cdfa CALIFORNIA DEPARTMENT OF FOOD & AGRICULTURE

California Pest Rating Proposal for

Phytophthora quercetorum Y. Balci & S. Balci 2008

Current Pest Rating: U/?

Proposed Pest Rating: B

Kingdom: Stramenopila, Phylum: Pseudofungi,
Class: Oomycetes, Order: Peronosporales,
Family: Peronosporaceae

Comment Period: 11/25/2020 through 01/09/2021

Initiating Event:

In 2014, a plant pathologist submitted an isolate of *Phytophthora* to CDFA's Plant Pest Diagnostics Center. The isolate was collected from coast live oak (*Quercus agrifolia*) growing in a nursery in Sacramento County for a restoration project. Diagnostician Suzanne Rooney-Latham sequenced part of the ITS region of the isolate using PCR and confirmed it as a match to *Phytophthora quercetorum*. This species was known to be associated with oak roots and rhizosphere soil of oak forests in the eastern and north central US, but the pathogenicity of the isolate was unknown. As an unofficial sample, it received a temporary U rating. Also, in 2014, the pathologist submitted a sample of *Q. agrifolia* roots from a restoration nursery in Alameda County, requesting testing for *Phytophthora*. S. Rooney-Latham isolated *Phytophthora quercetorum* using oregano leaf baits. In 2017, *P. quercetorum* was isolated from nursery effluent associated with *Q. agrifolia* and *Q. wislizeni* in a nursery in Fresno County and in 2019, an isolate collected from soil associated with *Q. agrifolia* with pear baiting was submitted from Alameda County. The risk to California from *Phytophthora quercetorum* is described herein and a permanent rating is proposed.

History & Status:

Background: Phytophthoras are filamentous, osmotrophic eukaryotes that resemble fungi morphologically, but belong to the class Oomycota in the kingdom Stramenopila. The genus *Phytophthora* include some of the most destructive plant pathogens of agricultural crops, ornamental plants, and forests. The number of recognized *Phytophthora* species is rapidly increasing and currently includes more than 180 provisionally named species (Yang et al., 2017). With DNA sequencing, the

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taxonomic concept for the genus has evolved from morphology to molecular phylogeny-based, and it has increased understanding of *Phytophthora* evolution and pathology. The genus is currently organized into clades (and subclades) based on genetic relationships. *Phytophthora quercetorum* was placed in clade 4 with *P. alticola*, *P. arenaria*, *P. megakarya*, and *P. palmivora*.

Phytophthora quercetorum was first described associated with oak roots and was isolated from soils collected at 12 oak forest sites located in Maryland, Minnesota, Ohio, Pennsylvania, Wisconsin, and West Virginia. Its geographic origin remains unknown, but it appears to be a common inhabitant of oak forest soils in the eastern and north central United States (Balci et al., 2008). It has been found with *Quercus rubra, Q. macrocarpa,* and *Q. phellos*, and is often found in addition to other *Phytophthora* species, including *P. citricola, P. cinnamomi, P. cactorum,* and *P. nicotianae*.

Hosts: Acer rubrum (red maple) (McConnell and Balci, 2014), *Hedera helix* (English ivy) (Hong et al., 2011), *Rosa californica* (Bourret, 2018), *Quercus agrifolia* (coast live oak) and *Q. wislizeni* (interior live oak) (CDFA database), *Q. alba* (white oak), *Q. macrocarpa* (burr oak), *Q. rubra* (red oak), *Q. phellos* (willow oak) (Balci et al., 2008).

Symptoms: Specific studies on this species are limited, and the symptoms alone are not diagnostic. Based on the literature, it appears *P. quercetorum* causes fine root rot and can infect taproots of one-year old seedlings of various oak species (Balci et al., 2008b), indicating it is not restricted to fine roots. When enough roots are infected, there may be enough inoculum present to initiate cankers at the soil line under flooded conditions. In the species description paper, Balci et al. (2008a) shows that *P. quercetorum* grew optimally on media from about 22.5 to 27.5 C, with a minimum growth temperature between 5 and 10 C and a maximum between 30 to 32.5 C, showing that it has wide adaptability to a range of temperatures. Balci et al. 2008b conducted pathogenicity tests in summer and winter in West Virginia. There was no consistent seasonal difference in taproot infections for *P. quercetorum* across the 6 oak species evaluated.

Transmission: Species of *Phytophthora* like *P. quercetorum* that cause root, collar, and stem rots survive cold winters or hot and dry summers as mycelium in infected roots or stems or in soil. During spring or fall, sporangia are produced. The sporangia can be infective, or under favorable environmental conditions, the sporangia produce motile spores (zoospores). They are attracted to the exudates from roots of susceptible hosts and can swim with their flagella. Infected soils, plants, planting stock, and seedlings, rain and irrigation water, and cultivation equipment and tools may spread contaminated soil and plant materials to non-infected plants and to new sites. Inoculum levels can increase exponentially under wet conditions (Agrios, 2005). It is homothallic and self-fertile, able to produce sexual oospores alone, chlamydospores are rarely produced (Balci et al., 2008a).

Damage Potential: Currently, there are no reports on quantitative economic losses in plant production caused specifically by *P. quercetorum*. 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 for outplanting in restoration sites could be particularly affected. It is common for multiple species of *Phytophthora* to co-occur in contaminated nursery blocks. Generally, infected stock cannot be rehabilitated and is instead destroyed (Rooney-Latham et al., 2019).

Worldwide Distribution: United States (California, Maryland, Minnesota, Ohio, Pennsylvania, South Carolina, Wisconsin, West Virginia).

Official Control: None

California Distribution: Official reports from Alameda, Fresno, and Sacramento Counties. Additional unofficial reports from Los Angeles, Orange and Santa Clara counties (T. Bourret, pers. comm).

California Interceptions: None

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

Consequences of Introduction:

1) **Climate/Host Interaction:** *Phytophthora* spp. are widespread in California and this species is likely to be able to establish wherever its hosts can grow.

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 of *P. quercetorum* include maple, ivy, and several species of oaks.

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 quercetorum* reproduces with multiple types of spores and is moved with water, contaminated soil, and infested nursery stock**.**

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:** *Phytophthora quercetorum* is known to be affecting woody plants in nurseries. There are few fungicide treatments, and none are curative. Strict adherence to best management practices and sanitation are necessary to keep nursery stock free from *Phytophthora* spp.

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

Economic Impact: A, B, D, 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.**

5) **Environmental Impact:** *Phytophthora quercetorum* has only been found associated with *Quercus agrifolia,* but this is a widely occurring native tree in California. It has the potential to cause damage to native plant landscapes and possibly to the native forests of California, as this has been observed with other Phytophthoras.

Environmental Impact: A, B, C, D, 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 quercetorum:* 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.

Evaluation is 'medium'. *Phytophthora quercetorum* has been sampled in 3 counties, Alameda, Fresno, Sacramento, with unofficial reports Santa Clara, Los Angeles and Orange Counties.

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* **= 11**

Uncertainty:

Detailed pathogenicity studies of this species have not been done. It is often found co-infecting with other *Phytophthora* species, and it can be difficult to differentiate the damage caused by each. Some assumptions of risk are made from knowledge of other members of *Phytophthora* clade 4. The host range could expand in the future.

Conclusion and Rating Justification:

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

References:

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Responsible Party:

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***Comment Period: 11/25/2020 through 01/09/2021**

***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: B