

Disease Index for the Rust *Puccinia psidii* on Rose Apple in Hawai'i



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Introduction

In 2005, *Puccinia psidii*, an invasive fungus causing guava rust in Brazil, was discovered on potted plants of 'ōhi'a (*Metrosideros polymorpha*), on O'ahu. This rust infects several members of the Myrtaceae, including rose apple and paperbark, but thus far infections of the common guava have been rare. Urediniospores are the most common type of spores formed by this rust. These bright yellow spores are spherical with tiny spines, easily airborne, and have resulted in distribution of the disease to all major islands in Hawai'i.

Rose apple (*Syzygium jambos*) has been devastated in parts of the state exposed to extended periods of moist weather. The disease also occurs in dry areas, but is less severe. Personnel with the federal government, such as the U.S. Forest Service, U.S. Geological Survey, and APHIS, and state agencies, such as the Department of Land and Natural Resources and the Department of Agriculture, are concerned about the extent of the rust's movement in Hawai'i. Thus efforts to survey forests, surrounding plant communities, and commercial nurseries were deemed to be of high priority.

Hikers and agency field workers can aid in this survey. To gather helpful data, observations of locations of the rust, the disease severity, and the environmental conditions are important. To help organize the disease survey, this disease index on rose apple, the most severely infected host, was prepared.

Young tissues that are diseased will be covered with few to many spots (Category 3 or 4). Spores (urediniospores) are formed in groups called pustules on the leaf spot. Leaf spots that are old will have only a few urediniospores, and older spores become white, but the tiny spines remain. On older spots, pustules that are slightly more orange or brown contain two-celled teliospores that are longer and have no spines. Teliospores can occur in any category on older lesions or spots and can be formed along with urediniospores in the same pustule.

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On the cover

Rose apple tree infected with *Puccinia psidii* along Hāna Highway, Maui, March 2007 (photograph by Forest and Kim Starr).

Photo credits: Photos of Category 4 leaf and stem distortion and Category 5 branch tip dieback and severely diseased stand were taken by Forest and Kim Starr; all other photographs were taken by R. Anderson.

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A series of disease indexes is being prepared to describe the *Puccinia* rust disease and to aid in monitoring it. In addition to this index on rose apple, others on 'ōhi'a and other *P. psidii* hosts such as paperbark (*Melaleuca quinquenervia*) and *Eugenia* are being prepared.

Anyone helping with this survey is sincerely appreciated and should report findings to one of the researchers listed on the back cover. If you observe symptoms other than those described here, or if you have questions, please contact the authors.

Disease symptoms

Rose apple is a highly susceptible host to *Puccinia psidii* rust in Hawai'i and elsewhere. Rose apple leaves, stems, fruit, and flowers can be affected, and the disease severity varies with the time of year. This plant is naturalized in the Hawaiian Islands in mesic to wet sites at elevations of 15–500 m (50–1650 ft), primarily in valleys and occasionally in disturbed mesic forests. Symptom severity is based on the age of the plant tissue, the environmental moisture and temperature, and the amount of time since infection. Young leaf tissues are usually most heavily diseased by the rust and typically become blighted and deformed.

Wet weather symptoms

Moisture is needed for infection, and disease severity increases during rainy or humid weather. Often, young tissues will be heavily infected with urediniospores (Category 4, page 8) during wet weather, while older leaves may have only a few lesions or spots (Category 1, page 5, or Category 2, page 6). When severely infected, leaves are blighted and deformed, and stems and leaves are often abundantly covered with yellow urediniospores. The urediniospores are the repeating stage of the rust, and they increase the epidemic by infecting new hosts or host tissue in the vicinity or miles away. Heavily infected leaves usually blacken and die, and after a month or so fall off, leaving only blackened stem tips (Category 5, page 9).

Dry weather symptoms

On young leaf tissue during dry weather, instead of the whole leaf becoming diseased, individual lesions approximately 3–5 mm ($\frac{1}{8}$ – $\frac{3}{16}$ inch) in diameter form. Adjacent lesions sometimes coalesce to become 10 mm ($\frac{3}{8}$ inch) or more in diameter. The lesions are reddish and have yellow urediniospores. As the leaves mature, the spots remain (Category 1 or 2), but fewer spores are formed. Six to eight weeks after the initial infection, spore formation is rare.

Making evaluations in the field

- For all sites, record the host plant, location, date, and disease category (as described below). A survey form is provided on page 11.
- For location, GPS coordinates are ideal. Lacking a GPS device, if you are on a trail, you can note which part you are on by estimating the distance traveled (first quarter of the trail, half way along, etc.), or you can note some land feature (near a certain stream, ridge, etc.); if near a highway, give its name and nearest milepost marker if available.
- Determine if the rust is present at a site by checking all sides of at least five trees; if no rust is found, the site's record is zero (absence of the rust at a site is useful information). For tall trees, check the lower canopy and make a note of the tree size.
- Place specimens in separate bags and wipe hands with a moist tissue before handling a new plant. Avoid touching healthy plants if you have handled plants with heavy infection levels. Wiping hands is recommended after each sampling. Although movement of the pathogen is largely by the wind and rain splash, contact can also move spores.
- In the field, evaluators should rate a site or tree using the highest category for the rating. When a tree is severely infected and young stems are covered with spores, the disease is Category 4, even if the older leaves have only a few spots (Category 1 or 2). Note the category of the older leaves, buds, flowers, and fruits, if present. When a tree has only old growth with dead branch tips, the disease is Category 5, but you should also make a note if there are other leaves in Category 1 to 3, and check for any other plant parts, such as flowers, that may be diseased.

Category 1

- Ten spots or fewer per leaf, each spot about 2 mm ($\frac{1}{16}$ inch) to more than 10 mm ($\frac{3}{8}$ inch) in diameter.
- Leaves have few urediniospores and, if present, few teliospores.

This category indicates that young leaves were infected when the inoculum level was very low, the environment was dry, or the leaf was mature enough to express some resistance. These leaves matured, developing only a few spots.

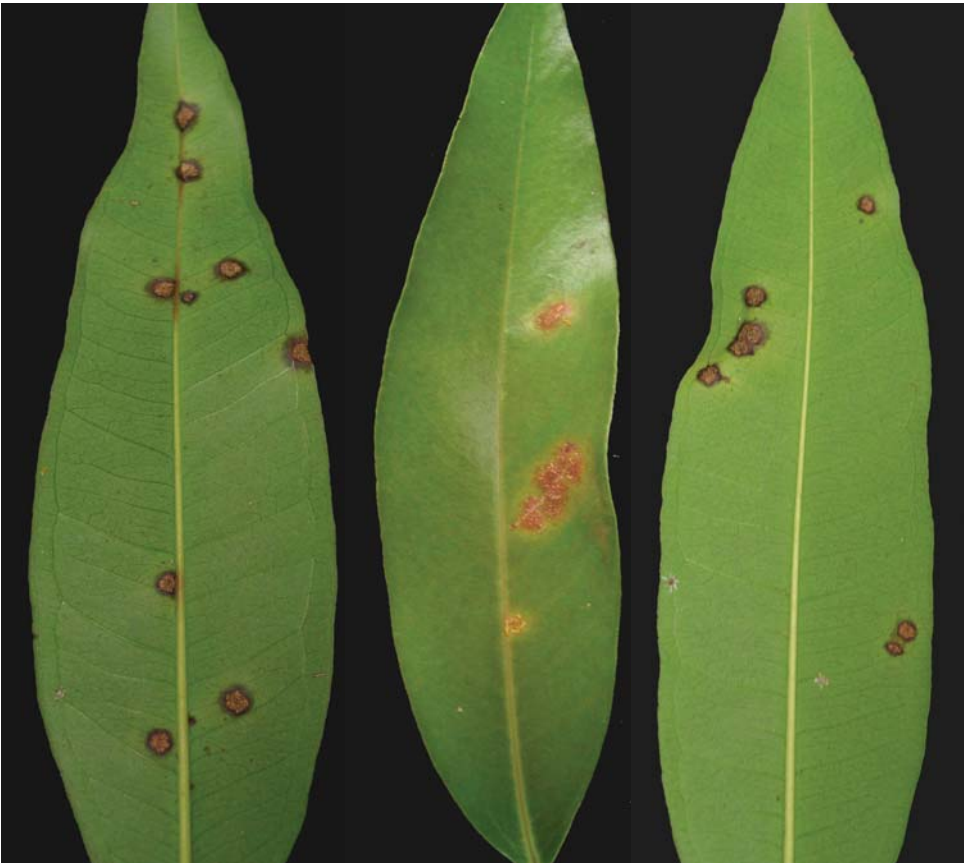


Close-up of leaf spots and empty pustules

Abaxial
(leaf undersurface)

Adaxial
(leaf upper surface)

Abaxial



Category 2

- More than 10 spots per leaf.
- Leaf spots may merge, causing formation of larger necrotic areas that are 25 mm (1 inch) or more long.
- Urediniospores are few, and teliospores may be present.
- Shot-holes, created by the loss of the diseased tissue, may also be present.

As in Category 1, this level of spotting may reflect a low inoculum level, low environmental humidity, or host resistance due to leaf maturity at the time the leaves were infected.



Close-up of leaf spot and empty pustules

Abaxial

Abaxial

Adaxial



Category 3

- Occurs on young leaves.
- Less than 30 percent of the leaf area is covered with rust pustules.
- Leaves are not severely infected, and stem lesions are rare.
- Check for presence of teliospores.

This generally represents infection of young tissue when the environment was dry.



Close-up of two clusters of pustules (groups of urediniospores)

Adaxial, few spores

Abaxial, many pustules and urediniospores



Category 4

- Severe infection of young leaves and new growth, with as much as 80–100 percent of the leaf surface covered with lesions.
- Leaves may be deformed, curled, or distorted.
- Lesions present on stems.
- Urediniospores are produced in large numbers and frequently fall like powder onto the lower leaves.
- Check for presence of teliospores.

During this epiphytotic (or plant epidemic), heavy rust growth and pustule formation causes young tissues to produce deformed new growth covered with yellow urediniospores.



Abaxial leaf surface



Close-up of stem lesions and uredinia, or pustules

Deformed apical tip and red, deformed leaves



Deformed leaves and stem



Category 5

- Leaves become necrotic (blackened) and abscise (drop from the stem).
- Branch tips are severely diseased and bare of leaves (photo below, and p. 10).

Following an epiphytotic on the young leaves, stems tips have no leaves and are brown or blackened. Dead branch tips are present in the upper canopy of the tree. Mature green leaves have Category 1 and 2 disease levels. New leaves produced on lower branches also become infected (Category 3 or 4).

Necrotic (dead) young leaves caused by severe infection (Category 4)



Close-up of branch tip dieback (new leaves circled)



Category 5 (continued)



Rose apple stand with severely diseased plants, Huelo, Maui



Infected fruit

Other symptoms

Pustules may be present on rose apple buds, flowers, and fruits.



Infected inflorescence



Infected bud, opening

For further information

<http://nt.ars-grin.gov/taxadescriptions/factsheets/index.cfm?thisapp=Pucciniapsidii>

www.hear.org/species/puccinia_psidii

For survey form

www.ctahr.hawaii.edu/oc/forms/rustsurvey.pdf

Field survey for *Puccinia psidii* rust disease

Host observed: rose apple 'ōhi'a other _____
Use a separate form for each host/observation.

Collector _____ date __/__/__ phone/e-mail _____

sample taken; sample no. _____
(Sample number might include your initials, the date, and a sequence number; e.g., RA 4/15/08-2.
Please give this form to the researcher along with the sample.)

Environment nursery natural location
island _____ location _____ trail/road _____
trail section/milepost _____ elev. (est.) _____
GPS _____

If no GPS, include further description of the site in the comments field.

Description of plant
 young mature with flowers and seeds in decline, repeated loss of young leaves
plant size _____
For 'ōhi'a: leaves pubescent (hairy) leaves glabrous (smooth)
flower color: _____

Rust occurrence leaf spots/rust spores not observed present
disease index category: 1 2 3 4 5 (check all that apply)

Extent of field examination 4 sides of host checked, at least 2-3 branches on each side examined; _____ sides checked and branches examined; only 1 side observed

Disease present mostly on young leaves mature leaves old leaves all leaves
Extent of rust infection in area: 1 tree only a few trees many trees all trees in the area have some infection

Nearby infected host plants rose apple 'ōhi'a paperbark java plum
 mountain apple bush cherry downy rose myrtle *Eugenia reinwardtiana*
others _____
Other *Metrosideros* species present:
 rugosa *macropus* *waialealae* *tremuloides*
M. polymorpha varieties present (specify) _____

Comments:

Researcher findings: initials _____ date _____ urediniospores teliospores

Please submit rust survey results to these researchers:

O'ahu

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We greatly appreciate any ***findings of new hosts***. If you find a plant not mentioned in this publication that may have the rust, please submit it to Janice Uchida, Robert Anderson, Robert Hauff, Scot Nelson, Norman Nagata, or Jeri Ooka. We will confirm the pathogen and report back to you.



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