CALIFORNIA DEPARTMENT OF FOOD & AGRICULTURE

# California Pest Rating Proposal for

## Grapevine flavescence dorée phytoplasma

**Current Pest Rating: none**

**Proposed Pest Rating: A**

Kingdom: Bacteria, Phylum: Tenericutes,
Class: Mollicutes, Order: Acholeplasmatales
Family: Incertae sedis, Genus: "*Candidatus* Phytoplasma"

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**Comment Period: 08/26/2021 through 10/10/2021**

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## Initiating Event:

This pathogen has not been through the pest rating process. The risk to California from Grapevine flavescence dorée phytoplasma (FD) is described herein and a permanent pest 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, their name was later changed to 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 transportation of photosynthate out of the leaves. They can also produce biologically active substances that are toxic, causing 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). The name "*Candidatus* Phytoplasma vitis" has been proposed for the Grapevine flavescence dorée phytoplasma but is not yet accepted by the International Research Programme for Comparative Mycoplasmology (IRPCM) Phytoplasma/Spiroplasma Working Team—Phytoplasma taxonomy group.

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'. They are transmitted by grafting, are usually slow-spreading, and do not typically have vectors. Flavescence (yellowing) dorée (golden) is the most damaging and best

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studied phytoplasma that infects grapevines. This phytoplasma has two described types based on the 16SrV-C and D ribosomal groups, and has been placed in the Elm yellows group, along with Elm yellows and Cherry lethal yellows (Daire et al., 1997).

FD was the first phytoplasma recognized as a pathogen of grapevines and was described from diseased vines in France (Caudwell, 1957). FD and another phytoplasma disease called "Bois Noir" (black wood), caused by '*Candidatus* Phytoplasma solani', are the most important grapevine yellows diseases in Europe. FD can reach epidemic levels and rapidly spread within vineyards due to vine-to-vine transmission by a cicadellid leafhopper. The disease has been described as a crisis-recovery-relapse disease cycle (Ripamonti et al., 2020). The phytoplasma is fastidious and localized in the phloem of infected grapevines. This is also the site of vector feeding. A single infectious insect may be enough to transmit the disease, thus starting an epidemic. Black alder (*Alnus glutinosa*) is a common asymptomatic host of 16SrV phytoplasmas in Europe and is considered the likely original host of FD (Malembic-Maher et al., 2020). However, it has been shown that that the entire life cycle can be completed in the grapevine and the vector. Both *Vitis vinifera* (European grape) and *V. riparia* (riverbank grape) can be infected naturally (Maixner, 1992), along with *Ailanthus altissima* (tree of heaven), additional *Alnus* spp., and *Clematis vitalba* (Filippin et al., 2011).

Flavescence dorée is known mainly from Southern Europe, notably causing serious damage in France, and Italy, and resulting in a quantitative and qualitative decrease of wine production. In these areas it is vectored by the cicadellid, *Scaphoideus titanus*. This ampelophagous insect was introduced into Europe from North America from the Great Lakes area (Caudwell and Dalmasso, 1985). There are no official records of *Scaphoideus titanus* from California, and FD has not been detected in the state. The presence of *S. titanus* in any viticultural region should be regarded as a threat because *S. titanus* is a highly specialized and efficient vector. Any introduction of planting material that is latently infected with the FD phytoplasma might result in serious epidemics of the disease (CABI-ISC, 2021).

*Hosts: Ailanthus altissima* (tree of heaven), *Alnus glutinosa* (black alder), *Alder* spp., *Clematis vitalba* (old man's beard), *Corylus avellana* (hazelnut), *Salix* sp., *Vitis acerifolia* (mapleleaf grape), *V. amurensis* (amur grape), *V. berlandieri* (Spanish grape), *V. coignetiae* (crimson glory vine), *Vitis* hybrids, *V. labrusca* (American grape), *V. pentagona*, *V. riparia* (riverbank grape), *V. rupestris* (mountain grape), *V. vinifera* (European grape), *V. vinifera* subsp. *sylvestris* (European woodland grapevine), *V.* x *champinii*, and *V.* x *doaniana* (EPPO, 2021).

*Symptoms*: The leaves of affected plants are thicker than normal, brittle, and rolled downward, which causes them to assume a triangular shape. They will show veinal yellowing, which is followed by necrosis. In white-fruited grape varieties, leaves develop small yellow spots that enlarge to form yellow bands along the veins. These yellow bands gradually expand to cover the entire leaf surface. Red varieties display similar leaf symptoms, but leaf discoloration is reddish in appearance. Symptoms may be sectorial, limited to a single or a few branches, and randomly distributed with vineyards. Symptoms are influenced by cultivar, environmental conditions, and cultural practices (Eveillard et al., 2016). One feature of this disease is that vines can seem to recover, going into spontaneous and unpredictable remission of symptoms (Belli, et al., 2010).

Shoots of susceptible grapevines demonstrate uneven ripening and fail to fully lignify. Infected shoots have a thin, rubbery appearance, are more flexible than normal, and droop. These shoots often die during the winter. Shoots can exhibit rows of black pustules that form along the internodes. Flowers are desiccated. Fruit set is reduced on infected vines and berries become brown and shriveled.

Disease detection is difficult because symptoms do not always appear every year and may only be present on one shoot or on a small number of shoots. In addition, *V. vinifera* varieties are not equally susceptible to FD and may not show symptoms with equal intensity. Rootstocks that are hybrids of various American *Vitis* spp. present minor symptoms or no symptoms at all (Caudwell et al., 1994).

*Transmission:* Grapevine phytoplasmas are graft- but not seed-transmissible. Some phytoplasmas including FD are spread by insect vectors. FD is transmitted by the leafhopper *Scaphoideus titanus* (Schvester et al., 1963). This insect produces only one generation a year, overwinters in the egg stage, and is strictly associated with grapevine, which it needs to complete its life cycle (Vidano, 1964). After the insect ingests phloem from diseased plants, there is an incubation/latency phase lasting for one to several weeks during which time the phytoplasma circulates, multiplies, and parasitizes various tissues and organs. Once their salivary glands have been colonized, insects are capable of transmitting FD during any subsequent feeding activity for their remaining lifespan. Transmission of the disease is persistent; the pathogen multiplies first in the cells of the diseased plant, and then in the body of the vector.

*Damage Potential:* Grapevines infected with yellows disease exhibit a decline in vine growth, significant yield loss, and poor fruit quality. All varieties of *Vitis vinifera* seem to be susceptible, to varying degrees (Kuzmanovic et al., 2008). Fruit produced by infected plants may show delayed or uneven ripening and may have altered concentration in sugar or in other compounds, resulting ultimately in lower quality juice. American rootstock varieties demonstrate weak symptoms but may serve as reservoirs for the disease. Some of the most important grape varieties are highly susceptible to yellows including Chardonnay, Cabernet sauvignon, Sauvignon blanc, Pinot noir, Pinot blanc, Pinot gris, Riesling, and Sangiovese. Despite attempts to control both the disease and the vector through mandatory measures, FD is still epidemic in several grapevine-growing areas of Southern Europe, where it can significantly impact fruit yield (Jeger et al., 2016).

**Worldwide Distribution**: Austria, Croatia, France, Hungary, Italy, Portugal, Serbia, Slovenia, and Switzerland (EPPO, 2021)

**Official Control:** Flavescence dorée is on the EPPO's A1 list for Argentina, Bahrain, Brazil, Chile, Eurasian Economic Union (EAEU), Egypt, Georgia, Jordan, Kazakhstan, Moldova, Paraguay, Russia, Turkey, Uruguay, Uzbekistan. A2 list for Comite Regional de Sanidad Vegetal del Cono Sur (COSAVE), European and Mediterranean Plant Protection Organization (EPPO), and a quarantine pest for Canada, Israel, Mexico, Morocco, Tunisia, and the United States of America. USDA Harmful organism list for Brazil, Chile, China, Colombia, Costa Rica, Georgia, Israel, Japan, Mexico, Morocco, New Caledonia,

Nicaragua, Oman, Paraguay, Peru, Thailand, Timor-Leste, Turkey, Ukraine, United Arab Emirates, and Uruguay (USDA-PCIT, 2021).

**California Distribution**: None

**California Interceptions**: None.

The risk Grapevine flavescence dorée phytoplasma would pose to California is evaluated below.

## Consequences of Introduction:

1) **Climate/Host Interaction:** It is likely that FD could successfully colonize grapevine wherever this crop is able to grow. Its ability to spread and cause an epidemic is limited by the availability of the *S. titanus* vector. However, *S. titanus* is likely to be able to establish in at least parts of northern and central California grapevine-growing areas. Desert climates with hot and dry conditions are likely to limit establishment.

   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 natural hosts include all *Vitis* spp. plus woody plants in other genera including *Alder*, *Salix*, and *Corylus*.

   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 disease can spread with trade of planting material of *Vitis* spp., and with spread of infectious vectors. There is also the possibility of transfer to grapevines of FD isolates from non-*Vitis* wild plant reservoirs. In Europe, alder (*Alnus* spp.), tree of heaven (*Ailanthus altissima*) and clematis (*C. vitalba*) are symptomless, natural hosts of FD.

   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:** FD is a very serious grapevine yellows disease in vineyards and a quarantine pest in Europe. The most common damage associated with FD is the significant loss of grape and wine production 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 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:** This disease is a quarantine pathogen in the United States and many other countries. Detections would have a significant impact on nurseries. FD 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 vector.

Evaluate the environmental impact of the pest to 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 Grapevine flavescence dorée phytoplasma*:* 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.

   There are no records of Flavescence dorée in California.

   ***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:

There may be additional North American hosts of FD and additional vectors not found in Europe. Despite regulation of both FD and the vector in Europe, including uprooting of the infected plants and insecticide treatments, the disease remains epidemic in some grape-growing areas, suggesting there could be additional vectors, 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 Grapevine flavescence dorée phytoplasma is A.

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## Responsible Party:

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***Comment Period: 08/26/2021 through 10/10/2021**

***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.

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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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