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Foliar Pathogens in Guam: *Albugo*

Disease: White Rust

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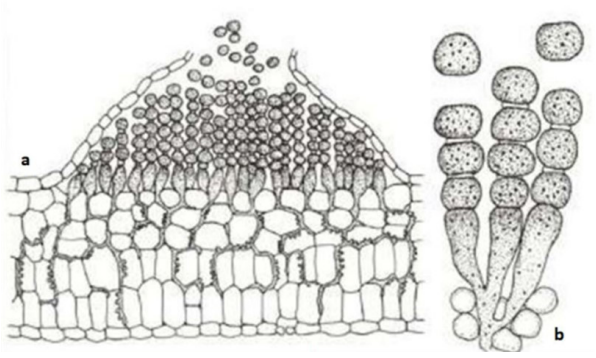

Figure 2. [A] section of infected host showing mycelium, conidiophores and conidia; [B] branching of conidiophores with chains of conidia
Recourse: https://ipm.illinois.edu/diseases/rpds/960.pdf

Introduction

WHITE RUST, sometimes called white blister, is a disease caused by several species of the oomycete *Albugo*. *Albugo* is a member of the class Oomycete which also includes *Pythium, Phytophthora, and Peronospora*. Although Oomycetes are no longer classified in the Kingdom Fungi, they are often grouped with true fungi based on their disease similarities. White rust is easily recognized by the chalk-white, cheesy, raised spore masses that occur most commonly on the underside of leaves (Fig. 1a, Fig. 6). It occurs on a wide range of plants including vegetables, ornamentals, and weeds. Susceptible plant families include cabbage, morning glory, and spinach. ***Albugo ipomoea-panduratae*** is responsible for white rust of *Ipomoea aquatica* (water spinach or kangkong). White rust has little effect on yield, but the unsightly appearance of infected leaves (white sporulating blisters and deformities) can significantly affect market value.

Hosts

The genus *Albugo* was mentioned as a foliar pathogen on 4 hosts in the Index of Plant Diseases on Guam, causing white rust on beach morning glory, morning glory, radish, and water spinach ("kangkong" in Chamorro). In the Diseases of Cultivated Crops in Pacific Island Countries it was listed on water spinach, radish, and Chinese cabbage.

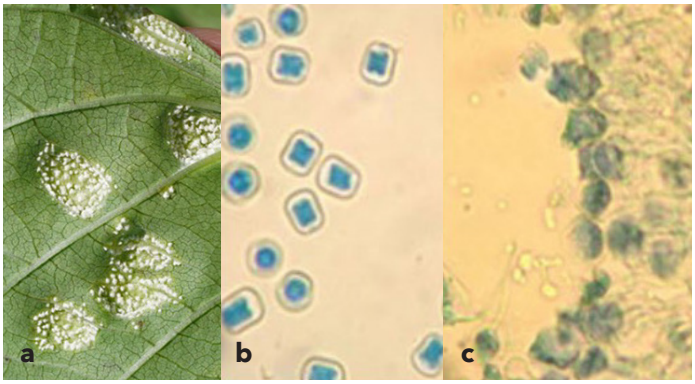

Figure 1. [a] *A. ipomoea-panduratae* on wild sweet potato exhibiting concentric white rust pustules. Source: https://bygl.osu.edu/node/1192 ; *A. ipomoeapandurante* on blue morning glory exhibiting [b] mature (cylindrical) and young (roundish) conidia, and [c] conidiophores with chains of conidia at terminal end
Source: https://www.scielo.br/pdf/bjm/v43n1/v43n1a36.pdf

Morphology of *Albugo ipomoea-panduratae*

There are no septa (cross-walls) in the hyphae that makes up the body of the oomycete. This oomycete has both a sexual and asexual stage, with the asexual stage being responsible for the majority of infections and disease spread. The asexual stage begins as immature sori (pustules), where hyphae accumulate in clusters just beneath the leaf surface. This gives rise to numerous sporangiophores; also referred to as conidiophores (spore-bearing hypha) (Fig. 2a). Conidiophores are hyaline, 12-15 x 30-40 µm, non-septate, and club-shaped (Fig. 2b). Sporangia (conidia) develop in short chains on the terminal end of conidiophores (Fig. 1c, Fig. 2b). Conidia are cylindrical to rectangular, 12-20 x 12-18 µm, hyaline, and thin-walled (Fig. 1b). Conidiophores and conidia eventually rupture through the host epidermis, creating chlorotic flecks composed of white spore masses

(held within 5-6 mm diameter sori). Depending on environmental conditions, conidia may germinate directly and produce a germ tube (hyphae), or indirectly and produce zoospores (spores with flagella that are capable of movement in water). Oospores (sexual spores) are rarely found in leaves; however, they may form in stems (Fig. 7). Oospores are spherical, yellowish-brown, 25-40 µm diameter, with low burnt ridges.

Visibility of *Albugo ipomoea-panduratae:*

- **With the unaided eye:** white, powdery spore masses (pustules) are visible on the underside of leaves, usually in concentric rings (Fig. 1a, Fig. 5 & 6).
- **With a 14X coddington hand lens:** individual pustules and their concentric pattern of development are visible (Fig. 1a).
- **With a dissecting microscope:** chains of conidia can be seen attached to the ends of conidiophores (Fig. 2a).
- **With a compound microscope:** characteristics of conidiophores and conidia are clearly visible (Fig. 1b-c, Fig. 2b).

Figure 5. Symptoms of white rust on lower leaf surface of water spinach
Source: http://www.pestnet.org/SummariesofMessages/Crops/Vegetables/Ipomoeaaquatica Albugo,whiteblisterrust,Ipomoea,Cambodia.aspx

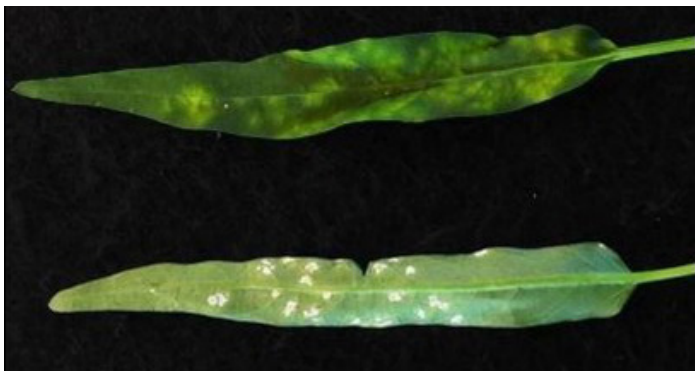

Figure 6. Symptoms of white rust on lower leaf surface bottom) and upper leaf surface (top) of water spinach
Source: https://www.researchgate.net/publication/341783444_Mycological_Characterization_Of_White_Pustule_Symptom_On_Ipomea_Reptans_Poir_Leaves_In_Bogor-Indonesia

Figure 7. Swollen galls caused by white rust on petioles of water spinach
Source: http://www.pestnet.org/SummariesofMessages/Crops/Vegetables/Ipomoeaaquatica/Albugo,whiteblisterrust,Ipomoea,Cambodia.aspx

Disease Development on Guam

Albugo survives in soil, plant debris, and infected seed. It is spread short distances when spores are splashed from plant to plant, and longer distances by wind and insects. Depending on conditions, sporangia germination takes place by liberation of zoospores or by production of germ tubes. Penetration of the host occurs through the stomata, thereby resulting in the majority of infections occurring on the lower leaf surface. Disease is favored by light rain or irrigation lasting for extended periods of time. On Guam, the disease is observed to be common and widespread on farms planting kangkong (water spinach) during the rainy season (July– November). Leaf wetness in excess of 2 to 3 hours is required for spore germination and infection. Management includes long crop rotations and removing plant debris after harvest.

Foliar Symptoms

White rust of water spinach (caused by *Albugo ipomoeae-panduratae*) causes blisters on the lower leaf surface. The blisters are closed at first and then burst to release powdery spores, similar to the development of the gold rust pustules of *Puccinia*, hence the name "white rust" (Fig. 1, Fig. 5). The pustules on the leaves usually contain asexual spores. The pustules may merge to form larger patches, and sometimes corresponding lesions will appear on the upper surface of the leaf (Fig. 6). In water spinach, the underlying tissue becomes necrotic, which is apparent after the sporangia are shed. In sweet potato the underlying tissue is chlorotic. Severe infections of some hosts will cause their leaves to twist, wither, and die. Occasionally, swollen galls form in the petioles and stems of some plants (Fig. 7) and even in the roots of radish, horseradish, and a few other plants.

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

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