



## POWDERY MILDEW OF APPLE

Powdery mildew, caused by the fungus *Podosphaera leucotricha*, occurs wherever apples are grown. Other susceptible plants include crabapple, pear, quince, and photinia.

Powdery mildew was a very minor disease in Midwest apple orchards for many years. The principal fungicide then used was sulfur. As organic fungicides including captan, dodine, and zineb came into general use and as sulfur was gradually eliminated from spray programs, powdery mildew became much more prevalent. The disease is common in Illinois south of a line from Quincy to Mattoon and becoming a more serious problem in orchards north of that line also.



Figure 1. Powdery Mildew on young apple leaves.

Of all apples grown in Illinois, the Jonathan is probably the variety most susceptible to mildew. Other susceptible varieties include Baldwin, Corland, Golden Delicious, Grimes Golden, Idared, Monroe, Rome, and Stayman. Mildew is usually less common on McIntosh, Prima, Priscilla, Red Delicious, and Winesap, however, no apple variety is immune to powdery mildew.

Damage occurs on the leaves, twigs, blossoms, and fruit:

1. Leaves and twig terminals are stunted, deformed, or killed.
2. Blossoms are blighted, so the fruit may fail to set.
3. The fruit that does mature is disfigured by surface russetting.
4. Fewer blossom buds develop for the following year.

If left uncontrolled, powdery mildew becomes more serious each year, reducing the yield and the quality of the fruit.

### SYMPTOMS

The powdery mildew fungus infects the lateral and terminal buds, young leaves, twigs, blossoms, and green fruits.

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**Leaves.** Superficial, felt-like patches of mycelium that are light gray or white and a white, powdery coating of spores (conidia) form on the leaves in the spring and early summer (Figure 1). The leaves soon become crinkled and curled (folded longitudinally), twisted, narrow, and cupped (Figure 2). Such leaves are stunted, brittle, and may die early.



Figure 2. Powdery mildew showing cupping, twisting, and rosetting of leaves.

**Twigs.** The mildew spreads rapidly from infected buds and leaves to the young succulent twigs of the current season. These twigs become stunted and covered with the powdery coating of conidia and mycelium. By midsummer, the grayish white mildew growth turns into a brown, felt-like covering.

Mildewed twigs are stunted or killed back (Figure 3). The lateral buds, which tend to be elongated and purplish red, are bunched together. After the buds develop, the terminal growth often has a rosetted, or Witches' broom, appearance and the infected twigs have weak buds.



Figure 3. Apple twigs infected with powdery mildew. Twigs are stunted, have weak buds, and may be winter-killed.

**Blossoms.** The entire blossom cluster may turn brown, shrivel, and die so that no fruit is produced. The flowers become infected from overwintering mycelia in the dormant blossom buds.

**Fruit.** Apples on heavily infected trees are usually stunted and partially or completely covered with a fine network of russetting (Figure 4). Sometimes the network is so closely woven that it appears as a solid patch. The gusseted areas harden, causing some expanding fruits to crack and to shrivel.



Figure 4. Apple fruits showing net russetting, a symptom of powdery mildew.

## DISEASE CYCLE

The powdery mildew fungus overwinters as mycelia in the leaf and flower buds. Infected buds open 2 to 5 days later than healthy buds. These weakened buds are frequently killed by low winter temperatures. As infected buds begin to open, the mycelia resume their growth, keeping pace with the development of the expanding leaves and twigs.

The fungus obtains its nourishment by means of specialized feeding organs, called haustoria, that penetrate the epidermal (top) layer of cells. Chains of barrel-shaped conidia are soon produced in tremendous numbers on the young leaves and twigs. The conidia are spread readily by the wind to new leaves, twigs, and fruits to start secondary infections. The conidia germinate only during periods of high relative humidity (90 to 99 percent) when the temperature is between 50° and 77°F (10° and 25°C), with

the optimum being 66° to 72° (19° to 22°C). Temperatures below 50°F (10°C) and above 80°F (27°C) slow down mildew growth. The conidia will not germinate in water.

Under ideal conditions, the incubation period from infection to the appearance of the symptoms is about 10 days. This cycle can be repeated a number of times during a growing season, as long as the days are warm and the nights cool and moist. From about 2 weeks after petal-fall until August 1, mycelia invade the buds, completing the disease cycle.

The round, dark brown to black, speck-sized cleistothecia (the sexual fruiting structures) occasionally form late in the summer in the felt-like mycelia on the surface of the twigs and leaves—rarely, on the fruits. The sexual stage of the mildew fungus is of little importance in the disease cycle and is unknown in certain areas.

## **CONTROL**

Unlike most apple diseases caused by fungi, powdery mildew is not as destructive when rains are frequent. Mildew develops rapidly, however, in extended periods of warm, dry weather when the morning dews are heavy. Therefore, accurate predictions can be made about the probable occurrence of the disease.

1. Sprays of microfine wettable sulfur, dinocap (Karathane), or benomyl (Benlate) are effective when applied at intervals of 7 to 10 days from the green tip stage until the second or third cover. Sulfur and benomyl are the preferred fungicides for use during the bloom period. Commercial orchardists should follow the spray program for apples outlined in the current supplement to Illinois Commercial Tree Fruit Spray Guide. Home fruit growers should follow the schedule for apples and crabapples outlined in Midwest Tree Fruit Pest Management Handbook. Thorough coverage is essential. Mildew is usually most prevalent in the tree tops, where complete coverage is difficult to obtain. Once established there, mildew can spread rapidly to other parts of the tree during the season. A special effort to spray the tree tops is needed where a problem with mildew exists. Do not apply sulfur or dinocap when the temperature is 85°F (29°C) or above as fruit russetting may result.
2. During the winter, prune out, remove from the orchard, and destroy the gray or silvery infected twigs wherever possible. Doing this will greatly reduce the amount of overwintering inoculum. However, this practice is not feasible on mature trees or in a large orchard. It is probably advisable to prune more heavily in orchards where mildew is severe than where the disease is absent.
3. Maintain trees in a vigorous condition by annual pruning, watering during summer droughts, and other beneficial cultural practices.

## **ALWAYS READ AND HEED LABEL DIRECTIONS WHEN USING A FUNGICIDE.**

Note: Mention of a trade name or proprietary product does not constitute warranty of the product and does not imply approval of this material to the exclusion of comparable products that may be equally suitable.