CALIFORNIA DEPARTMENT OF FOOD & AGRICULTURE

California Pest Rating Profile for

Phytophthora kernoviae Brasier, Beales & S.A. Kirk 2005

Previous Pest Rating: none

Pest Rating: A as of 07/31/2024

Kingdom: Chromista, Phylum: Oomycota,
Class: Oomycetes, Order: Peronosporales,
Family: Peronosporaceae

Comment Period: 06/04/2024 through 07/19/2024

Initiating Event:

This pathogen has not been through the pest rating process. *Phytophthora kernoviae* is listed as a National Priority Pest for survey in the United States for 2024 (Cooperative Agricultural Pest Survey (CAPS) program, Plant Protection Act 7721). The risk to California from *Phytophthora kernoviae* is described herein and a permanent rating is proposed.

History & Status:

Background: *Phytophthora kernoviae* was first observed in southwest England in 2003 and described as a new species by Brasier et al. in 2005. It is a serious pathogen there, causing significant diseases of the native *Fagus sylvatica* (European beech) and the exotic *Rhododendron ponticum* in woodlands. Other trees and shrubs are also affected. *Phytophthora kernoviae* infection also causes lesions on the trunks of *Quercus robur* and *Liriodendron tulipifera* and on the foliage of *Magnolia* spp. and *Pieris* spp. The host range and pathogenesis process of *P. kernoviae* in Europe is similar to that of the sudden oak death pathogen, *Phytophthora ramorum*, in California. However, these two species are phylogenetically distant from one another. Phylogenetically, *P. kernoviae* is in clade 10b of the genus while *P. ramorum* is in clade 8c (Abad et al., 2023).

Isolates from the UK were a match to several isolates from New Zealand: recovered from a diseased cherimoya orchard in in 2002 (Braithwaite et al., 2007), and from soils from a native kauri forest and a Monterey pine plantation (Beever et al., 2006). Studies have concluded that *P. kernoviae* has been in New Zealand for more than 50 years, where it is relatively widespread in the North Island, in soil in native forests, or recently converted native forests (Ramsfield et al., 2009; Man in ‘t Veld et al., 2007). In 2016, *P. kernoviae* was isolated from fallen leaves of *Drimys winteri* and from streams in southern Chile by Sanfuentes et al. (2016). Whole genome sequencing of isolates indicates greater genetic

variation in those from New Zealand than those from Europe or South America, lending support to a New Zealand origin for this species (Studholme et al., 2019).

Hosts: Aesculus hippocastanum (European horse chestnut), *Agathis australis* (kauri)*, Annona cherimola* (cherimoya), *Berberis s*p. (barberry), *Castanea sativa* (sweet chestnut), *Drimys winteri* (winter's bark), *Fagus grandiflora* (American beech), *Fagus sylvatica* (European beech), *Gevuina avellana* (Chilean hazel), *Hedera helix* (common ivy), *Ilex aquifolium* (common holly), *Leucothoe fontanesiana* (doghobble), *Liriodendron tulipifera* (tulip tree), *Lomatia myricoides* (river lomatia), *Magnolia amoena* (Tianmu magnolia), *M. cylindrica* (Huangshan magnolia)*, M. delavayi* (Chinese magnolia)*, M. kobus* (kobushi magnolia)*, M. liliiflora* (lily magnolia), *M. salicifolia* (willowleaf magnolia), *M. sargentiana* (Sargent's magnolia), *Magnolia* sp., *M. sprengeri* (Sprenger's magnolia), *M. stellata* (star magnolia), *M. wilsonii* (Wilson's magnolia), *M. x brooklynensis, M. x soulangeana, Michelia doltsopa, Pieris formosa* (Himalayan andromeda), *Pieris japonica* (Japanese andromeda), *Pieris* sp. (andromeda), *Pinus radiata* (Monterey pine), *Podocarpus salignus* (willowleaf podocarp)*, Prunus laurocerasus* (cherry laurel), *Quercus ilex* (holly oak), *Q. robur (*English oak), *Rhododendron macrophyllum* (Pacific rhododendron)*, R. occidentale* (western rhododendron), *R. ponticum* (common rhododendron), *Rhododendron* sp., *Sequoiadendron giganteum* (giant sequoia)*, Umbellularia californica* (California bay laurel), *Vaccinium myrtillus* (European blueberry) (CABI, 2024: Farr and Rossman, 2024).

Symptoms: Infection with *P. kernoviae* causes a diverse range of symptoms (EPPO, 2013). These include bleeding cankers on the trunks of beech (*F. sylvatica*) where the pathogen kills extensive areas of inner bark, often extending for meters up the stem. This necrotic zone oozes a black, sticky fluid, forming so-called 'bleeding cankers'. These types of symptoms have also been found on oak (*Quercus robur*). It can cause leaf necrosis on *Rhododendron, Pieris*, and *Magnolia*. On rhododendron leaves there is also often blackening down the mid-vein and pedicel. Extensive dieback of bilberry (*V. myrtillus*), including stem blackening and necrotic leaves which are quickly shed, has been observed, along with leaf spot, bud blast, and blossom blight on *Magnolia*. For other species, it primarily causes leaf necrosis.

Transmission: Phytophthora kernoviae produces sporangia on some, but not all infected hosts. The sporangia are caducous (deciduous and detached primarily by water), which aids dispersal from aerial parts of the plants. Under favorable conditions, *P. kernoviae* releases zoospores from sporangia. These spores are dispersed locally by rain splash and wind. Wind-blown rain and running water, including streams and rivers, may also carry infected abscised leaves and plant parts further distances (Webber and Rose, 2008). *Phytophthora kernoviae* has not been found to produce chlamydospores which are long-term survival structures, however, it has been found to produce oospores, and it is known to be homothallic (able to reproduce sexually without an opposite mating type). Local spread between plants may occur via infected roots and rhizomes (Fichtner et al., 2011). Long-range dispersal of *P. kernoviae* is through moving infected ornamental and nursery plants, contaminated soil on machinery, tools, and footwear, and infected wood with bark attached (Widmer, 2011).

Damage Potential: Phytophthora kernoviae has had a significant impact on environmentally important hosts in the United Kingdom including beech trees (*F. sylvatica*) and bilberry (*V. myrtillus*) with

consequences for natural ecosystems. On oaks and beech, the severity of damage can be the same as that caused by *P. ramorum* to trees in California. For both *Phytophthora* species, for infection to occur, the trees need to be within five meters of an infected sporulating host. In the UK, this sporulating host is often *Rhododendron ponticum*, an invasive and undesirable understory woodland plant, which provides primary inoculum for infection of neighboring broadleaf trees (Defra, 2008).

A study by Fichtner et al. (2012) showed that leaves and roots of important North American forest shrubs, *Rhododendron macrophyllum, R. occidentale* and *Umbellularia californica*, are susceptible to infection by *P. kernoviae*, which will sporulate on their foliage. From this point, sporangia could move to the trunks of susceptible California forest trees. *Phytophthora kernoviae* can also infect a wide range of ornamental garden species, with the potential for significant economic implications for the nursery and landscape trades if the pathogen accidentally enters their production systems (EPPO, 2024).

In New Zealand, *P. kernoviae* infects cherimoya but has not been considered a major pathogen (Scott and Williams 2014). However, Fraser et al. (2020) described *P. kernoviae* as a causal agent of an important needle disease of *Pinus radiata* in New Zealand. *Pinus radiata*, the Monterey pine, has native stands on California's central coast. In the past 30 years, it has been heavily damaged by another invasive disease, pine pitch canker, caused by *Fusarium circinatum.* (https://blogs.cdfa.ca.gov/Section3162/?p=9784).

Worldwide Distribution: Argentina, Chile, Ireland, New Zealand, and the United Kingdom (CABI, 2024; Farr and Rossman, 2024).

Official Control*: Phytophthora kernoviae* is on the EPPO's A1 list for Egypt, Kazakhstan, and the Eurasian Economic Union. It is on the A2 list for the United Kingdom and the European Plant Protection Organization and is a regulated quarantine pest in Morocco (EPPO, 2024). It is on the USDA PCIT's harmful organisms list for Australia, Chile, Colombia, Egypt, Eurasian Customs Union, Japan, Nauru, the Republic of North Macedonia, The Republic of Korea, and the United Kingdom (USDA PCIT 2024).

California Distribution: none.

California Interceptions: none.

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

Consequences of Introduction:

1) **Climate/Host Interaction:** *Phytophthora kernoviae* is likely to survive wherever its hosts can grow, likely in the same forests where *P. ramorum* has established.

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 be established 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 is multiple species in multiple plant families.

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: Phytophthoras reproduce with a combination of spore types and move easily in water, soil, and nursery stock.

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: There has been significant mortality of trees and shrubs in European forests. Ornamentals are also at risk, especially in nurseries without adequate phytosanitary techniques to exclude phytophthoras. It is a regulated pest in other countries.

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

Economic Impact: A, C, D, G

A. The pest could lower crop yield.
B. The pest could lower crop value (including increasing crop production costs).
C. The pest could trigger the loss of markets (including 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:
- 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: Several species that are known hosts of *P. kernoviae* are an important part of riparian areas, and the death of large numbers of trees could have a large impact on the ecosystem. As a regulated pest, any detection would trigger official eradication programs. Additional hosts could be

discovered if this pathogen becomes established and spread in California. Once trees are infected, there are no curative treatments.

Evaluate the environmental impact of the pest on California using the criteria below.

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 kernoviae:* High

Add up the total score and include it here. 14
-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 '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 the 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* ***= 14***

Uncertainty:

There is a high likelihood of additional hosts continuing to be detected. Detection of *P. kernoviae* ccan be difficult to detect due to its ability to produce zoospores on asymptomatic hosts. More information is needed to understand the role of role of oospores and root infections.

Conclusion and Rating Justification:

Based on the evidence provided above the proposed rating for ***Phytophthora kernoviae*** **is A.**

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Responsible Party:

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***Comment Period: 06/04/2024 through 07/19/2024**

***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.

Pest Rating: A