionable, and under eradication in several Southern California counties (<u>CDFA Action Plan</u>).

Damage Potential: Ca. Phytoplasma aurantifolia is a well-characterized phytoplasma causing a lethal disease of citrus. It is a significant limiting factor for acid lime production in the Middle East. It poses a threat to global production. Trees of any age can become infected. Since 1975, Oman has lost 98% of their acid limes to WBLD. Between 2000 and 2010, Iran lost 30% of their acid lime trees (over half a million trees/7000 hectares) (Mardi et al., 2011). California already has one of the two known vectors of WBLD as an invasive pest. Asian citrus psyllids are established in the citrus-growing areas of Southern California and on the Central Coast as far north as northern Santa Barbara County, with limited colonies in the San Francisco Bay area (CDFA PDR Database, 2025).

<u>Worldwide Distribution</u>: *Ca.* Phytoplasma aurantifolia has been reported in Oman, the United Arab Emirates, Saudi Arabia, Iran, and Brazil (Al-Subhi et al., 2021; Bové, 1986; Garnier et al., 1991; Bové et al., 2000).

<u>Official Control</u>: *Ca.* Phytoplasma aurantifolia is listed on the European and Mediterranean Plant Protection Organization (EPPO) A1 list for Argentina, the Asia and Pacific Plant Protection Commission (APPC), the European Union (EU), Serbia, Switzerland, Türkiye, the United Kingdom, and Uruguay. It is on the A2 list for Bahrain and Iran and is a quarantine pest in China, Israel, Morocco, and Tunisia (EPPO, 2025).

The USDA Phytosanitary Certificate Issuance & Tracking System (PCIT) lists it as a harmful organism for Colombia, the European Union, Indonesia, the Republic of Korea, and Uruguay (USDA-PCIT, 2025). It is also designated as a U.S. Regulated Plant Pest (USDA-APHIS).

California Distribution: none

California Interceptions: none

The risk posed by Ca. Phytoplasma aurantifolia to California is evaluated below.

Consequences of Introduction:

1) Climate/Host Interaction: *Citrus aurantifolia* is sensitive to cold temperatures and grows in warmer parts of Southern California. The phytoplasma is likely to be found wherever its hosts are grown.

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 be established in a larger but limited part of California.
- High (3) likely to establish a widespread distribution in California.
- 2) Known Pest Host Range: The natural host range is limited to citrus, but there are many experimental hosts in multiple families.

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: Phytoplasmas are limited to living inside the vascular systems of their hosts.

Evaluate the natural and artificial dispersal potential of the pest.

Score: 2

- 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: WBLD is a lethal pathogen of citrus. In the 4-8 years it takes the tree to die, it stops flowering and producing fruit. It is a quarantine pest in many countries. It is vectored by insects, which are also pests.

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

Economic Impact: A, B, C, E

- A. The pest could lower crop yield.
- B. The pest could lower crop value (including increasing crop production costs).
- C. The pest could trigger the loss of markets (including 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: As a US-regulated pest, detections in California could trigger regulatory action up to and including tree removals. This disease would impact home gardeners.



Evaluate the environmental impact of the pest on 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 Ca. Phytoplasma aurantifolia: medium

Add up the total score and include it here. **12** -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 the 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 = 12



Uncertainty:

Asian citrus psyllid, *Diaphorina citri*, is also a vector of Huanglongbing (HLB), which is transient, actionable, and under eradication in several counties in Southern California <u>https://www.cdfa.ca.gov/citrus/docs/committee/ActionPlan.pdf</u>. Symptoms of HLB could overlap with symptoms of WBLD, making field detection more difficult.

Conclusion and Rating Justification:

Based on the evidence provided above the proposed rating for *Ca.* Phytoplasma aurantifolia is A.

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Responsible Party:

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*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.

Pest Rating: A