

# Diseases

## Fruit Rots

**Black Rot** (*Guignardia bidwellii*): This is probably the most damaging grape disease in New England. Most loss is caused by damage to the berries, though leaves, tendrils and new shoots are also damaged. The fruit is susceptible from fruit set until veraison; resistance increases from pea-size to veraison.

This disease is caused by a fungus which overwinters in mummified berries and stem lesions. Mummies on the soil surface release spores when rain soaks them in the spring. There is a continuous production of spores throughout the spring and summer. These are carried to new plants by wind. Young tissue is infected in less than 12 hours between 60½ - 90½F. Spores germinate and produce mycelium resulting in symptoms in 8 to 25 days, depending on the weather. New leaves and half-grown berries are most susceptible. Secondary infections occur when new spores are produced on the current year's infections. Secondary spores are produced into August, and are spread by splashing rain.

On leaves, infections appear as yellowish-tan spots in late spring. These spots enlarge and become reddish-brown with a dark outline. Lesions are roughly circular in shape. Shoots develop sunken, elliptical lesions, black in color up to 2 cm in length. On the berry, symptoms do not appear until the fruit is half grown. Lesions start as a small whitish dot and quickly engulf the whole berry. The infected area develops a reddish brown color. The berry wrinkles and blackens completely within a few days. These fruit become mummies that are very hard and stony, and supply inoculum for the following year.

**Management:** Sanitation is very important. Destroy all mummies and canes with lesions. Remove infected tendrils from vines. Plant grapes in locations having good air circulation, taking advantage of prevailing winds and sun. Black rot is more likely to occur near woodland borders. It occurs much more severely in wet years than in dry years. Protectant fungicides offer good control when they are applied initially when the shoots are 10-16 cm long and continued until the berries contain approximately 5% sugar. Abound, Elite, Flint, Sovran and Nova are excellent eradicator and protectant materi-

Table 42. Grape black rot leaf wetness duration-temperature combinations necessary for grape foliar infection by black rot.

Temperature (½F)	Minimum leaf wetness duration for light infection (hr)
50	24
55	12
60	9
65	8
70	7
75	7
80	6
85	9
90	12

als. Varietal resistance is another control option. See pest management schedule for recommended materials and timing.

**Bitter Rot** (*Greeneria uvicola*): Bitter rot, while most common in southern grape regions, may infect grapes in New England. If 10% of the berries in a wine pressing are infected with bitter rot, the wine can be undrinkable. Bitter rot may be easily confused with black rot. Infected berries first develop brownish, water-soaked lesions. The bitter rot fungus infects ripe grapes, and unlike the black rot fungus, does not infect green berries. Bitter rot susceptibility increases right at veraison. Lesions often have concentric rings in white-fruited varieties. Berries turn brown but retain their shape. In 3 or 4 days black pustules erupt on the berry. If overripe berries become infected, they are not easily detected, because pustules do not form. These berries are the most bitter, and the most likely to be mistakenly harvested.

Warm, humid weather at the time berries ripen favors the disease. The fungus grows rapidly, and can rot berries in 5 to 7 days. Wounding promotes fungal growth.

**Management:** Good air circulation for good drying in the vineyard. Fungicides used for the control of some of the previously discussed diseases usually will also control bitter rot. If conditions are right for infection, late season sprays should not be omitted. Most varieties have some degree of resistance to the fungus.

**Botrytis Bunch Rot** (*Botrytis cinerea*): *Botrytis* rot can cause serious losses in susceptible varieties. While some rot is acceptable in wine grapes, and may even be desirable, the disease can get out of control. The fungus which causes the disease is present in grape mummies, debris on the vineyard floor and in organic matter around the planting. Spores are released in moist, cool weather in spring, and then throughout the growing season. These first spores infect blossoms at the end of bloom. A second infection occurs at berry maturity. The fungus uses senescing or dead material as a base to spread into healthy tissue. *Botrytis*-infected berries are at first soft and watery. The berries usually become covered with gray, fuzzy fungal mycelium within a few days. Rotted berries shrivel, then drop to the ground to eventually become mummies.

**Management:** Good air circulation and vineyard sanitation are helpful. Leaf removal around the clusters has shown excellent control of the disease in California. Protective fungicides (Elevate, Vanguard) should be used when wet weather occurs near bloom and berry ripening. White-fruited varieties (particularly Riesling and Seyval) are highly susceptible. See pest management schedule for recommended materials and timing. Fungicides should be used intelligently to avoid development of resistance by the fungus.

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## Foliage and Cane Diseases

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**Downy Mildew** (*Plasmopara viticola*): This disease causes damage primarily by attacking the vine, though all parts of the plant are susceptible to injury. The optimum conditions for the disease are cool to moderate temperatures, and wet weather. The disease is caused by a fungus which needs living tissue as a host. In spring, spores of the fungus come from dead tissue on the ground. Free water is required for infection, and infections may occur during high humidity throughout the season. Splashing water or handling wet plants may readily spread the spores. The spores grow into cottony masses, producing many new spores which can spread the infection. As tissue dies, it falls to the ground where the fungus overwinters. Severe epidemics can defoliate the vine.

On leaves, new infections are difficult to see. They appear first as generally angular, pale-yellow spots delimited by veins which later become brown.

On the underside of the leaf the cotton-like 'downy' growth appears. Fruit infection occurs at two times. First, when the berries are the size of small peas, infections will cause berries to turn light brown and soft. Berries will shatter easily. Sometimes the downy growth covers the berries. During the heat of the summer, little fruit infection occurs. The second infections occur in the late summer or early autumn. These berries do not turn soft or develop downy growth, but turn dull green, then purplish-brown. Shoots and tendrils develop water-soaked lesions, become stunted and distorted, and may die.

**Management:** Remove debris from the vineyard floor. Maximize air circulation to improve drying. European grapes are generally more susceptible than American grapes. The most serious epidemics occur when a wet winter is followed by a wet spring and a warm summer with frequent precipitation. Fungicides should be applied when disease pressure is high. Apply just before bloom; 7-10 days later; 10-14 days later; 3 weeks later. See pest management schedule for recommended materials and timing.

**Powdery Mildew** (*Uncinula necator*): Powdery mildew causes loss by infecting leaves and berries. It is primarily a problem on European grape varieties, although American varieties may be damaged. It may be confused with downy mildew. (See above description.) Losses are not generally heavy from the disease, although it can build up over several years.

The fungal pathogen overwinters in specialized structures on or in living tissue. In spring, spores are released which attack new tissue. Rain and free moisture are not important to the spread of powdery mildew, unlike other grape diseases. Wind carries newly produced spores from infected areas into new locations. Dry conditions with low relative humidity favor this disease. Infected tissue, especially on leaves, looks as though a white powder were on the surface. Severely infected leaves curl and defoliation may occur. Leaves of American varieties like Niagara and Concord are very susceptible. Young fruit and blossoms may be misshapen by infections; mature fruit is immune.

**Management:** Use fungicides where infections are known to occur. Copper and lime sulfur dormant applications provide good early season control. However, there are label restrictions. Check with your state Extension Specialist for recommendations. Some varieties are sensitive to sulfur and it should always be applied at cooler temperatures

(<85½F). Abound, Elite, Flint, Sovran and Nova are also effective, but care should be taken to avoid fungicide resistance by the fungus. See pest management schedule for recommended materials and timing.

Cultural practices can help reduce disease incidence. Planting in sites with good air circulation and sun exposure and the use of appropriate training systems which allow for good air movement are highly advisable.

**Eutypa Dieback** (*Eutypa armeniacae*): This disease also has been known as “dead arm.” It causes limbs to die back and forms cankers. Recently, it was shown to occur in conjunction with *Phomopsis*, causing the dead arm symptoms. Cankers are frequently found around old pruning cuts. They are usually under the bark, and show only as a flattened area on the surface. The cankers run lengthwise along the limb. Infections occur on pruning cuts in early spring. Over several years, the infection increases, causing new leaves to emerge small and yellowed. New shoot growth has shortened internodes, leaves are small and cupped and all growth is chlorotic. Eventually the cane dies. After about 5 years, the bark sloughs off. This is seldom seen in vineyards less than 8 years old.

**Management:** Infected material should be removed. Make cuts well below cankers. Destroy all prunings. Prune directly after a rain because the risk for infection is lowest at this time as the atmospheric spore load has been washed out temporarily. Prune late in the dormant season to promote rapid healing of wounds. Large pruning cuts can be painted with a concentrated benomyl solution to guard against infection. Note: all future sales and registrations of benomyl have been cancelled. Growers may use existing product until December 31, 2003. It may be necessary to remove the whole plant. Multiple trunk systems are recommended on an 8 to 10 year cycle. This helps with both *Eutypa dieback* and crown gall. All commercial varieties are susceptible.

**Phomopsis cane and leaf spot** (*Phomopsis viticola*): This is a fungal disease which causes reddish-brown lesions on canes, leaf spots and fruit rot. Small black spots at the base of developing shoots are the first sign of infection. These areas may crack, and late in the season may appear bleached. Leaf infections appear as small, dark lesions with yellow margins. Usually the lower

leaves are affected first. Berry infections are rare, and symptoms are similar to black rot symptoms. The fungus overwinters in lesions in wood. In spring, spores are released and spread by rain. Cool, wet weather promotes spread of the disease.

**Management:** Prune and destroy infected canes. Late dormant sprays help to kill the overwintering fungal fruiting bodies on the surface of the vine. Two applications of Captan (at 1" and at 6" shoots) provide good management under normal conditions. Protectant fungicides (especially Abound and Mancozeb) are helpful at preventing infection if they are less susceptible to the fungus. See pest management schedule for recommended materials and timing. Concord, Catawba, Chelois, Delaware, Niagara, and Rougeon are the most susceptible varieties.

**Anthracnose** (*Elsinoe ampelina*): This disease, like several of the others discussed, is worst during those growing seasons which are warm, humid and rainy. It reduces the quantity and quality of the berries. Circular “birds-eye” lesions are produced on the leaves with brown to black angular-shaped margins. If infection is severe, numerous lesions may coalesce, making large areas of the leaf necrotic. Often lesions will be concentrated on the veins. Necrotic tissue may drop out, leaving a “shot hole.” Youngest leaves are the most susceptible.

Lesions on the stems and shoots may also be numerous; coalescing lesions will split open the tissue into the pith. Margins will be raised and purplish to brown in color. Lesions on the rachis and pedicels of the fruit cluster are similar to the stem lesions. If infections are numerous, berries may drop off entirely, or they may develop cracking. Numerous spores are released from overwintering lesions on stems or berries and are dispersed by rainfall. Spores are infectious over a wide temperature range, but need water in order to penetrate susceptible tissue. Hail injury may especially favor infection by this fungus.

**Management:** Do not plant highly susceptible varieties in heavy soils with poor drainage. Dormant fungicide sprays help to reduce inoculum of the pathogen. Protectant sprays beginning when shoots are 5-10 cm long and continuing at 2-week intervals are recommended. A fungicide should be applied 24 hours after hail injury.

Table 43. Effectiveness of fungicides on grape diseases.

Fungicide	Phomopsis				
	Cane and Leaf Spot	Black Rot	Downy Mildew	Powdery Mildew	Botrytis Rot
Abound <sup>a</sup>	++++	++++	++++	+++	-
Aliette	-	-	++++	-	-
Armcarb	-	-	-	+++	-
Bayleton <sup>d</sup>	-	++++	-	++++	-
Bordeaux mix <sup>b</sup>	++	++	++++	+++	++
Captan	+++	+	+++	-	+
Copper & lime	+	+	+++	++	+
Elevate	-	-	-	-	+++
Ferbam	++	+++	++	-	-
Fixed Copper <sup>c</sup>	++	++	+++	++	+
Flint <sup>a</sup>	++	++++	+++	++++	-
JMS Stylet Oil	-	-	-	+++	-
Mancozeb <sup>f</sup>	+++	+++	+++	-	-
Messenger	?	?	?	?	?
Nova <sup>d</sup>	+	++++	-	++++	-
Nutrol	-	-	-	+++	-
Procure <sup>d</sup>	-	++	-	++++	-
Ridomil Gold MZ <sup>g</sup>	-	+	++++	-	-
Ridomil/Copper <sup>g</sup>	+	+	++++	++	+
Rovral <sup>e</sup>	-	-	-	-	+++
Rubigan <sup>d</sup>	-	++	-	++++	-
Serenade	-	-	-	-	+
Sovran <sup>a</sup>	++	++++	+++	++++	++
Sulfur <sup>h</sup>	+	-	-	+++	-
Topsin-M	-	++	-	+++	+ <sup>i</sup>
Va guard	-	-	-	-	+++
Ziram	++	+++	++	-	-

++++=excellent, +++=good, ++=moderate, +=slight, -=not effective, ?=unknown.

<sup>a</sup> Do not use azoxystrobin (Abound), kresoxim methyl (Sovran), or trifloxystrobin (flint) continuously. Rotate with other fungicide groups as per label. Abound can cause serious injury to some apple cultivars. Avoid drift to apples and do not spray apples with equipment used for spraying Abound. Flint should not be used on Concord grapes. Sovran can injure some cherry cultivars.

<sup>b</sup> Bordeaux mix is a mixture of copper sulfate and hydrated lime; it may be purchased prepacked or mixed fresh by the grower.

<sup>c</sup> Fixed copper compounds that are registered for use on grapes include Kocide 101, BCS-Copper Fungicide, Ten-Cop 5E, copper oxychloride sulfate (C-O-C-S), and many other compounds and formulations. The main drawback of copper fungicides is the potential for severe injury to grape foliage, depending on variety and weather conditions, and for reduced vine vigor and yields even in the absence of visible foiar injury. Cool wet weather generally makes copper toxicity worse. Phytotoxicity can be lessened by adding spray loime. One should be very careful mixing other pesticides with preparations containing lime: many of these combinations are incompatible. Excessive use of copper within 30 days of harvest may interfere with wine makein.

<sup>d</sup> Bayleton, Nova, and Elite can control black rot after infection has occurred. For effective control, infection periods must be monitored and fungicide applied within 3 days after the start of an infection period. Application of these materials and Rubigan and Pricure to sporulating lesions of powdery mildew is best avoided to prevent selection of resistant strains of the pathogen. Continuous heavy use of this group of fungicides may result in the development of resistant strains of fungi.

<sup>e</sup> Continuous heavy use of this fungicide (iprodione) may result in the development of strains of fungi (esp. Botrytis) that are resistant to it. Iprodione resistant strains of Botrytis have been found in east coast vineyards. Do not routinely apply more than two iprodione sprays per season.

<sup>f</sup> Trade names for mancozeb include Manzate 200, Manzate 200 DF, Dithane M45, Dithane F45, Dithane DF, Penncozeb, and Manex II.

<sup>g</sup> Ridomil Gold MZ contains 10% mefenoxam plus 48% mancozeb, Ridomil Gold/Copper contains 10% mefenoxam plus 60% copper hydroxide.

<sup>h</sup> Sulfur may cause damage to sensitive varieties, it should always be used under cool temperatures.

<sup>i</sup> Continuous use of Topsin M may result in the development of strains of Botrytis that are resistant to it. Topsin-M resistant Botrytis has been found in east coast vineyards.

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## Root and Trunk or Crown Diseases

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**Crown Gall** (*Agrobacterium vitis*): Crown gall is a bacterial disease that infects more than 2,000 species of plants (including brambles). Crown gall of grape is a major problem in cold climate regions. Wounds are necessary for infection to occur. Observations suggest that freeze injury and mechanically induced wounds are highly conducive to infection. The disease is particularly severe following winters that result in freeze injury on cold-sensitive cultivars, such as those of *Vitis vinifera*. Crown gall is characterized by galls or overgrowths that usually form at the base of the trunk. Galls form as high as 3 feet or more up the trunk (aerial galls). Galls generally do not form on roots. The disease affects all grape cultivars. Vines with galls at their crowns or on their major roots grow poorly and have reduced yields. Severe economic losses result in vineyards where a high percentage of vines become galled within a few years of planting.

The disease first appears as small overgrowth or galls on the trunk, particularly near the soil line. Early in their development, the galls are more or less spherical, white or flesh-colored, and soft. Because they originate in a wound, the galls at first cannot be distinguished from callus. However, they usually develop more rapidly than callus tissue. As galls age, they become dark brown, knotty, and rough. The bacterium can survive in the soil for many years even in the absence of grapevines.

**Management:** Control procedures include: (1) planting only nursery stock which is free of any obvious galls on crowns or roots; (2) not planting into a field where crown gall has occurred previously, unless a non-host crop, such as strawberries or most vegetables, is grown for two or more years before replanting; and (3) minimizing winter injury to root and crown systems.

In addition to the above procedures, a nonpathogenic bacterium, *Agrobacterium radiobacter*, strain K-84, is commercially available for biological control of crown gall. The biocontrol agent may be applied to roots of healthy plants when they are first set out. After planting, the control becomes established in the soil around the root zone and prevents crown gall bacterium from entering this region. However, the biocontrol agent will not cure plants which are already infected before its application.

## Insects

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### Fruit Pests

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**Grape Berry Moth** (*Paralibesia viteana*): The moth is about 3/8 - 1/4" long and has a broad gray band across the middle of its wings. The larva is grayish-green and about 3/8" long when full grown. Larvae are found in the blossoms, young fruit clusters, and newly-formed berries; later they are found in green and ripening berries. Larvae feeding in the green and ripening berries cause most losses. Green berries will be seen to have a maroon coloration on one side, especially where the berry comes closest to or contacts a nearby berry in the same cluster. Such coloration indicates that a larva has fed on one berry, burrowed into another, and connected them with webbing. Ripening berries infested with larvae are detected by the wrinkled, shrunken appearance of the fruit.

**Management:** Remove wild grape plants from areas adjoining the vineyard. Till between rows to bury overwintering larvae. Pheromone traps are available to monitor onset of activity and pressure. Traps should be placed in the vineyard prior to the onset of GBM activity, usually around bloom. Threshold numbers for these traps have not been verified for New England, but they are useful to determine the onset of GBM activity. Mating disruption is being used successfully in some vineyards with the application of Isomate™ pheromone ties. These ties emit GBM pheromones slowly over time and when dispersed throughout the vineyard, make it difficult or impossible for male and female GBM moths to find one another and mate. These ties are recommended for vineyards 5 acres in size or larger. They are available from Pacific Biocontrol in Davis, California and Micro Flo in Lakeland, Florida. Contact your local Extension Specialist for help getting Isomate™ ties.

When damage is seen, it is too late to treat. It may be necessary to treat with insecticide the following season. See pest management schedule for recommended materials and timing. Applications should be made post-bloom, 10 days later and again in late July or early August.