Powdery mildew is a common disease on many types of plants. There are many different species of powdery mildew fungi (such as *Erysiphe* species, *Sphaerotheca* species) and each species only attacks specific plants. A wide variety of vegetable crops are affected by powdery mildews, including artichoke, beans, beets, carrot, cucumber, eggplant, lettuce, melons, parsnips, peas, peppers, pumpkins, radicchio, radishes, squash, tomato, tomatoes, and turnips (Table 1). Powdery mildews generally do not require moist conditions to establish and grow, and normally do well under warm conditions; thus they are more prevalent than many other leaf-infecting diseases under California’s dry summer conditions.

**IDENTIFICATION AND DAMAGE**

Powdery mildew first appears as white, powdery spots that may form on both surfaces of leaves, on shoots, and sometimes on flowers and fruit (Fig. 1). These spots gradually spread over a large area of the leaves and stems. An exception is one of the powdery mildews that affects artichokes, onions, peppers, and tomatoes: it produces yellow patches on leaves but little powdery growth.

Leaves infected with powdery mildew may gradually turn completely yellow, die, and fall off, which may expose fruit to sunburn. On some plants, powdery mildew may cause the leaves to twist, buckle, or otherwise distort. Powdery mildew fungal growth does not usually grow on vegetable fruits, although pea pods may get brownish spots. Severely infected plants may have reduced yields, shortened production times, and fruit that has little flavor.

**LIFE CYCLE**

All powdery mildew fungi require living plant tissue to grow. Year-round availability of crop or weed hosts is important for the survival of some powdery mildew fungi. Special resting spores are produced, allowing overwinter survival of the species that causes the disease in cucurbits, lettuce, peas, and certain other crops.

Most powdery mildew fungi grow as thin layers of mycelium (fungal tissue) on the surface of the affected plant part (Fig. 2). Spores, which are the primary means of dispersal, make up the bulk of the white, powdery growth visible on the plant’s surface and are produced in chains that can be seen with a hand lens; in contrast, spores of downy mildew grow on branched stalks that look like tiny trees.

Powdery mildew spores are carried by wind to new hosts. Although humidity requirements for germination vary, all powdery mildew species can germinate and infect in the absence of free water. In fact, spores of some powdery mildew fungi are killed and 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. Spores and fungal growth are sensitive to extreme heat (above 90°F) and direct sunlight.

**MANAGEMENT**

The best method of control is prevention. Planting resistant vegetable varieties when available, or avoiding the most susceptible varieties, planting in the full sun, and following good cultural practices will adequately control powdery mildew in many cases (Table 1). However, very susceptible vegetables such as cucurbits (cucumber, melons, squash, and pumpkins) may require fungicide treatment. Several least-toxic fungicides are available but must be applied no later than the first sign of disease.

**Resistant Varieties**

In some cases, varieties resistant to powdery mildew may be available. If available, plant resistant varieties of cantaloupe, cole crops, cucumber,
Cultural Practices
Plant in sunny areas as much as possible, provide good air circulation, and avoid applying excess fertilizer. A good alternative is to use a slow-release fertilizer. Overhead sprinkling may help reduce powdery mildew because spores are washed off the plant. However, overhead sprinklers are not usually recommended as a control method in vegetables because their use may contribute to other pest problems.

Fungicide Application
In some situations, especially in the production of susceptible cucurbits, 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. The products listed here are for home garden use. Commercial growers should consult the UC Pest Management Guidelines, which are available online at the following address: http://www.ipm.ucdavis.edu/PMG/crops-agriculture.html.

Fungicides. Several least-toxic fungicides are available, including horticultural oils, neem oil, jojoba oil, sulfur, and the biological fungicide Serenade. With the exception of the oils, these materials are primarily preventive. 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 Saf-T-Side Spray Oil, Sunspray Ultra-Fine Spray Oil, or one of the plant-based oils such as

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

<table>
<thead>
<tr>
<th>Hosts</th>
<th>Fungus species</th>
<th>Controls</th>
</tr>
</thead>
<tbody>
<tr>
<td>cucumbers, endive, lettuce, melons, potato, pumpkin, squash</td>
<td><em>Erysiphe cichoracearum</em></td>
<td>resistant varieties of lettuce, cucumber; water sprays; fungicides if necessary on squash and pumpkin</td>
</tr>
<tr>
<td>broccoli, Brussels sprouts, cauliflower, and other cole crops; radicchio, radishes, turnips</td>
<td><em>Erysiphe cruciferarum</em></td>
<td>not usually required</td>
</tr>
<tr>
<td>tomatoes</td>
<td><em>Erysiphe lycopersici</em></td>
<td>fungicides if necessary</td>
</tr>
<tr>
<td>peas</td>
<td><em>Erysiphe pisi</em></td>
<td>resistant varieties; sprinkler irrigation</td>
</tr>
<tr>
<td>carrots, parsley, parsnips</td>
<td><em>Erysiphe heraclei</em></td>
<td>tolerant varieties</td>
</tr>
<tr>
<td>beets</td>
<td><em>Erysiphe polygoni</em></td>
<td>tolerant varieties</td>
</tr>
<tr>
<td>artichoke, eggplant, peppers, tomatillo, tomatoes beans, black-eyed peas, cucurbits, okra</td>
<td><em>Leveillula taurica</em></td>
<td>rarely required; fungicides if necessary</td>
</tr>
<tr>
<td></td>
<td><em>Sphaerotheca fuliginea</em></td>
<td>resistant varieties for some; fungicides if necessary</td>
</tr>
</tbody>
</table>

Figure 2. Powdery mildew life cycle on squash.
neem oil or jojoba oil (such as 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 sulfur and oil sprays may be even longer; always consult the fungicide label for any special precautions.

**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 (such as Safer Garden Fungicide). However, sulfur can be damaging to

For more information contact the University of California Cooperative Extension in your county. See your telephone directory for addresses and phone numbers.

**REFERENCES**


**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.

Pesticides applied in your home and landscape can move and contaminate creeks, rivers, and oceans. 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 or 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.