

## POWDERY MILDEWS

Powdery mildews occur throughout the temperate zones worldwide and, next to rusts, are probably the most common, widespread and recognizable diseases of food and ornamental plants. The total loss of crop yield and plant growth on all crops more than likely surpass losses caused by any other single plant disease. There are hundreds of species of powdery mildew. Over 10,000 species of Angiosperms, belonging to more than 1,600 genera, are

susceptible to the powder mildew fungi. At this time, there are no known Gymnosperm hosts.



**Mycelium and spores of powdery mildew**

Powdery mildews seldom kill their host but are responsible for water and nutrient loss and impaired growth and development. They can increase respiration and transpiration, interfere with photosynthesis and reduce yields. These factors can cause stress that can lead to general debilitation of the host plant. Powdery mildew fungi are **obligate parasites** (organisms that are totally dependent on a living host for its nutrients) and all but a few are **ectoparasitic** (living on the outside of the host). Most fungi produce reproductive structures known as **spores**. Spores can be sexual or asexual depending on the type of fungus and the stage of its life cycle. When spores germinate, they produce thread-like structures called **hypha** (Pl. hyphae). A **mycelium** (an aggregate of hyphal strands) grows on the surface of the host tissue but does not penetrate the epidermal tissue. The mycelia produce **appressoria** (organs that formed from a hypha for attachment to a host) which attach to the host surface. From the appresorium, **haustorium** (a hyphal branch) is produced which penetrates the host cells of the plant to obtain nutrients. Powdery mildews are common and can cause serious disease in cool or warm humid areas. They are most commonly found, and considerably more severe, in warm dry climates. Unlike most phytopathogenic fungi, all powdery mildew species can germinate and infect the host tissue in the absence of free water. Spores of these fungi can be killed and the growth of the mycelium inhibited by the presence of free water. Atmospheric water in the form of humidity is necessary and conducive to spore germination.



**Powdery Mildew on rhododendron**

In the early stages of development, most powdery mildew appear as gray spots or patches on the host tissue. These spots can enlarge, coalesce, and completely cover the infected organs of the host within a short period of time. This powdery looking growth is the **mycelia** and **conidia** (asexual spores) of the fungus. The conidia of the powdery mildews grow in chains and can generally be seen with a hand

lens (10x). The mycelial growth is most common on the upper side of leaves; however, a few species can infect the lower side of the leaves as well. The young succulent growth of leaves, buds and fruit are the most susceptible tissues on the host plant and are more often infected than the older parts of the host plant.

The life cycle of powdery mildew includes both **sexual** and **asexual** reproduction. Asexual spores produce **conidia** and the sexual stage produces **cleistothecia** (**ascocarps** or **fruiting bodies**) which contain **ascospores**. The number of **asci** (a sac-like cell that contains ascospores) in each cleistothecia and the kind of cleistothecial appendages identify the genera of this group of fungi. The ascocarp can be an over-wintering structure and is important to the survival of the fungi. The asexual, or conidial, stage of the infection serves to spread the disease and intensify its effects.

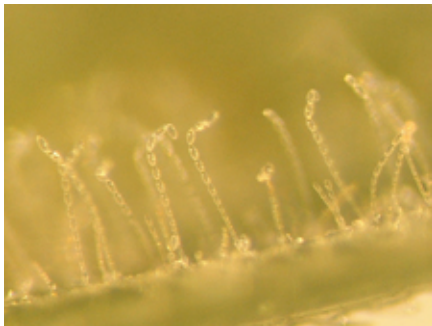


**Cleistothecia of Powdery Mildew**

Powdery mildews can also survive winter conditions as dormant mycelia within the buds and other plant tissue of the host. These infected parts of the host can be the source of primary inoculum that can initiate further infection when conditions are right. Some of the mildews are host specific while others can infect many different types of plants. It is important to know the range of hosts in order to apply effective control measures.

## DIAGNOSIS

**Mycelia** and **conidia** are the most conspicuous signs of an infection in its first stages.



**"True chains" of conidia**

They will appear as white to grayish or brown **spots** or **patches** on **young** plant tissue. These signs will usually be on the **upper side** of the infected leaves and on tender new growth. Often, symptoms of chlorosis and senescence will appear under the mycelia. By mid-summer, the infected parts of the host can be covered with

powdery **mycelial** growth and **conidia**. As the disease progresses, small (0.1 to 0.3 mm) spherical, pinhead-sized cleistothecia may be present on the mycelial growth. They can be single or in groups. As the **cleistothecia** develop, they



will appear white then later turn to a yellow-brown color and then finally **black**.

The tissue of the effected host will often show symptoms such as **stunting**, **discoloration** and **distortion**. Fruit, such as apples, may be **scarred** or **russeted**.

## CONTROL

Good cultural practices go a long way in preventing and controlling powdery mildews. Avoid planting susceptible plants in shady, humid areas. Prune for enhanced light penetration and air circulation. When the first symptom and/or sign of disease are noticed prune out and destroy the infected shoots and plant tissue. Destroy pruned material by burning, burying or removing to a landfill or appropriate location. It is best not to compost



any diseased material. Dormant pruning of over-wintering infected terminal tissue will help in reducing primary inoculum. Avoid over fertilizing with nitrogen. Use healthy planting stock and when possible use resistant cultivars. When home gardeners employ sensible cultural practices the necessity for chemical application is reduces dramatically.

Chemical application for disease prevention and control has been employed for generations and many are safe and effective when used properly. Sulfur, carbonates and petroleum-derived spray oils traditionally are effective in powdery mildew management. There are numerous chemical fungicides, when employed singly or in combination, that can provide prevention/eradication of this group of fungi and are suitable for commercial or home use. Also, there are a number of products on the market, and approved for home use, that are systemic within the host.



**Lilac Powdery Mildew**

approved for organic gardening and agriculture are essential if chemical methods are to be employed.

Nonetheless, homeowners, due to possible adverse environmental impact, should avoid chemical applications as much a possible. It is difficult to make general recommendations for chemical control due to the diversity of hosts and species of powdery mildews. Before starting a spraying program, be sure to refer to authoritative and current sources such as your local government agencies, university publications, and manufacturers labels. Timing and proper application of both manufactured

fungicides and elements and compounds

## CLASSIFICATION

**PHYLUM:** Ascomycota

**CLASS:** Filamentous ascomycetes

**ORDER:** Erysiphales (the powdery mildew fungi) Asci in fruiting bodies completely closed (cleistothecia). Mycelium, conidia and cleistothecia on surface of plant. Obligate parasites.

The following are some of the main genera of powdery Mildews and some of the important diseases they cause.

**GENUS:** *Blumeria*; cereals and grasses

*Erysiphe*; Herbaceous plants. Begonia, chrysanthemum, Cucurbits, dahlia, zinnia, legumes, beets, crucifers, tomato.

*Leveillula*; Tomato

*Microsphaera*; Azalea, rhododendron, lilac,

*Oidium*; (anamorph only) tomato, begonia.

*Phyllactinia sp*; Shade and forest trees.

*Podosphaera*; Apple (*P. leucotricha*), quince, apricot, cherry, Peach, plum, cucurbits.

*Sphaerotheca*; strawberry, gooseberry, currant, peach, rose.

*Uncinula*; Grape (*U. necator*).

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