CALIFORNIA DEPARTMENT OF FOOD & AGRICULTURE

California Pest Rating Proposal for

Phytophthora alni species complex (Brasier & S.A. Kirk, 2004) Husson, Ioos & Marçais, 2015, nothosp. nov.

Alder Phytophthora

Current Pest Rating: None

Proposed Pest Rating: A

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

Comment Period: 11/17/2021 through 01/01/2022

Initiating Event:

The USDA's Federal Interagency Committee on Invasive Terrestrial Animals and Pathogens (ITAP.gov) Subcommittee on Plant Pathogens has identified the worst plant pathogens that are either in the United States and have potential for further spread or represent a new threat if introduced. *Phytophthora alni* species complex, Alder Phytophthora, is on their list. A pest risk assessment of this species complex is presented here, and a permanent pest rating for California is proposed.

History & Status:

Background: A serious decline of alders (*Alnus* spp.) was reported in Britain in the early 1990s. An unusual *Phytophthora* was consistently isolated from bark lesions at the base of dying trees in riparian areas, shelterbelts and nurseries. Pathologists saw that it resembled *P. cambivora*, a well-known tree pathogen, but had significant morphological differences. They suggested it might be a new or recently introduced strain (Braiser et al., 1995). Further studies showed it was a new species, formed by interspecific hybridization, forming a polyploid hybrid taxon. It was named *Phytophthora alni* by Brasier and Kirk in 2004.

Over years of research in Europe, it became clear that there were three taxa involved in alder Phytophthora. They were initially designated as subspecies of *P. alni*. The one that was the most aggressive on alder was named *P. alni* subsp. *alni*. There were also two identified as parents of subsp. *alni*, that were weaker pathogens of alders, and they were known as *P. alni* subsp. *uniformis* and *P. alni*

subsp. *multiformis* (Brasier et al., 2004). In 2015, Husson et al. published evidence for homoploid speciation in *P. alni* and confirmed that *multiformis* and *uniformis* are the parents of *alni*, and *alni* contains half of the genome from each of the parents. They proposed the three subspecies be raised to species status, and renamed them *Phytophthora ×alni*, *P. ×multiformis* and *P. uniformis*. Using the multiplication symbol x before the species name and the epithet nothospecies nov., shows that it is a new hybrid which is formed directly by hybridization of two recognized species, not from recombination of other hybrids. These three types now form the *P. alni* species complex. The most common species of the complex is *P. ×alni*, which is found across much of Europe. One of the parental species, *P. uniformis*, appears to be native in North America (records from Alaska and Oregon) and was accidentally introduced into Europe (Aguayo et al., 2013). The origin of the second parent, *P. ×multiformis*, remains unknown.

Alders (*Alnus* spp.) are deciduous trees and shrubs in the birch family (Betulaceae). *Alnus rubra* (red alder) is found in the coast ranges and the Klamath mountains of California; *A. incana* subsp. *tenuifolia* (creek alder) is also in these ranges in addition to the Sierra Nevada. *Alnus rhombifolia* (white alder) is widespread in California everywhere except the northeastern counties and the southeastern deserts. *Alnus viridis* (Siberian alder) subsp. *fruticosa* and subsp. *sinuata* are found in northwestern California along the coast (Calfora, 2021). None of the species in the *P. alni* species complex have been found in California, and they are a threat to native and introduced alder species in forests and landscapes.

Hosts: Alnus spp. (alder), *Alnus alnobetula* (green alder), *Alnus cordata* (Italian alder), *Alnus glutinosa* (European alder), *Alnus incana* (grey alder), *Alnus incana* subsp. *tenuifolia*, *Alnus rubra* (red alder), *Castanea sativa* (chestnut) (Downing et al., 2010; Ioos et al., 2006; Santini et al., 2003; Cerney et al., 2008).

Symptoms: The symptoms on *Alnus* are typical for a Phytophthora root and collar disease (Brasier et al., 1995). Foliage seems sparse or thin with abnormally small yellow leaves. There is branch and crown dieback. Trees often show early and excessive fructification with unusually small cones (catkins). Cankers can form at the base of the main stem. The cankers have sunken dead inner bark stripes that extend from the collar up to about 1 m high. Black or rust colored exudates ooze from spots across the canker surface. Cankers look very similar to those caused by other root and collar infecting *Phytophthora*, i.e. *P. cinnamomi*, *P. citricola, P. cambivora* or *P. multivora*. Root rots also occur and are especially damaging to young trees (Jung and Blaschke, 2004).

Transmission: Phytophthora ×alni produces asexual sporangia and zoospores in the soil and on infected primary roots. Zoospores can be spread in saturated soil or river water and can swim short distances with flagella. They infect fine roots or the bark of alders (saplings or mature trees). A major infection court is the collar and root collar area of the tree, with the pathogen able to penetrate unwounded bark through lenticels (Lonsdale, 2003). *Phytophthora ×alni* does not have resistant spores; chlamydospores are absent and sexual reproduction with oospores has not been confirmed in the field.

European populations of *P. uniformis* were shown to be either strictly clonal or selfing; however, in North America, populations have a mixed mating system, including selfing with rare outcrossing

(Aguayo et al., 2013). This species should be able to produce viable oospores in Europe and thus should have resistant spores in natural conditions. Long–distance spread is mainly through planting of infected nursery stock, followed by rapid downstream spread in river water by motile zoospores.

Damage Potential: Alder Phytophthora is widespread in Europe in the riparian ecosystems where alder commonly grows, with heavy losses in some of the large alder forests in Scotland, western England and Wales, northeastern France, and Bavaria in Germany. It is also damaging alder in forest plantations, especially in Germany. Surveys and modeling show that risk for infection is higher in warmer, slow moving waters, and in fine textured soil, especially clay loams. Although alder trees dying because of *P. xalni* are usually seen along river systems, diseased trees have been found in sites well away from riverbanks or other water courses, for example in orchard shelter belts and in new woodland plantings. This suggests that the alder plants were already infected at the nursery prior to planting (Marçais, 2018).

In Alaska and Oregon, *P. uniformis* was recovered from soil, not trees. Although isolates were pathogenic in artificial inoculation, it was apparently not damaging alder trees in Alaska. In Oregon it causes limited root lesions on red alder (Hansen, 2012).

Worldwide Distribution: Europe: *Austria, Belgium, Croatia, Czechia, Denmark, France, Germany, Hungary, Ireland, Italy, Latvia, Lithuania, Netherlands, Norway, Poland, Portugal, Slovakia, Slovenia, Spain, Sweden, Switzerland, United Kingdom,* North America: *United States* (Alaska and Oregon, only *P. uniformis*) (Jung et al., 2017; Marçais, 2018).

Official Control: *Phytophthora alni* is on the USDA PCIT's harmful organism list for the Eurasian Customs Union (USDA, 2021), and on the EPPO A1 list for Eurasian Economic Union and Kazakhstan, (EPPO, 2021). It is a US regulated Pest (USDA APHIS).

California Distribution: None

California Interceptions: None

The risk *Phytophthora alni* species complex would pose to California is evaluated below.

Consequences of Introduction:

1) **Climate/Host Interaction:** This Phytophthora is likely to be able to survive wherever its hosts can grow.

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 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 is mostly *Alnus* spp.

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:** Phytophthoras reproduce with a combination of spore types and move easily in water, soil, and with 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 to alder forests in Europe. Ornamentals are also at risk, especially in nurseries without adequate phytosanitary techniques to exclude Phytophthoras. It is a regulated pest in the United States and other countries.

Evaluate the economic impact of the pest to 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 (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:** *Alnus* spp. are an important part of riparian areas and 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. Once trees are infected, there are no curative treatments.

Evaluate the environmental impact of the pest to California using the criteria below

Environmental Impact: A, 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 alni* species complex*:* 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 '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* ***= 13***

Uncertainty:

The taxonomy of the species complex has changed several times, and more revisions could be made in the future as more information is available.

Conclusion and Rating Justification:

Based on the evidence provided above the proposed rating for *Phytophthora alni* species complex is A.

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Responsible Party:

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***Comment Period: 11/17/2021 through 01/01/2022**

***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