

California Pest Rating Proposal for

Phytophthora pseudocryptogea Safaief., Mostowf., G.E. Hardy & T.I. Burgess 2015

Current Pest Rating: Z

Proposed Pest Rating: B

Kingdom: Chromista: Phylum: Heterokontophyta:

Class: Oomycota

Order: Peronosporales: Family: Peronosporaceae

Comment Period: 5/22/2020 through 7/6/2020

Initiating Event:

In April, May, and June of 2018, CDFA plant pathologist Suzanne Rooney-Latham received samples of pears that were used to bait *Phytophthora* spp. from water collected from nursery stock from a federal park in San Francisco County. This method takes advantage of the fact that *Phytophthora* spp. are attracted to pears and the zoospores will swim to and infect the fruit. It is then much easier to isolate the *Phytophthora* spp. from the pears than from water or nursery soil. The *Phytophthora* species she recovered from the pears were originally identified as *P. cryptogea*, but new sequence data better aligned them with *P. pseudocryptogea*. Sampling of water is an indirect method of detection and does not confirm a specific host-pathogen relationship. However, the nursery stock in the park that was baited included *Heteromeles arbutifolia*, *Mimulus aurantiacus*, *Baccharis pilularis*, *Cotoneaster lacteus*, *Juncus effusus*, *J. lescurii*, *J. phaeocephalus*, *Grevillea lanigera*, and *Diplacus aurantiacus*. Other species of *Phytophthora* were also detected from these samples, highlighting the prevalence of these pathogens in the nursery trade. Subsequently, the pathogen has also be detected directly from diseased nursery stock and landscape trees. The risk to California from *P. pseudocryptogea* is described and a permanent rating is proposed herein.

History & Status:

Background:

Phytophthora pseudocryptogea is an oomycete pathogen that has a wide host range and can cause a range of disease symptoms including root rot, collar and crown rot, and stem cankers. *Phytophthora* spp. are widespread in temperate regions of all continents and occur in soils of natural forests, agricultural fields, landscaping, and orchards. They can persist and spread in different environments and can survive in the soil in the absence of a host. Since the discovery of *Phytophthora ramorum*, causal organism for the Sudden Oak Death and Ramorum blight, there has been an increase of surveys throughout the world for *Phytophthora* spp. which has resulted in the description of several new species. *Phytophthora pseudocryptogea* is a member of clade 8a of the *Phytophthora* phylogenetic tree and was formally described in 2015 as a close relative of *P. cryptogea* and *P. erythroseptica* (Delshad et al., 2018).

Many studies over recent years recognized *Phytophthora cryptogea* as a likely species complex, with several distinct lineages perhaps representing as yet undescribed species (Yang et al., 2017). *Phytophthora pseudocryptogea* was described from the *P. cryptogea* complex in 2015 based on material collected from the roots of dying *Isopogon buxifolius* in Western Australia (Safaiefarahani et al.). Additional specimens in their analysis included isolates from *Xanthorrhoea preissii* and *Banksia cirsioides*, also in Australia, and isolates from *Solanum melongena* from Iran. This species produces abundant sporangia, it has a heterothallic mating system, and chlamydospores are not known. To separate *P. pseudocryptogea* out of the species complex, colony morphology, growth rate, cardinal temperatures, breeding system, and morphology of sporangia, oogonia, oospores, and antheridia were determined. DNA markers from nuclear and mitochondrial genes were also used for speciation. Members of the *P. cryptogea* species complex are all important pathogens of agriculture that have been transported globally. With the apparent ease of hybridization within this group there is ample opportunity for virulent hybrids to form, perhaps with extended host ranges (Safaiefarahani et al., 2016).

Hosts: The full host range of *P. pseudocryptogea* is likely more extensive than the following list of confirmed hosts: *Abies amabilis* (Pacific silver fir), *Actinidia chinensis* (kiwi fruit), *Arbutus marina* (strawberry tree) *Arctotis acaulis* (African daisy) *Banksia cirsioides* (thistle dyandra), *Beta vulgaris* (sugar beet), *Corymbia calophylla* (marri tree), *Cucumis sativus* (cucumber), *Curcubita pepo* (squash), *Daucus* sp. (carrot) *Isopogon buxifolius*, *Juglans regia* (walnut), *Lycopersicon esculentum* (tomato), *Malus pumila* (apple), *Solanum marginatum* (purple African nightshade), *Solanum melongena* (eggplant), *Solanum tuberosum* (potato), *Xanthorrhoea preissii* (Western Australian grass tree) (Farr and Rossman, 2020; Khaliq et al., 2019; Dalshed et al., 2020).

Symptoms: The pathogen infects the host at the soil line causing water soaking and darkening of the trunk bark. This infected area enlarges and may encircle the entire stem of small plants, which wilt and eventually die. On large plants and trees, the infected, necrotic area may be on one side of the stem and become a depressed canker below the level of the healthy bark. Collar rot canker may spread down the root system. Roots are invaded at the crown area or at ground level. Mycelium and spores grow in abundance in cool, wet weather causing damage where the soil is too wet for normal growth of susceptible plants and low temperatures (15-23°C) prevail (Agrios, 2005).

Transmission: Generally, species of *Phytophthora* that cause root, collar, and stem rots survive cold winters or hot and dry summers as thick-walled, resting oospores or mycelium in infected roots or stems or in soil. During spring or fall, the oospores germinate to produce motile spores (zoospores) that swim around in soil water and to the roots of susceptible hosts. Infected soils, plants, nursery and planting stock, and seedlings and rain and irrigation water and cultivation equipment and tools may spread contaminated soil and plant materials to non-infected sites. Inoculum levels can increase exponentially under wet conditions (Agrios, 2005).

Damage Potential: Currently, there are no reports on quantitative economic losses in plant production caused by *Phytophthora pseudocryptogea*. However, infestations may result in significant damage and loss in production and stands of host plants by causing root and collar rots of infected plants. Nursery ornamentals and plants grown in natural ecosystems could be particularly affected. In general for *Phytophthora* spp., young seedlings of trees and annual plants may be killed within a few day, weeks, or months (Agrios, 2005).

Worldwide Distribution: Australia, Ecuador, Iran, Vietnam, and United States (Jung et al. 2020; Croeser et al., 2018; Farr and Rossman, 2020.)

Official Control: None.

California Distribution: Detections have been made in landscapes and nurseries in the following counties: Contra Costa, Marin, Mendocino, San Francisco, Santa Barbara, Santa Clara, Santa Cruz, Sonoma, Solano, Ventura.

California Interceptions: None.

The risk *Phytophthora pseudocryptogea* would pose to California is evaluated below.

Consequences of Introduction:

- 1) Climate/Host Interaction:** *Phytophthora pseudocryptogea* has already been detected in nurseries and landscapes in multiple counties. Within California, it is likely to establish in cool, wet climates when there are susceptible hosts present.

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.**
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- 2) Known Pest Host Range:** The full host range of *Phytophthora pseudocryptogea* is likely not known. Known hosts include woody and herbacious plants from temperate climates.

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:** *Phytophthora pseudocryptogea* is primarily spread artificially via infested soils, plants, nursery and planting stock, seedlings, run-off and splash irrigation water, cultivation equipment, and tools that may spread contaminated soil and plant materials to non-infected sites. It has been detected in water collected from containerized nursery stock. It is not known to produce chlamydospores.

Evaluate the natural and artificial dispersal potential of the pest.

Score: 2

- 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:** Although quantitative economic losses in plant production have not been reported, the potential for infected plants to result in root and collar rot, canker, and shoot dieback could decrease stands on non-infected plants, increase production costs, and cause loss of market of infected nursery stocks. The capability of the pathogen to survive and spread in infected soils and irrigation water could require changes in normal cultivation practices of host plants.

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

Economic Impact: A, B, G

- 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.**
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- 5) **Environmental Impact:** Currently, the host range and geographic distribution of *P. pseudocryptogea* are not fully known. The few known host plants (see 'Hosts' above) can be found in natural ecological habitats as well as in nursery environments. Subsequently, under favorable climate conditions, natural plant communities and ecosystems, as well as home/urban gardening and ornamentals may be negatively impacted.

Environmental Impact: 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 *Phytophthora pseudocryptogea* is High:

Add up the total score and include it here. # (score followed by bolded bullet)

- 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 'Medium'. Detections have been made in multiple counties and clearly it is already in the nursery trade in California.

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.**
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-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 = 11*

Uncertainty:

Due to the fairly recent separation of *P. pseudocryptogea* from *P. cryptogea*, it is possible that many past detections would be changed, making *P. pseudocryptogea* more common in more parts of California, and attacking additional hosts. Continued statewide surveys for *Phytophthora* spp. occurring in nurseries and natural ecosystems (e.g. restoration sites) will contribute to the present knowledge of this pathogen group as well as that of *P. pseudocryptogea*. Consequently, the current proposed rating of *P. pseudocryptogea* may be affected.

Conclusion and Rating Justification:

Based on the evidence provided above **the proposed rating for *Phytophthora pseudocryptogea* is B**

References:

Agrios, G. N. 2005. Plant Pathology fifth edition. Elsevier Academic Press, Massachusetts, USA. 922 p.

Croeser, L., Paap, T., Calver, M. C., Andrew, M. E., St. J. Hardy, G.E., and Burgess, T. I. 2018. Field survey, isolation, identification and pathogenicity of *Phytophthora* species associated with a Mediterranean-type tree species. Forest Pathol. 48(3): e12424.

Delshad, D., Mostowfizadeh-Ghahamfarsa, R. and Safaiefarahani, B. 2020. Potential host range and the effect of temperature on the pathogenicity of *Phytophthora pseudocryptogea* and its close relatives. J Plant Pathol (2020). <https://doi.org/10.1007/s42161-020-00501-w>.

Jung, T., Scanu, B., Brasier, C. M., Webber, J., Milenković, I., Corcobado, T., Tomšovský, M., Pánek, M., Bakonyi, J., Maia, C., Bačová, A., Raco, M., Rees, H., Pérez-Sierra, A., Horta Jung, M. 2020. A survey in natural forest ecosystems of Vietnam reveals high diversity of both new and described *Phytophthora* taxa including *P. ramorum*. Forests 11(1), 93. <https://doi.org/10.3390/f11010093>

Khaliq, A., St. J. Hardy, G. E., McDougall, K. L., and Burgess, T. I. 2019. *Phytophthora* species isolated from alpine and sub-alpine regions of Australia, including the description of two new species; *Phytophthora cacuminis* sp. nov. and *Phytophthora oreophila* sp. nov. Fung. Biol. 123(1): 29-41.

Safaiefarahani, B., Mostowfizadeh-Ghalamfarsa, R., St. J. Hardy, G.E., and Burgess, T.I. 2015. Re-evaluation of the *Phytophthora cryptogea* species complex and the description of a new species, *Phytophthora pseudocryptogea* sp. nov. Mycol. Progr. 14(108): 1-12.

Safaiefarahani, B., Mostowfizadeh-Ghalamfarsa, R., St. J. Hardy, G.E., and Burgess, T.I. 2016. Species from within the *Phytophthora cryptogea* complex and related species, *P. erythroseptica* and *P. sansomeana*, readily hybridize. Fungal Biol. 2016 Aug;120(8):975-987. doi: 10.1016/j.funbio.2016.05.002. Epub 2016 May 14.

Yang, X., Tyler, B.M., and Hong, C. 2017. An expanded phylogeny for the genus *Phytophthora*. IMA Fungus 8(2): 355-384.

Responsible Party:

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***Comment Period: 5/22/2020 through 7/6/2020**

*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[[@](mailto:permits@cdfa.ca.gov)]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
