

## California Pest Rating Proposal for *Peronospora sordida* Berk. & Broome 1861

**Current Pest Rating: Z**

**Proposed Pest Rating: B**

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

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**Comment Period: 07/08/2022 through 08/22/2022**

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### Initiating Event:

In April 2018, a Santa Barbara County agricultural biologist collected leaves of *Scrophularia californica* (bee plant) with necrotic spots during a regulatory nursery inspection. CDFA Plant Pathologist Suzanne Rooney-Latham diagnosed downy mildew caused by *Peronospora sordida*, a pathogen known to be in California on this host. As this pathogen has not been through the pest rating system, she assigned it a temporary Z rating. A second detection was made on the same host in another regulatory nursery inspection in Contra Costa County in April 2022. The pest risk for *P. sordida* is described herein and a permanent pest rating is proposed.

### History & Status:

#### Background:

Oomycetes are also known as water molds. They are distinct from fungi, more closely related to algae and to green plants. Among them are some of the most devastating plant pathogens responsible for causing spectacular and catastrophic epidemics. The downy mildews are obligate parasites. They primarily cause fast moving foliar blights, growing rapidly on young leaves, twigs, and fruits, and causing rapid and severe losses in cool, wet weather. *Peronospora* is the largest genus in Peronosporaceae and its hosts are mainly eudicots but also include some monocots in Alliaceae and Liliaceae. They have purplish gray to blackish sporangia that germinate directly with a germ tube rather than by producing zoospores. Downy mildews are generally highly host specific (Choi and Thines, 2015).

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Members of the Scrophulariaceae (figworts) can be annual, biennial, or perennial herbs or shrubs. This family has seen major revisions based on phylogenetic evidence. Some species formerly placed here are now placed in the Linderniaceae, Orobanchaceae, Paulowniaceae, Phrymaceae, and Plantaginaceae. There are California native plants in this family including in the genera *Buddleja*, *Limosella*, *Nuttallanthus*, and *Scrophularia* (Calflora, 2022). There are also non-native and invasive members including *Buddleja davidii* (butterfly bush), *Myoporum laetum* (mousehole tree), and *Verbascum thapsus* (woolly mullein) (Calflora, 2022)

*Hosts:* *Buddleja stachyoides* (Argentine butterfly bush), *Collinsia parviflora* (few flowered blue eyed mary), *Odontites verna* var. *serotina* (red bartsia), *Orthocarpus hispidus* (annual white paintbrush), *Scrophularia aestivalis*, *S. alata*, *S. auriculata* (water figwort), *S. californica* (California figwort), *S. lanceolata* (American figwort), *S. marilandica* (eastern figwort), *Scrophularia nodosa* (common figwort), *S. scopolii* (Italian figwort), *Scrophularia* sp. (figwort), *S. stylosa*, *S. umbrosa* (green figwort), *Verbascum* spp. (mullein), *Veronica hederifolia* (small henbit), and *Veronica polita* (gray field speedwell) (Farr and Rossman, 2022).

*Symptoms:* At first, small, pale yellow, irregular spots appear on the upper surface of the leaves, and a white downy growth of the sporangiophores produced by the pathogen appears on the undersides of the spots. Soon after, the infected leaf areas are killed and turn brown, while the sporangiophores of turn gray. The spots often enlarge and coalesce to form large dead areas on the leaf. The leaves curl and become distorted, and infection frequently results in premature defoliation. When stems are infected, there is enlargement of the affected cells and the large volume of mycelium present in the intercellular spaces cause distortion and hypertrophy. The affected stem cells are killed and collapse, producing brown, sunken areas. In the young fruits, infection is also intercellular; chlorophyll breaks down and disappears, and the cells collapse and turn brown. Some *Peronospora* spp. also produce a sexual spore (oospore) (Agrios, 2005). It is unknown if *P. sordida* forms oospores; they have not been observed on the samples collected.

*Transmission:* The pathogen overwinters as oospores in dead leaf lesions and shoots and, in some hosts, as mycelium in infected, but not killed, woody tissues. During rainy periods in the spring the oospores germinate to produce a sporangium. The sporangium or its zoospores are transported by wind or water to the wet leaves near the ground, which they infect through stomata of the lower surface. The sporangia may be carried by wind or rain to nearby healthy plants, germinate quickly, and produce many zoospores that cause secondary infections and thus spread the disease rapidly. A disease cycle may take from 5 to 18 days, depending on temperature, humidity, and varietal susceptibility (Agrios, 2005).

*Peronospora* grows systemically throughout the plant. Sporangia are easily spread short distances by air currents or splashing water and they may be wind-blown long distances to new locations. Because sporangia may not be produced until weeks after the plant is initially infected, asymptomatic plants may mistakenly be assumed to be disease-free and shipped.

*Damage Potential:* *Peronospora* spp. require very wet or humid conditions. Water is required for infection, and humidity above 90% is needed for sporulation. Growth of the pathogens is favored by

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cool temperatures (40° to 60° F). Downy mildew spores are usually short-lived, although they may survive several days under cool, moist conditions. They are airborne, and when they land on a susceptible plant with free water present, germination and infection generally occur within 8 to 12 hours. Disease severity is highly dependent on environmental conditions. When temperatures are ideal, and the foliage remains wet for long periods of time, complete defoliation and systemic infections that kill plants are possible (Agrios, 2005).

**Worldwide Distribution:** Andorra, Austria, Brazil, Bulgaria, Canary Islands, China, Czechia, Germany, Ireland, Italy, Ireland, Missouri, Poland, Portugal, Russia, Scotland, Spain, United Kingdom, United States (*California, Illinois, Iowa, Nebraska, New Jersey, New York, Oregon, Wisconsin*) (Farr and Rossman, 2022).

**Official Control:** None

**California Distribution:** This pathogen has been found at nurseries in two widely separated counties. It should be presumed to be in the nursery trades as it is not under regulation.

**California Interceptions:** none

The risk *Peronospora sordida* would pose to California is evaluated below.

## Consequences of Introduction:

- 1) Climate/Host Interaction:** *Peronospora* spp. require cool, wet conditions. These conditions are common near the coast of California, or in nurseries where overhead irrigation is used. Hot, dry temperatures limit disease severity and spread.

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 limited to plants in the figwort family

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.
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- 3) Pest Reproductive Potential:** *Peronospora* spp. can reproduce very rapidly with airborne spores under ideal conditions, leading to epidemics. Infections are severely reduced by dry conditions.

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:**

Presence of the pathogen in field and/or greenhouse environments can significantly lower crop value and yield. Normal cultivation practices, including delivery and supply of irrigation water, would need to be altered to prevent spread of the pathogen.

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

**Economic Impact: A, 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:** This pathogen is known to infect two native plants, *Collinsia parviflora* and *Scrophularia californica*. Home/urban gardening of host ornamental plants can be significantly impacted if the pathogen is present in these environments.

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

A

**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.

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**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 *Peronospora sordida*: 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.

There have been two nursery detections, one in Santa Barbara County and one in Contra Costa County.

***Evaluation is 'medium'.***

**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:**

The host range of this pathogen may continue to expand and include more native plants.

**Conclusion and Rating Justification:**

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Based on the evidence provided above the proposed rating for *Peronospora sordida* is B.

### References:

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

Albuquerque, S.T., Rocha, F.B. and Barreto, R.W., 2013. First report of downy mildew caused by *Peronospora sordida* on butterflybush (*Buddleja stachyoides*) in Brazil. Plant Disease, 97(4), pp.560-560.

Calflora Database. Accessed 5/18/2021. Berkeley, CA. calflora.org

Choi, Y.J. and Thines, M., 2015. Host jumps and radiation, not co - divergence drives diversification of obligate pathogens. A case study in downy mildews and Asteraceae. PloS one, 10(7), p.e0133655.

EPPO Global Database. 2022. [https://gd.eppo.int/taxon/ PEROSO](https://gd.eppo.int/taxon/PEROSO) Accessed 5/18/22

Farr, D.F., and Rossman, A.Y. Fungal Databases, U.S. National Fungus Collections, ARS, USDA. Retrieved July 6, 2022, from <https://nt.ars-grin.gov/fungaldatabases/>

USDA Phytosanitary Certificate Issuance and Tracking System, Phytosanitary Export Database (PEXD) Harmful Organisms Database Report. Accessed 5/15/2022

### Responsible Party:

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**\*Comment Period: 07/08/2022 through 08/22/2022**

### \*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](mailto:permits@[cdfa.ca.gov).

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### Comment Format:

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- ❖ 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.

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**Proposed Pest Rating: B**

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