

## downy mildew

*Plasmopara viticola* (Berk. & Curt.) Berl. & de Toni

### INTRODUCTION

Downy mildew, a fungal disease native to North America, attacks most species of wild and cultivated grape. The disease was inadvertently introduced into European vineyards in the late 1870's where it devastated the European grape, *Vitis vinifera*, which is generally more susceptible to the disease than native American grapes. Today, the disease can be found on grapevines in most regions of the world that are wet during the growing season. The fungus causes direct yield losses by rotting inflorescences, clusters, and shoots, and indirect losses by prematurely defoliating vines which increases their susceptibility to winter injury and delays ripening of the fruit.

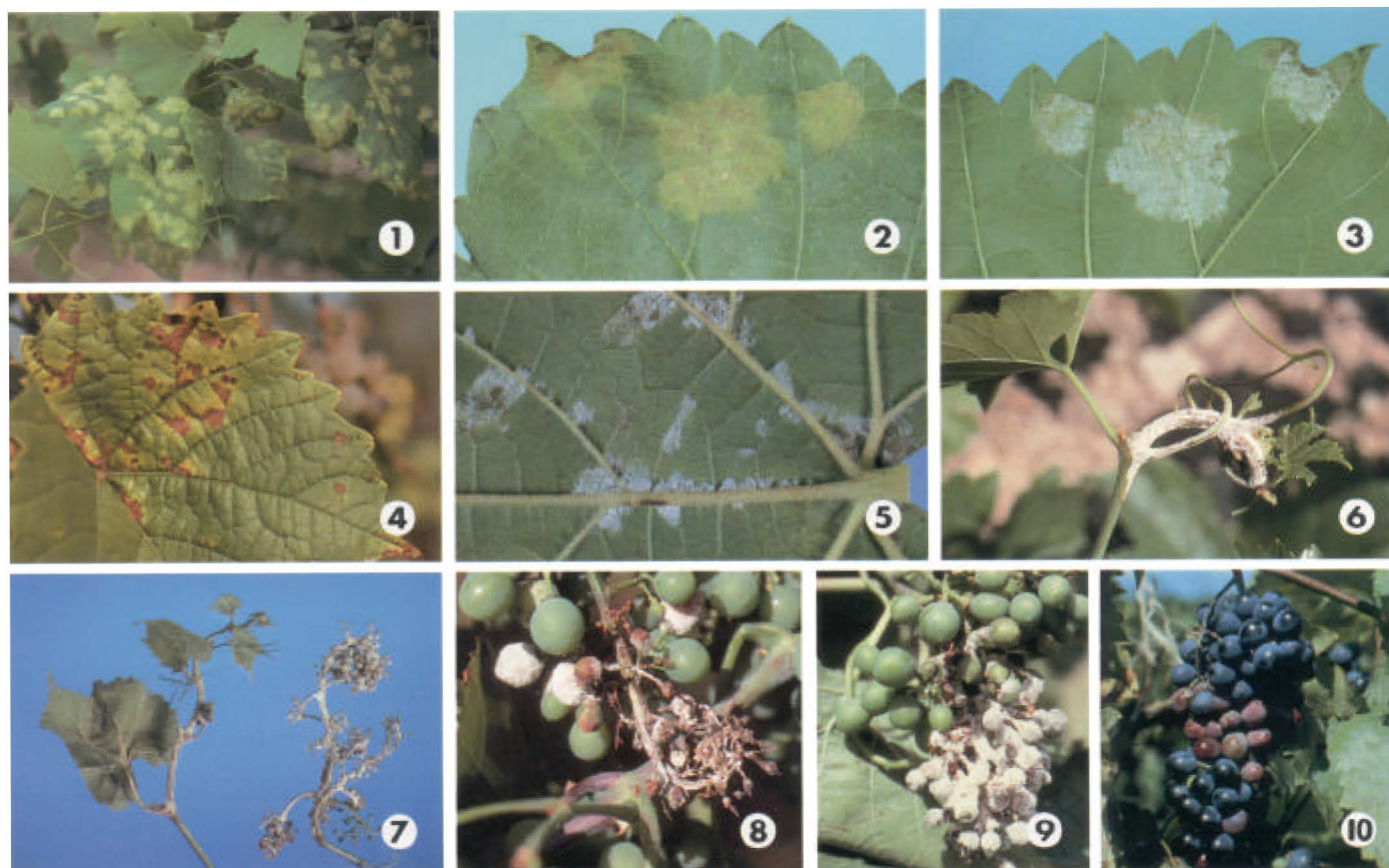
### SYMPTOMS AND SIGNS

*Plasmopara viticola* can infect all green, actively growing parts of the vine that have mature, functional stomata (tiny pores or openings) which are used for air exchange on plant tissues. Leaves develop yellowish-green lesions on their upper surfaces 7-12 days after infection (Fig. 1). As lesions expand, the affected areas

turn brown, necrotic or mottled (Fig. 2). White, "downy" sporulation of the fungus forms on the lower leaf surface within the borders of the lesion (Fig. 3). Severely infected leaves may curl and drop from the vine. The disease attacks older leaves in late summer and autumn producing a mosaic of small, angular, yellow to red-brown spots on the upper leaf surface (Fig. 4). Lesions commonly form along leaf veins and the fungus sporulates in these areas on the lower leaf surface (Fig. 5). When young shoots, petioles, tendrils, or cluster stems are infected, they frequently become distorted, thickened or curled (Figs. 6, 7). White, downy sporulation can be abundant on the surface of infected areas. Eventually, severely infected portions of the vine wither, brown, and die (Fig. 8). Infected green fruit turn light brown to purple, shrivel, and detach easily. White, cottony sporulation is abundant on these berries during humid weather (Fig. 9). The fruits remain susceptible as long as stomata on their surfaces are functional. After that, new infections and sporulation do not develop, but the fungus continues to grow into healthy berry tissue from previously infected areas. Later in the season, infected berries turn dull green to reddish purple, remain firm, and are easily distinguished from noninfected ripening berries in a cluster (Fig. 10). Infected berries are easily detached from their pedicels leaving a dry stem scar.

### DISEASE CYCLE

The fungus overwinters as tiny oospores in leaf debris on the vineyard floor. In the spring, the oos-

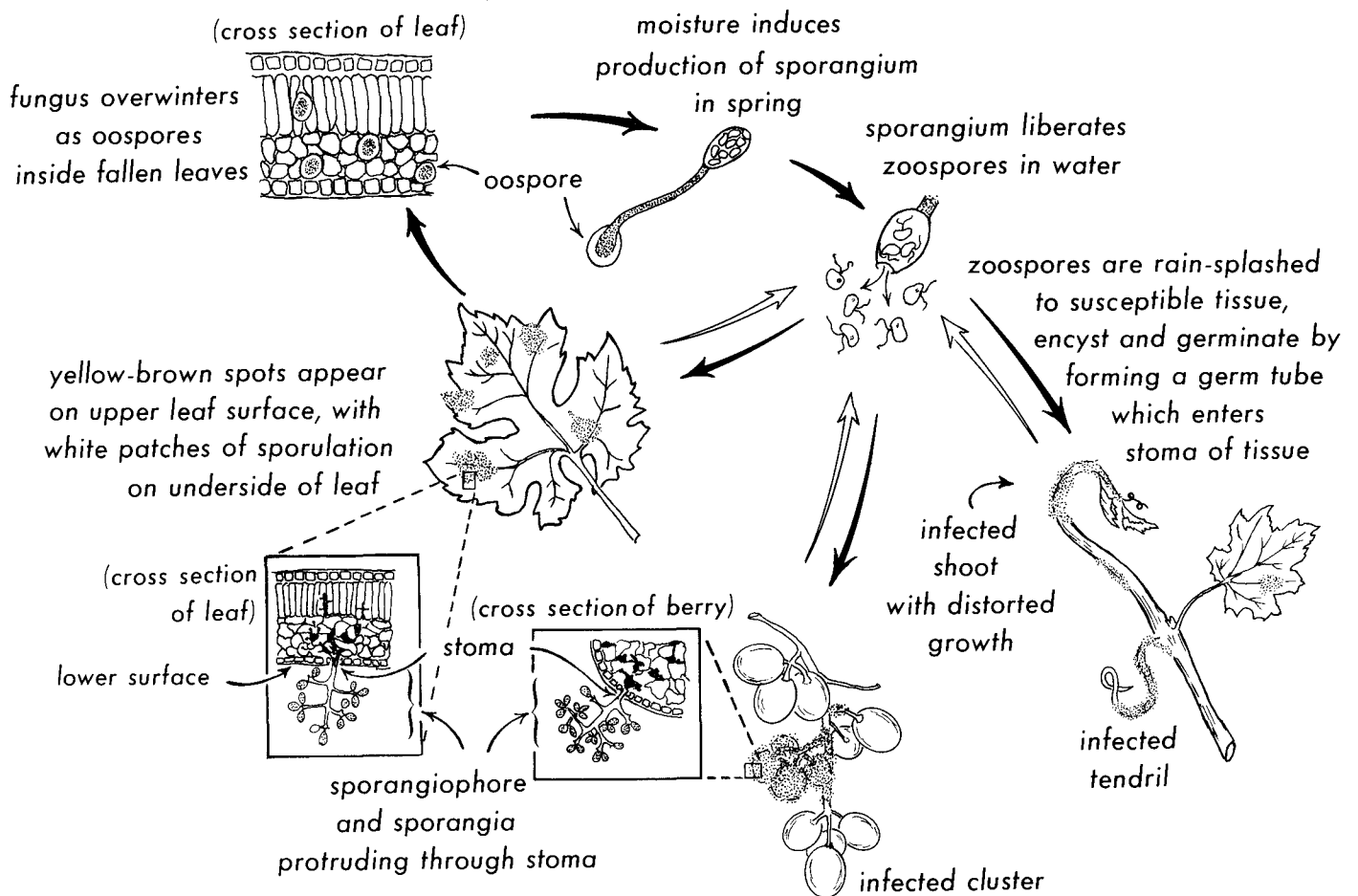


pores germinate in water to form sporangia. The sporangia liberate small swimming spores, called zoospores, if standing water is present. The zoospores are disseminated by rain splash to grape tissues where they swim to the vicinity of stomata and encyst. Encysted zoospores infect grape tissues by forming germ tubes that enter stomata and from there invade inner tissues of the plant. At night during periods of high humidity and temperatures above 13 C (55 F), the fungus sporulates by forming sporangia on numerous branched structures, called sporangiophores, that protrude out through stomata. Sporulation only occurs on plant surfaces that contain stomata, such as the undersides of leaves, and it gives the surface of the lesion its white, downy appearance. Sporangia are disseminated by wind or rain splash to other susceptible tissue. There they liberate zoospores into water films formed by rain or dew and these zoospores initiate secondary infections. Infection can occur in as little as 2 hours of wetting at 25 C (77 F) or up to 9 hours at 6 C (43 F). Infections are usually visible as lesions in about 7-12 days, depending on temperature and humidity. The number of secondary infection cycles depends on the frequency of suitable wetting periods that occur

during the growing season and the presence of susceptible grape tissue. In general, Catawba, Chancellor, Chardonnay, Delaware, Fredonia, Ives, Niagara, White Riesling, and Rougeon are highly susceptible cultivars.

## CONTROL

Downy mildew is controlled by using strategies that combine cultural and chemical methods. Cultural practices that improve air circulation in the vineyard promote drying of foliage and shorten the duration of wetting periods are beneficial in reducing disease severity. When planting the vineyard, orient rows for optimum air drainage and light interception. Proper pruning improves air circulation and penetration of the canopy by sprays. Spring cultivation around the base of the vines will control weeds and also bury leaf and vine debris that harbors overwintering oospores of the pathogen. Proper soil drainage will minimize standing water that promotes the spread of the fungus. Downy mildew is controlled efficiently by the use of properly applied, effective fungicides. Consult the nearest Cooperative Extension office for current control recommendations.



*Downy Mildew disease cycle (adapted from G. Agrio's Plant Pathology, 1969. Used with permission of the author and publisher, Academic Press, Inc.).*