CALIFORNIA DEPARTMENT OF FOOD & AGRICULTURE

California Pest Rating Proposal for

Candidatus Phytoplasma australiense Davis, Gillaspie, Vidaver & Harris 1997

Australian grapevine yellows

Current Pest Rating: None

Proposed Pest Rating: A

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

Comment Period: 03/05/2024 through 04/19/2024

Initiating Event:

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

History & Status:

Background: In 1967, Doi et al. observed mollicutes in the phloem of plants exhibiting yellows and witch's broom symptoms. Initially called mycoplasma-like organisms, these single-celled bacteria that lack a cell wall were renamed phytoplasmas. Phytoplasmas are phloem-limited pleomorphic bacteria lacking the cell wall, mainly transmitted through leafhoppers, but also by plant propagation materials. They cause yellowing symptoms by clogging some of the sieve tubes and interfering with the transportation of photosynthate out of the leaves. They can also produce biologically active substances that are toxic, causing the death of the leaves, inflorescences, and vegetative buds of their hosts. Because descriptions of organisms cultured in vitro are required for naming of species in the class Mollicutes, and phytoplasmas are very difficult to isolate and grow in culture, phytoplasma lineages are generally referred to as "*Candidatus* Phytoplasma species." (Davis and Sinclair, 1998).

A "yellows disease" of grapes was first observed in 1975 in Australia and was immediately suspected to be caused by a mycoplasma-like organism (Magarey and Wachtel, 1986). Its sensitivity to the bactericidal antibiotic tetracycline and electron microscopic observations of phytoplasma in the phloem of diseased grapevines provided adequate evidence to support a phytoplasmal etiology. The symptoms were nearly identical to those attributed to *flavescence dorée* in France. In 1997, Davis et al.

were able to use molecular techniques to amplify phytoplasma DNA from diseased grapevines. The use of the 16S rDNA operon is the most frequent approach to identify and characterize phytoplasmas, specifically the ~1.2-kb 16S rDNA F2nR2 fragment, which can be amplified through a nested PCR reaction with appropriate primers. They named the pathogen "*Candidatus* Phytoplasma australiense" and reported it as the putative cause of Australian grapevine yellows disease.

There are more than 10 taxonomically unrelated phytoplasmas that are associated with grapevine diseases (Tessitori et al., 2018; CABI-CPC, 2021). They cause nearly identical symptoms and are loosely referred to as 'grapevine yellows'. There are two that are problematic in Europe: Flavescence doree is caused by a phytoplasma classified in 16s rRNA RFLP group 16rV (elm yellows and related phytoplasmas) and bois noir (Vergilbungskrankheit, stolbur, or southern European grapevine yellows) is caused by a phytoplasma classified in 16S rRNA gene RFLP group 16SrXII (Stolbur group). *Ca.* Phytoplasma australiense is also in the Stolbur group (16SrXII), in subgroup 16SrXII-B (Davis and Sinclair, 1998).

Candidatus Phytoplasma australiense is associated with several diseases in Australia and New Zealand. Important commercial crop hosts include grapevine, papaya, strawberry, and cabbage trees (Andersen et al., 2001). Yellows diseases are often vectored by phloem-sucking insects, specifically by leafhoppers, planthoppers, and psyllids, and by propagation or grafting with infected plant materials. It is listed as a quarantine pest for the USA.

Hosts: Asclepias physocarpa (balloon plant), *Apium graveolens* (celery), *Carica papaya* (papaya), *Catharanthus roseus* (periwinkle), *Cicer arietinum* (chickpea), *Coprosma macrocarpa* (coprosma), *Coprosma robusta* (coprosma), *Cordyline australis* (cabbage tree), *Cordyline banksii* (cabbage tree), *Cucumis myriocarpus* (paddy melon), *Cucurbita maxima* (pumpkin), *Cucurbita moschata* (pumpkin), *Exocarpos* (*Exocarpus*) *cupressiformis* (cherry ballart), *Fragaria x ananassa* (strawberry), *Fragaria virginiana* (strawberry), *Gomphocarpus fruticosa* (also cited as *G. fructicosus)* (cottonbush; swan plant), *Jacksonia scoparia* (winged broom pea), *Liquidambar* (*Liquidamber*) *styraciflua* (sweetgum), *Medicago sativa* (alfalfa), *Melilotus indicus* (hexham scent), *Paulownia fortunei* (paulownia), *Phaseolus vulgaris* (bean), *Phormium cookianum* (mountain flax), *Phormium tenax* (New Zealand flax), *Rubus loganobaccus* (logan berry), *Rubus ursinus* (boysenberry), *Solanum pseudocapsicum* (Jerusalem cherry), *Solanum tuberosum* (potato), *Trifolium pratense* (red clover), *Vigna radiata* (mung bean), *and Vitis vinifera* (grape) (EPPO, 2024; Sullivan and Mackesy, 2013).

Symptoms: Symptoms caused by *Ca.* Phytoplasma australiense are nearly identical to the yellows diseases caused by other phytoplasma species. As the name "grapevine yellows" suggests, infected grapes have leaves that turn yellow and curl downward. Shoots are stunted and unlignified. Any time after flowering, berry bunches may shrivel and fall. Disease incidence is highest in the warmer, inland regions of Australia and some cultivars show more symptoms than others (Magarey and Wachtel, 1986). The leaves of affected plants are thicker than normal, brittle, rolled downward, and show veinal yellowing followed by necrosis. Shoots of affected branches exhibit rows of black pustules that develop along the internodes. Due to incomplete lignification, these shoots are more flexible than normal and

confer a drooping aspect to the plants. Flowers and berry bunches are whiter and desiccated (CABI, 2023).

On *Cordyline,* the disease is called “sudden decline”. Leaves of affected trees droop, turn brown, and fall off over two or three months. The bark on the trunks becomes whitish and loosely flaky. Over time, dead branches appear square-tipped and drop off the main trunks. Once infected, trees do not recover. Dead trees gradually rotted and disappeared altogether after two to four years (Brockie, 2020).

Strawberries infected with *Ca*. Phytoplasma australiense can develop “green petal disease” (Brochu, et al., 2021). The symptoms include the flower petals changing from white to green in color, with the development of a central fruit-like structure and strawberry fruit phyllody. The phyllody symptom appears inside the developed fruit and coexists with the green flowers. Infected plants are easily recognized from these symptoms. Additionally, leaves can redden.

Transmission: Phytoplasmas are transmitted by phloem sap-feeding insect vectors, mainly leafhoppers, in a persistent-propagative manner. In New Zealand, the insect vectors have been confirmed to be the endemic cixiid planthoppers *Zeoliarus atkinsoni* and *Z. oppositus*, while in Australia no vector has yet been determined, although the leafhopper, *Orosius argentatus*, is suspected to be a vector. The spread of the phytoplasma is possible through infected vegetative propagating material but it is not seed-borne (CABI, 2024). These vectors are not known to be in California.

Damage Potential: Grapevines infected with yellows disease exhibit a decline in vine growth, significant yield loss, and poor fruit quality. It is an economic problem for Australian viticulture but varies from season to season in the losses it causes. It is estimated that crop loss becomes economic when the incidence of yellows disease exceeds ~20% vines of vines in a vineyard. Fruit produced by infected plants may show delayed or uneven ripening and may have altered concentration in sugar or other compounds, resulting ultimately in lower-quality juice. Severely affected grape vines can produce up to 54% less fruit than healthy grape vines (CABI, 2024).

Papaya dieback is responsible for annual losses of 10% and up to 100% during epiphytotics in central and southern Queensland plantations (Guthrie et al., 1998). Infected strawberries do not yield marketable fruit (Andersen et al., 2001).

Worldwide Distribution: Australia, Israel, New Caledonia, and New Zealand (CABI, 2024).

Official Control: *Ca.* Phytoplasma australiense is on the EPPO’s A1 list for Bahrain, Chile, the European Union, Switzerland, and the United Kingdom, and the Quarantine list for China and the United States (EPPO, 2024). It is on the USDA PCIT’s harmful organisms list for Chile, China, Colombia, Costa Rica, European Union, Japan, and Morocco (USDA, 2024).

California Distribution: None

California Interceptions: None

The risk that *Candidatus* Phytoplasma australiense would pose to California is evaluated below.

Consequences of Introduction:

1) **Climate/Host Interaction:** This pathogen could likely infect grapevine wherever this crop can grow. Its ability to spread and cause an epidemic is limited by the availability of vectors.

   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 host range is large including multiple agronomic crops, plus ornamentals and weeds.

   Evaluate the host range of the pest.

   Score: 3
   - 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:** This disease can spread with the trade of planting material and with the spread of infectious vectors.

   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:** Ca. Phytoplasma australiense is a very serious grapevine yellows disease in vineyards in Australia and a quarantine pest in the United States. The most common damage associated with the significant loss of grape and wine production is due to the progressive decline of the plants. In most cases, especially in the more sensitive varieties, the infected grapevines die within a few years.

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

   Economic Impact: A, 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: Detections would have a significant impact on nurseries. It could infect native species and wild grapevines, although if it is asymptomatic on these hosts, it would not cause damage. These could however be subject to abatement or insecticide treatments, as they are potential reservoirs of the pathogen and vectors.

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

Environmental Impact: A, D
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 *Candidatus* Phytoplasma australiense*:* High

Add up the total score and include it here.
-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 ns.

-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* ***= 14***

Uncertainty:

There may be additional North American hosts of this disease and additional vectors not found in Australia. There could be asymptomatic hosts, or other methods of disease transmission that are not yet understood.

Conclusion and Rating Justification:

Based on the evidence provided above the proposed rating for ***Candidatus*** **Phytoplasma australiense is A.**

References:

Andersen, M.T., Beever, R.E., Sutherland, P.W. and Forster, R.L., 2001. Association of "*Candidatus* Phytoplasma australiense" with sudden decline of cabbage tree in New Zealand. Plant Disease, 85(5), pp.462-469.

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Brochu, A.S., Rodríguez-Martínez, D., Goulet, C. and Pérez-López, E., 2021. Strawberry green petal disease: a diagnostic guide. Plant Health Progress, 22(4), pp.591-595.

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Responsible Party:

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***Comment Period: 03/05/2024 through 04/19/2024**

***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
