

California Pest Rating Proposal for *Phytophthora pini* Leonian 1925

Current Pest Rating: Z

Proposed Pest Rating: C

Kingdom: Chromista, Phylum: Pseudofungi

Class: Oomycetes, Order: Peronosporales

Family: Peronosporaceae

Comment Period: 7/21/2020 through 9/4/2020

Initiating Event:

In May 2013, an agricultural inspector from Santa Cruz County submitted raspberry plants (*Rubus idaeus*) from a commercial nursery for testing prior to the issuance of a phytosanitary certificate for export. CDFA plant pathologist Cheryl Blomquist isolated *Phytophthora* DNA from the roots and requested a resample which was submitted. In September 2013, she confirmed the presence of *Phytophthora pini* by DNA sequencing of the ITS region. Prior to the resurrection of the species name of *P. pini* by Hong et al. in 2011, this pathogen would have been classified as *P. citricola* sensu lato. Thus, it was given a Z rating. The threat to California from *P. pini* is described herein and a permanent rating is proposed.

History & Status:

Background: *Phytophthora* is a genus of oomycete pathogens that generally have wide host ranges and can cause devastating disease symptoms including root rot, collar and crown rot, stem cankers, and leaf spots. *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 some 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 also stimulated systematic research.

Phytophthora pini was named by Leonian in 1925 but it had no type strain and was largely ignored until it was merged with *P. citricola* by Waterhouse (1963). Although *P. citricola* and *P. pini* are similar morphologically, Hong et al. (2011) demonstrated that *P. pini* should return to being considered a distinct species, separate from *P. citricola*, and they resurrected the name *P. pini*. Phylogenetically, *P. pini* is in a terminal cluster different from *P. citricola* sensu stricto, and it was assigned to a new subclade called 2c by Yang et al. (2017) that includes *P. citricola*, *P. plurivora*, *P. acerina*, *P. pachypleura*, *P. capensis* and *P. multivora*.

Hosts: *Abies balsamea* var. *phanerolepis* (Caanan fir), *Abies fraseri* (Fraser fir), *Adenostoma fasciculatum* (chamise), *Buxus sempervirens* (boxwood), *Cistus salvifolius* (sage-leaved rock-rose), *Fagus grandifolia* (American beech), *Fagus sylvatica* (European beech), *Heuchera* sp. (coral bells), *Ilex meserveae* (blue holly), *Lonicera hispidula* (pink honeysuckle), *Olea europaea* (European olive), *Pieris japonica* (Japanese pieris), *Pinus resinosa* (red pine), *Quercus alba* (white oak), *Rhododendron* spp. (rhododendron), *Rubus idaeus* (raspberry) *Syringa* spp. (lilac), and *Vancouveria chrysantha* (Siskiyou inside-out flower).

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 healthy bark. Collar rot cankers 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). Leaf spots have also been reported on *Syringa* (CDFA PDR database).

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: *Phytophthora pini* has been detected in multiple samples collected in California since 2013, usually associated with diseased roots. Infection of nursery stock is a major concern as it provides a pathway to outplanting in landscapes and in restoration areas (Rooney-Latham et al., 2019). Often other *Phytophthora* spp. are isolated at the same time as *P. pini*, making it difficult to assess damage from *P. pini* alone (Rooney-Latham et al., 2019). *Phytophthora acerina*, *P. pini*, and *P. plurivora* have been shown to be causing root rot and sudden death of olive trees in Italy (Linaldeddu et al., 2020).

Worldwide Distribution: Canada, Finland, Italy, United States (California, Connecticut, Maryland, Minnesota, Missouri, New York, North Carolina, Oregon, and West Virginia) (Farr and Rossman, 2020).

Official Control: None

California Distribution: Contra Costa, Los Angeles, Monterey, San Francisco, San Luis Obispo, Santa Clara, Santa Cruz, and Solano counties.

California Interceptions: One incoming nursery shipment of *Syringa* sp. from Ohio, collected in San Francisco, was found to have leaf spots caused by *P. pini*.

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

Consequences of Introduction:

1) Climate/Host Interaction:

Phytophthora pini has already been detected in nurseries and landscapes in multiple counties. Within California, it is likely to establish in landscapes with cool, wet climates when there are susceptible hosts present and statewide in nurseries.

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 full host range of *Phytophthora pini* is likely not known. Known hosts include woody shrubs and trees 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 pini 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. Chlamydo spores have not been seen.

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:** More is known about *P. citricola* sensu lato than about *P. pini* specifically. Direct economic damage is from root rot, crown rot, and plant decline including loss of canopy and vigor. Nurseries must use strict sanitation methods to prevent contamination as there are no curative treatments.

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

Economic Impact: medium

- 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: 2

- 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:

Currently, the host range and geographic distribution of *P. pini* are not fully known. Some of the 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: 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.
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- 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 pini*: Medium

Add up the total score and include it here. **12**

- 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.**
- 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 = 10*

Uncertainty:

It is possible that isolates identified as *P. citricola* sensu lato in major culture collections are *P. pini* or *P. plurivora*. Similarly, many plant species currently listed as hosts of *P. citricola* (Farr et al. 2020) might be hosts of *P. pini* instead. Work is needed to evaluate the host ranges of *P. pini* and other emerging entities from inside *P. citricola* sensu lato.

Conclusion and Rating Justification:

Based on the evidence provided above the proposed rating for *Phytophthora pini* is C.

References:

Agrios, G. N. 2005. Plant Pathology, 5th Edition. Elsevier Academic Press. 922 pg

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Hong, C. X., Richardson, P. A., Kong, P. 2008. Pathogenicity to ornamental plants of some existing species and new taxa of *Phytophthora* from irrigation water. *Plant Dis.* 92: 1201–1207

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Rooney-Latham, S., Blomquist, C.L., Kosta, K.L., Gou, Y.Y., and Woods, P.W. 2019. *Phytophthora* species are common on nursery stock grown for restoration and revegetation purposes in California. *Pl. Dis.* 103(3): 448-455.

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

Waterhouse, G. 1963. Key to the Species of *Phytophthora* de Bary. *Mycological Paper* 92. Surrey, England: Commonw. Mycol. Inst.

Responsible Party:

Heather J. Scheck, Primary Plant Pathologist/Nematologist, California Department of Food and Agriculture, 204 West Oak Ave, Lompoc, CA. Phone: 805-736-8050, [permits\[@\]cdfa.ca.gov](mailto:permits[@]cdfa.ca.gov).

***Comment Period: 7/21/2020 through 9/4/2020**

*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\[@\]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: C
