

*Phytophthora bishii* Z.G. Abad, J. A. Abad & F. J. Louws 2008

Variant spelling

*Phytophthora bisheria* Z.G. Abad, J. A. Abad & F. J. Louws 2008

APRIL 9, 2015 | JOHN CHITAMBAR

### California Pest Rating for

*Phytophthora bishii* Z. G. Abad, J. A. Abad & F. J. Louws, 2008

**Pest Rating: B**

### PEST RATING PROFILE

#### Initiating Event:

The epithet of this name was corrected in accordance with Article 60 of the ICBN. The current name is *Phytophthora bishii*.

Recently a nursery in Tehama County sent a raspberry root sample of greenhouse-grown plants exhibiting symptoms of rot to Dr. Cheryl Blomquist, plant pathologist, CDFA, for disease diagnosis. Dr. Blomquist identified *Phytophthora bisheria* associated with the symptomatic roots. Drs. Blomquist and Suzanne Latham also detected *P. bisheria* in raspberry root samples from nursery greenhouses in Santa Cruz County in 2013 and 2014 (CDFA Plant Pathology pest detection records). A temporary Q rating was assigned to the pathogen. The risk presented by the introduction of *P. bisheria* to California is assessed here and a permanent rating is proposed.

#### History & Status:

**Background:** In 1999, Abad *et al.* isolated an unknown *Phytophthora* sp. from strawberry plants growing in a greenhouse in North Carolina and showing symptoms of slight yellowing and root rot. They tentatively

named this species, *P. bisheria* in 2001 and deposited genetic sequences of the internal transcribed spacer (ITS) of the nuclear ribosomal DNA (rDNA) gene region in GenBank before publishing an official morphological and molecular description of the species. Soon other researchers in the Netherlands and Australia discovered that they were working with the same species associated with root rot of roses and raspberry, accordingly, based on the similarity of their test ITS sequences with that of *P. bisheria* in GenBank. Taking into account isolates from strawberry, rose and raspberry, Abad *et al.*, (2008) provided an official description of the species and validated *P. bisheria* as a new *Phytophthora* species.

The genus *Phytophthora* is a fungus-like genus that contains more than 80 species including several important plant pathogens. *Phytophthora bisheria* belongs to the Oomycetes in the kingdom Straminipila. It is a self-fertile (homothallic), slow growing species that characteristically produces semipapillate (small protuberant growth), persistent sporangia (specialized structures containing spores) and unique paragynous antherida (male sexual organs) that broadly attach to the oogonial (female sexual organs) walls.

**Hosts:** Presently, the known host range is limited to three different hosts in the plant family, Rosaceae, namely, strawberry (*Fragaria ananassa*, *Fragaria* sp., *Fragaria* x *ananassa*), rose (*Rosa* sp.) and raspberry (*Rubus idaeus*) (Abad *et al.*, 2008; Farr & Rossman, 2014).

**Symptoms:** Symptoms of *Phytophthora bisheria* infected plants are mainly root rot and yellowing and wilting of above ground growth. Infected strawberry plants exhibit symptoms of slight yellowing and root rot. Rose plants show stunting, fewer side shoots, smaller dull green leaves that yellow and shed prematurely. Newly formed roots are rotted with numerous fungal spores and sexual structures (sporangia, oospores, oogonia) that are only visible through a microscope. Infected raspberry plants show symptoms of root rot, general wilting of plants, and chlorotic leaves with necrotic margins.

**Damage Potential:** Quantitative economic losses in plant production due to *Phytophthora bisheria* have not been reported, however, infestations may result in significant damage and loss in production and stands of host plants mainly by causing root rot of infected plants.

**Disease Cycle:** Generally, species of *Phytophthora* that cause root rot survive cold winters or hot and dry summers as mycelium in infected host tissue or soil or thick-walled, resting spores (oospores and chlamydospores). These resting spores are liberated into the soil once infected tissue dies and decompose. During spring, the oospores and chlamydospores germinate, and mycelium within infected tissue grow, to produce specialized structures (sporangia) containing motile spores (zoospores) that are released and swim around in soil water to roots of susceptible hosts. In general for *Phytophthora* species commonly associated with raspberry root rot, the range of temperatures for zoospore release is 4-25°C (Wilcox, 1991). The production of sporangia is favored by very wet to moist soil conditions. Soil moisture is also required for the dispersal of zoospores. Optimum zoospore discharge occurs when soils become completely saturated with water and discharge is severely hindered when moisture is drained from soils. Roots are invaded at the crown area or at

ground level. Mycelium and zoospores 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:** Infected soils, plants, nursery and planting stock, seedlings, run-off and splash irrigation water, cultivation equipment and tools that may spread contaminated soil and plant material to non-infected sites. Reports on the distribution of the species indicate that *P. bisheria* is mainly spread through infected nursery plant materials. Since to date *P. bisheria* has only been isolated from greenhouse grown plants, it is likely that this pathogen is not aggressive in the field (Abad, et al., 2008).

**Worldwide Distribution:** Australia (Victoria), Europe: the Netherlands, and North America: USA (North Carolina, California). It is likely that the distribution of this species may be wider than what is currently known but has been unnoticed as it is a slow growing species that is difficult to isolate (Abad et al., 2008).

**Official Control:** No official control has been reported. Currently, *Phytophthora bisheria* is a Q-rated, quarantine pathogen in California.

**California Distribution:** Tehama and Santa Cruz Counties. During 2013-14, *Phytophthora bisheria* was detected in *Rubus* sp. nursery stock intended for export and grown in nursery greenhouses in Tehama and Santa Cruz Counties. The 2013 detection marked CDFA's first official record of the pathogen in California.

**California Interceptions:** There are no records of the interception of *Phytophthora bisheria* in incoming plant shipments to California.

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

### Consequences of Introduction:

**1) Climate/Host Interaction:** Evaluate if the pest would have suitable hosts and climate to establish in California. Score:

- **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.
- **Risk is Medium (2)** - So far, *Phytophthora bisheria* has only been isolated from plants grown within greenhouse environments in California - as well as internationally. Although California provides suitable and wet climate conditions favorable for the establishment of this pathogen, researchers have suggested that the latter may be less aggressive under field conditions than under controlled greenhouse conditions.

**2) Known Pest Host Range:** Evaluate the host range of the pest. Score:

- **Low (1)** has a very limited host range.
- **Medium (2)** has a moderate host range.
- **High (3)** has a wide host range.

**Risk is Low (1)** - Currently the known host range of *Phytophthora bisheria* is limited to strawberry, rose and raspberry - all members of the plant family *Rosaceae*.

**3) Pest Dispersal Potential:** Evaluate the natural and artificial dispersal potential of the pest. Score:

- **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.

**Risk is High (3)** - *Phytophthora bisheria* is primarily spread artificially via infested plants, nursery planting stock, seedlings, soils, run-off and splash irrigation water, cultivation equipment and tools that may spread contaminated soil and plant materials to non-infected sites.

**4) Economic Impact:** Evaluate the economic impact of the pest to California using the criteria below.  
Score:

- 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.

- **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.

**Risk is High (3)** - The pathogen could lower crop yield, increase production costs and cause loss of market mainly of infected nursery stock in greenhouses. 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.

**5) Environmental Impact:** Evaluate the environmental impact of the pest on California using the criteria below.

- 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.

Score the pest for Environmental Impact. Score:

- **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.

**Risk is Medium (2)** - *The impact that Phytophthora bisheria may have on the environment is currently not known as this pathogen has only been detected in plants grown in greenhouses.*

*Phytophthora bisheria is thought to be a less aggressive a pathogen in freld environments. Nevertheless, there is always the likelihood that under conditions most suitable for its growth and spread, this pathogen may impact home/urban gardening or ornamental plantings.*

### Consequences of Introduction to California for *Phytophthora bisheria*:

Add up the total score and include it here. (Score)

- Low**= 5-8 points
- Medium**= 9-12 points
- High**= 13-15 points

Total points obtained on evaluation of consequences of introduction of *Phytophthora bisheria* to California= **(11)**.

**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. (Score)

- 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.

**Evaluation is (-1).** The pathogen has been detected in two counties: Santa Cruz and Tehama.

### Final Score:

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:

*The host range of Phytophthora bisheria is presently limited to plants in Rosaceae. Further host range studies are needed to determine a more complete host range or establish that the range is only specific to Rosaceae. Also needed are statewide surveys specifically for P. bisheria in nursery, field and natural environments to provide further information on its distribution. This information may alter the proposed rating for P. bisheria.*

### Conclusion and Rating Justification:

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

### References:

- Abad, Z. G., J. A. Abad, and F. J. Louws. Morphological and molecular characterization of *P. bisheria* sp. nov., from strawberries. *Phytopathology* 91:SI.
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**Responsible Party:**

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**Comment Period: CLOSED**

The 45-day comment period opened on Thursday, April 9, 2015 and **closed on May 24, 2015**.

**Pest Rating: B**