CALIFORNIA DEPARTMENT OF FOOD & AGRICULTURE

# California Pest Rating Proposal for

## *Candidatus* Phytoplasma prunorum Seemüller & Schneider, 2004

## European stone fruit yellows

**Current Pest Rating: none**

**Proposed Pest Rating: A**

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

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**Comment Period: 01/04/2023 through 02/18/2023**

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## Initiating Event:

*Candidatus* Phytoplasma prunorum is the cause of European stone fruit yellows disease and a target of CDFA's stone fruit commodity surveys. These surveys are done according to the predictions of risk models in commercial orchards, nurseries, and residential areas. This pathogen has not been through the current pest rating process. The risk to California from *Ca.* Phytoplasma prunorum from is described herein and a permanent rating is proposed.

## History & Status:

**Background:**

Collectively referred to as stone fruit, *Prunus persica* (peaches and nectarines), *P. salicina* (fresh plum fruits) and *P. domestica* (French plums, prunes, and pluots), *P. armeniaca* (apricots and hybrids to apricots), *P. avium* (sweet cherries) and *P. cerasus* (tart cherries) are closely related fruit tree crops widely grown in California. California produces about 70% of the nation's peaches and 100% of nectarines (valued at $308M), 95% of apricots (valued at $30M), 95% of fresh plums and 99% of dried plums (valued at $325M). California produces about 20% of the national crop of sweet cherries (valued at $210M). All stone fruit have a similar irrigation demand of about 36-40 inches per year. However, they differ significantly in their dormant chilling requirements. Stone fruit orchards stretch from the

northern end of the Sacramento valley to the southern end of the Central Valley. Residential stone fruit is statewide (https://www.cdfa.ca.gov/Statistics/PDFs/2021_Ag_Stats_Review.pdf).

Phytoplasmas (formerly known as Mycoplasma-like organisms) are phloem-limited pleomorphic bacteria lacking a cell wall, mainly transmitted by leafhoppers, and are also moved with plant propagative materials. They 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).

European stone fruit yellows (ESFY) disease is mainly known in Europe but has also been reported in western Asia. ESFY poses a major threat to stone fruit because of the severity of the disease, its ability to spread, and the fact that infected plants may not show visible symptoms as they allow the vectors to spread disease to more susceptible cultivars. ESFY is an epidemic disease, characterized by rapid and widespread movement when conditions are favorable for host plants and the insects that can spread the disease (Marcone et al., 2011). Previously, the disease was known by the names plum leptonecrosis, apricot chlorotic leaf roll, Cherry Molières disease and others, named according to the crop affected and the symptoms induced (Lorenz et al., 1994).

In 2004, a taxonomic study by Seemüller and Schneider described '*Ca.* Phytoplasma mali' infecting apples, '*Ca.* Phytoplasma pyri' infecting pears and peaches, and '*Ca.* Phytoplasma prunorum' infecting stone fruit, as unique entities. Phylogenetic analyses revealed that the 16S rDNA sequences of strains of these three phytoplasmas were identical or nearly identical, however, supporting data for distinguishing these three at the species level were obtained by examining other molecular markers, including the 16S–23S rDNA spacer region, protein-encoding genes, and randomly cloned DNA fragments. The three phytoplasmas also differed in serological comparisons and showed clear differences in vector transmission and host-range specificity. They concluded that the requirements for defining phylogenetically closely related phytoplasmas as putative species were fulfilled, and that the European stone fruit yellows phytoplasma, which they named *Ca.* Phytoplasma prunorum, is a discrete, coherent taxon.

*Hosts: Celtis australis* (European nettle wood), *Convolvulus arvensis* (bindweed), *Corylus avellana* (hazel), *Cynodon dactylon* (Bermuda grass), *Fraxinus excelsior* (ash), *Prunus* (stone fruit), *P. armeniaca* (apricot), *P. avium* (sweet cherry), *P. cerasifera* (myrobalan plum), *P. cerasus* (sour cherry), *P. domestica* (plum), *P. dulcis* (almond), *P. mahaleb* (mahaleb cherry), *P. mume* (Japanese apricot tree), *P. persica* (peach), *P. salicina* (Japanese plum), *P. spinosa* (blackthorn), *Ribes* (currants), *Rosa canina* (Dog rose), *Vitis* (grape) (CABI, 2022; EPPO, 2022).

*Symptoms*: Symptoms caused by ESFY are influenced by the species, the cultivar, and the environmental factors. The best times for detecting symptoms are before flowering and at the end of the summer. Symptoms can include premature bud-break, leaf vein enlargement, leaf coloration, phloem necrosis and off-season vegetative growth. In apricot, there can be abnormal stimulation of new growth during winter dormancy. In the spring, infected trees will produce their leaves before the flower buds open. If winter temperatures fall below -5°C, infected trees show phloem browning of the middle layer of the bark. The cambium is affected, but in spring the outer bark appears normal, remaining green if the suber layer is sufficiently thin. One to two months later, the exterior bark dries out. Leafroll symptoms develop through the summer, becoming most clearly visible at the end of September. The lamina rolls up along lines running from the petiole to the tip. Irregular interveinal chlorosis is also seen. There can be a proliferation of rudimentary buds at the end of short shoots and a tendency for buds to open on old wood.

The symptoms on *P. salicina* are leaves that are smaller and reddish and show cylindrical rather than conical rolling. Defoliation is earlier than normal and new growth can be initiated between October and December. Diseased branches die within a few years and eventually the entire tree dies (Seemüller and Foster, 1995). On peach symptoms vary according to the cultivar. In some white-fleshed cultivars, red foliage in summer or early autumn and a slight rolling or curling of leaves is observed. In some yellow-fleshed cultivars, symptoms cannot be distinguished from those caused by peach X-disease (*Ca.* Phytoplasma pruni) and peach yellow leaf roll phytoplasma (*Ca.* Phytoplasma pyri).

European plum and cherry can have mildly chlorotic leaves in summer, which are not usually observed until trees reach 3-7 years of age, when small, deformed leaves, rosetting, poor lignification of young shoots, phloem and bark necrosis are observed. The trees bloom abundantly, but flowers are often malformed and fruit set is poor. Fruits that develop have short peduncles, remain small and drop prematurely. Affected trees decline and die (CABI, 2022).

*Transmission:* The plum psyllid *Cacopsylla pruni*, is the only known vector of ESFY in Europe and this psyllid is one of the most serious pests in European stone fruit production. The psyllids migrate to stone fruit orchards for mating and oviposition in early spring, feeding on sap infected with phytoplasma from the plant sieve tube elements, transmitting from plant to plant. The young adults of the new generation leave the prunus trees in summer and emigrate to their overwintering hosts like spruce and other conifers (Gallinger and Gross, 2018). The pathogen is also transmitted over long distances through infected plant materials that were propagated by budding and grafting of infected mother trees. All propagative plant parts except for fruit are a risk for spreading the pathogen (CABI, 2022).

*Damage Potential:* Fewer flowers and fruits develop on diseased trees; fruits are smaller and ripen later than on healthy trees. Sensitive varieties decline and die. Apricot, peach, and Japanese plum are most sensitive to ESFY, which causes considerable economic losses due to the high mortality (Kison and Seemüller, 2001). European plum, myrobalan plum and Damson plum have been found to be affected to a lesser degree (Kison and Seemüller, 2001; Cieślińska, 2011).

**Worldwide Distribution**: Africa: Egypt, Tunisia. Asia: Iran. Europe: Azerbaijan, Belgium, Belarus, France, Italy, Serbia, Albania, Austria, Bosnia and Herzegovina, Bulgaria, Croatia, Czechia, France, Germany, Greece, Hungary, Italy, Poland, Romania, Slovenia, Spain, Switzerland, Turkey, United Kingdom (EPPO, 2022).

**Official Control:** EPPO's A1 list for Bahrain, Chile, and Jordan, the A2 list for Egypt, Turkey, and United Kingdom, on the Alert list for the North American Plant Protection Organization, and a Quarantine pest for Canada, Israel, Mexico, Moldova, Tunisia, and the United States of America (EPPO, 2022). It is on the USDA's PCIT harmful organisms list for Chile, Colombia, Ecuador, Honduras, Japan, Mexico, and the Republic of North Macedonia (USDA PCIT, 2022).

**California Distribution**: none

**California Interceptions**: none

The risk *Ca.* Phytoplasma prunorum would pose to California is evaluated below.

## Consequences of Introduction:

1) **Climate/Host Interaction:** This disease in Europe is most severe around the Mediterranean. It is likely to occur anywhere its hosts can grow in California.

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

   **Score**: **3**
   - 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 *Prunus* but there are records from herbaceous and woody plants in other 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:** This pathogen reproduces only within the vascular system of its hosts. In the absence of a vector, it is spread with infected budwood. Where the vector is present, it spreads rapidly from tree to tree.

   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:** European stone fruit yellows causes severe yield losses and even death of trees. It has a flying insect vector in Europe. It is a quarantine pest for multiple countries.

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. In Europe they use vector control and budwood certification programs 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* sp. in California and their susceptibility to ESFY 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 *Ca.* Phytoplasma prunorum*:* High

Add up the total score and include it here. **14**
-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.

   There are limited annual surveys for this pathogen in California as part of a stone fruit commodity survey. There have been no detections.

   ***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* ***= 14***

## Uncertainty:

Western X-disease phytoplasma (now, *Ca*. Phytoplasma pruni) is generally distributed throughout California and has been detected on plum, cherry, apricot, peach, nectarine, and almond. *Ca.* Phytoplasma pyri occurs in limited areas of Northern California. There is some overlap in symptoms with these and with *Ca*. Phytoplasma prunorum, 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 prunorum is A.

## References:

CABI Crop Production Compendium 2022. https://www.cabidigitallibrary.org/doi/10.1079/cabicompendium.34065 Accessed 12/6/22

Cieślińska, M., 2011. European stone fruit yellows disease and its causal agent '*Candidatus* Phytoplasma prunorum'. Journal of Plant Protection Research, 51(4).

Davis, R.E. and Sinclair, W.A., 1998. Phytoplasma identity and disease etiology. Phytopathology, 88(12), pp.1372-1376.

EPPO Database 2022. https://gd.eppo.int/taxon/PHYPPR

Gallinger, J. and Gross, J., 2018. Unraveling the host plant alternation of *Cacopsylla pruni*–adults but not nymphs can survive on conifers due to phloem/xylem composition. Frontiers in Plant Science, 9, p.484.

Kison, H. and Seemüller, E., 2001. Differences in strain virulence of the European stone fruit yellows phytoplasma and susceptibility of stone fruit trees on various rootstocks to this pathogen. Journal of Phytopathology, 149(9), pp.533-541.

Lorenz, K.H., Dosba, F., Poggi-Pollini, C., Llacer, G. and Seemüller, E., 1994. Phytoplasma diseases of Prunus species in Europe are caused by genetically similar organisms. Journal of Plant Diseases and Protection, pp.567-575.

Marcone, C., Jarausch, B., Jarausch, W. and Dosba, F., 2011. European stone fruit yellows phytoplasma. Virus and virus-like diseases of pome and stone fruits, pp.233-241.

USDA Phytosanitary Certificate Issuance and Tracking System, Phytosanitary Export Database (PExD) Harmful Organisms Database Report. Phytoplasma prunorum. Accessed 12/5/2022

## Responsible Party:

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***Comment Period: 01/04/2023 through 02/18/2023**

***NOTE:**

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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.

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## 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.

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## Proposed Pest Rating: A

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