

The **GM PRO** Stephen T. Nameth
on
Disease Management

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Controlling powdery mildew requires identification, vigilance

Powdery mildew is relatively easy to identify, characterized by fluffy, white fungal growth on leaves, stems and flowers. The disease typically shows up on leaves first and, if left unchecked, spreads to stems and flowers. The disease can be first seen as small, white/powdery colonies on the upper surface of the leaf. These colonies can continue to grow until the entire leaf surface is covered with the characteristic powdery white growth.

A cloud of white spores can be released if severely infected plants are handled or disturbed. This indicates a severe problem and at this

point the disease has probably spread to stems and flowers. Leaf, stem and flower distortion is common in severe infestations. Plants with severe distortion are unsalable.

Downy vs. powdery mildew

How do you distinguish powdery mildew from downy mildew? The fungus that causes downy mildew disease is not related to the fungi that cause powdery mildew. Downy mildew is not as common as powdery mildew and the initial fungal growth tends to show up on the underside of the leaf. Powdery

mildew tends to show up on the leaf's upper surface first.

Downy mildew is brownish-gray as opposed to powdery mildew's white to off-white color in most cases. This distinction is important since chemical controls for these two diseases are completely different.

There are a half dozen or so fungal genera and a variety of species that can cause powdery mildew on greenhouse-grown crops. Although powdery mildew can be found on many hosts, the fungi that cause disease on a given plant species tend to be somewhat host-specific. However, the fungus that causes powdery mildew on gerbera can also cause disease on more than 20 other flowering plant species.

Infection and development

All powdery mildew fungi produce thousands of microscopic airborne spores in the proper environment. If a spore lands on the leaf, stem or flower of a susceptible host and conditions are favorable for the spore to germinate (95-plus percent relative humidity and warm temperatures), disease initiation begins. The germ tube of the germinating spore can

penetrate the leaf surface within six hours of the spore landing on it.

The invading fungus produces a nutrient-gathering structure (haustorium) inside the epidermal cells of the host. The haustoria act as a nutrient sink for the fungus at the expense of the host's health. While this is taking place, the fungus is growing on the leaf surface, producing the white growth typically associated with the disease. As part of this surface growth, the fungus also produces hundreds of microscopic erect structures, called conidiophores. Dozens of airborne fungal spores are produced at the ends of these structures. These spores are then released and moved by air onto a new host. The more haustoria produced, the more the fungus grows on the surface. The more surface growth, the more spores are produced.

There is a lag time of five days from the time the germ tube enters the plant and the first appearance of fungal growth on the leaf surface. This is why it is important to treat the entire crop when using a fungicide since many plants that appear healthy are infected. The disease cycle will continue until the plant dies, environmental conditions change or chemical control applications are initiated.

Management and control

Powdery mildew is responsible for economic losses in many crops. A partial list of susceptible bedding and potted plants: African violet, ageratum, begonia, calendula, gerbera, poinsettia, hydrangea, impatiens, salvia, verbena and zinnia. Herbaceous perennials such as ajuga, aquilegia, aster, chrysanthemum, delphinium, echinacea, monarda, phlox, poppy and rudbeckia are hosts of powdery mildew. Rose powdery mildew is very common on miniature roses.

Another way to reduce disease is to breed mildew-resistant varieties.

Modify the environment

One of the best ways to control powdery mildew on all hosts is to modify the greenhouse environment so that it does not favor disease initiation and development, in other words, disease prevention. In a greenhouse, powdery mildew tends to be a problem early and late in the growing season. It can become more significant when the night temperatures are cooler and the days are warm (spring and fall). However, it depends on the individual powdery

mildew species and the host as to when and where it will show up.

Since fungal spores germinate at a relative humidity of 95 percent or higher, it is imperative to provide good air movement. Keeping the air constantly moving around the plants helps reduce the relative humidity and the probability that the fungus can establish a foothold.

Avoid anything that contributes to increasing greenhouse humidity. For instance, humidity will be lower in a greenhouse with few weeds. Humidity will also be lower in a greenhouse where water is not allowed to sit on floors and benches.

Powdery mildew spores need at least two to four hours of high humidity before they can germinate. They need another two hours before they can penetrate the host's epidermal cells. It is important that the foliage on overhead-irrigated plants dry before sunset.

If you can implement as many humidity-reducing practices as possible, you will go a long way in reducing the odds that you will have to deal with powdery mildew as well as many other fungal-initiated diseases such as botrytis and rust.

Also, do not hold over powdery mildew-infected plants from season to season. Even if plants show no outward mildew symptoms, there is a strong possibility dormant spores on those plants can serve as a source of disease inoculum. Discard infected material and treat the greenhouse with a commercially available greenhouse disinfectant, such as ZeroTol, GreenShield or Physan before clean plant material is moved in. When removing severely infected plants, don't disturb them too much as it encourages the release of spores. Some growers cover infected plants with a paper or plastic bag before removal.

Chemical options

When modifying the environment fails or in cases where you must have zero tolerance for powdery mildew (on poinsettias for example), chemical applications are necessary. A wide variety of chemicals, both traditional and biological, can be used to combat powdery mildew. Some work better than others; however, the more you do culturally to keep mildew to a minimum, the more effective the fungicide will be.

In a situation where you have a

Common fungicides used to control powdery mildew^A

Fungicide	Class	Efficacy ^B
Banner MAXX	Triazole	Good/very good
Strike	Triazole	Good/very good
Systhane	Triazole	Good/very good
Terraguard	Triazole	Good/very good
Camelot	Copper	Good
Phyton-27	Copper	Good/very good
Junction	Copper combination	Good
Compass	Strobilurin	Good/very good
Decree	Hydroxanilide	Fair
Pipron	Piperalin	Good/very good
Rubigan	Pyrimidine	Good/very good
Cleary's 3336	Benzimidazole	Good
First Step	Bicarbonate	Good/very good

A Be sure that the crop to be treated is listed on the chemical label.

B Based on experimental observations, testimony from other plant health professionals and growers.

high degree of infestation, it may be wise to spray a contact and a protectant fungicide before disturbing (deadheading, harvesting, etc.) infected plants. Disturbing infected plants releases spores and the protectant will help keep those spores from germinating on new hosts.

With other fungal-initiated diseases it is important that you rotate different classes of fungicides from one application to another. This helps prevent resistance development by the fungi that cause powdery mildew.