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Hop Powdery Mildew
Identification and Management

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Hops are dioecious flowering plants in the Cannabaceae family and are indigenous to the temperate regions of the Northern Hemisphere. Hop cones are primarily used as a flavoring agent and preservative of beer.

Powdery mildew is caused by the fungus *Podosphaera macularis* and occurs in most commercial production regions around the world. The level of cone infection is directly correlated with the level of leaf infection, though even severe leaf infections do not appear to impact bine growth. Losses are associated with cone infections and the cost of controlling the disease.

Maturing hop cones in a hop yard in northern Wisconsin

Disease cycle

The pathogen overwinters in the soil in hardy fungal survival structures or as mycelia (fungal threads) in plant buds.

Flag shoot showing severe infection with powdery mildew.

Foliar signs of powdery mildew on hop in Washington State.

Photos (left and above): David Gent, USDA Agricultural Research Service, Bugwood.org

Ideal conditions

Environmental conditions favoring powdery mildew development are consistent with those required for succulent plant growth: low light, excess fertility, and high soil moisture. Temperatures between 64°F and 70°F are optimal. Disease is reduced by long periods of leaf wetness, intense light, or limited soil moisture.

Symptoms and effects

Signs of powdery mildew, as the name suggests, are powdery and glistening white colonies that may be discrete (affecting small, circular areas) or indiscrete (covering large areas of the plant).

Expression of signs and symptoms is dependent on the cultivar, weather conditions, and fertility. Infected cones and burrs show only the white fungal structures initially. Symptoms such as brown necrotic tissue develop later in the disease cycle. Cones infected early in their development are often distorted or reduced in size.

Management

The most effective way to manage powdery mildew on hop is through prevention. The use of resistant cultivars and prophylactic fungicide programs, supplemented by cultural practices, is best. Early and continuous intervention throughout the growing season is critical.

Hop leaf and cone showing signs of powdery mildew
Photo: David Gent, USDA Agricultural Research Service, Bugwood.org

Cones showing symptoms of powdery mildew. Note the abnormal browning of cone tissue.
Photo: David Gent, USDA Agricultural Research Service, Bugwood.org

Varieties resistant to Pacific-Northwestern powdery mildew include 'Nugget', 'Cascade', and 'Mt. Hood'. Moderately resistant varieties include 'Fuggle', 'Perle', 'Tettnang', and 'Hallertau'.

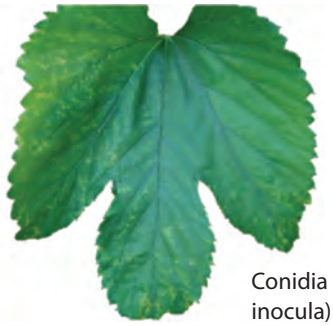
There are several fungicides that are effective against powdery mildew. When choosing reduced-risk, single-site mode of action fungicides, carefully follow resistance management practices, as per the label. Make few or no fungicide applications during burr development, because the burr is highly susceptible to damage. To reduce disease development during this time, remove basal growth just prior to flowering and apply a protectant fungicide with long residual action.

Cultural practices that help prevent downy mildew include managing nutrients and water, reducing initial inoculum, and removing basal growth. Fertilizer and water inputs should be sufficient but not excessive.

Methods of removing inoculum vary depending on the overwintering method of the pathogen. Where chasmothecia (hardy survival structures) develop, removing diseased tissue from the field by cultivating the soil or burying the plant residue can be effective. If the pathogen overwinters in buds, removing buds 5–7 cm below the soil prior to shoot emergence can significantly reduce the number of flag shoots in the spring. Spring pruning that completely removes green tissue can be nearly as effective as crowning.

Applying a band of fungicide onto hills before closure can help to reduce disease spread prior to training or pruning. Once the bines have grown 2.5–3.0 m up the string, remove basal growth periodically to prevent damage to the growing tip.

Hop Powdery Mildew Disease Cycle



Masses of conidia on plant tissues results in the white, talcum-like appearance of infected plants.

Conidia (secondary inocula) are produced on infected plant tissues. Conidia disperse aerially and further infect healthy plant tissues.

Photo: David Gent, USDA Agricultural Research Service, Bugwood.org

Survival structures called chasmothecia are formed toward the end of the growing season. They are spherical black structures with spiked appendages.

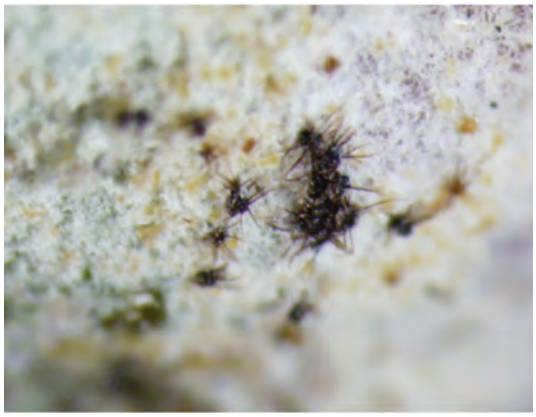


Photo: Bruce Watt, University of Maine, Bugwood.org

Under favorable conditions, the chasmothecia rupture, releasing sac-like asci containing ascospores.

Photo: Bruce Watt, University of Maine, Bugwood.org

Ascospores are primary inocula and travel by wind or rain splash. Upon landing on a host plant, they germinate and infect to initiate powdery mildew for the production season.

Nondiscrete (above) and discrete (right) foliar infection of hop leaves by the powdery mildew pathogen.
Photo: David Gent, USDA Agricultural Research Service, Bugwood.org

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