Online Guide To
GRAPEVINE DISEASES
Virginia Tech

Downy mildew of grape

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Introduction: Downy mildew (DM) of grapes occurs in most parts of the world where grapes are grown, but favors those regions that experience warm, wet conditions during the vegetative growth of the vine. The downy mildew pathogen is native to North America but does not seriously affect native grapes. Introduced into Europe in 1875, *Vitis vinifera* was highly susceptible. Downy mildew spreads rapidly, destroying vineyards in France and most of Europe. Downy mildew is still one of the most destructive disease in Europe and the eastern half of the United States, where severe epidemics occur year after year. Downy mildew affects the leaves, fruit, and shoots of grapevines. Losses occur through death of leaf tissue, low-quality fruit, and weakened young shoots. When weather is favorable and no control measures are taken, downy mildew can easily cause 50-75% crop losses in one season.

Fig. 1

Symptoms and signs: Symptoms of downy mildew are usually first noticed on leaves as yellowish, oily lesions initially visible on the leaf's upper surface and commonly bound by leaf veins (Fig. 1). Soon after the lesions are observed, a white cottony, felt-like, or 'downy' mass is observed on the corresponding under side of the leaf (Fig. 2). This downy growth is distinctive and should not be confused with natural hairiness or pubescence on the lower leaf surface of many grape varieties or grape erineum mite. Foliar lesions may be numerous enough to cause defoliation, particularly in September and October when spray programs "slack off". Such defoliation reduces sugar accumulation and decreases cold hardiness.

Fig. 2

Downy mildew is often observed on young shoot tips and fruit clusters. Infected shoot tips thicken, curl, and become white during sporulation. Eventually,

affected tips become brown and die. Similar symptoms may be seen on petioles, tendrils, and young inflorescences.

Young berries are highly susceptible, appearing grayish when infected and 'downy' during sporulation (Fig. 3). Berries become less susceptible as they mature, however rachis infection can spread into the older fruit. Infected older fruit on white varieties may turn gray-green, while red varieties may turn pinkish-red. Fruit infections lead to direct crop loss by shelling of berries.

Fig. 3

Pathogen life cycle and conditions for development: Downy mildew is favored by warm, wet growing seasons. The fungus overwinters primarily as sexual spores or oospores in the leaf litter. The spores germinate in water in early spring when temperatures reach 51.8°F to produce sporangia from which primary dispersal of zoospores (asexual spores produced by sporangium) occurs by rain-splash. Sporangia are produced in a process requiring 95 - 100% humidity, appropriate temperatures, and 4 hours of darkness; followed by rain during the night or the following morning. The optimal temperature for sporangia production is 64 - 77°F (no production above 85°F). The sporangia or their zoospores are dispersed by wind or water to wet leaves, where they infect (primary infection) through stomata on the lower leaf surface. Primary infection of downy mildew usually occurs in Virginia between 2 -3 weeks prebloom (~10-inches shoot growth) until fruit set (and probably beyond).

The fungal mycelium then spreads into the intercellular spaces of the leaf; haustoria (specialized feeding structures) grow into the cells to obtain nutrients. When the mycelium reaches the substomatal cavity of the leaf it forms a cushion of mycelium from which sporangiophores (sporangia-bearing stalks) arise and emerge through the stomata and in young fruit, the lenticels. The sporangia are carried by wind or rain to nearby healthy leaves, germinate quickly, and produce many zoospores that cause secondary infections, rapidly spreading the disease. Depending on temperature, humidity, and varietal susceptibility, a disease cycle may take from 4 to 18 days. In hot, dry weather (usually July in Virginia), downy mildew will "go on vacation" and reappear when conditions are once again favorable (i.e. late July and August).

Young leaves are highly susceptible to downy mildew while they are expanding but become increasingly resistant after they reach full size. Young clusters and berries are also highly susceptibly, becoming resistant about 4 weeks after fruit set.

Cultural control: Based on hastening drying of wet foliage.

- Plant in sites with good air circulation, soil drainage, and sun exposure.
- Orient rows for optimum air drainage and light interception.
- Use training systems that allow good air movement through the canopy and prevent excess shading.
- Control weeds and bury or remove infected leaf litter from the vineyard.

- Practice canopy management that allows good sunlight exposure – maintain a relatively thin or open canopy. This also aids spray penetration.
- Plant varieties less susceptible to downy mildew.

Chemical control: For most varieties, economic control will involve the use of fungicides (most recent VT Pest Management Guide). Applications should begin about 2 to 3 weeks before bloom (depending on the weather). With all of these fungicides it is important to remember that good coverage (50 gallons/acre spray material prebloom and 100 gallons/acre spray material postbloom) is required to control this disease.

- Copper fungicides have long been used against downy mildew infections. However, copper fungicides have the potential to burn susceptible grape varieties. This has generally not been a problem in Virginia, but some hybrids and American varieties are quite susceptible. Prolonged wetting of copper treated foliage will increase the likelihood of copper injury. Copper residues on fruit may also pose wine quality problems if used near to harvest.
- Mancozeb (including Manzate, Penncozeb, Dithane, and others) and Captan are old standards because they work. Mancozeb formulations have a 66 day PHI during which time they may not be applied. Captan has a 0 day PHI but a 3 day REI with the newest formulation. Therefore, as harvest approaches captan should be used instead of mancozeb.
- Among the QoI or strobilurin fungicides, Abound and Pristine are highly effective DM fungicides, whereas Sovran and Flint are less active. However, precautions must be taken to slow the development of strains of DM that are resistant to those fungicides. Regardless of which QoI you choose to use, it should be alternated with another downy mildew product in a season-long program. Do not apply the QoI fungicides to sporulating DM-diseased vines. Use the higher end of a recommended product rate per acre and do not exceed the label's recommended interval for repeat applications. <u>QoIs should only be used in vineyards where resistance development has not occurred.</u>
- Metalaxyl products (Ridomil Gold MZ and Ridomil Gold Copper) are excellent (especially Gold MZ) products for downy mildew. Ridomil Gold MZ has a 66 day PHI because of the mancozeb component. Ridomil Gold Copper now has a 42 days PHI, however should not be used on copper sensitive varieties. Ridomil formulations are locally systemic and have good curative activity if used within 4 days of infection. Unfortunately, Ridomil is costly and highly prone to resistance development. Precautions should be taken to slow resistance and Ridomil should not be applied on vineyards with sporulating downy mildew lesions.
- Phosphorous acid (PA) products provide good control of downy mildew and have a zero day PHI (4 hour REI). These products have been available for two seasons and have generally performed well across several regions. A note on terminology: phosphorous acid (or phosphite or phosphonate) has no nutrient

activity and is not the same as phosphoric acid or phosphate which is commonly found in fertilizer and has no fungicidal activity.

- Post harvest sprays should include an effective downy (and powdery) mildew fungicide that will protect foliage through natural senescence or the first fall frost.

Please refer to the most recent VT Pest Management Guide at http://www.ext.vt.edu/pubs/pmg/hf3.pdf for current information.

Notes: For more detailed information on DM and DM fungicides follow the links at http://www.ext.vt.edu/news/periodicals/viticulture/03january/03january.html.

References: see Viticulture Notes Vol Aug 1989, Apr 1993, May 1998, Jul 1998, May 1999

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