

California Pest Rating Proposal for *'Candidatus Phytoplasma pyri'* Seemüller & Schneider 2004

**Pear decline phytoplasma
Yellow leaf roll of peach**

Current Pest Rating: none

Proposed Pest Rating: B

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

Comment Period: 01/24/2023 through 03/10/2023

Initiating Event:

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

History & Status:

Background:

California produces about 70% of the nation's peaches and 100% of nectarines (valued together at \$308M). Peaches and nectarines are grown commercially from the northern end of the Sacramento Valley to the southern end of the Central Valley. California is the 3rd largest pear producing state after Washington and Oregon with production on 10,000 acres mainly in Mendocino, Lake, and Sacramento counties. The value for California pears in 2020 was \$68M.
(https://www.cdfa.ca.gov/Statistics/PDFs/2021_Ag_Stats_Review.pdf).

Formerly referred to as Mycoplasma-like organisms, phytoplasmas are phloem-limited prokaryotes, lacking a cell wall. They are mainly transmitted by leafhoppers, though they can also be moved with plant propagative materials. A broad diversity of strains have been associated with disease symptoms in hundreds of plant species (Lee et al., 2000). Many cause yellowing symptoms by clogging phloem tissue sieve tubes and interfering with transportation of photosynthate out of the leaves. They can also produce biologically active toxic substances, causing 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. 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; Firrao et al., 2004).

Molecular analyses have provided information about the diversity and genetic interrelationships of phytoplasmas. A classification scheme based on actual and virtual RFLP analyses of the 16S rRNA gene sequence has allowed the identification of 36 phytoplasma groups and more than 100 subgroups. To date, nearly 50 species of the provisional genus "*Ca. Phytoplasma*" have been formally described (Miyazaki et al., 2018).

Candidatus *P. pyri* (16SrX-C subgroup) has been described as the cause of pear decline, a disease that affects pear production by causing severe damage and losses in this crop in both hemispheres (Seemüller and Schneider, 2004). Pear decline has varying effects on the trees depending on variety, rootstock, quality of the growing site, and pear psyllid (the vector) numbers. The importance of *Ca. P. pyri* in pear production is increasing, and it is regulated as a quarantine pathogen in the European Union (A2 List) and other regions (EPPO, 2022). Loss of pear crop and tree vigor, and sometimes loss of trees, can occur from pear decline.

Peach yellow leaf roll was first described by Schlocker and Nyland in 1948, with the disease found in Butte, Placer, Sutter, and Yuba counties and occasionally in San Joaquin and Stanislaus counties. The disease caused moderate losses in the 1950s and 1960s, with the incidence increasing dramatically in the late 1970s when a major epidemic reportedly killed tens of thousands of peach trees in 1979 alone (Purcell et al., 1981).

In 2002, Blomquist and Kirkpatrick described two major phytoplasma diseases in California affecting peaches, *Ca. P. pruni* (western X-disease), and *Ca. P. pyri* (peach yellow leaf roll and pear decline). The main vector of *Ca. P. pyri* is the pear psyllid *Cacopsylla pyricola* (Davies et al., 1992), a widespread insect, by which *Candidatus* *P. pyri* is thought to have been introduced into California (Purcell and Suslow, 1984). The disease is no longer found at epidemic levels due to clean planting programs and psyllid control with insecticides, but County restrictions are in place to prevent the movement of uncertified peach and nectarine trees for planting from Northern to Southern California (<http://pi.cdfa.ca.gov/pqm/manual/pdf/507.pdf>).

Hosts: *Corylus avellana* (hazel), *Cydonia oblonga* (quince), *Malus domestica* (apple), *Prunus armeniaca* (apricot), *P. avium* (sweet cherry), *P. dulcis* (almond), *P. persica* (peach and nectarine), *P. salicina* (Japanese plum), *Pyrus betulifolia* (birchleaf pear), *P. calleryana* (callery pear), *P. communis* (pear), *P. pyrifolia* (Oriental pear tree), *P. pyrifolia* var. *culta* (Asian pear), *P. ussuriensis* (Harbin pear), *Ribes* spp. (currant) (EPPO, CABI, 2022).

Symptoms: Pear and peach trees infected by this phytoplasma exhibit symptoms of yellowing, reddening, loss of vigor, early blooming, and, in some cases, a general collapse and death (Sabaté et

al., 2018). Symptoms are most apparent in late summer with the premature development of autumn leaf color on affected trees. Most pear cultivars develop a premature red color when infected, but some may develop a premature yellow color. There may be some leaf cupping or curling and there is usually premature leaf drop. The following spring affected trees suffer from weak growth and sparse pale foliage. The severity of the spring symptoms can vary from almost none to tree death. There may be a line of necrotic tissue in the bark at the graft union between scion and rootstock. In peaches, phytoplasma infection produces leaves of a normal size, but they are yellow and roll downward by late summer (thus the common name of yellow leaf roll). The leaf midribs and lateral veins are enlarged, sometimes with leaf shot holing. Tree decline can be very rapid; however, the infected trees generally take 2 to 3 years to die after the onset of symptoms (Blomquist and Kirkpatrick, 2002).

Ca. P. pyri is found in mature sieve tubes in the phloem of affected trees but is best detected in late summer, autumn and early winter when the titers are highest (Schaper & Seemüller, 1982). The pathogen may also be unevenly distributed through the tree, requiring several different parts of the tree to be tested. Disease development and symptoms expressed are highly influenced by the rootstock as well as the length of time the tree has been infected (Seemüller et al., 2011).

Transmission: *Candidatus P. pyri* can be transmitted by grafting, budding, and chip budding. *Candidatus P. pyri* is also spread by the pear psyllid *Cacopsylla pyricola* (Davies et al., 1992), a C-rated pest in California (Varela et al., 2012). It is likely that related species, *C. pyri* and *C. pyrisuga* can also act as vectors (CABI, 2022). The pear psyllid is already one of the most serious insect pests of pears because of its feeding damage on its hosts and its ability to develop resistance to insecticides.

For peach and nectarine orchards in California, the source of infected psyllids and phytoplasma inoculum is infested pear orchards. In late fall, psyllids disperse from pear orchards to overwinter in adjacent peach orchards. Pear psyllids are found on peach trees only at this time. There is usually a gradient of diseased trees observed in affected peach orchards, with the highest percentage of infected trees closest to the peach-pear orchard border (Blomquist and Kirkpatrick, 2002). Pear growers are now aware that pears are the primary reservoir for *Ca. P. pyri* in northern California. Using insecticides to control late season populations of pear psyllids has greatly reduced the incidence of transmission to peaches. Hundreds or even thousands of pear psyllids appear to be necessary for transmission of *Ca. P. pyri* to peach, making it a comparatively rare event compared to transmission from pear to pear. Peaches and nectarines become a dead-end host with the vectors not actively spreading the disease from peach to peach.

Damage Potential: In the mid-20th century, serious epidemics of *Ca. P. pyri* were reported in California peaches and pears, mostly in the Sacramento and San Joaquin valleys. Pears are the main host of this pathogen worldwide, and there are cultivars that are considered highly susceptible, with some rootstocks prone to rapid tree collapse (quick decline) The disease is also seen on quinces. Fruits, if produced, are smaller and fewer than from healthy trees.

Worldwide Distribution: Africa: *Libya, Tunisia*. Americas: *Argentina, Canada, Chile, United States of America* (California, Connecticut, Oregon, Utah, Washington). Asia: *Azerbaijan, Iran, Israel, Lebanon*. Europe: *Albania, Austria, Bosnia and Herzegovina, Belarus, Belgium, Bulgaria, Croatia, Czech Republic,*

France, Germany, Greece, Hungary, Italy, Moldova, Netherlands, Norway, Poland, Portugal, Serbia, Slovakia, Slovenia, Spain, Switzerland, Turkey, United Kingdom (EPPO, 2022).

Official Control: *Ca. P. pyri* is on the EPPO's A1 list for Argentina, Bahrain, Brazil, Egypt, Jordan, Kazakhstan, Paraguay, Uruguay; on the A2 list for the Eurasian Economic Union, the European and Mediterranean Plant Protection Organization, and Turkey; a Quarantine pest for Canada, China, Israel, Mexico, Moldova, Morocco, Norway, Tunisia; and a regulated non-quarantine pest for Switzerland, and the United Kingdom (EPPO, 2022). It is on the USDA PCIT's harmful organism list for Brazil, Colombia, Eurasian Customs Union, Mexico, Morocco, Paraguay, The Republic of Korea, and Uruguay (USDA-PCIT, 2022).

Some California counties maintain restrictions on yellow leaf roll of peach in lieu of a formal interior quarantine. The agricultural commissioners in the southern California area have established restrictions on the movement of host materials from infested counties. Counties enforcing restrictions include Imperial, Kern, Los Angeles, Orange, Riverside, San Bernardino, San Diego, Santa Barbara, and Ventura. Infested regulated areas are the entire counties of Butte, Fresno, Kings, Madera, Merced, Placer, San Joaquin, Stanislaus, Sutter, Tulare, Yuba, and any other county subsequently found infested with this disease (this includes Yolo County). Regulated articles include peach and nectarine trees (*Prunus persica* and *P. persica* var. *nectarina*, respectively), including their flowering forms, and all parts of these trees for or capable of propagation except fruit pits and registered trees or budwood identified by an official state tag and seal (<http://pi.cdfa.ca.gov/pqm/manual/pdf/507.pdf>).

California Distribution: Butte, Fresno, Kings, Madera, Merced, Placer, San Joaquin, Solano, Stanislaus, Sutter, Tulare, Yolo, and Yuba counties (French, 1989; CDFA PDR database, 2022).

California Interceptions: none

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

Consequences of Introduction:

- 1) Climate/Host Interaction:** It is likely to occur anywhere its hosts can grow in California. The risk of infection in peaches and nectarines is more likely when trees are planted adjacent to infected pears.

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 main host is pear, but other pome fruits and stone fruits are susceptible hosts.
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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:** This pathogen reproduces only within the vascular system of its hosts. In the absence of a vector, it is spread with infected propagative material. Where the vector is present, it spreads rapidly from pear to pear, and occasionally from pear to peach.

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:** *Candidatus P. pyri* causes severe yield losses and even death of trees. It has a flying insect vector established in the state. It is a quarantine pest for some counties.

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

Economic Impact: A, C, 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:** There are no treatments for infected trees. Vector control and budwood certification programs are used to manage the disease. Wild *Prunus* is infected in Europe and acts as a source of inoculum and vectors to stone fruit orchards. There are native *Prunus* spp. in California and their susceptibility to yellow leaf roll is unknown.

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

Environmental Impact: A, 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 *Candidatus Phytoplasma pyri*: 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.

This pathogen is under regulation to prevent its movement from northern to southern California in peach or nectarines. Pears are grown commercially mainly in 3 northern California counties.

Evaluation is 'medium'.

Score: -2

- 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)**
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Final Score: *Score of Consequences of Introduction – Score of Post Entry Distribution and Survey Information = 11*

Uncertainty:

Western X-disease phytoplasma (*Ca. P. pruni*) is generally distributed throughout California and has been detected on plum, cherry, apricot, peach, nectarine, and almond. *Ca. P. pyri* occurs in limited areas of Northern California. There is some overlap in symptoms and a diagnostics lab is necessary to separate them.

Conclusion and Rating Justification:

Based on the evidence provided above the proposed rating for *Ca. Phytoplasma pyri* is B.

References:

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Responsible Party:

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***Comment Period: 01/24/2023 through 03/10/2023**

***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](mailto: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: B
