CALIFORNIA DEPARTMENT OF FOOD & AGRICULTURE

California Pest Rating Proposal for

'Candidatus Phytoplasma solani'
Quaglino, Zhao, Casati, Bulgari, Bianco, Wei & Davis 2013

(stolbur phytoplasma/bois noir phytoplasma)

Current Pest Rating: none

Proposed Pest Rating: A

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

Comment Period: 09/22/2021 through 11/06/2021

Initiating Event:

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

History & Status: 16Sr XII-A

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 by leafhoppers, but also by plant propagative materials. They cause yellowing symptoms by clogging some of the sieve tubes of the phloem tissue 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. 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). '*Ca.* Phytoplasma solani' strains are associated with bois noir (black wood) disease of grapevine, and with stolbur disease in wild and cultivated herbaceous and woody plants (Quaglino, 2017).

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 spread by leafhopper vectors. They are fastidious and localized in the phloem of infected grapevines. This is also the site of vector feeding. Bois noir was first reported in 1961 by Caudwell in vineyards of northeastern France. Its symptoms were the same as for Flavescence dorée (golden yellowing) phytoplasma. Flavescence dorée spreads more slowly and is transmitted by a different vector (*Scaphoideus titanus*, in contrast to Bois noir, which is vectored by the insect *Hyalesthes obsoletus)*. Bois noir has spread to many countries in the Euro-Mediterranean area and to some on other continents, especially in Asia, where it is responsible for serious crop losses (Belli et al., 2010; CABI-CPC, 2021). '*Ca.* Phytoplasma solani' strains are also associated with stolbur disease in wild and cultivated herbaceous and woody plants (Quaglino et al., 2013). *Hyalesthes obsoletes,* the most common vector, is not known to transmit any other phytoplasmas (Langer and Maixner, 2004). Neither '*Ca.* Phytoplasma solani', nor the vector *H. obsoletes*, are known to be in California (CDFA PDR database).

Hosts: Actinidia deliciosa (kiwifruit)*, Allium ampeloprasum* (wild leek), *Amaranthus retroflexus* (redroot pigweed), *Anethum graveolens (dill), Apium graveolens* (celery), *Artemisia scoparia, Artemisia vulgaris* (mugwort), *Asteraceae, Beta vulgaris* (beet), *Brassica oleracea* (cabbages, cauliflowers), *Brassica rapa* (field mustard), *Bupleurum tenuissimum, Calendula officinalis* (Pot marigold), *Calystegia sepium* (great bindweed), *Cannabis sativa* (hemp), *Capsicum annuum* (bell pepper), *Carica papaya* (pawpaw), *Catharanthus roseus* (Madagascar periwinkle)*, Cephalaria transylvanica, Chenopodium album* (fat hen), *Cichorium intybus* (chicory), *Cirsium arvense* (creeping thistle), *Convolvulus arvensis* (bindweed), *Cuscuta* (dodder), *Cynara cardunculus* var. *scolymus* (globe artichoke), *Cytisus scoparius* (Scotch broom), *Datura stramonium* (jimsonweed), *Daucus carota* (carrot), *Dianthus barbatus* (sweet william), *Dianthus deltoides* (maiden pink), *Echinacea purpurea* (purple coneflower), *Echium vulgare* (common viper's-bugloss), *Erigeron bonariensis, Eucalyptus camaldulensis* (red gum), *Euonymus japonicus* (Japanese spindle tree), *Euphorbia falcata, Fallopia convolvulus* (black bindweed), *Ficus carica* (common fig), *Fragaria ananassa* (strawberry), *Freesia, Galium, Gomphocarpus physocarpus* (balloon cotton bush)*, Helianthus annuus* (sunflower), *Helminthotheca echioides* (bristly oxtongue), *Hibiscus cannabinus* (kenaf), *Hypericum barbatum, Hypericum perforatum* (St. John's wort), *Jasmium officinale, Lactuca saligna, Lavandula angustifolia* (lavender), *Lavandula x intermedia, Lepidium draba* (hoary cress), *Linaria vulgaris* (common toadflax), *Lotus corniculatus* (bird's-foot trefoil), *Malus domestica* (apple), *Malva sylvestris, Medicago sativa* (lucerne), *Mentha arvensis* (corn mint), *Mentha piperita* (peppermint), *Mercurialis annua, Monarda fistulosa, Nicotiana tabacum* (tobacco), *Oenothera biennis* (common evening primrose), *Paeonia* (peonies), *Paeonia suffruticosa* (tree peony), *Paeonia tenuifolia, Pastinaca sativa* (parsnip), *Persea americana* (avocado), *Petroselinum* (parsley), *Phaseolus lathyroides* (phasey bean), *Phaseolus vulgaris* (common bean), *Picris hieracioides* (hawkweed oxtongue), *Pistacia vera* (pistachio), *Pisum sativum* (pea), *Plantago lanceolata* (ribwort plantain), *Plantago major* (broad-leaved plantain), *Polygonum aviculare* (prostrate knotweed)*, Polygonum persicaria* (redshank), *Portulaca oleracea* (purslane), *Potentilla reptans* (sulfur cinquefoil), *Prunus* (stone fruit), *Prunus americana* (American plum), *Prunus armeniaca* (apricot), *Prunus avium* (sweet cherry), *Prunus domestica* (plum), *Prunus persica* (peach), *Punica granatum* (pomegranate), *Pyrus communis* (European pear), *Ranunculus bulbosus* (bulbous buttercup), *Raphanus sativus* (radish), *Rhododendron*

sp., *Rubia peregrina, Rubus fruticosus* (blackberry), *Rumex acetosa* (sour dock), *Salix alba* (white willow), *Salix babylonica* (weeping willow), *Salvia miltiorrhiza, Salvia sclarea, Saponaria officinalis* (soapwort), *Setaria viridis* (green foxtail), *Silene latifolia subsp. alba* (white campion), *Silene vulgaris* (bladder campion), *Solanum dulcamara* (bittersweet nightshade), *Solanum glaucophyllum, Solanum habrochaites, Solanum lycopersicum, Solanum melongena* (eggplant), *Solanum nigrum* (black nightshade), *Solanum tuberosum* (potato), *Sonchus* (Sowthistle), *Sophora alopecuroides, Sorghum halepense* (Johnson grass), *Syringa vulgaris* (lilac), *Tagetes erecta* (Mexican marigold), *Taraxacum officinale complex* (dandelion), *Thymus vulgaris* (thyme), *Trifolium* (clovers), *Trifolium pratense* (red clover), *Triticum aestivum* (wheat), *Tussilago farfara* (Colt's-foot), *Ulmus glabra* (mountain elm), *Urtica dioica* (stinging nettle), *Urtica urens* (annual nettle), *Vaccinium corymbosum* (blueberry), *Valeriana officinalis* (common valerian), *Vicia villosa* (hairy vetch), *Vinca minor* (common periwinkle), *Viola odorata* (English violet), *Vitex agnus-castus* (lilac chastetree), *Vitis* sp. (grape), *Vitis vinifera* (grapevine), *Zea* sp.*, Zea mays* (maize) (EPPO, 2021).

Symptoms: Symptoms caused by '*Ca.* Phytoplasma solani' are variable and are affected by environmental factors. Annual crops develop symptoms within weeks of inoculation by the vector, while symptoms on perennial hosts may not develop until one or more years after infection (Eveillard et al., 2016; EFSA, 2014). The leaves of affected grapevines are thicker than normal, brittle, and rolled downward, which causes them to assume a triangular shape. They will show veinal yellowing 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 within vineyards. Symptoms are influenced by cultivar, environmental conditions, and cultural practices. One feature of this disease is that vines can exhibit remission of symptoms, but apparent recovery may be followed by spontaneous and unpredictable reappearance 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 Bois noir and may not show symptoms with equal intensity (Quaglino, 2017).

Symptoms of '*Ca.* Phytoplasma solani' infection on tomato include short internodes near the plant meristem, and smaller curled leaves with thicker tissues. The leaves show yellow and purple discoloration. Adventitious roots sometimes appear on the stem. Plants infected early become bushy following the development of numerous axillary buds. The flowers are abnormally straight, sterile, and can have sepals with purple veins, or remain completely sealed with an enlarged calyx (big bud symptom); petals and stamens remain green (virescence); sepals can develop into leaves (phyllody), or fail to differentiate. Fruits are smaller, remaining green with a higher density, leading to a significant yield loss (CABI, 2021).

Potatoes grown from infected tubers can show spindly sprouts (hair-sprouting). If they have normal sprouts, they may become yellow with rolling of the leaves. This is followed by production of aerial stolons and tubers in different parts of the stems close to the axils. There can be upward rolling and purplish or red discoloration of the top leaves, shortened internodes, early senescence followed by plant wilting and death (Holeva et al., 2014; Mitrović et al., 2016).

Maize redness symptoms are more severe in areas with early-planted fields and hot, dry summers (Jovic et al., 2009). Midrib reddening is followed by reddening of leaves and stalks and then whole-plant desiccation. Maize redness also involves abnormal ear development and reduced seed numbers, and reduction in yield. Lavender decline involves yellowing and either standing up or rolling down of the leaves, and reduction and abortion of inflorescences (Boudon-Padieu and Cousin 1999). symptoms may be localized to only some branches or affect the whole plant. Affected branches dry, resulting in plants with a mix of dead and green branches. After several growth cycles, the plants become completely brown and dry (Boudon-Padieu and Cousin, 1999).

Transmission: Phytoplasmas are graft- but not seed-transmissible, and they can be transmitted by the parasitic plant dodder (*Cuscuta* spp.). '*Ca.* Phytoplasma solani' is transmitted from plant to plant by the polyphagous insect *Hyalesthes obsoletus* (Cixiidae), and this is the only known vector of Bois noir disease in grapevine. This insect can only complete its life cycle on a small number of plant species, but it feeds on a much wider range. Perennial plants are the main reservoirs of the phytoplasma and hosts of the vectors (Weintraub and Beanland, 2006). *Convolvulus arvensis* (bindweed) and *Urtica dioica* (nettle) have been reported as being the main host plants of *H. obsoletus* in Europe (Mori et al., 2013). All crops except lavender are considered epidemiological dead-end hosts as *H. obsoletus* does not develop on any others (Weintraub and Beanland, 2006). It does incidentally transmit '*Ca.* Phytoplasma solani' to other hosts during adult stage probing and feeding. There is no transovarial transfer of '*Ca.* Phytoplasma solani' (EFSA, 2014; Quaglino, 2017). Recent studies have demonstrated the presence of additional insect vectors of this phytoplasma in Europe. Movement of infected propagative material has led to restriction of imports of plants in the family Solanaceae and the genus *Vitis* in Europe. (Quaglino, 2017; Sforza et al., 1998).

Damage Potential: Economic impact of '*Ca.* Phytoplasma solani' is variable, depending on variations in insect vectors, and the prevalence of the other hosts. Economic impact may increase in the future from geographical range extension of the pathogen and from increase in density of vector populations because of climate change (EFSA, 2014;). In severe epidemics, yield losses as high as 60% in tomato, 90% in pepper, and 100% in celery have been reported (Navrátil et al., 2009). Maize redness has been linked to yield reductions of 40–90% in Serbia (Jović et al., 2007). *Ca*. Phytoplasma solani' causes losses in economically important cultivated species, such as grapevine, maize, potato, and tomato (EPPO, 2020). It can survive and complete its life cycle without cultivated host plants, using wild plants or weeds. The main symptom caused by '*Ca*. Phytoplasma solani' on grapevine is the loss of production due to berry shrivel; the economic impact of the disease, especially on susceptible varieties, is significant. '*Ca*. Phytoplasma solani' also has a high impact on lavender because *H. obsoletus* can complete its life cycle on this plant and the disease can become epidemic, destroying fields within 4–5 years in southeastern France (EFSA, 2014).

Worldwide Distribution: Africa: *Niger*. Asia: *Armenia, Azerbaijan, China, Georgia, India, Iran, Israel, Japan, Jordan, Kyrgyzstan, Lebanon, Saudi Arabia, South Korea, Syria, Taiwan, Tajikistan, Turkey, Uzbekistan*. Europe: *Albania, Austria, Bosnia and Herzegovina, Bulgaria, Croatia, Cyprus, Czechia, France, Germany, Greece, Hungary, Italy, Moldova, Montenegro, North Macedonia, Poland, Russia, Serbia, Slovakia, Slovenia, Spain, Switzerland, Ukraine*. South America: *Chile*. (CABI-CPC, 2021).

Official Control: '*Ca*. Phytoplasma solani' is on the EPPO's A1 list for Argentina, Bahrain, Egypt, Jordan, and Paraguay, and on the A2 list for the European Plant Protection Organization and Turkey. It is a quarantine pest in Canada, Israel, Mexico, Morocco, Norway, Tunisia, and the United States. It is also on the USDA-PCIT's harmful organism list for Canada, European Union, and United Kingdom (USDA PCIT, 2021)

California Distribution: None

California Interceptions: None.

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

Consequences of Introduction:

1) **Climate/Host Interaction:** '*Ca*. Phytoplasma solani' occurs in many climates from central and northern Europe, to the Mediterranean, to tropical Africa and Asia. Any climate that supports the hosts are likely to support the phytoplasma, which is a fastidious phloem inhabitant.

   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:** '*Ca*. Phytoplasma solani' has a wide host range, including woody and herbaceous plants, many wild/weed species, ornamentals, and crops. The main natural reservoirs for '*Ca*. Phytoplasma solani' in Europe are field bindweed (*Convolvulus arvensis*) and stinging nettle (*Urtica dioica*) and these occur nearly statewide in CA (Quaglino et al., 2013; Calflora, 2021).

   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 trade of infected planting material and with 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 solani' is a serious grapevine yellows disease in vineyards and a quarantine pest in Europe. The most common damage associated with Bois noir 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. Different from other grapevine yellows phytoplasmas, '*Ca.* Phytoplasma solani' also causes serious disease on other hosts, including potato, tomato and lavender.

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: '***Ca*. Phytoplasma solani' and its main vector have been found in different agro-ecosystems in many countries in Europe and the eastern Mediterranean area. Disease control is difficult in the field, and there is limited information about methods to control the insect vector or about the availability of resistant/tolerant crops. This disease is a quarantine pathogen in the United States and many other countries. Detections would have a significant impact on nurseries.

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 *Candidatus* Phytoplasma solani*:* High

Add up the total score and include it here. **15**
-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 '*Ca.* Phytoplasma solani' 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* ***= 15***

Uncertainty:

There may be additional North American hosts of '*Ca.* Phytoplasma solani' and additional vectors not found in other countries. Despite regulation of both the pathogen 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. Economic impact may increase in the future from range extension and from increase in density of vector populations because of climate change (EFSA, 2014).

Conclusion and Rating Justification:

Based on the evidence provided above, the proposed rating for '*Ca*. Phytoplasma solani' is A.

References:

Belli, G., Bianco, P.A. and Conti, M., 2010. Grapevine yellows in Italy: past, present and future. Journal of Plant Pathology, pp.303-326.

Boudon-Padieu, E. and Cousin, M.T., 1999. Yellow decline of *Lavandula hybrida* Rev and L. vera DC. International Journal of Tropical Plant Diseases, 17(1/2), pp.1-34.

CABI-CPC. 2021. https://www.cabi.org/isc/datasheet/108243 *Candidatus* Phytoplasma solani (Stolbour phytoplasma)

Caudwell, A. 1990. Epidemiology and characterization of flavescence doree (FD) and other grapevine yellows. Agronomie 10, 655-663.

Caudwell, A. and Dalmasso, A., 1985. Epidemiology and vectors of grapevine viruses and yellows diseases. Phytopathologia Mediterranea, pp.170-176.

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

Doi, Y.O.J.I., Teranaka, M., Yora, K. and Asuyama, H., 1967. Mycoplasma-or PLT group-like microorganisms found in the phloem elements of plants infected with mulberry dwarf, potato witches' broom, aster yellows, or paulownia witches' broom. Japanese Journal of Phytopathology, 33(4), pp.259-266.

EFSA Panel on Plant Health (2014) Scientific Opinion on the pest categorization of *Candidatus* Phytoplasma solani. EFSA Journal 12 (12). https://doi.org/10.2903/j.efsa.2014.3924

EPPO (2021) '*Candidatus* Phytoplasma solani'. EPPO datasheets on pests recommended for regulation. Available online. https://gd.eppo.int

Holeva, M. C., Glynos, P. E., Karafla, C. D., Koutsioumari, E. M., Simoglou, K. B. and Eleftheriadis, E. 2014 First report of *Candidatus* phytoplasma solani associated with potato plants in Greece. Plant Disease 98(12), 1739.

Hren, M., Boben, J., Rotter, A., Kralj, P., Gruden, K. and Ravnikar, M., 2007. Real-time PCR detection systems for Flavescence dorée and Bois noir phytoplasmas in grapevine: comparison with conventional PCR detection and application in diagnostics. Plant Pathology, 56(5), pp.785-796.

Jović, J., Cvrković, T., Mitrović, M., Krnjajić, S., Petrović, A., Redinbaugh, M.G., Pratt, R.C, Hogenhout, S.A. and Toševski, I. 2009 Stolbur phytoplasma transmission to maize by *Reptalus panzeri* and the disease cycle of maize redness in Serbia. Phytopathology 99(9), 1053-1061.

Kuzmanovic, S., Martini, M., Ermacora, P., Ferrini, F., Starovic, M., Tosic, M., Carraro, L. and Osler, R., 2008. Incidence and molecular characterization of Flavescence dorée and stolbur phytoplasmas in grapevine cultivars from different viticultural areas of Serbia. VITIS-GEILWEILERHOF-, 47(2), p.105.

Langer, M., and Maixner, M., 2004. Molecular characterization of grapevine yellows associated phytoplasmas of the stolbur-group based on RFLP-analysis of non-ribosomal DNA. Vitis, 43(4), 191-199.

Mori, N., Mitrovic, J., Smiljkovic, M., Duduk, N., Paltrinieri, S., Bertaccini, A., Duduk, B., 2013. Hyalesthes obsoletus in Serbia and its role in the epidemiology of corn reddening. Bulletin of Insectology, 66(2), 245-250. http://www.bulletinofinsectology.org/

Mitrović, M., Jakovljević, M., Jović, J., Krstić, O., Kosovac, A., Trivellone, V., Jermini, M., Toševski, I and Cvrković, T. 2016 '*Candidatus* Phytoplasma solani' genotypes associated with potato stolbur in Serbia and the role of *Hyalesthes obsoletus* and *Reptalus panzeri* (Hemiptera, Cixiidae) as natural vectors. European Journal of Plant Pathology 144(3), 619-630.

Malembic-Maher, S., Desqué, D., Khalil, D., Salar, P., Bergey, B., Danet, J.L., Duret, S., Dubrana-Ourabah, M.P., Beven, L., Ember, I. and Acs, Z., 2020. When a Palearctic bacterium meets a Nearctic insect vector: Genetic and ecological insights into the emergence of the grapevine Flavescence dorée epidemics in Europe. PLoS pathogens, 16(3), p.e1007967.

Navrátil, M, Válová, P, Fialová, R, Lauterer, P, Šafárová, D and Starý, M. 2009. The incidence of stolbur disease and associated yield losses in vegetable crops in South Moravia (Czech Republic). Crop Protection 28(10), 898-904.

Quaglino, F., Maghradze, D., Chkhaidze, N., Casati, P., Failla, O., Bianco, P. A., 2014. First report of '*Candidatus* Phytoplasma solani' and 'Ca. P. convolvuli' associated with grapevine bois noir and bindweed yellows, respectively, in Georgia. Plant Disease. 98 (8), 1151. DOI:10.1094/PDIS-01-14-0026-PDN

Quaglino, F., Zhao Yan, Casati, P., Bulgari, D., Bianco, P. A., Wei Wei, Davis, R. E., 2013. '*Candidatus* Phytoplasma solani', a novel taxon associated with stolbur- and bois noir-related diseases of plants. International Journal of Systematic and Evolutionary Microbiology, 63(8), 2879-2894.

Quaglino, F., 2020. *Candidatus* Phytoplasma solani (Stolbur phytoplasma). Crop Protection Compendium. Wallingford, UK: CABI. DOI:10.1079/CPC.108243.20210104834

Sforza, R., Clair, D., Daire, X., Larrue, J. and Boudon‐Padieu, E., 1998. The role of *Hyalesthes obsoletus* (Hemiptera: Cixiidae) in the occurrence of bois noir of grapevines in France. Journal of Phytopathology, 146(11‐12), pp.549-556.

Tessitori, M., La Rosa, R. and Marzachì, C., 2018. Flavescence dorée and bois noir diseases of grapevine are evolving pathosystems. Plant Health Progress, 19(2), pp.136-138.

USDA Phytosanitary Certificate Issuance and Tracking System, Phytosanitary Export Database (PExD) Harmful Organisms Database Report. Accessed 7/23/2021

Weintraub, P. G., Beanland, L., 2006. Insect vectors of phytoplasmas. Annual Review of Entomology, 51, 91-111. http://www.annualreviews.org doi: 10.1146/annurev.ento.51.110104.151039

Responsible Party:

Heather J. Scheck, Primary Plant Pathologist/Nematologist, CDFA/PHPPS ECOPERS, 2800 Gateway Oaks Suite 200, Sacramento, CA 95833 Phone: (916) 654-1017, permits[@]cdfa.ca.gov.

***Comment Period: 09/22/2021 through 11/06/2021**

***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.

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
