College of Agriculture, Food and Environment
Cooperative Extension Service

Plant Pathology Fact Sheet **PPFS-FR-S-13**

Downy Mildew of Grape

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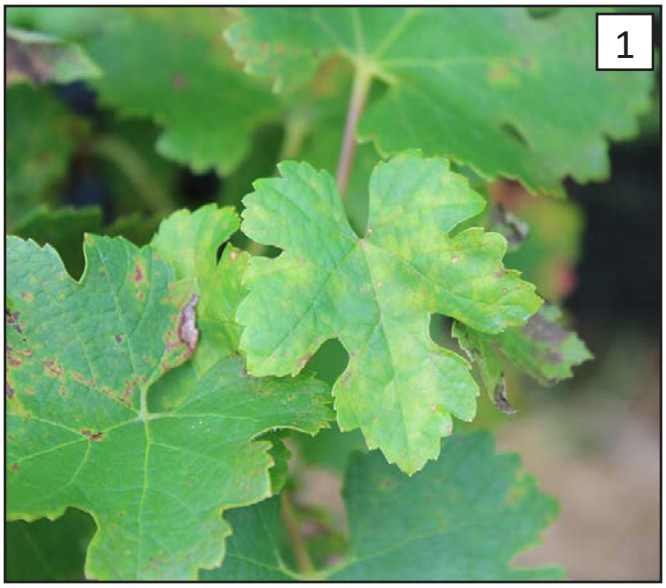
Introduction

Downy mildew is an important disease of commercial and backyard grapes in Kentucky. This disease causes direct yield losses when flowers, fruit, and shoots become infected. Indirect losses result when premature defoliation impacts fruit quality, predisposes vines to winter injury, and reduces fruit set the following season.



Symptoms & Signs

Leaves

Early in the season, infected leaves develop yellowish-green lesions (Figure 1) on their upper surfaces that can appear shiny (often referred to as "oil spots") (Figure 2). As lesions expand, the affected areas turn brown (necrotic) or mottled. Severely infected leaves may curl and prematurely drop from vines. The disease also affects older leaves in late summer and autumn, producing a mosaic of small, angular, yellow to red-brown spots on the upper leaf surface that become necrotic (Figure 3). Lesions are commonly limited by leaf veins. The pathogen sporulates on the underside of foliar lesions, producing the white, downy fungal-like growth that is characteristic of this disease (Figure 4).

Fruit

Infected green fruit turn light brown to purple, shrivel, and detach easily. White, downy sporulation is abundant on diseased berries during humid weather (Figure 5). Diseased berries are easily detached from their pedicels leaving a dry stem scar. Fruit become resistant to downy mildew infection about 3 to 4 weeks after bloom, but cluster stems (rachis), fruit stems (pedicels), and leaves remain susceptible throughout the growing season.

Shoots

When young shoots, petioles, tendrils, or cluster stems are infected, they frequently become distorted, thickened, or curled (Figure 6). White, downy sporulation can be abundant on the surface of infected areas. Eventually, these tissues wither and die.

Figure 1. Downy mildew begins as yellowish-green lesions that develop on upper leaf surfaces.
Figure 2. Expanding lesions can appear shiny and are often referred to as "oil spots."

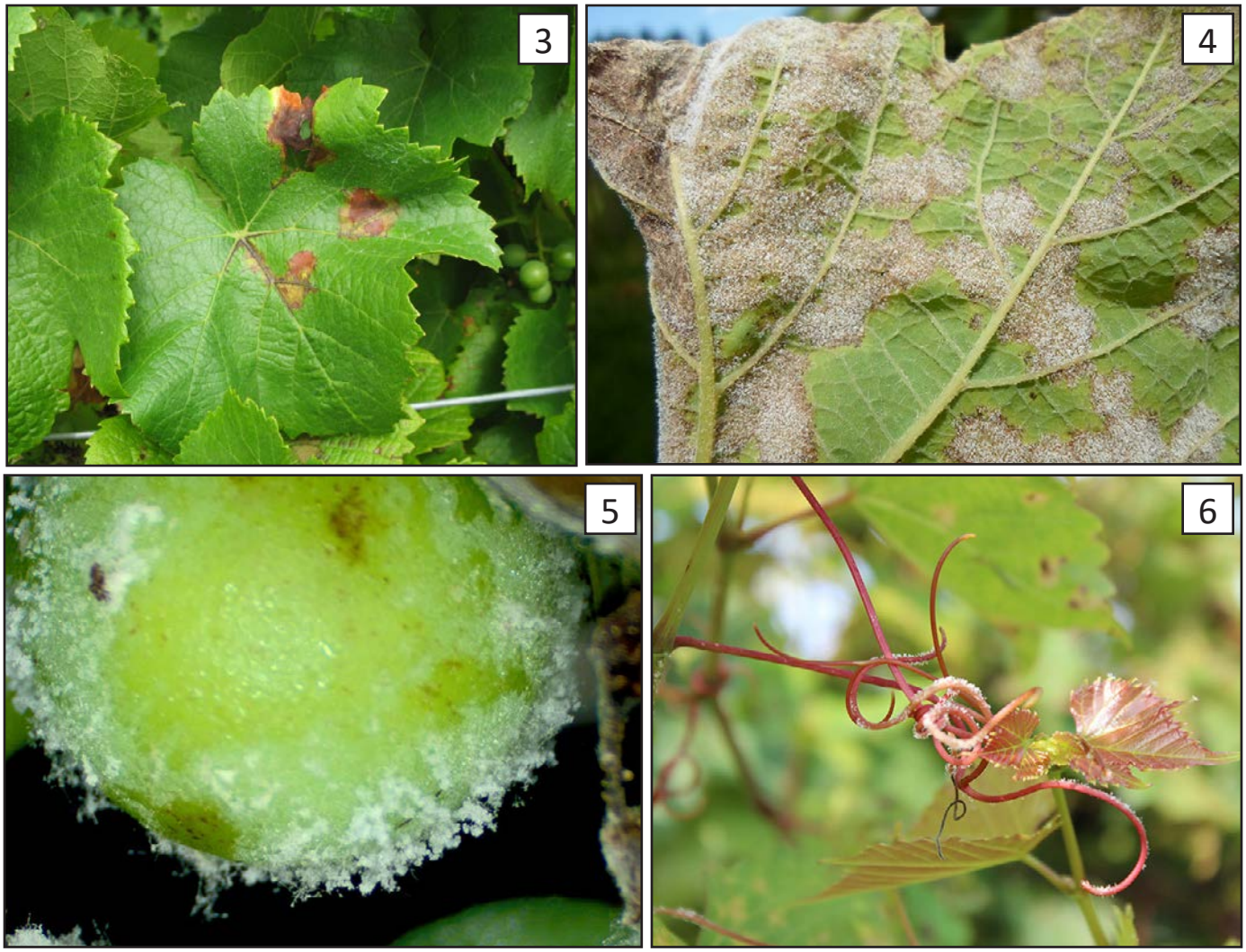


Figure 3. Figure 3. Advanced lesions develop a mosaic of yellow to red-brown spots limited by leaf veins.
Figure 4. White, downy pathogen sporulation that is characteristic for downy mildew develops on the underside of foliar lesions.
Figure 5. The downy mildew pathogen sporulates on infected fruit when weather conditions are wet or humid.
Figure 6. Downy mildew-infected shoots and tendrils become thickened and distorted.

Cause & Disease Development

Downy mildew is caused by the fungus-like organism (oomycete, water mold) *Plasmopora viticola*. This organism overwinters as thick-walled oospores in leaf debris on vineyard floors. During wet periods in spring, oospores germinate to form sporangia. The sporangia, which are disseminated by wind or rain-splash, release small swimming zoospores when free water (e.g., rain or dew) is present. Zoospores are disseminated by rain splash to grape tissues, where they swim to the vicinity of leaf stomata (tiny natural pores mainly located on leaf undersides). Infection occurs when zoospores form germ tubes that invade the inner plant tissues through stomatal openings.

The pathogen can infect all green, actively growing parts of the vine that have mature, functional stomata. Visible lesions can develop in about 5 to 7 days after infection, depending on temperature and relative humidity. At night, during periods of high humidity and temperatures above 55°F, the pathogen produces sporangia (capsules containing zoospores) capable of initiating secondary infections. These sporangia are produced on numerous branched structures that protrude out through stomata and give the leaf its typical downy appearance.

Disease Management

Planting site

- Establish a new vineyard in a site with full sun, particularly in the morning, to encourage drying.
- Orient vineyard rows toward the prevailing winds in order to provide good air circulation to facilitate drying.
- Avoid low lying, poorly drained sites.

Cultivar & plant selection

- Avoid planting highly susceptible grape cultivars. In general, vinifera (*Vitis vinifera*) cultivars are much more susceptible than American types, with French hybrids somewhat intermediate in susceptibility. A list of cultivar susceptibility is available in the *Midwest Fruit Pest Management Guide* (ID-232).
- Purchase disease-free planting material from a reputable nursery.

Cultural practices

- Follow a training system and leaf removal practices that promote rapid drying of plant tissues (good air circulation) and increase sunlight penetration. Opening the canopy also improves fungicide spray penetration.
- Manage weeds to aid in improving air circulation and drying.
- Avoid use of overhead irrigation; opt for soil-directed irrigation.
- Prune and destroy (remove from the vineyard) diseased plant material during the dormant season. Use a cart or tarp to load and haul debris; avoid dropping clippings onto the ground.

Fungicides

- Follow a full-season fungicide program when producing susceptible cultivars. The period from pre-bloom through 3 to 4 weeks after bloom is critical for controlling fruit or cluster infections. However, additional sprays may be necessary post-harvest to protect foliage from infections that cause premature defoliation late in the season.
- Commercial growers should refer to the *Midwest Fruit Pest Management Guide* (ID-232) for specific fungicide names, timing, and applications rates.
- Residential growers will find this information in *Disease and Insect Control Programs for Homegrown Fruit in Kentucky, Including Organic Alternatives* (ID-21)

Disease Forecasting

- Utilize disease prediction models, which analyze local weather data and help growers determine risk for infection. Using prediction models, growers apply fungicides only during periods of high risk, resulting in fewer applications when compared to calendar-based spray programs.
- Kentucky growers should refer to the UK Ag Weather Center site for disease prediction models related to grape.

Additional Resources

Predictive Models

- Ag Weather Plant Disease Prediction Models

http://wwwagwx.ca.uky.edu/ky/agmodels.php

- Using Prediction Models to Manage Diseases in Fruit

https://plantpathology.ca.uky.edu/files/ppfs-fr-t-07.pdf

Management

General

- Cultural Calendar for Commercial Grape Production (PPFS-FR-S-27)

https://plantpathology.ca.uky.edu/files/ppfs-fr-s-27.pdf

- Fruit, Orchard, and Vineyard Sanitation (PPFS-GEN-05)

https://plantpathology.ca.uky.edu/files/ppfs-gen-05.pdf

Residential growers

- Backyard Grape Disease, Pest, and Cultural Practices Calendar (PPFS-FR-S-24)

https://plantpathology.ca.uky.edu/files/ppfs-fr-s-24.pdf

- Disease and Insect Control Programs for Homegrown Fruit in Kentucky, Including Organic Alternatives (ID-21)

http://www.ca.uky.edu/agc/pubs/id/id21/id21.pdf

- Simplified Backyard Grape Spray Guide (PPFS-FR-S-23)

https://plantpathology.ca.uky.edu/files/ppfs-fr-s-23.pdf

Commercial growers

- Commercial Grape Fungicide Spray Schedule Worksheet and Sample Spray Guides
https://plantpathology.ca.uky.edu/files/ppfs-fr-s-20.pdf
- Effectiveness of Fungicides for Management of Grape Diseases (PPFS-FR-S-18)
https://plantpathology.ca.uky.edu/files/ppfs-fr-s-18.pdf
- Midwest Fruit Pest Management Guide (ID-232)
https://ag.purdue.edu/department/hla/extension/_docs/id-465.pdf
- Midwest Small Fruit Pest Management Handbook, B-861 (University of Kentucky in cooperation with the Midwest Fruit Workers Group)
https://plantpathology.ca.uky.edu/files/mw_sm_fruit_b861_osu_2004.pdf

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Photos: University of Kentucky—Nicole Gauthier (1 & 6), Kim Leonberger (2), and Julie Beale (3); Bugwood.org—Jonas Janner Hamann, Universidade Federal de Santa Maria (UFSM)(4) and Bruce Watt, University of Maine (5)

Revised from *Downy Mildew of Grape* (PPFS-FR-S-13) by John R. Hartman, Julie W. Beale, and Cheryl A. Kaiser.