CALIFORNIA DEPARTMENT OF FOOD & AGRICULTURE

# California Pest Rating Proposal for

## *Hemileia vastatrix* Berk. & Broome (1869)

## Coffee leaf rust

**Current Pest Rating: none**

**Proposed Pest Rating: A**

Kingdom: Fungi, Phylum: Basidiomycota,

Class: Pucciniomycotina, Subclass: Pucciniomycetes,

Order: Pucciniales, Family: Chaconiaceae

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**Comment Period: 12/02/2020 through 01/16/2021**

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## Initiating Event:

On October 30, 2020, coffee leaf rust (CLR) was confirmed by the United States Department of Agriculture (USDA) from coffee plant samples collected on the island of Maui by the Hawaii Department of Agriculture. This led to a statewide survey, and a second positive sample from the island of Hawai'i was confirmed on November 10. These detections are the first for this pathogen in the United States. California has a small but growing coffee industry concentrated in in Santa Barbara and San Diego counties. The risk to California from *Hemileia vastatrix* is described herein and a permanent rating is proposed.

## History & Status:

**Background:** Coffee is an understory plant from forests in the mountains of Ethiopia and adjacent Kenya and Sudan (USDA GRIN, 2020). The genus *Coffea* in the family Rubiaceae includes approximately 100 species of small trees. Three species are cultivated for coffee bean production, with the tropical lowland species *C. canephora* (robusta coffee) and *C. liberica* (Liberian coffee) grown to a lesser degree than the more valuable arabica coffee for blending or instant coffee production (Mabberley, 2008). Its early use was probably as a drink for medicinal purposes and for religious rituals. Coffeehouses were common throughout Egypt, Arabia, and Turkey by the early 1500s, and the Dutch began to plant coffee in Ceylon, Sumatra, and Java. Coffee leaf rust symptoms were first documented near Lake Victoria

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(East Africa) on wild *Coffea* species. Coffee growers in Ceylon reported a "coffee leaf disease" in 1867, and Berkeley determined the cause was a rust fungus. The name "vastatrix" was chosen because Berkeley correctly predicted this pathogen would have a devastating effect on coffee plantations. Within a few years, the pathogen had spread to India, Sumatra, and Java, and coffee production shifted to the Americas, with Brazil becoming the world's major coffee grower. With strict quarantine efforts, Brazil remained free from rust until 1970, when it became established there. Once in Brazil, this fungus spread rapidly to all the coffee- growing areas of South America and Central America in a decade and a half. Hawaii was the last major coffee producing area to be free-from rust, but detections have recently been made on two Hawaiian Islands (https://hdoa.hawaii.gov/blog/main/nr20-16clronbi/). Major disease outbreaks in Asia, Africa, and America continue to cause severe yield losses, making this the most important disease of arabica coffee (Arneson, 2000).

Arabica coffee (*C. arabica*), the source of the majority and most highly valued portion of the world's coffee production is now in cultivation in southern California. Since the early 2000s, California has been developing a small -scale premium coffee industry and as of 2018 it had approximately 45 farms growing coffee trees. The biggest growers are in Santa Barbara and San Diego counties. Data suggests that the mesoclimate of southern California provides enough heat and sunlight units to grow arabica coffee. California also offers the unique advantage of having no serious coffee pests or diseases. Coffee plants are often intercropped with avocados. (Rolshausen and Dzung, 2018).

*Hosts: Coffea arabica, Coffea arabica* var*. mokka, Coffea arabica* var*. myrtifolia, Coffea bengalensis, Coffea canephora, Coffea canephora* var*. robusta, Coffea congensis, Coffea congensis* var*. chalotii, Coffea eugenioides, Coffea excelsa, Coffea laurina, Coffea liberica, Coffea quillon, Coffea robusta, Coffea stenophylla, Coffea ×arabica-canephora, Coffea ×arabica-liberica, Cucumis melo, Gardenia* sp., *Gardenia thunbergia, Gardenia volkensii* subsp*. volkensii*

*Symptoms*: CLR mainly attacks the leaves and is found only rarely on young stems and coffee berries. The disease is recognized by the yellow-orange powdery lesions or spots on the undersides of leaves. Initially, very young lesions appear as chlorotic or pale-yellow spots before they begin to sporulate. These spots vary in size and can coalesce. While the lesions can develop anywhere on the leaf, they tend to be concentrated around the margins, where moisture collects.

Since sporulation of this pathogen occurs through the leaf stomata, characteristic structures that rupture the leaf epidermis do not form, and the lesions are not referred to as rust pustules. The spots eventually dry and turn brown, while the margins of the lesions continue to expand and produce urediniospores. Early in the season, the first lesions usually appear on the lowermost leaves, and the infection slowly progresses upward in the tree. The infected leaves drop prematurely, leaving long twigs without of leaves (Nutman, and Roberts, 1963; Ferreira and Boley, 1991; Arneson, 2000).

*Transmission: Hemileia vastatrix* is a hemicyclic fungus producing uredinia (stage II), telia (stage III), and basidia (stage IV). There is no known aecial (stage I) host. Urediniospores and teliospores are produced in the same sorus, but at different times. Urediniosporesare are produced asexually and can re-infect coffee leaves whenever environmental conditions are favorable. Teliospores occur rarely and form

basidiospores. Basidiospores cannot infect *Coffea*, and no other host plant has been identified (Talhinhas et al., 2017).

The urediniospores can be dispersed by both wind and rain. Splashing rain is an important mechanism of local dispersal. The long-range dispersal is primarily by wind. A small, perhaps epidemiologically insignificant amount of dispersal is by thrips, flies, wasps, and other insects. Movement across oceans, deserts, and mountain ranges has very likely been caused by people moving infected plants. The disease may be seed-borne. Spores may have spread over very large areas with high altitude winds. CLR survives primarily as mycelium in the living tissues of the host. Even after heavy defoliation, a few green leaves can persist on the coffee plants that can support limited fungal growth and begin new cycles of infection as the tree refoliates (Yigra, 2020; Kushalappa and Eskes, 1989).

*Damage Potential:* In monetary value, coffee is the most important agricultural product in international trade. Reduction in coffee yields or increase in production costs caused by CLR, along with the imposition of quarantines, has a huge impact on the coffee producers, especially in those areas whose economies are dependent on coffee export. CLR is one of the most important diseases of *C. arabica* in the world (Kushalappa and Eskes, 1989). Infection causes premature defoliation, which reduces the ability of the plant to photosynthesis and store up the appropriate resources for fruit and growth. Because the following season's berries are borne on the current season's shoots, rust infections reduce the following season's yields. Severe infection can result in dieback of twigs and can weaken or even kill trees (Ferreira and Boley, 1991).

**Worldwide Distribution**: Africa: *Angola, Benin, Burundi, Cameroon, Central African Republic, Comoros, Democratic Republic of the Congo, Cote d'Ivoire, Ethiopia, Ghana, Guinea, Kenya, Liberia, Madagascar, Malawi, Mauritius, Mozambique, Nigeria, Reunion, Rwanda, São Tomé and Príncipe, Sierra Leone, Somalia, South Africa, Sudan, Tanzania, Togo, Uganda, Zambia, Zimbabwe*; Americas: *Argentina, Belize, Bolivia, Brazil, Colombia, Costa Rica, Cuba, Dominican Republic, Ecuador, El Salvador, Guatemala, Haiti, Honduras, Jamaica, Mexico, Nicaragua, Panama, Paraguay, Peru, Puerto Rico, Venezuela*; Asia: *Bangladesh, Brunei, Darussalam, Cambodia, China, India, Indonesia, Laos, Malaysia, Myanmar, Philippines, Singapore, Sri Lanka, Taiwan, Thailand, Vietnam, Yemen*; Oceania: *American Samoa, Cook Islands, Fiji, French Polynesia, New Caledonia, Papua New Guinea, Samoa, Vanuatu* (EPPO, 2020; Farr and Rossman, 2020).

**Official Control:** *Hemileia vastatrix* is a quarantine pest in the United States and Mexico (EPPO, 2020), and on the USDA-PCIT's harmful organism list for Antigua and Barbuda, Australia, Costa Rica, Dominica, French Polynesia, Grenada, Mexico, Nauru, New Caledonia, Saint Lucia, and Tonga (USDA, 2020).

**California Distribution**: none

**California Interceptions**: none

The risk *Hemileia vastatrix* would pose to California is evaluated below.

## Consequences of Introduction:

1) **Climate/Host Interaction:** Both coffee and gardenia are damaged by low temperatures. They can be grown outside in only limited parts of California or with frost protection. Susceptible hosts are therefore limited in distribution 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:** The host range is mainly restricted to *Coffea* spp. *Gardenia* spp. are also reported as hosts in South Africa and there is one record on *Cucumis* from Thailand.

   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:** CLR reproduces with asexual urediniospores that are produced in very large numbers, with repeating cycles in a single season. They are spread great distances with wind. It is also spread with infected plant material.

   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:** CRL causes defoliation, which reduces the yield of coffee plants and may even weaken or kill the trees. Disease control in areas where CLR has become established requires multiple fungicide applications or replacing trees with resistant varieties. CLR is a quarantine pest in the United States and Mexico.

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

   **Economic Impact: A, B, C**

   **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:** Control of CLR on susceptible arabica coffee varieties requires preventative fungicide treatments with a fungicide resistance management program. Gardenias are grown in California as an ornamental and for florists' stock and these could also be impacted.

**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 *Hemileia vastatrix:* 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 'not established'***. There have been no detections in California. Recent detections in Hawaii raise the concern that the pathogen may be accidentally introduced.

**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* **= 12**

## Uncertainty:

None

## Conclusion and Rating Justification:

Based on the evidence provided above the proposed rating for *Hemileia vastatrix* is A.

## References:

Arneson, P.A. 2000. Coffee rust. The Plant Health Instructor. DOI: 10.1094/PHI-I-2000-0718-02. Updated 2011.

CABI Crop Production Compendium 2020. Hemileia vastatrix. Accessed November 23, 2020: https://www.cabi.org/cpc/datasheet/26865

EPPO Global Database. 2020. Accessed November 23, 2020: https://gd.eppo.int/taxon/ HEMIVA.

Ferreira, S.A. and R.A. Boley. 1991. *Hemileia vastatrix*. Accessed November 23, 2020: http://www.extento.hawaii.edu/kbase/crop/Type/h_vasta.htm

Kushalappa, A.C. and Eskes, A.B. 1989. Advances in coffee rust research. Annual Review of Phytopathology 27: 503-31

Mabberley, D. J. 2008. Mabberley's Plant-Book, ed. 3. Cambridge University Press

Nutman, F. J. & F. M Roberts. 1963. Studies on the biology of *Hemilea vastatrix*. Trans. Brit. Myc. Soc. 46:27-48.

Rodrigues Jr, C. J., Bettencourt, A. J. and Rijo, L., 1975. Races of the pathogen and resistance to coffee rust. Annual Review of Phytopathology, 13(1), pp.49-70.

Rolshausen, P. and Dzung, N. A. 2018. A taste of coffee. Topics in subtropics. UCANR. Accessed November 23, 2020:https://ucanr.edu/blogs/Topics/index.cfm?tagname=coffee

Talhinhas, P., Batista, D., Diniz, I., Vieira, A., Silva, D. N., Loureiro, A., Tavares, S., Pereira, A. P., Azinheira, H. G., Guerra-Guimarães, L., Várzea, V., Silva, M. D. C. The coffee leaf rust pathogen *Hemileia vastatrix*: one and a half centuries around the tropics. Mol Plant Pathol. 2017 Oct;18(8):1039-1051.

USDA Agricultural Research Service GRIN website https://npgsweb.ars-grin.gov/gringlobal/taxon/taxonomysimple Accessed November 23, 2020

USDA Phytosanitary Certificate Issuance and Tracking System, Phytosanitary Export Database (PExD) Harmful Organisms Database Report. Accessed November 23, 2020: *Hemileia vastatrix*.

Yirga, M. 2020. Potential effects, biology and management options of coffee leaf rust (*Hemileia vastatrix*): A review. International Journal of Forestry and Horticulture (IJFH). 6:19-31

## Responsible Party:

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## *Comment Period: 12/02/2020 through 01/16/2021

## *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.

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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:**

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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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