

California Pest Rating Proposal for *Uromyces aloës* Cooke (Magnus) 1892

Aloe vera rust

Current Pest Rating: A

Proposed Pest Rating: A

Kingdom: Fungi, Phylum: Basidiomycota,
Class: Pucciniomycotina, Subclass: Pucciniomycetes,
Order: Pucciniales, Family: Pucciniaceae

Comment Period: 08/05/2024 through 09/19/2024

Initiating Event:

On October, 2020, the Plant Health Director of the California Department of Food and Agriculture was notified by the Plant Industry Administrator of the Hawaii Department of Agriculture of a detection of aloe rust (*Uromyces aloës*) in Honolulu County, Hawaii. Since this pathogen is not known to be in Hawaii, a sample was sent to the APHIS-PPQ Domestic Diagnostic Coordinator in Riverdale, Maryland where the diagnosis of *Uromyces aloës* was confirmed. The detection was made on aloe plugs (rooted cuttings for planting) that were shipped to Hawaii from a nursery in San Mateo County, California in March 2020. Traceback investigations from CDFA's Pest Exclusion branch determined that the plugs originated in Zimbabwe. No infected aloe plants or other known hosts were found at the California nursery.

There have been two historical detections of aloe rust in California. In 1978, it was found on *Aloe* spp. at a nursery in San Diego County, and in 1980, it was found on *Aloe* spp. in a large, private exotic garden in Santa Barbara County. In 1982, it was given an A rating. Currently, aloe rust is not known to be in California. The risk to California from *Uromyces aloës* is evaluated herein, and the 1982 rating is re-evaluated.

History & Status:

Background: The genus *Aloe* is native to and widespread in southern and eastern continental Africa, from Eritrea and the Arabian Peninsula to the Cape of Good Hope. Aloes have been widely traded and moved around the world as ornamental and medicinal plants, especially *Aloe vera*. Aloe sap is used as an antibiotic, astringent, analgesic, anticoagulant, and dietary supplement (Sahu et al., 2013).

Uromyces is the second-largest genus of rust fungi in the family Pucciniaceae. *Uromyces* contains more than 1568 epithets and over 800 reported species (Gautam et al., 2022). This genus produces unicellular teliospores that help to characterize it and distinguish it from another important genus in the family, *Puccinia*. *Uromyces aloës* seems to be native to the same regions as *Aloe* spp., and the earliest described samples were collected in 1892 from South Africa and Eritrea. It was first confirmed as a pathogen of aloe by Doige in 1945, and has subsequently been described as infecting additional members of the tribe Aloeeae including some in the genera *Lomatophyllum* and *Haworthia*.

Uromyces aloës has been found on outdoor aloe plantings in additional sub-tropical and tropical regions including Madagascar, India, southern France, and southern Spain, with periodic detections on greenhouse-grown plants in cooler climates including Japan, the United Kingdom, and the United States. *Uromyces aloës* is a microcyclic rust, producing only teliospores (Stage III) and basidiospores (Stage IV). It is an obligate parasite with no known alternate hosts.

The first report of *Aloe vera* rust caused by *Uromyces aloës* in an ornamental nursery in the United States (Pennsylvania) was published by Bily et al., in 2021. They described symptomatic *A. vera* plants with rust pustules that had very high genomic sequence identity with a *U. aloës* isolate from South Africa. The plants were thought to have shipped to Pennsylvania from Florida or Ontario, Canada, and were destroyed.

Hosts: *Agave* sp., *Aloe abyssinica*, *A. arborescens*, *A. arborescens* var. *natalensis*, *A. barbadensis*, *A. barbertoniae*, *A. baumii*, *A. claviflora*, *A. davyana*, *A. dewetii*, *A. eru*, *A. ferox*, *A. glauca*, *A. grandidentata*, *A. greatheadii*, *A. greatheadii* var. *davyana*, *A. greenii*, *A. karasbergensis*, *A. latifolia*, *A. macroclada*, *A. maculate*, *A. marlothii*, *A. marlothii* subsp. *marlothii*, *A. parvibracteata*, *A. parvibracteata* var. *zuluensis*, *A. purpurascens*, *A. saponaria*, *A. schimperi*, *Aloe* sp., *A. spicata*, *A. striata*, *A. striata* subsp. *striata*, *A. thraskii*, *A. transvaalensis*, *A. vera*, *A. vulgaris*, *Haworthia altilinea*, *H. reinwardtii*, *H. retusa*, *Haworthia* sp., and *Lomatophyllum occidentale* (Farr and Rossman, 2024).

Symptoms: The earliest symptom of infection is the appearance of small, yellowish, rounded spots on the leaves. From these areas, small sori erupt through the epidermis in a single, circular arrangement of pustules. These areas continue developing into concentric expanding rings of sori up to 5 cm in diameter. The rings may begin to overlap and form necrotic infection patches. Leaves can become dry and shriveled (Soni et al., 2011; Matsumoto et al., 1982).

Transmission: There are no published epidemiological studies specifically on this species. However, it can be assumed to behave similarly to other members of the genus. *Uromyces aloës* is an autoecious rust, meaning it can complete a life cycle on a single host species. The fungal sori produced on aloe leaves contain numerous, thick-walled, 2-celled teliospores. The teliospores can be spread a considerable distance by wind. Additionally, the single teliospore can germinate and produce 4 haploid

basidiospores. The basidiospores are very fragile, sensitive to drying and UV damage, but are easily spread with wind and cause exponential increases in infection, usually on a local scale. Long-distance spread is through the movement of infected plants.

Damage Potential: Rusts rarely kill their hosts, but high levels of infection result in loss of crop quality and quantity for harvesting for medicinal uses (Soni et al., 2011). In gardens in Spain, it has been described as causing “massive infestations” (Alvarez et al., 2004). In general, ornamentals such as aloe that are grown for their ornamental leaves have a very low tolerance for foliar pathogens. The perennial nature of the plants leads to increased incidence as the rust pustules continue to develop on a plant over the years.

Worldwide Distribution: Eritrea, Ethiopia, France, India, Japan, Madagascar, Malawi, South Africa, Southern Africa, Spain, Tanzania, Uganda, United Kingdom, United States (Pennsylvania), Zimbabwe (Farr and Rossman, 2020; Jalla et al., 2015; Montón et al., 2004; Soni et al., 2011).

Official Control: *Uromyces aloës* is a U.S. Regulated Plant Pest (USDA APHIS) and an A-rated pathogen in California. It is on the APHIS Harmful Organism list for French Polynesia

California Distribution: None

California Interceptions: None

The risk *Uromyces aloës* would pose to California is evaluated below.

Consequences of Introduction:

- 1) Climate/Host Interaction:** As an obligate pathogen, *Uromyces aloës* is only expected to be found in association with its host. Many aloes are sensitive to cold injury and are damaged by freezing temperatures, limiting them to a greenhouse or protected cultivation except in the warmest parts of the state.

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 be established 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 limited to aloes, with one report on *Agave* sp.

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: This is a rust pathogen that uses two types of spores that are produced in large numbers and can be moved by wind to new areas.

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: This pathogen causes significant damage to ornamental and commercial plantings. It is a U.S. Regulated pest.

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: There are no native aloes in California, but they are widely planted. There are native *Agave* spp. that are desert plants and classified as rare; their susceptibility to this rust is not known.

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.
 - 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 *Uromyces aloës*: Medium

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

-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 are two historical detections of *Uromyces aloës* in California, one in San Diego County in 1978 and one in Santa Barbara County in 1980. All plants were destroyed, and the pathogen was eradicated. The 2020 detection traced to San Mateo County was also from a nursery.

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 the 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:

There is uncertainty over a report of *Uromyces aloës* infecting *Agave* spp. in California as this is the only location ever making a detection. Agave plantings are increasing in parts of California where drought-resistant landscapes are desired, and to produce distilled agave spirits (similar to Tequila).

Conclusion and Rating Justification:

Based on the evidence provided above the proposed rating for *Uromyces aloës* is **A**.

References:

- Alvarez, L. A., Vicent, A., Armengol, J., García- Jimenez, J., García-Figuerez F. et Montón, C. 2004. -Deteccion de *Uromyces aloe* sobre *Aloe vera*. Phytoma España 163: 22-25
- Bily, D., Nikolaeva, E., Olson, T., Rebert, S., Kang, S. and Molnar, C., 2021. First Report of Aloe vera Rust Caused by *Uromyces aloës* in an Ornamental Nursery in the United States. Plant disease, 105(11), p.3739.
- Doidge E. M. 1939. South African Rust fungi III. Bothalia, 5: 895-918.
- Farr, D. F. and Rossman, A. Y. Fungal Databases, U.S. National Fungus Collections, ARS, USDA. Retrieved July 11, 2024, from <https://nt.ars-grin.gov/fungaldatabases/>
- Gautam, A.K., Avasthi, S., Verma, R.K., Sushma, Niranjana, M., Devadatha, B., Jayawardena, R.S., Suwannarach, N. and Karunaratna, S.C., 2022. A global overview of diversity and phylogeny of the rust genus *Uromyces*. Journal of Fungi, 8(6), p.633.
- Jalla, J. L., Durrieu, G. and Falgas, B. 2015. *Uromyces aloës* (Cooke) Magnus (Pucciniaceae, Uredinales) nouveau pour la France. Carnets natures, vol. 2: 41-43
- Matsumoto, T. T., Gillette, W., Supkoff, D and Fukushima, C. 1982. Rust of aloe, *Uromyces aloës*. California Plant Pest and Disease Report. April-May 1982. Pg 41
- Montón, C., Figueres, F. G., Armengol, J., Álvarez, L. A., Civera, A. V. and Jiménez, J. G. 2004. Detección de "*Uromyces aloës*" sobre "*Aloe vera*". Phytoma España: La revista profesional de sanidad vegetal, (163), pp.22-25.
- Sahu, P.K., Giri, D.D., Singh, R., Pandey, P., Gupta, S., Shrivastava, A.K., Kumar, A. and Pandey, K.D., 2013. Therapeutic and medicinal uses of *Aloe vera*: a review. Pharmacology & Pharmacy, 4(08), p.599.
- Soni, K. K., Pyasi, A., Pooja, T., and Verma, R. K. 2011. Occurrence of Aloe vera rust (*Uromyces aloës*): A new record from Madhya Pradesh, India. J Mycol Plant Pathol, 41(4), pp.644-646.

Responsible Party:

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

***Comment Period: 08/05/2024 through 09/19/2024**

***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: A
