

California Pest Rating Proposal for
***Phakopsora cherimoliae* (Lagerh.) Cummins 1941**

Annona rust

Domain: Eukaryota, Kingdom: Fungi
Division: Basidiomycota, Class: Pucciniomycetes
Order: Pucciniales, Family: Phakopsoraceae

Current Pest Rating: Q

Proposed Pest Rating: A

Comment Period: 12/07/2020 through 01/21/2021

Initiating Event:

In September 2019, San Diego County agricultural inspectors collected leaves from a sugar apple tree (*Annona squamosa*) shipping from a commercial nursery in Fort Myers, Florida to a resident of Oceanside. CDFA plant pathologist Cheryl Blomquist identified in pustules on the leaves a rust pathogen, *Phakopsora cherimoliae*, which is not known to occur in California. She gave it a temporary Q-rating. In October 2020, Napa County agricultural inspectors sampled an incoming shipment of *Annona* sp. from Pearland, Texas, that was shipped to a resident of American Canyon. This sample was also identified by C. Blomquist as *P. cherimoliae*. The status of this pathogen and the threat to California are reviewed herein, and a permanent rating is proposed.

History & Status:

Background: The Phakopsoraceae are a family of rust fungi in the order Pucciniales. The genus *Phakopsora* comprises approximately 110 species occurring on more than 30 dicotyledonous plant families worldwide, mainly in the tropics (Kirk et al., 2008). This genus holds some very important and damaging pathogen species including *Phakopsora pachyrhizi* on soybeans, *P. euvitis* on grapevine, and *P. gossypii* on cotton. *Phakopsora cherimoliae* occurs from the southern USA (Florida, Texas) in the north to northern Argentina in the south (Beenken, 2014).

Annona is a genus of approximately 140 species of tropical trees and shrubs, with the majority of species native to the Americas, with less than 10 native to Africa. It contains several economically important fruit trees that are cultivated worldwide in tropical and subtropical areas. These fruit trees include cherimoya (*A. cherimola*), custard apple (*A. reticulata*), sugar apple (*A. squamosa*) and the soursop (*A. muricata*). The genus is native to the Neotropics (mostly South America) except for a few species found in Africa (Beenken, 2014).

Cherimoya is a large, premium-priced fruit that requires a relatively frost-free environment with temperatures above -3C. It is native to tropical highlands, but in areas without prolonged high humidity, and it is adaptable to Mediterranean climates. Because of these climatic requirements, commercial cherimoya production in the United States is limited to Southern California, from Santa Barbara to San Diego, in warm areas within a few miles of the coast. Sugar apple (*A. squamosa*) and atemoya (*A. squamosa* x *A. cherimola*) are grown in the humid tropics including warm locations along the southeast and southwest coasts of Florida, and in southeastern Texas (Faber and Vieth, 2014).

Hosts: *Annona cherimola* (cherimoya), *A. jahnii*, *A. purpurea* (soncoya), *A. reticulata* (custard apple), *A. squamosa* (sugar apple), *A. squamosa* x *A. cherimola* (atemoya), *Annona exsucca* (syn =*Rollinia exsucca*) (wild sugar-apple) (Farr and Rossman, 2020).

Symptoms: *Phakopsora cherimoliae* is an obligate pathogen that cannot survive without its host. It is a short- or microcyclic rust with no known alternate host. Stage 0 spermogonia and stage 1 aecia are unknown. It reproduces primarily with stage II urediniospores. Uredinia form in small groups or scattered on abaxial leaf sides, as subepidermal, erumpent pustules only 0.1–0.5 mm in diameter. Stage III teliospores have been observed in telia formed close to the uredinia. Telia are subepidermal, crust-like, and dark brown. Urediniaspores are a repeating, dikaryotic, vegetative spore (Beenken, 2014). Although the spores are microscopic, they are produced in pustules on the leaves that can be seen without magnification. Their red, orange or brown color is responsible for the common name of “rust”.

Transmission: Epidemiological studies of this rust are lacking but it can be assumed to be like other *Phakopsora* species. Once viable spores have landed on the leaf surface of a susceptible host, infection and subsequent epidemic development are dependent on environmental conditions. Generally, infection occurs when leaves are wet and temperatures are moderate, ideally between 15°C to 30°C. At 25°C, some infection occurs in as little as 6 hours of leaf wetness, but 12 hours are typically required. After infection, lesions and pustules with urediniospores can appear within 7 or 8 days. A short life cycle means that, under the right conditions, rust epidemics can quickly build up from almost undetectable to very high levels. Urediniospores are known to travel long distances with wind, especially with storm systems that protect them from damaging UV radiation (Rupe and Sconyers, 2008). Spread can also occur with infected nursery stock. Fruit infection has not been documented.

Damage Potential: *Phakopsora cherimoliae* and anthracnose (*Colletotrichum* sp.) are the principal diseases affecting atemoya and sugar apple production in Florida (Ploetz, 2003). Severe levels of rust infection can cause defoliation (Simone, 1999). Trees that are defoliated yield fewer fruit.

Worldwide Distribution: Argentina, Colombia, Costa Rica, Cuba, Ecuador, Guatemala, Honduras, Mexico, Philippines, Trinidad and Tobago, United States (Florida, Texas), Venezuela, West Indies (Farr and Rossman, 2020).

Official Control: It is on USDA's Harmful organism list for Chile, Mexico, and Sri Lanka (USDA-PCIT, 2020), on the EPPO A2 list for Chile, and it is a quarantine pest for Mexico (EPPO, 2020).

California Distribution: None

California Interceptions: Two interceptions have been made on *Annona* trees as incoming shipments, one from Florida and one from Texas.

The risk *Phakopsora cherimoliae* would pose to California is evaluated below.

Consequences of Introduction:

- 1) Climate/Host Interaction:** The climatic requirements of *Annona* spp. limit them to restricted areas of Southern California. The rust is an obligate pathogen that stays on its host.

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:** All hosts are members of the family Annonaceae.

Evaluate the host range of the pest.

Score: 1

- **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:** Short cycle, uredinial rusts produce massive numbers of spores that can travel long distances with wind.

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.**
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4) Economic Impact: In Florida, heavy infection by *Phakopsora cherimoliae* causes trees to defoliate.

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

Economic Impact: A, B

- 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: 2

- 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 is a narrow host range pathogen. There are no native *Annona* spp. in California. However, controlling rust diseases in nurseries, orchards, or landscapes is very difficult and can require multiple fungicide applications to protect trees.

Environmental Impact: 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 *Phakopsora cherimoliae*: Medium

Add up the total score and include it here. **11**

- Low = 5-8 points
 - Medium = 9-12 points**
 - High = 13-15 points
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- 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'. *Phakopsora cherimoliae* has only been found on plants shipping into California.

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 = 11*

Uncertainty: None

Conclusion and Rating Justification:

Based on the evidence provided above the proposed rating for *Phakopsora cherimoliae* is A.

References:

Beenken, L., 2014. Pucciniales on Annona (Annonaceae) with special focus on the genus *Phakopsora*. *Mycological Progress*, 13(3), pp.791-809.

Faber, B., and Vieth, R. 2014. Cherimoya. *Topics in subtropics*. UC ANR <https://ucanr.edu/blogs/blogcore/postdetail.cfm?postnum=12863>

Farr, D. F., and Rossman, A. Y. *Fungal Databases*, U.S. National Fungus Collections, ARS, USDA. Retrieved November 6, 2020, from <https://nt.ars-grin.gov/fungaldatabases/>

Kirk, P. M., Cannon, P. F., Minter, D. W. and Stalpers, J. A. 2008. Dictionary of the fungi, 10th edn. CABI Europe.

EPPO Global Database. 2020. [https://gd.eppo.int/taxon/ PHAKCH](https://gd.eppo.int/taxon/PHAKCH). Accessed 11/6/2020

Ploetz, R.C., 2003. Diseases of atemoya, cherimoya, soursop, sugar apple and related fruit crops. Diseases of tropical fruit crops, pp.21-34.

Rupe, J. and L. Sconyers. 2008. Soybean Rust. The Plant Health Instructor. DOI: 10.1094/PHI-I-2008-0401-01

Simone, G.W., 1999. Disease Control in *Atemoya* (*Annona cherimola* x *A. squamosa*). Florida Cooperative Extension Service, Institute of Food and Agricultural Sciences, University of Florida

USDA Phytosanitary Certificate Issuance and Tracking System, Phytosanitary Export Database (PEXD) Harmful Organisms Database Report. *Phakopsora cherimoliae*. Accessed 2/26/2020

Responsible Party:

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***Comment Period: 12/07/2020 through 01/21/2021**

*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.
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❖ 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
