



Foliar Pathogens in Guam: *Peronospora*

Disease: Downy Mildew

Robert L. Schlub, Ph.D., Julia Hudson, and Elizabeth Hahn
Cooperative Extension & Outreach, College of Natural & Applied Sciences,
University of Guam

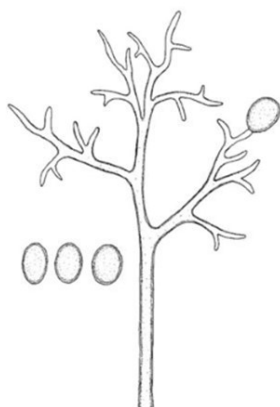


Figure 1. Sporangiphore and sporangia of a downy mildew fungus
Source: https://www.researchgate.net/figure/Peronospora-verbenae-on-Verbena-officinalis-A-conidiophore-B-conidia-Bar-50-m_fig1_269995285



Figure 2. Example of conidiophore masses caused by downy mildew
Source: <https://www.insectimages.org/browse/subthumb.cfm?sub=9440#>

Introduction

DOWNY MILDEW is the name of a disease or the growth of a group of oomycetes or fungal-like organisms that appear as a downy or fuzzy growth. The growth consists of mycelium, spore-bearing structures, and spores. It occurs on various host surfaces (leaves, branches, and fruits). They are among a larger group of fungi known as oomycetes, also known as “water molds,” which include *Pythium*, *Phytophthora*, and *Albugo*. Those that produce the downy mildew disease include *Peronospora*, *Plasmopara*, *Bremia*, *Pseudoperonospora*, *Peronosclerospora*, *Sclerospora*, and *Sclerophthora*.

Hosts

In the Index of Plant Diseases in Guam, *Corynespora* was listed on 41 different hosts, all of which exhibited foliar symptoms. Of these, it is most severe on cucumber, papaya, and tomato. Other hosts on Guam include banana, guava, melon, pumpkin, edible soybean, pepper, and common weeds such as beggarticks, morning glory, browne’s blechum, and siam weed. In the Diseases of Cultivated Crops in Pacific Island Countries it was listed on papaya and cucumber.

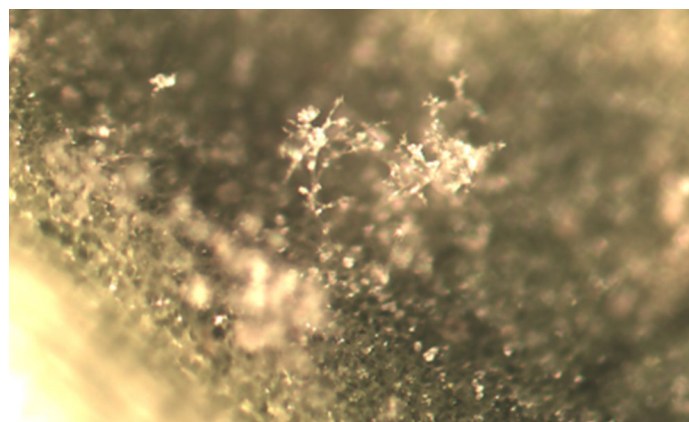


Figure 3. Branched conidiophores produced on wedelia, typical of downy mildew, as viewed under a dissecting scope
Photo: B. Deloso

Morphology of *Pseudoperonospora cubensis*

Differentiation of the various downy mildew is based upon the branching structure of their conidiophores (spore-bearing hypha). Characteristic of the genus *Peronospora* is the production of spore-bearing hypha (conidiophores) on erect trunks with 2-10 branches, which terminate to sharp points where a single sporangium (conidium) is formed (Fig. 1). *P. cubensis* conidiophores are long (5.4-7.2





x 180-400 μm), highly branched (Fig. 1), white initially, and emerge from stomata on the leaf surface. Its conidia are ovoid to ellipsoid, 14-25 x 20-40 μm , and thin walled with a papilla (a nipple-shaped protrusion) at the distal end and short protruding pedicel on the other end. Initially the conidia are white in color, but they may darken as they age.



Figure 4. Conidia on branched conidiophores produced on wedelia, typical of downy mildew, as viewed under a compound scope. Photo: B. Deloso

Visibility of *Peronospora*

- **With the unaided eye:** spots can be seen on both sides of leaves—pale yellow on the top and darker, water-soaked spots on the bottom (Fig. 5).
- **With a 14X coddington hand lens:** conidiophores are barely visible as a white spore mass (Fig. 2).
- **With a dissecting microscope:** conidiophores are more clearly visible (Fig. 3).
- **With a compound microscope:** conidia can be seen on tips of branched conidiophores (Fig. 4).

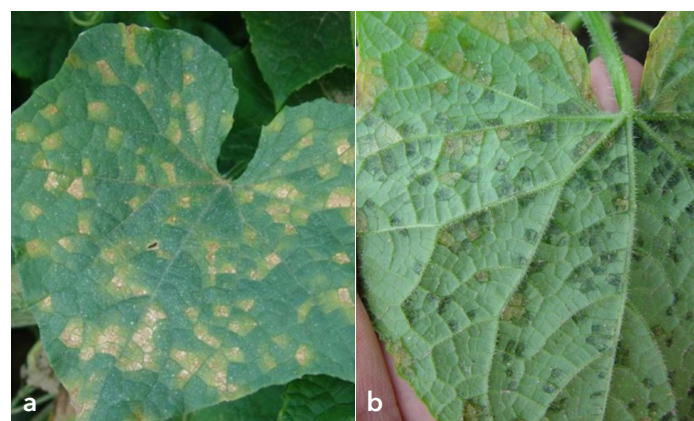


Figure 5. Downy mildew infection on the (a) upper leaf surface and (b) lower leaf surface of cucumber.

Source: (a) <https://www.maine.gov/dacf/php/gotpests/diseases/downy-mildew.htm> (b) <https://www.maine.gov/dacf/php/gotpests/diseases/downy-mildew.htm>



Figure 6. Downy mildew infection on the (a) lower leaf surface and (b) upper leaf surface of cabbage; (c) close-up of white fungal growth on lower leaf surface.

Source: (a,b) https://www.pestnet.org/fact_sheets/cabbage_downy_mildew_192.htm (c) <https://pnwhandbooks.org/plantdisease/host-disease/cabbage-cauliflower-brassica-oleracea-downy-mildew-staghead>

Disease Development on Guam

Downy mildew is favored by a wet, humid environment with cool or warm nights. A film of water is needed on plant tissue for spore germination and infection. Optimum conditions for disease development are night temperatures of 8 -16°C (46 - 61°F) for 4 or more successive nights. The fact that Guam’s night-time lows never dip below 74°F is likely why this disease is not common on Guam. The organism spreads by wind and water splash. It survives from season to season on volunteer hosts and weeds (it cannot live on dead plants).

Foliar Symptoms

General symptoms for most downy mildews begin as small, pale greenish-yellow spots with indefinite borders on the upper leaf surface, later merging and becoming brown (Fig. 5a, Fig. 6b). On the lower leaf surface of cucurbits (like cucumber), sporangial masses may give the surface a “dirty” appearance because of their gray to purplish coloration en masse, and lesions often appear water-soaked (Fig. 5b). This will lead to the leaf death and drying out. On hosts like cabbage, an abundant grayish/white fungal growth develops on the lower leaf surface, sometimes appearing on the upper surface during moist conditions (Fig. 6c). Leaves will dry out, become papery, and die. Older leaves may have a “speckled” appearance (Fig. 6a, 6b).





For further information

Contact the College of Natural & Applied Sciences, Extension and Outreach at 735-2080 for help or more information. Additional publications can be found on our website at: uog.edu/extension/publications.

Acknowledgments

This material is based upon work that is supported by the University of Guam and the National Institute of Food and Agriculture, U.S. Department of Agriculture, under award number 2019-38640-29880 through the Western Sustainable Agriculture Research and Education program under project number WPDP20-001. USDA is an equal opportunity employer and service provider. Any opinions, findings, conclusions, or recommendations expressed in this publication are those of the author(s) and do not necessarily reflect the view of the U.S. Department of Agriculture or the University of Guam. The factsheet was prepared by UOG Extension Specialist Robert L. Schlub, Ph.D. and UOG Extension Associates Julia Hudson and Elizabeth Hahn on 10/19/2022. Reviewed by Drs. Marin T. Brewer and Leilani G. Sumabat.

References

- Williams-Woodward, J., Eaker, T., Fowler, J. (2001) Fungal Identification From Plant Material.
- The University of Georgia, Cooperative Extension Service. Schlub, R.L. (2017). Index of Plant Diseases in Guam. Guam Cooperative Extension, College of Agriculture and Life Sciences.
- Kohler, F., Pellegrin, F., Jackson, G., & McKenzie, E.. (1997). Diseases of Cultivated Crops in Pacific Island Countries. South Pacific Commission.
- Keinath, A. et al. (1996). Compendium of Cucurbit Diseases and Pests, (2nd ed 2017). American Phytopathological Society Press.
- Palti, J. and Cohen, Y. (1980). Downy mildew of cucurbits (*Pseudoperonospora cubensis*): the fungus and its hosts, distribution, epidemiology and control. CABI Invasive Species Compendium.

Published: 19 October 2022



Published by the College of Natural & Applied Sciences (CNAS), University of Guam, in cooperation with the U.S. Department of Agriculture, under Dr. Lee S. Yudin, Director/Dean. University of Guam, CNAS, UOG Station, Mangilao, Guam 96923. © For reproduction and use permission, contact cnasteam@triton.uog.edu, (671) 735-2080. The University of Guam is an equal opportunity/affirmative action institution providing programs and services to the people of Guam without regard to race, sex, gender identity and expression, age, religion, color, national origin, ancestry, disability, marital status, arrest and court record, sexual orientation, or status as a covered veteran. Find CNAS publications at uog.edu/extension/publications. If you anticipate needing any type of reasonable accommodation or have questions about the physical access provided, please call the UOG EEO/ADA/Title IX Office at (671) 735-2971/2244 or email efgogue@triton.uog.edu.

For more information on UOG Cooperative Extension & Outreach, visit uog.edu/extension or call (671) 735-2080.

TR 12-22 | 3

