# California Pest Rating Proposal for

## *Synchytrium vaccinii* Thomas 1889
## Cranberry red gall

**Current Pest Rating: none**

**Proposed Pest Rating: A**

Kingdom: Fungi, Phylum: Chytridiomycota,
Class: Chytridiomycetes, Order: Chytridiales,
Family: Synchytriaceae

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**Comment Period: 06/21/2023 through 08/05/2023**

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## Initiating Event:

This pathogen has not been through the pest rating process. Attestation of freedom from this pathogen is frequently requested for export of blueberry plants for planting to Mexico. The risk to California from *Synchytrium vaccinii* is described herein and a permanent pest rating is proposed.

## History & Status:

**Background:**

The Chytridiomycetes, often referred to as "chytrids", are primitive water- or soil-inhabiting fungi. Instead of true mycelium, they have a round or irregularly shaped thallus which is composed of chitin. They live in the soil or within their host's cells. The class Chytridiomycetes contains three plant pathogenic genera: *Olpidium, Physoderma,* and *Synchytrium*.

*Synchytrium* spp. depend on having live hosts to complete their life cycle. Infected plant cells are not usually killed. Instead, cells infected by *Synchytrium* are stimulated to divide and enlarge excessively. The diseases they cause are often called "warts" or "galls". There are over 200 described species in the genus; the best-known disease is potato wart, caused by *Synchytrium endobioticum*, which is on the USDA's Select Agent list. All are highly dependent on water for spore maturation, dissemination, and infection. Most species are reported from cold wet soils, specifically from swamps, ditches, and intermittently inundated meadows (Karling, 1964).

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*Synchytrium vaccinii* has potential to be an economic pathogen of American cranberry (*Vaccinium macrocarpon)* as it causes red rust or red gall disease. It was first found and described by Halstead in 1886, in a cranberry bog near Burlington County, New Jersey. Thomas (1889) described the thallus of the fungus as a "resting spore which germinates in the spring and produces infective zoospores". Halstead (1889) also thought that the thallus was a "resting spore", but he referred to it as a sporangium. Karling (1954) conducted a morphological, cytological, and developmental study of the fungus on three hosts and showed that *S. vaccinii* is a valid short-cycled species of *Synchytrium* with a defined thallus, sporangia, and zoospores.

In 1966, Eglitis et al. published "Fungi found on Ericaceae in the Pacific coastal area" as a Washington State University Agricultural Extension Bulletin. Funded by the Cranberry Research Committee, they surveyed from 1952-1966 for fungi occurring on economically important Ericaceae. They made one report of *S. vaccinii*, in Point Arena, Mendocino County, on *Arctostaphylos nummularia* (glossy leaf manzanita). In the Compendium of Blueberry, Cranberry, and Lingonberry Diseases (Polashock et al., 2017), *S. vaccinii* is only listed as a disease of cranberry.

*Hosts: Acer rubrum* (red maple), *Amelanchier* sp. (serviceberry), *Andromeda glaucophylla* (bog rosemary), *Arctostaphylos nummularia* (glossyleaf manzanita), *Aronia arbutifolia* (red chokeberry), *Rhododendron viscosa*, *Chamaedaphne baccata, Chamaedaphne calyculata* (leatherleaf), *Clethra alnifolia* (coastal sweet pepperbush), *Gaultheria procumbens* (wintergreen), *Gaylussacia baccata* (black huckleberry), *Gaylussacia* sp. (huckleberry), *Ilex* sp. (holly), *Kalmia angustifolia* (dwarf-laurel), *Rhododendron groenlandicum* (Labrador tea), *Rhododendron viscosum* (clammy azalea), *Rhodora canadensis, Rubus hispidus* (swamp blackberry), *Spiraea* sp., *Vaccinium angustifolium* (lowbush blueberry), *Vaccinium corymbosum* (highbush blueberry), *Vaccinium macrocarpon* (American cranberry), and *Vaccinium* sp. (Farr and Rossman, 2023).

*Symptoms*: *Synchytrium vaccinii* infects the epidermal cells of the leaves, young stems, petioles, flowers, and fruits of cranberry. The most noticeable symptom is the presence of galls or swellings on the upper surface of the leaves. If they are heavily parasitized when young, plant growth becomes stunted, and fruits will abort. The galls are brilliantly raspberry- or lavender-red, and easy to identify in the field. As they age, the galls may turn black. They are largely superficial. In severe cases, the galls can cover a significant portion of the leaf surface, leading to defoliation (Karling, 1958).

*Transmission: Synchytrium vaccinii* is classified as having a "short cycle" with only asexual and no sexual reproduction. In the spring, resting sporangia germinate from their overwintering sites in decaying host tissues or soil and infect new leaves, stems, and fruit. Additional secondary asexual reproduction occurs during spring and summer when there is adequate water supply for gemination of sporangia to occur. Sporangia germinate into infectious, mobile zoospores. These mobile spores can move with flagella up to 2 inches in wet soil and infect the new growth of susceptible hosts. If conditions are suitable, including adequate water, the disease cycle will continue with the production of more sporangia. When adverse conditions (including dry weather with low humidity) occur, galls decay and release sporangia into the soil. Abundant moisture favors the local spread of the pathogen (Karling, 1954).

*Synchytrium vaccinii* is primarily spread through the movement of infected plant material. Infected leaves or plant debris can harbor the pathogen and serve as a source of inoculum. Additionally, the zoospores can be carried by water, wind, or insects, facilitating the spread of the disease within and between cranberry bogs. Over long distances the pathogens are spread in infected plant parts or on contaminated plants and in soil (Karling, 1954; 1958).

*Damage Potential:* In cranberry bogs the galls fall to the ground in the fall and winter. The practice of flooding the bogs in the winter to prevent desiccation of the cranberry vines and the subsequent freezing over appear to be conducive to maturation of the spores and their germination in the spring. Flooding the bogs creates ideal conditions for zoospore dissemination and almost countless zoospores are present in the water as the new leaves of the host emerge in the spring. The galls interfere with normal leaf functions, affecting photosynthesis and reducing the overall vigor of the plant. Severe infections can lead to defoliation, which can weaken the plant, reduce fruit quality, and potentially affect yield (Karling, 1954; 1958; 1964).

**Worldwide Distribution**: Canada, United States: *Maine, Michigan, Mississippi, New Jersey, and New York* (Farr and Rossman, 2023).

**Official Control:** *Synchytrium vaccinii* is on the EPPO's A1 list for Argentina, and is a quarantine pest for Mexico (EPPO, 2023). It is on the USDA PCIT's harmful organism list for Argentina, India, and Mexico (USDA, 2023).

**California Distribution:** There are no official detections. There is one unofficial report from Mendocino County (Eglitis et al., 1966).

**California Interceptions:** None

The risk *Synchytrium vaccinii* would pose to California is evaluated below.

## Consequences of Introduction:

1) **Climate/Host Interaction:** This pathogen is highly dependent on free water to disperse and infect. It appears to be restricted to very wet, boggy, or flooded areas.

   Evaluate if the pest would have suitable hosts and climate to establish in California.

   **Score**: **1**

   **- 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 includes species in the families Ericaceae, Aceraceae, Rosaceae, Aquifoliaceae, and Primulaceae. However, these records are based on morphology only, there are no studies using DNA sequence analysis, which is the modern standard.

   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:** This fungus can produce enormous numbers of swimming spores and can have multiple reproductive cycles per year. However, it is highly dependent on flooded and saturated conditions to spread and infect.

   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:** Despite a long history in the Eastern U.S. and a lack of regulatory control, there are no modern records of this disease. It is a quarantine pest for Mexico, an important trading partner with California for *Vaccinium* spp.

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

   **Economic Impact: A, 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:** The unofficial report of this pathogen on *Arctostaphylos* in California is a concern that the host range could include California sensitive species, especially in wet areas.

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

**Environmental Impact: A**

**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*:* Medium

Add up the total score and include it here. **10**
-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* ***= 10***

## Uncertainty:

The lack of modern literature could mean the pathogen is not an economic issue, however, it remains a quarantine pest of concern for some trading partners. The host list is based mainly on microscopy with limited inoculation studies. If the work was done today, it would include pathogen DNA sequence analysis.

## Conclusion and Rating Justification:

Based on the evidence provided above the proposed rating for ***Synchytrium vaccinii*** **is A**

## References:

Eglitis, M., Gould, C.J., and Johnson, F., 1966. Fungi found on Ericaceae in the Pacific coastal area. Bulletin / Washington Agricultural Experiment Station, Washington State University, 675, pp.1-21.

EPPO Global Database, 2023. *Synchytrium vaccinii*. https://gd.eppo.int/taxon/SYNCVA. Accessed 5/23/23.

Karling, J.S., 1954. Host reaction, host-parasite relationship, hosts, and taxonomic criteria in *Synchytrium.* Mycologia, 46(3), pp.293-313.

Karling, J.S., 1958. *Synchytrium vaccinii*. Sydowia: International Journal of Mycology, 12, pp.149-159.

Karling, J.S., 1964. *Synchytrium.* Academic Press, New York and London. 465 pages.

Polashock, J.J., Caruso, F.L., Averill, A.L., Schilder, A. and Press, A.P.S. eds., 2017. Compendium of blueberry, cranberry, and lingonberry diseases and pests (p. 231). St. Paul, MN: APS Press.

USDA Phytosanitary Certificate Issuance and Tracking System, Phytosanitary Export Database (PExD) Harmful Organisms Database Report. *Synchytrium vaccinii*. Accessed 5/23/23.

## Responsible Party:

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***Comment Period: 06/21/2023 through 08/05/2023**

***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.

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**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.

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**Proposed Pest Rating: A**

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