

POWDERY MILDEW ON ORNAMENTALS

Integrated Pest Management for Home Gardeners and Landscape Professionals

Powdery mildew is a common disease on many types of plants and is very prevalent under the dry summer conditions found in many areas of California. Different powdery mildew fungi cause disease on different plants (Table 1). Powdery mildew fungi tend to be either family-specific, infecting plants in the same family, or host-specific, infecting only one species of plant.

IDENTIFICATION AND DAMAGE

Powdery mildew can be recognized easily on most plants by the white, powdery mycelial and spore growth that forms on both surfaces of leaves, sometimes on flowers and fruits, and on shoots. Powdery mildews may infect new or old foliage. This disease can be serious on woody species such as rose, crape myrtle, and sycamore where it attacks new growth including buds, shoots, and flowers as well as leaves. New growth may be dwarfed, distorted, and covered with a white, powdery growth. Infected leaves generally die and drop from the plant earlier than healthy leaves.

LIFE CYCLE

All powdery mildew fungi require living plant tissue to grow. On perennial hosts such as roses, powdery mil-

dew survives from one season to the next as vegetative strands in buds or as fruiting bodies, called cleistothecia, on the bark of branches and stems.

Most powdery mildew fungi grow as thin layers of mycelium on the surface of the affected plant parts. Spores, which can be seen with a hand lens, are part of the white, powdery appearance of powdery mildew fungi and are produced in chains on upper or lower leaf surfaces or on flowers, fruits, or herbaceous stems. In contrast, downy mildew, another fungal disease that produces visible powdery growth, has spores that grow on branched stalks and look like tiny trees. Also, downy mildew spores occur mostly on the lower leaf surface. Environmental conditions that favor the growth of downy mildew are different than those that favor powdery mildew and include low temperatures (50° to 70°F), high relative humidity (90% or higher), and free moisture.

Powdery mildew spores are carried by wind to new hosts. Although relative humidity requirements for germination vary, all powdery mildew species can germinate and infect in the absence of free water. In fact, spores of most powdery mildew fungi are killed and



Figure 1. Powdery mildew on rose.

germination is inhibited by water on plant surfaces for extended periods. Moderate temperatures (60° to 80°F) and shady conditions generally are the most favorable for powdery mildew development. Powdery mildew spores and mycelium are sensitive to extreme heat and sunlight, and at leaf temperatures above 90°F, some may be killed.

MANAGEMENT

The best method of control is prevention. Avoiding the most susceptible cultivars, providing plants full sun, and following good cultural practices

Table 1. Host Plants and Control Measures for Powdery Mildew Species.

Hosts	Fungus species	Controls
begonia, Composit family (chrysanthemum, dahlia, phlox, sunflower, zinnia)	<i>Erysiphe cichoracearum</i>	water sprays; fungicides if necessary
crape myrtle	<i>Erysiphe lagerstroemiae</i>	use resistant cultivars
rose	<i>Sphaerotheca pannosa</i>	use resistant cultivars; fungicides if necessary

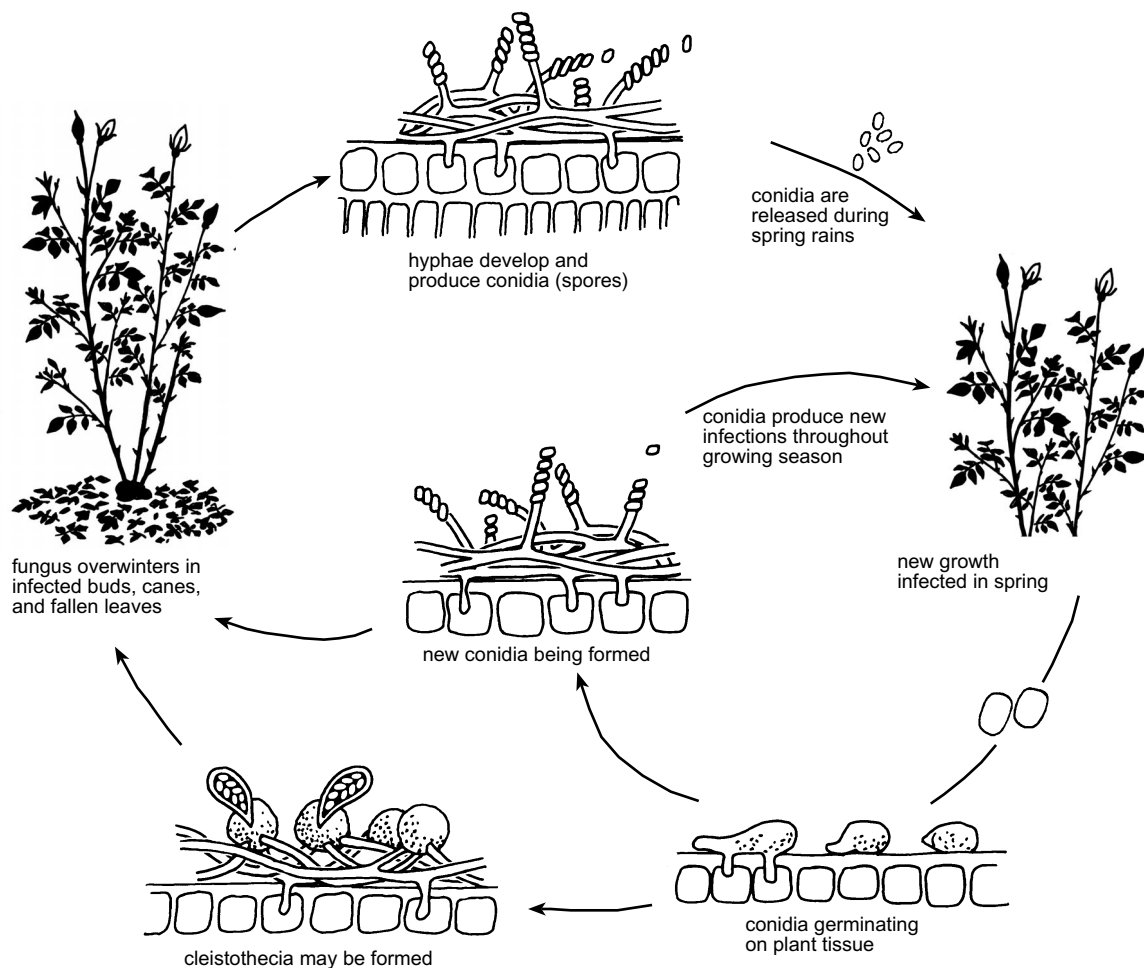


Figure 2. Life cycle and stages (magnified) of *Sphaerotheca pannosa* infecting rose.

will adequately control powdery mildew in many situations. However, some ornamentals require protection with fungicide sprays where conditions are most favorable for mildew. Fungicide applications are most often needed on susceptible varieties of rose and crape myrtle.

Resistant Varieties

Cultivars that are resistant to powdery mildew are available for some susceptible plants (Table 2). Purchase resistant cultivars of rose, crape myrtle, euonymus, and sycamore. Be aware that control actions will probably be needed when more susceptible varieties are planted.

Cultural Practices

Shade and moderate temperatures favor most powdery mildews. Locate plants in sunny areas as much as possible, provide good air circulation, and avoid excess fertilizer. A good alternative is to use slow-release fertilizer. Overhead sprinkling may actually reduce the spread of powdery mildew because it washes spores off the plant; also, if spores land in water, they die. The best time to irrigate is in mid-morning so that the plants dry rapidly, reducing the likelihood of infections by other fungi, such as the ones that cause rust or black spot infections on roses. As new shoots begin to develop on perennial plants, watch closely for the appearance of powdery mildew.

Fungicide Applications

In some situations, especially when growing roses, fungicides may be needed. Fungicides function as protectants, eradicants, or both. A protectant fungicide prevents new infections from occurring, whereas an eradicant can kill an existing infection. Apply protectant fungicides to highly susceptible plants before the disease appears. Use eradicants at the earliest signs of the disease. Once mildew growth is extensive, control with any fungicide becomes more difficult.

Fungicides. Several least-toxic fungicides are available, including horticultural oils, neem oil, jojoba oil, sulfur, potassium bicarbonate, bicarbonate of

Table 2. Some Common Ornamental Plants that are Highly Susceptible to Powdery Mildew and Resistant Varieties.

Susceptible plant	Resistant cultivars (if available)
aster	
azalea (deciduous)	
begonia (tuberous)	
calendula	
California poppy	
China aster (<i>Callistephus</i>)	
chrysanthemum	
Clarkia	
columbine	
coral bells (<i>Heuchera</i>)	
corn flower	
cosmos	
crape myrtle	those with Native American names, e.g., 'Catawba,' 'Cherokee,' 'Hopi'
dahlia	
delphinium	
euonymus	variegated varieties more resistant than nonvariegated types
forget-me-not	
gaillardia	
hydrangea	
lilac	
London plane tree	'Yarwood,' 'Columbia,' 'Liberty'
lupine	
mint	
monarda	'Marshall's Delight,' 'Blaustrumph,' 'Colrain Red'
oak	
pansy	
phlox	<i>Phlox maculata</i> 'Natasha'; <i>P. glaberrima</i> 'MorrisBerd'; <i>P. paniculata</i> 'Robert Poore' and 'David'
ranunculus	
rose	'Simplicity' and 'Meidiland' roses; <i>Rosa rugosa</i> varieties <i>R. yakushmanum</i> , <i>R. macrophyllum</i> , <i>R. 'Nova Zembla</i> ,' <i>R. 'Palestrina'</i>
rhododendron	
rudbeckia	
snapdragons	
sweet pea	
verbena	
vinca	
zinnia	Pulcino and African zinnias

soda (baking soda), and the biological fungicides AQ10 and Serenade. With the exception of the oils, these materials are primarily preventive, although potassium bicarbonate has some eradicant activity. Oils work best as eradicants but also have some protectant activity.

Oils. To eradicate mild to moderate powdery mildew infections, use a horticultural oil such as JMS Stylet Oil,

Saf-T-Side Spray Oil, Sunspray Ultra-Fine Spray Oil, or one of the plant-based oils such as neem oil (e.g., Powdery Mildew Killer) or jojoba oil (e.g., E-rase). *Be careful, however, to never apply an oil spray within 2 weeks of a sulfur spray or plants may be injured. Also, oils should never be applied when temperatures are above 90°F or to drought-stressed plants.* Some plants may be more sensitive than others, however, and the interval required between sul-

fur and oil sprays may be even longer; always consult the fungicide label for any special precautions. Of the horticultural oils, JMS Stylet Oil is the most highly refined and therefore the least likely to damage plants, but it may be more difficult to obtain than the others.

Sulfur. Sulfur products have been used to manage powdery mildew for centuries but are only effective when applied before disease symptoms appear. The best sulfur products to use for powdery mildew control in gardens are wettable sulfurs that are specially formulated with surfactants similar to those in dishwashing detergent (e.g., Safer Garden Fungicide). However, sulfur can be damaging to some ornamental cultivars. *To avoid injuring any plant, do not apply sulfur when temperature is near or over 90°F and do not apply it within 2 weeks of an oil spray.* Other sulfur products, such as liquid lime sulfur or sulfur dust, are much more difficult to use, irritating to skin and eyes, and limited in terms of the plants they can safely be used on.

Bicarbonates. Also available is a fungicide containing potassium bicarbonate (e.g., Kaligreen) and a fungicide that can be made at home by combining 2½ tablespoons of horticultural oil (Sunspray Ultra-Fine, Saf-T-Side, etc.) in a gallon of water and adding 4 teaspoons baking soda. This solution is sprayed on plants to prevent powdery mildew infections. Sprays of both potassium bicarbonate and baking soda can injure the plant, so use these materials with caution. Also, baking soda sprays can have deleterious effects on soil structure and should be used sparingly.

Biological Fungicides. Biological fungicides (AQ10 and Serenade) are commercially available beneficial microorganisms formulated into a product that, when sprayed on the plant, destroys fungal pathogens. AQ10 is a parasitic fungus, *Ampelomyces quisqualis*, that actively attacks and destroys the powdery mildew fungus. The active ingredient in Serenade is a bacterium, *Bacillus subtilis*,

that helps prevent the powdery mildew from infecting the plant. These products have some effect in killing the powdery mildew organism but are not as effective as the oils or sulfur in controlling it.

Synthetic Fungicides. Myclobutanil (Immunox) is also available to the home gardener and functions as an eradicant and protectant against both powdery mildew and rust.

How to Use. Apply protectant fungicides to susceptible plants before or in the earliest stages of disease develop-

ment. Once mildew growth is mild to moderate, it is generally too late for effective control with protectant fungicides. The protectant fungicides are only effective on contact, so applications must thoroughly cover all susceptible plant parts. As plants grow and produce new tissue, additional applications may be necessary at 7- to 10-day intervals as long as conditions are conducive to disease growth.

If mild to moderate powdery mildew symptoms are present, the horticultural oils and plant-based oils such as neem oil and jojoba oil can be used.

REFERENCES

- Dreistadt, S. H., J. K. Clark, and M. L. Flint. 1994. *Pests of Landscape Trees and Shrubs: An Integrated Pest Management Guide*. Oakland: Univ. Calif. Agric. Nat. Res. Publ. 3359.
- Gubler, W. D., and D.J. Hirschfeld. 1992. Powdery Mildew. In *Grape Pest Management*. Oakland: Univ. Calif. Agric. Nat. Res. Publ. 3343. pp 57-63.
- McCain, A. H. 1994. *Powdery Mildew*. HortScript #3, Univ. Calif. Coop. Ext. Marin County.

For more information contact the University of California Cooperative Extension or agricultural commissioner's office in your county. See your phone book for addresses and phone numbers.

CONTRIBUTORS: R. D. Raabe, W. D. Gubler, and S. T. Koike
 EDITOR: B. Ohlendorf
 TECHNICAL EDITOR: M. L. Flint
 DESIGN AND PRODUCTION: M. Brush
 ILLUSTRATIONS: Illustrations: Fig. 1 Christine M. Dewees; Fig. 2 adapted from *IPM for Floriculture*. Oakland: Univ. Calif. Agric. Nat. Res. Publ. 3402.

Produced by IPM Education and Publications, UC Statewide IPM Project, University of California, Davis, CA 95616-8620

This Pest Note is available on the World Wide Web (<http://www.ipm.ucdavis.edu>)



This publication has been anonymously peer reviewed for technical accuracy by University of California scientists and other qualified professionals. This review process was managed by the ANR Associate Editor for Pest Management.

To simplify information, trade names of products have been used. No endorsement of named products is intended, nor is criticism implied of similar products that are not mentioned.

This material is partially based upon work supported by the Extension Service, U.S. Department of Agriculture, under special project Section 3(d), Integrated Pest Management.

WARNING ON THE USE OF CHEMICALS

Pesticides are poisonous. Always read and carefully follow all precautions and safety recommendations given on the container label. Store all chemicals in the original labeled containers in a locked cabinet or shed, away from food or feeds, and out of the reach of children, unauthorized persons, pets, and livestock.

Confine chemicals to the property being treated. Avoid drift onto neighboring properties, especially gardens containing fruits or vegetables ready to be picked.

Do not place containers containing pesticide in the trash nor pour pesticides down sink or toilet. Either use the pesticide according to the label or take unwanted pesticides to a Household Hazardous Waste Collection site. Contact your county agricultural commissioner for additional information on safe container disposal and for the location of the Household Hazardous Waste Collection site nearest you. Dispose of empty containers by following label directions. Never reuse or burn the containers or dispose of them in such a manner that they may contaminate water supplies or natural waterways.

The University of California prohibits discrimination against or harassment of any person employed by or seeking employment with the University on the basis of race, color, national origin, religion, sex, physical or mental disability, medical condition (cancer-related or genetic characteristics), ancestry, marital status, age, sexual orientation, citizenship, or status as a covered veteran (special disabled veteran, Vietnam-era veteran, or any other veteran who served on active duty during a war or in a campaign or expedition for which a campaign badge has been authorized). University policy is intended to be consistent with the provisions of applicable State and Federal laws. Inquiries regarding the University's nondiscrimination policies may be directed to the Affirmative Action/Staff Personnel Services Director, University of California, Agriculture and Natural Resources, 300 Lakeside Dr., Oakland, CA 94612-3350; (510) 987-0096.