



Figure 1. Powdery mildew is readily diagnosed by the white, powdery coating on the leaf surface. All Photos by Janna Beckerman, unless otherwise noted.

DISEASES OF LANDSCAPE PLANTS

Powdery Mildew

Powdery mildew is a common fungal disease that can attack a wide range of plants (Fig. 1, Table 1). There are thousands of species of powdery mildew fungi; most are very specific to their plant host, meaning powdery mildew of lilac will not spread to phlox or other annual and perennial flowers.

Table 1. Midwest landscape plants that can be infected by powdery mildew.

Annuals and Perennials			
aster (<i>Aster</i> , <i>Stokesia</i> , others)*	columbine	Knautia	Prunella
bachelors button (<i>Centaurea</i>)	Cosmos	lupine	Sage (<i>Salvia</i>)
bee balm (<i>Monarda</i>)*	Coreopsis (tickseed)	lungwort (<i>Pulmonaria</i>)	Scabiosa
Begonia*	Dahlia*	million-bells* (<i>Calibrichoa</i>)	Sedum*
bellflower (<i>Campanula</i>)	Gerbera daisy	pansy (<i>viola</i>)	sunflower (annual and perennial)
black-eyed Susan (<i>Rudbeckia</i>)	Geranium*, perennial	Penstemon	Veronica*
bugleweed (<i>Ajuga</i>)	goldenrod	Peony*	yarrow
Chrysanthemum*	Jacob's ladder (<i>Polemium</i>)	Petunia	Zinnia*
Cineraria (and other daisies)	Joe-Pye weed (<i>Eupatorium</i>)	Phlox*	
Trees and Shrubs			
alpine currant (<i>Ribes</i>)	dogwood	Hydrangea	smoke-tree
azalea*/rhododendron	firethorn (<i>Pyracantha</i>)	lilac	Spirea
buckeye/horse-chestnut	flowering cherry and plum	maple	sycamore
burning bush (<i>Euonymous</i>)	heavenly bamboo (<i>Nandina</i>)	ninebark	tulip-poplar
Cinquefoil (<i>Potentilla</i>)	honeysuckle	rose*	Viburnum
crape-myrtle*	honey-locust	serviceberry	Wisteria
oaks (<i>Quercus spp.</i>)			

*resistant varieties available.

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Figure 2. Powdery mildew infection can cause deformity and distortion on leaves and stems.

Symptoms

Powdery mildew is easily diagnosed on most plants by its characteristic coating of “powder” that consists of the disease-causing fungus. The disease is often observed (but not limited to) the upper leaf surface (Fig. 1). Powdery mildew rarely causes serious damage to its host, but infection by the fungus can discolor leaves, causing those leaves to die and/or drop. Powdery mildew can also infect, disfigure and deform shoots and flowers (Fig. 2). In some rare instances, the characteristic sign of powdery mildew infection, the white powder caused by spores and mycelia, may not be easily visible without a microscope on some plants (Fig. 3). Repeated infections can result in weak, distorted stems, fewer leaves, and reduced flowering. Although unsightly, powdery mildew is rarely fatal, and even dieback is rare.

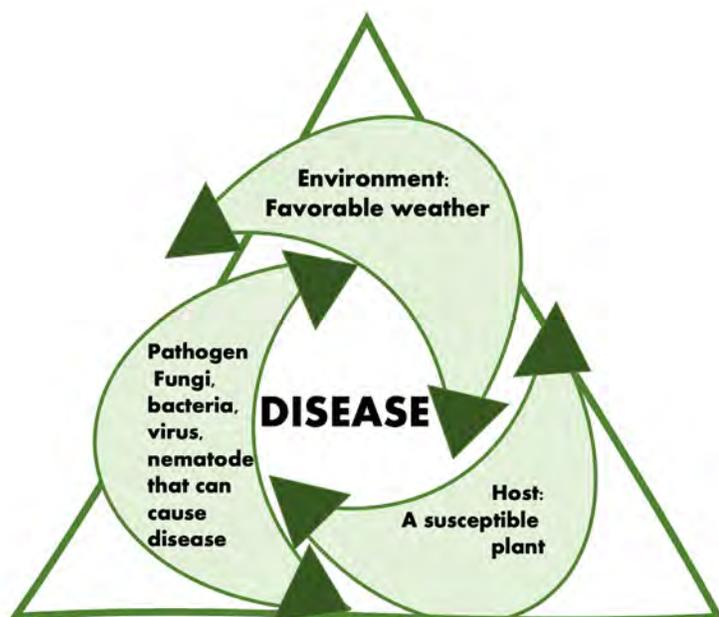


Figure 4. The plant disease triangle is a model to explain how the host, pathogen and environment interact resulting in disease.



Figure 3. Powdery may present without the characteristic ‘powdery’ coating, making diagnosis difficult. These sedum were later confirmed to be infected by powdery mildew.

The disease triangle is a useful tool to understand powdery mildew (Fig. 4). Symptom severity depends upon how virulent the pathogen is coupled with the susceptibility of the host plant (Fig. 5). Plant age, health, and vigor (due to too much or too little fertilizer) also impacts disease severity. Finally, environmental conditions affect both the plant and the fungus, with hot, dry weather causing plant stress, while providing conditions that favor the powdery mildew fungus to infect.

Biology and Disease Cycle

A variety of microscopically distinct fungi cause powdery mildew, so while the white growth covering different plants may look the same to the naked eye, the fungi causing powdery mildew on one plant are usually microscopically and biologically distinct from those on another plant (Fig. 6). In the Midwest, powdery mildews frequently infect azalea, buckeye, lilac, rose, tulip-tree,



Figure 5. Veronica is just one plant species that produces a diversity of symptom responses to powdery mildew infection.

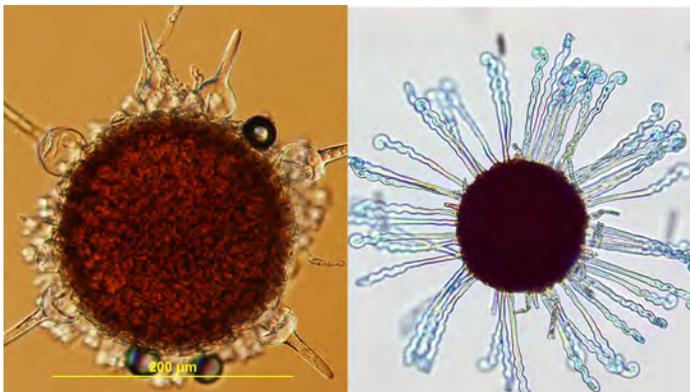


Figure 6. *Chasmothecia* of powdery mildew pathogens on dogwood (left, by Bruce Watt) and buckeye (right, by Christopher Detranaltes).

along with numerous annuals and perennials (Table 1). In most cases (some perennials being the exception), the pathogen is host specific, meaning that the rose powdery mildew pathogen cannot infect lilac, or vice versa.

In the spring, chasmothecia (specialized spore structures that look like Koosh balls) that developed on previously infected plant material, rupture and release fungal spores (Fig. 6). Wind carries these spores to newly emerging, susceptible tissues where they begin to grow on the surface, and into the upper layer of the leaf. Successful infection results in asexual reproduction, with the fungus producing columns of spores capable of causing repeated infections (Fig. 7).

Fungal growth, coupled with spore production throughout the growing season, give infected leaves a white- to light gray characteristic dusting (Fig. 1). Powdery mildew is most prevalent when temperatures are cooler and humidity is high, or when it is extremely dry. Powdery mildew pathogens are some of the only fungal organisms that can germinate and infect in the absence of free water

Management

Cultural practices aimed at alleviating high humidity can help prevent the disease or decrease its severity. Such practices involve increasing air circulation and light penetration by pruning and thinning plants to reduce overcrowding in the landscape.

When selecting new plants, choose those that have powdery mildew resistance (Fig. 8). There are many powdery mildew resistant varieties of trees, shrubs, perennial and annual plants. See 'Disease Resistant Annuals and Perennials in the Landscape.' When



Figure 7. Closeup of powdery mildew infection. Micrograph by Tom Creswell.

planting, allow for adequate spacing in the appropriate site (i.e., too much or too little sunlight can stress plants and predispose them to severe disease).

Water inhibits spore germination for most powdery mildews, so overhead watering of the leaves during the day and when humidity is low greatly inhibits infection and can protect the plant. Using water to control powdery mildew is moderately effective only if other leaf diseases are not a problem. Because most other pathogens do require water on the leaf surface to infect, take care that powdery mildew prevention occurs at the expense of another foliar disease!

Powdery mildew seldom warrants chemical control in the home landscape and is more often an issue of nursery and greenhouse production. When addition disease control is desired, materials with low environmental impact, such as horticultural oils or neem oil can prevent infection when applied to green tissue on the plant. Such applications can remain effective for



Figure 8. Many plants are selected or bred for powdery mildew resistance.

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7 to 14 days in the home landscape (depending upon plant growth and rainfall), but will likely require repeated reapplication. Do not apply these products when temperatures are above 85°F.

For greenhouse or nursery production, more products require reapplication on a 7-14 day schedule (Table 2). Always read and follow product labels to make sure the crop is on the label and for the site of use. If additional control is needed, apply a fungicide on a regular schedule as the label recommends until conditions change.

Most products labeled for powdery mildew control are available only to certified commercial applicators, not homeowners. Table 2 lists all fungicides labeled for powdery mildew. Products set in parentheses are available for homeowner use.

For deciduous shrubs that have repeated, yearly infections, a dormant fungicide such as lime-sulfur may be applied in the fall, and again in early spring before new growth begins (do not use lime-sulfur on sulfur-sensitive plants like viburnum, grape, and many garden vegetables.). Read all chemical labels for recommended plants for treatment before purchasing and using. Label information is the final authority. Read all fungicide labels carefully and apply only as directed. Always read and follow product labels to make sure the crop is on the label and for the site of use. Inclusion does not imply endorsement or recommendation.

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Table 2. Products labeled for powdery mildew control.

Trade name	Common Name	FRAC Code	Protectant or Systemic	REI	Site ¹
Avelyo	Mefentrifluconazole	3	S	12	G, N, L, I, S
Armada	trifloxystrobin + triademfon	11+3	S	12	N, L, I
Banner Maxx Propiconazole (Bonide Infuse Systemic Disease Control Conc.)	propiconazole	3	S	24h	N,L
Broadform	trifloxystrobin + fluopyram	7+11	S	12 h	G, N, L, I, S
Camelot O	Copper octanoate	M	P	4 h	G, N, L, I, S
Cleary's 3336; OHP6672	thiophanate-methyl ²	1	S	12	G,N,L,I
Compass,	trifloxystrobin,	11	S	12 h	G, N, L, I, S
Concert II	propiconazole + chlorothalonil	M+3	P+S	12	N,L
Daconil (Ferti-lome Broad Spectrum Landscape & Garden)	chlorothalonil	M5	P	12 h	G,L,I
Disarm	fluoxastrobin	11	S	12h	G, N, L, I, S
Eagle, Sythane,	myclobutanil	3	S	24h	G,N,L
Heritage	azoxystrobin	11	S	4 h	G, L, N, S
Horticultural oil (Bonide All Seasons Spray Oil Concentrate, Southern Ag ParaFine Horticultural Oil)	mineral oil	M	P	Varies	G, N, L, I, S
Milstop Broad Spectrum Foliar Fungicide (Monterey Bi-Carb Old Fashioned Fungicide)	potassium bicarbonate	M	P	1 hr	G, N, L, I, S
Mural	azoxystrobin + benzovindiflupyr	7 + 11	S	12 h	G, N, L, S
Neem oil (Bonide, Fertilome, SouthernAg)	neem oil	M	P	varies	G, N, L, I, S
Orkestra	fluxapyroxad + pyraclostrobin	7 + 11	S	12 h	G, N, L, I, S
Pageant Intrinsic	pyraclostrobin + boscalid	11+7	S	12 h	G, N, L, I, S
Palladium	cyprodinil + fludioxonil	9+12	S	12 h	G, N, L
Pipron	piperalin	5	S	12	G, S
Rubigan	fenarimol	3	S	12h	N,L
Spectro 90	thiophanate-methyl + chlorothalonil	M+1	P+S	12h	G, N, L
Strike, Bayleton	bayleton	3	S	12	G,N,L
Sulfur, (Safer Garden Fungicide)	sulfur	M	P	varies	
Terraguard	triflumazole	3	S	12	G, N, L
Torque (Bayer BioAdvanced All-in-One Rose & Flower Spray Concentrate - with insecticide)	tebuconazole	3	S	12	N,L
Tourney	metconazole	3	S	12	N,L
Trinity	triticonazole	3	S	12	G, N, L, I, S

¹ G=greenhouse; N=nursery; L=landscape; I=interiorscape; S=shadehouse

² resistance may be an issue