



## POWDERY MILDEW OF APPLE

Powdery mildew of apple, caused by the fungus *Podosphaera leucotricha*, occurs in all major apple-growing areas of the world, especially in semiarid regions. The fungus infects apples, flowering crabapples, and pears. Losses from the disease vary depending on susceptibility of the cultivar, environmental conditions, and management practices. In Illinois, powdery mildew of apples is effectively managed and losses to this disease is negligible; management of scab, rusts, and powdery mildew is carried out together by Illinois growers.

### SYMPTOMS

Powdery mildew of apple produces symptoms on blossoms, young shoots, leaves, and fruit. In general, symptoms are most noticeable on the leaves and fruit.



Figure 1. McIntosh apple cultivar at tight-cluster with powdery mildew. (Courtesy APS and J. Clements).

**On Blossoms.** Infected flower buds have a silver-gray appearance and open 5-8 days later than healthy ones, if at all. When they emerge, flowers parts and leaves are usually covered with the white mycelium (Figure 1). Petals are distorted and pale yellow or light green.

**On Shoots.** In spring when the terminal buds begin to grow, the fungus colonizes the young, green tissue as it emerges. The infected shoots have a silver-gray appearance and may exhibit defoliation, stunted growth, and die-back (Figure 2). In the following weeks, as the growing season progresses, the primary infections on the shoots produce inoculum, which causes secondary infections on leaves and fruit.



Figure 2. Apple shoot and leaves with powdery mildew.

**On Leaves.** Leaves are colonized as they emerges from the buds. White fungal colonies develop on

For further information contact **Mohammad Babadoost**, Extension Specialist in Fruit and Vegetable Pathology, Department of Crop Sciences, University of Illinois at Urbana-Champaign. (Phone: 217-333-1523; email: [babadoos@illinois.edu](mailto:babadoos@illinois.edu)).

leaves (Figure 3). Lesions first appear as whitish, felt-like patches of fungal mycelium and spores on the undersides and along the margins. The lesions spread rapidly and may cover the entire leaf. Infected leaves are narrower than normal, are folded longitudinally, and become stiff and brittle with age.

**On Fruit.** Fruit are rarely infected, unless the disease is built up to high levels. Infected fruit are russeted and sometimes stunted (Figure 4).

## DISEASE CYCLES

*P. leucotricha* overwinters as mycelium in dormant flower and shoot buds infected the previous year. In spring, the infected buds break dormancy and the fungus resumes growth, colonizing the developing shoots and young leaf tissue. From these primary infections, asexual conidia are produced on conidiophores and dispersed by wind (Figure 5). Conidia germinate at high relative humidity (greater than 70%, which is commonly available in the microclimate of the lower leaf surface) at temperatures between 60 and 80°F (16 - 27°C). Spore germination and mycelial development are slowed between 40 and 50°F, and both are significantly reduced at temperatures above 90°F. Mycelium from the germinating spores branches and spreads over the surface of the leaf, putting down small “roots,” termed haustoria, into the epidermal cells for nutrition. More spores are quickly produced and the cycle is repeated. Secondary cycles continue to occur until tree growth stops in late summer. Small, dark brown globular fruiting bodies known as cleistothecia (chasmothecia) are sometimes formed in the mycelial mat on stems and petioles in late summer. Each cleistothecium (chasmothecium) has one ascus containing eight ascospores, but it is doubtful they play an important role in overwintering the fungus.

Mildew infected buds are more susceptible to freezing than healthy buds. At 15°F or colder, most infected buds are killed.

Because the mildew fungus is an obligate parasite, it cannot survive after the buds are killed.

Mildew is a chronic recurrent problem. High disease levels at the end of a season may: (1) increase the percentage of infected buds, leading to high levels of primary inoculum the next spring; and/or (2) inhibit flower bud formation, reducing or eliminating the fruit crop the following season. Therefore, management of the disease must focus on reducing the primary inoculum in spring and protecting the trees from secondary inoculum during the season.

## DISEASE MANAGEMENT



Figure 3. Apple leaves with powdery mildew.



Figure 4. An apple fruit with powdery mildew.

**Cultivar Selection.** The use of less susceptible apple cultivars is an effective way of preventing mildew. Some of mildew susceptible cultivars are Baldwin, Cortland, Ginger Gold, Granny Smith, Ida Red, Jonathan, Monroe, Rome Beauty, and Stayman. Some mildew resistant cultivars include Enterprise, Jonafree, Prima, and Winesap. Cultivar selection is influenced more by commercial appeal, fruit qualities, marketability, and pollination characteristics than by disease resistance. Apple cultivars and their susceptibility to mildew are shown in Table 1.

**Cultural Practices.** Primary infections can be controlled by removal of the primary inoculum sources (i.e., flower and shoot buds infected the previous year). Growers should note any whitened terminal shoots and prune them out during winter or early spring. Unfortunately, complete removal of this type of inoculum is just not economically feasible. The best candidates to use this control practice are small young orchards with low numbers of primary infections per tree.

**Chemical Management.** Where susceptible cultivars are grown, midewcide should be included in the scab program to provide control of both diseases. Begin sprays at tight cluster and continue until terminal growth stops. Early spray (tight cluster to petal fall) are essential to success in management of powdery mildew. Commercial orchardists should follow the suggested spray program outlined in the “Midwest Fruit Pest Management Guide” (<https://ag.purdue.edu/hla/Hort/Documents/ID-465.pdf>).

Table 1. Relative susceptibility of some apple cultivars to powdery mildew. Adapted from the website of the American Phytopathological Society (<http://www.apsnet.org/edcenter/intropp/lessons/fungi/ascomycetes/Pages/ApplePowderyMildew.aspx>).

Highly susceptible	Moderately susceptible	Resistant
Cortland Ginger Gold Granny Smith Idared Jonathan Rome Beauty Stayman Winesap	Empire Golden Delicious Liberty McIntosh	Braeburn Britegold Delicious Enterprise Fuji Gala Jonafree Nittany Prima Winesap

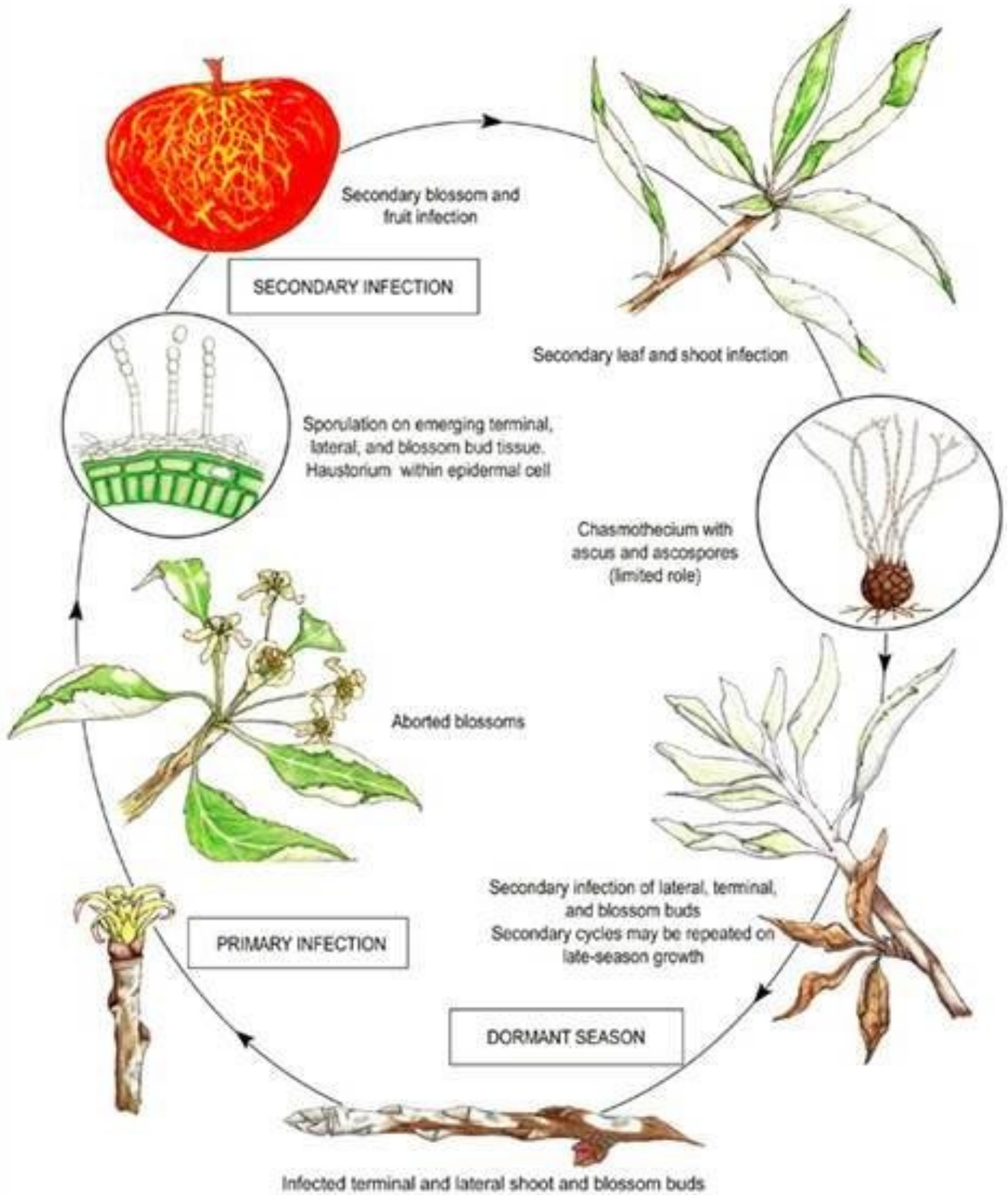


Figure 5. Disease cycle of apple powdery mildew. (Courtesy American Phytopathological Society).