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Powdery Mildew of Poinsettia

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Powdery mildew is a common disease of poinsettia (*Euphorbia pulcherrima*) foliage and is caused by the plant-pathogenic fungus *Oidium* sp. (Celio and Hausbeck 1998, Benson et al. 2001). This pathogen is a serious problem in the commercial production of poinsettias, especially in greenhouses. The pathogen is restricted to poinsettia, however, and does not infect other plant species. The disease causes a whitish, powdery discoloration of the upper and lowers surfaces of the leaves and colored bracts (Benson et al. 2001).

Powdery mildew of poinsettia foliage in a landscape near Kailua-Kona.

In Hawai'i, the disease tends to occur and develop rapidly in areas where cooler air temperatures coincide with high relative humidity. Powdery mildew, when severe or left unmanaged, may render poinsettia plants unfit for sale. Here we discuss the symptoms of powdery mildew of poinsettia, describe the pathogen, and suggest integrated practices for effective prevention and management of the disease.

Host

The poinsettia is an ornamental plant grown for its showy bracts, which vary in size, shape, and color. These bracts are commonly referred to as the flower, but in fact they surround the flowers. The female flower does not have petals and often lacks sepals. It is surrounded by individual male flowers and enclosed in a cup-shaped structure called a cyanthium (Benson et al. 2001). The poinsettia is native to Mexico and arrived in the U.S. in the 1800s (Benson et al. 2001). Since that time, it has become a popular ornamental plant in the U.S., including Hawai'i. In 2008, potted poinsettia sales in Hawai'i were about $1.45 million (Hawai'i Flowers & Nursery Products Annual Summary 2008).

Disease Symptoms and Signs

Of the 700 to 1,000 species in the genus *Euphorbia*, poinsettia is the only species known to be susceptible to the *Oidium* sp., which causes powdery mildew on this host (Benson et al. 2001). Though a powdery mildew infection of poinsettia may not be lethal to the plant, it reduces its value and may make it unmarketable. Typical symptoms include yellow- to brown-colored blotches on the upper surfaces of leaves and bracts (Mullen et al. 2006), as well as the white, powdery, dust-like structures that are a classic sign of the fungus and typically appear first on the undersides of leaves. Fungal growth eventually develops on the upper leaf surfaces if the disease is not managed and conditions are favorable for infection and pathogen growth (Mullen et al. 2006). These unsightly powdery structures are the pathogen's thread-like

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hyphae and its chains of conidia, or infectious spores. These hyphae and conidia appear as discrete white colonies up to 1 cm in diameter (Celio and Hausbeck 1998). Colonies may initially appear patchy but can eventually cover large portions of the leaf (Koike et al. 1998).

As an infection progresses, the conspicuous white mycelium (which are comprised of all of the hyphae together) can be observed on both sides of mature and immature leaves, bracts, stems, and petioles. Severely diseased leaves become twisted and bent and age prematurely (Koike et al. 1998).

Pathogen

Powdery mildew is an obligate parasite, meaning that it requires a living host plant to complete its life cycle. The disease was first reported in the U.S. in Pennsylvania and the Pacific Northwest in 1990 and has since become a significant disease for growers across the continent and in Hawai'i (Celio and Hausbeck 1998). The asexual form of the causal organism, *Oidium* sp., and its cell wall features are similar to those of the fungal plant pathogens *Erysiphe euphorbiae* and *Microsphaera euphorbiae*. The powdery mildew fungus *M. euphorbiae*, a known pathogen of wild poinsettia (*Euphorbia heterophylla*), has also been shown to be closely related to the species on poinsettia according to phylogenetic evidence (Celio 2003). These similarities have created some confusion as to the identity of the causal agent responsible for powdery mildew of poinsettia (Celio 2003). Since only the anamorph (asexual) stage, with no visible chasmothecia (sexual stage), has been observed to date, the pathogen is simply referred to as *Oidium* sp. (Celio and Hausbeck 1998, Koike et al. 1998, Benson et al. 2001, Celio 2003).

The conidia of this fungus are cylindrical to slightly barrel shaped, measure 25.4 to 32.3 µm × 11.6 to 18.5 µm, and are borne singly on conidiophores (Koike et al. 1998). Conidia have a length-to-width ratio greater than 2.0 (Koike et al. 1998). Foot cells of the conidiophores are cylindrical, sometimes bent at the base, and flexuous (Koike et al. 1998).

The white mycelium is epiphytic and grows on all sides of the plant parts, with hyphae measuring approximately 4.6 to 6.9 µm in diameter (Koike et al. 1998). Appressoria—the thickened tips of germ tubes that facilitate penetration of the plant surface—are lobed and sometimes opposite (Koike et al. 1998).

Pathogen Biology

The mycelium of the powdery mildew fungus grows over the surface of its host plant, forms appressoria, and then penetrates the plant surface. The penetration pegs that grow into the plant from the appressoria enter epidermal

The conspicuous white powdery spots on the poinsettia's leaves render it unmarketable.

The scarlet bracts of the poinsettia, often mistaken for its flower, are also affected by powdery mildew.

cells and form lobed structures called haustoria. These haustoria absorb nutrients from the plant, usually without killing the cells (UC: IPM 2009). Spores of the pathogen are spread by splashing rain or irrigation water and by the movement of air currents (Mullen et al. 2006, Celio and Hausbeck 1998, Benson et al. 2001).

Free water on the plant surface is a requirement for the conidia of most other fungi to germinate (UC: IPM 2009). This moisture may come from dew, leaf guttation, rain, or water from overhead irrigation. Conidia of powdery mildew are unique in this regard, however: Not only do they not require free water for germination; they in fact die in water (UC: IPM 2009). Therefore such free water will inhibit the infection of poinsettia by powdery mildew.

Powdery mildews are favored by cool to moderate temperatures between 20°C and 30°C (68°F to 86°F) and a relative humidity of 85% or higher (UC: IPM 2009). Air temperatures above 30°C (86°F) have been shown to severely limit conidial germination, while leaf temperatures greater than 32.2°C (90°F) kill some mildew spores and colonies (UC: IPM 2009).

Disease Management

Growers should scout and monitor plants more intensely in the final stages of poinsettia crop development during fall and winter. Careful monitoring by growers will allow a quick response to the disease, making treatments more effective. Symptoms that appear during the final stages of a poinsettia crop development can have dramatic economic impacts for a grower. Such infections occur readily when reduced air movement develops within the dense, mature plant canopy, causing an increase in relative humidity. These conditions are ideal for spore germination and spread of the fungus (Chase 2001, GPN). The disease may not be detected until late in the production cycle, when bracts are infected and plants are unsalable. Plants that do not exhibit mildew symptoms until after leaving a production greenhouse will likely cause customer dissatisfaction (Celio and Hausbeck 1998).

Areas in Hawai‘i where powdery mildew is apt to be severe include Kula, Maui, and some higher-elevation sites on the island of Hawai‘i, where the weather conditions favor infection and disease development. As with most other powdery mildew diseases in Hawai‘i, for example those on mango, locations having warm days and cool nights are most prone to the mildews. Powdery mildew is less likely to occur where hot, dry conditions inhibit the pathogen.

Management recommendations for powdery mildew of poinsettia include the following:

- Do not transplant mildewed poinsettia seedlings. The pathogen can be introduced on infected cuttings, so inspection of cutting shipments is important to catch potential problems.
- Remove any unwanted poinsettia plants from the landscape near a poinsettia farm, as they can harbor the pathogen.
- Wet down poinsettia leaf surfaces with overhead irrigation. This will inhibit mildew development but may favor the growth of other pathogens.
- Scout the poinsettia crop frequently for symptoms of powdery mildew, being sure to inspect both sides of several mature and young leaves and bracts.
- Immediately remove infected leaves or bracts, bag the material, then remove it from the production site or destroy it.

Table 1. Fungicides registered in Hawai‘i for control of powdery mildew of poinsettia

Product Name	Active Ingredient	Formulation
Bayleton® 50 Systemic Fungicide	Triadimefon (50%)	Water-soluble packets
Spectracide® Immunox Multi-Purpose Fungicide Spray Concentrate	Myclobutanil (1.55%)	Spray concentrate
Terraguard® SC Ornamental Fungicide	Triflumizole (42.14%)	Soluble concentrate
Pipron® Liquid Concentrate	Piperalin (84.4%)	Liquid concentrate

- Do not leave the mildewed plants in greenhouses or fields between crops, or the disease may transfer to the new crop.
- Where possible, reduce relative humidity in shade houses or other structures used for poinsettia cultivation by increasing air circulation before the onset of cooler evening temperatures.
- Ensure adequate spacing between poinsettia plants to promote air movement among the plants. This will reduce relative humidity around the foliage, especially in the later stages of crop growth.
- Grow poinsettia cultivars that are more resistant to powdery mildew infection. For example, plants with white, pink, or variegated bracts have more resistance to powdery mildew than plants with red bracts (Celio and Hausbeck 1997). However, many of the cultivars listed in the above-referenced article are not currently popular among growers. Growers wishing to pursue this course should periodically check the Web sites of the main companies introducing poinsettias (e.g., Dummen, Ecke, Syngenta, Selecta/Ball, and Beekenkamp) to see whether powdery mildew resistance is mentioned.
- Apply protectant or eradicant fungicides (see below), especially in areas where powdery mildew has previously caused extensive damage (Mullen et al. 2006).
- As temperatures above 30°C (86°F) inhibit the pathogen, select a warm location for growing poinsettia. However, a related problem would be high water usage and possibly weaker growth due to the high temperatures.

Fungicides

There are a few fungicides registered for powdery mildew of poinsettia in Hawai'i that give excellent control and can prevent a heavy crop loss. Always use fungicides as directed by the label. Our mention of any product does not constitute its endorsement.

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