

## California Pest Rating Proposal for *Peronospora mesembryanthemi* Verwoerd 1924

Current Pest Rating: B

Proposed Pest Rating: C

---

Comment Period: **06/01/2022 through 07/16/2022**

---

### Initiating Event:

On December 11, 2015, Oregon State University Plant Clinic (OSUPC) informed the CDFA that they had received an *Aptenia cordifolia* (red apple iceplant) sample infected with downy mildew from San Diego County, California. A sample of the diseased plant was submitted by OSUPC to the USDA APHIS National Mycology Laboratory where the identity of the associated pathogen was confirmed as the downy mildew pathogen, *Peronospora mesembryanthemi*. Consequently, in California, official samples of diseased red apple iceplant were collected by Pat Nolan, plant pathologist, San Diego County, and submitted to the CDFA Plant Pathology Laboratory. The downy mildew pathogen, *P. mesembryanthemi* was detected in those samples by Suzanne Rooney-Latham, plant pathologist, CDFA, who assigned a temporary Q-rating. The risk to California was described by Dr. John Chitambar, CDFA Primary State Plant Pathologist, and a permanent rating of B was given on April 14, 2016.

In the eight years that have followed, detections have been made on additional hosts and in additional counties, triggering a reassessment of the B rating. The risk to California from *P. mesembryanthemi* is reassessed herein and a new permanent rating is proposed.

### History & Status:

**Background:** *Peronospora mesembryanthemi* is an oomycete in the order Peronosporales that causes downy mildew disease of host plants in the family Aizoaceae. The pathogen was first detected in *Mesembryanthemum* sp. in South Africa (Verwoerd, 1924). Several decades later, it was also reported from the United Kingdom (Wales) and New Zealand (Francis and Waterhouse, 1988; McKenzie and Dingley, 1996).

*Peronospora mesembryanthemi* causes downy mildew disease in its host plants. Generally, downy mildews overwinter as thick-walled resting spores called oospores that are produced through the

---

fertilization of two mating types. However, no oospores have so far been reported for this pathogen. It is likely that the pathogen survives as mycelium and/or conidia (sporangia spores) in infected plant buds, plant debris, leaf tissue and shoots. Downy mildews are severe in cool or warm (but not hot), high humid climates and when a film of water is present on plant tissue. They primarily cause foliar blights and rapidly spread in young green leaf, twig and fruit tissues. Under favorable weather conditions, conidia are carried by wind or water to wet leaves near the ground where they infect through stomata of the lower leaf surface. A conidium germinates via a germ tube that grows through leaf stomata into intercellular spaces within the leaf tissue and eventually penetrates plant cells through special structures called haustoria. Developing hyphae that spread intercellularly form a cushion of mycelia just below the stomata. From this cushion, conidophores arise and emerge through stomata. At their tips, conidia (sporangia/spores) are produced simultaneously and are carried by wind and rain to new infection sites of the same or different plant.

The 2016 detection of *P. mesembryanthemi* on *Aptenia* sp. in San Diego County, California, marked the first record of this pathogen in the USA. At the time of the detection, downy mildew disease was already widespread in San Diego County, over several acres of red apple iceplant growing in mature landscapes, specifically in shaded areas and areas that receive sunlight for limited periods of the day (personal communication: Pat Nolan, plant pathologist, San Diego County).

Soon after the initial detection on *Aptenia cordifolia*, detections were made on two other species of iceplant in San Diego County, *Lampranthus* spp. and *Delosperma* spp. Also in the spring of 2016, detections were made in Santa Barbara County with additional detections in the spring of 2018. In 2017, it was found on *Aptenia cordifolia* in Los Angeles County and on the islands of Hawaii and Oahu, HI (Farr and Rossman, 2022).

**Hosts:** The USDA Fungal database lists the hosts of this pathogen as members of the family Aizoaceae, a large family of dicotyledonous flowering plants containing 135 genera and about 1800 species. They are commonly known as ice plants. Many are desert and salt-adapted, they are largely endemic to Southern Africa, the deserts of South America, and Central Australia. California detections have been on these genera: *Aptenia*, *Delosperma*, *Drosanthemum* and *Lampranthus*.

**Symptoms:** Infection starts on lower leaves and progresses upwards. Initially symptoms appear as yellowing (slightly chlorotic) of affected leaves with the veins remaining green. Following this, the central portion of a chlorotic lesion may become necrotic; slight curvature of leaves occurs followed by premature leaf fall. In some cases, the entire area of the leaf surface is affected. Grey to brown, furry, or downy (conidia) growth is apparent on underside of symptomatic leaves giving the leaves a dirty appearance. These symptoms may sometimes occur on upper surfaces of leaves. Older leaves will defoliate, leaving bare stems with new growth occurring at the tips only.

**Transmission:** The pathogen can spread through contaminated plant cuttings, transplants, fresh leaves and within seeds. Also, it produces airborne conidia that can disperse and be carried by humid air currents. It can also be present in soil associated with host and non-host plants and therefore, can spread by any means that aids in the movement of soil and/or water from infected plants to non-infected ones.

---

*Damage Potential:* While estimates of crop losses caused by *P. mesembryantheri* have not been reported, downy mildew pathogens can cause rapid and severe losses of young plants in seedbeds and in the field. Currently, downy mildew disease on red apple iceplant is widespread over several acres of mature landscapes in San Diego County. Nursery stock producers and landscape growers of iceplant species may be at risk of severe damages caused by this downy mildew pathogen.

**Worldwide Distribution:** Africa: *South Africa*; Europe: *United Kingdom (Wales)*; North America: *USA* (California, Hawaii); Oceania: *New Zealand* (Farr and Rossman, 2022; Francis and Waterhouse, 1988; McKenzie and Dingley, 1996; Verwoerd, 1924).

**Official Control:** *Peronospora mesembryantheri* is on the “Harmful Organism Lists” for Namibia and South Africa (USDA PCIT, 2022). Currently, it has a “B” rating in California.

**California Distribution:** Los Angeles, San Diego, and Santa Barbara counties.

**California Interceptions:** None

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

## Consequences of Introduction:

- 1) Climate/Host Interaction:** *Peronospora mesembryantheri* is likely to establish in cool to warm and humid to wet climates where iceplant grows in California

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:** *Peronospora* spp. in general are obligate, host specific pathogens. The host range for this species is described as limited to members of the family Aizoaceae. In California, the pathogen has most often been reported from red apple iceplant, a common landscape cover plant grown in coastal regions of the State.

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:** Sporangia are easily produced simultaneously and in abundance. The pathogen is transmitted via infected plant material; conidia are dispersed by winds, water, and associated soil.

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:** While estimates of crop losses caused by *Peronospora mesembryanthemi* have not been reported, presence of the pathogen in open fields/landscapes and/or in nursery stock produced in greenhouse environments can cause severe damage under cool or warm and humid climates resulting in significantly lower crop value and yield. Infected, symptomatic nursery stock plants are not marketable, resulting in total loss in recovery of production costs. Markets for crop sale are directly affected. 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, B, C, 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:** Commercial and residential landscape plantings of iceplant can be significantly impacted if infected by the downy mildew pathogen. Iceplant was introduced to California in the early 1900s as an erosion stabilization tool used on railroad tracks, and later used by Caltrans on roadsides. It has been used as an ornamental for many years and is sold in nurseries. Unfortunately, it has become invasive in coastal California from north of Humboldt County to as far south as Baja California. When it establishes in a location, it forms a large, thick mat that chokes out all other native plants and alters the soil composition of the environment. Under favorable climate conditions, disruption of these communities and changes in ecosystem could occur with severe and widespread infestations of downy mildew.
-

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

**Environmental Impact: 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: 2**

- 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 mesembryanthemi*: 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.

**Evaluation is 'low'**. The pathogen has been found along the coast from Santa Barbara to San Diego

**Score: -1**

- 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:**

This pathogen continues to be detected on new iceplant hosts. Over time it is likely going to continue to spread north along the coast. Spread to the warmer inland areas will be limited by the moisture required for the pathogen to sporulate and spread, but in sprinkler irrigated landscapes, there may be enough water for localized or widespread epidemics.

### **Conclusion and Rating Justification:**

Based on the evidence provided above the proposed rating for *Peronospora mesembryantheri* is **C**.

### **References:**

Agrios, G. N. 2005. Plant Pathology (Fifth Edition). Elsevier Academic Press, USA. 922 p.

Farr, D.F., and Rossman, A. Y. Fungal Databases, Systematic Mycology and Microbiology Laboratory, ARS, USDA. Retrieved May 3, 2022, from <http://nt.ars-grin.gov/fungaldatabases/>.

Francis, S., and G. Waterhouse. 1988. List of Peronosporaceae reported from the British Isles. Trans. Brit. Mycol. Soc. 91: 1-62.

McKenzie, E.H.C., and J. M. Dingley. 1996. New plant disease records in New Zealand: miscellaneous fungal pathogens III. New Zealand Journal of Botany 34: 263-272.

USDA PCIT. 2022. USDA Phytosanitary Certificate Issuance & Tracking System. <https://pcit.aphis.usda.gov/PEXD/faces/ReportHarmOrgs.jsp>.

Verwoerd, L. 1924. *Peronospora mesembryantheri* n. sp., die oorsaak van 'n donsige skimmelsiekte van *Mesembryanthemum*-soorte. Ann. Univ. Stellenbosch 2A (1): 13-23.

### **Responsible Party:**

Heather J. Scheck, Primary Plant Pathologist/Nematologist, CDFA/PHPPS ECOPERS, 1220 N St Rm 221, Sacramento, CA 95814 Phone: (916) 654-1017, [permits\[@\]cdfa.ca.gov](mailto:permits[@]cdfa.ca.gov).

---

**\*Comment Period: 06/01/2022 through 07/16/2022**

---

**\*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).

---

**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: C**

---