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Common Diseases of the Grapevine in Michigan

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Black Rot

This disease, caused by the fungus *Guignardia bidwellii*, is common throughout Michigan, the Eastern United States and Canada. If uncontrolled, it can be devastating in terms of crop loss. Well-timed effective fungicide sprays can give almost 100% control.

Symptoms and Disease Cycle

Small, circular reddish-brown spots ⅛ to ¼ inch in diameter appear, usually on the lower leaves, in mid- to late-June (Fig. 1). The lesions are the result of spring ascospore infections originating from old black rot fungus infected berries and canes. Only a few hundredths of an inch of rain are necessary to promote ascospore release and subsequent leaf infection. The lesions develop a black border and small black, pimple-like pycnidia are found in the reddish-brown part of the lesion. The herbicide Paraquat®, often used in vineyards for weed control, can cause similar-appearing leaf spots, but these do not show the black pycnidia in the lesions.

Ascospores and conidiospores (secondary spores) infect the blossoms during each rain. However, the results of early blossom and fruit infection are not visible until mid-July or early August, when infected grape berries begin to shrivel in the clusters. Leaf, cane and tendril infection can occur only when the tissue is young, but berries can be infected until almost fully grown if an active fungicide residue is not present.

Mid-season infection of green fruit is evidenced by a whitish circular spot ⅛ inch in diameter on the fruit at the point of infection. About two weeks later, after the fungus has grown throughout the berry, it begins to shrivel and look like a hard blueish raisin (Fig. 2). These eventually fall to the ground and are an inoculum source for the rest of the season. American varieties such as 'Concord' and 'Niagara' are quite susceptible to the pathogen; 'Delaware' and certain French-American hybrids are moderately resistant. 'Aurore' is a particularly susceptible variety. (See Table 1).

Fig. 1. Black rot lesions on leaf. Note dark borders of spots.

Fig. 2. Black rotted grapes shrivel in the cluster and resemble blue raisins.

Control

Fungicidal control is very effective. Good spray coverage is essential. Consult the MSU Fruit Pesticide Handbook (Extension Bulletin E-154) for recommended fungicides, rates and timing of sprays.

Downy Mildew

This disease can be extremely serious in grapes and will cause severe crop loss. The fungus *Plasmopara viticola* causes downy mildew.

Symptoms and Disease Cycle

The fungus overwinters in diseased leaves on the ground. Spores are released in the spring and spread to the leaves and berries by splashing rain or wind. During years with warm, extended wet periods during bloom, fruit clusters may be partially or totally killed (Fig. 3). Clusters infected early in the season soon become covered with a white fungus growth. Attacks later in the season are restricted to cluster stems, or to individual berries in the cluster which shrivel. The older infected berries harden and turn red or yellow instead of ripening.

Leaf symptoms appear in early to mid-July. Small, pale yellow circular lesions ⅛ to ¼ inch in diameter are seen first on the upper surface of the leaf (Fig. 4). On the underside of the leaf are corresponding areas of whitish-greyish fungus growth (Fig. 5). The fungus produces sporangia, which liberate zoospores into a film of water and spread the infection during prolonged rains or dew. Later, the leaf tissue dies in the area of the lesion. If lesions are numerous, they will coalesce, causing large areas of the leaf to turn dark brown or black. Badly damaged leaves will prematurely fall leaving berries exposed to sun scald. See Table 1 for a rating of varietal susceptibility.

Control

Downy mildew is comparatively easy to control with fungicides. Apply fungicide sprays just before bloom, during bloom (if bloom is slow), after bloom, 10-14 days later, about August 1 and

Table 1. Disease Susceptibility and Sulfur Sensitivity of American, French Hybrid, and Vinifera (European) Grape Varieties.

	Rot Black	Downy Mildew	Powdery Mildew	Botrytis	Sulfur Sensitive?	Susceptibility to Viruses PRMV	TmRSV
Aurore (S5279)	+ + +	+	+ + +	+ + +	No	Yes	No
Baco Noir (Baco #1)	?	?	+ +	?	No	Yes	Yes
Cascade (S13053)	+	+	+ +	?	No	?	Yes
Catawba	+ + +	+ + +	+ +	?	No	Yes	No
Chancellor (S7053)	?	+ + +	+ + +	?	?	?	?
Pinot Chardonnay	+ + +	+ + +	+	?	No	?	?
Chelois (S10878)	?	+	+ + +	+	No	Yes	Yes

Fig. 3. The downy mildew fungus causes shriveling of large portions of infected clusters. Note white mycelium on shriveled portions.

Fig. 6. The powdery mildew fungus causes white, webby patches on leaves and other green parts of the vine.

Figs. 4 (top) & 5 (bottom). Yellow areas on upper leaf surface correspond with white mycelial patches of the downy mildew fungus on the lower leaf surface.

again about September 1. It is most economical to use a fungicide or combination of fungicides that will control both black rot and downy mildew. Consult the MSU Fruit Pesticide Handbook (Extension Bulletin E-154) for fungicide rates.

Powdery Mildew

Powdery mildew is most severe on French hybrids and European (*Vitis vinifera*) grapes. However, in some years it can cause moderate damage to American grapes. Leaves heavily infected by powdery mildew are less able to manufacture food (photosynthesize) resulting in decreased plant vigor and increased chance of winter injury to the vines.

Symptoms and Disease Cycle

Leaf symptoms of powdery mildew appear in early to mid-July as a white powdery or dusty fungus growth on the upper surfaces of the leaves and other green parts of the vine (Fig. 6). Severely affected leaves turn brown and fall.

Attacks later in the season are restricted to the berries and cluster stems. Infected cluster stems can cause shelling of ripe fruit. Infected berries turn hard, brown, and fail to properly mature. In late summer and early autumn, minute black fruiting bodies called cleistothecia form on infected parts; this is the overwintering stage of the fungus.

Some varieties are more susceptible than others. Consult Table 1 for relative varietal susceptibility.

Control

Fungicide sprays, beginning about two weeks after bloom followed by another spray about three weeks later and a third one about September first, will control powdery mildew fairly well. Consult the MSU Fruit Pesticide Handbook (Extension Bulletin E-154) for suggested fungicides and rates.

Eutypa Dieback

The disease Eutypa dieback was earlier called "dead-arm" due to an error made by plant pathologists many years ago. What was called "dead-arm" was really the symptoms of two diseases: Eutypa dieback, caused by the fungus *Eutypa armeniacae* and phomopsis leaf and cane spot disease caused by the fungus *Phomopsis viticola*. This latter disease will be described later. Eutypa dieback is present in about 10% of the 'Concord' grapevines in Michigan. It is a very serious and costly disease.

Symptoms and Disease Cycle

The most striking symptoms appear in the late spring and early summer when new shoots are 6 to 12 inches long. The shoots are stunted and the leaves are cupped upward, smaller than normal and yellow or yellow-streaked (Fig. 7). These symptoms are caused by a deep-seated wood rot of the arms or trunk; probably a toxin is given off by the fungus. As the disease progresses over several years one or more arms may die (hence the old name of "dead-arm") as well as the whole vine.

Careful examination of the arms or trunk will reveal that the initial infection occurred at a pruning wound. Around this old wound is a dark "stroma" (Fig. 8) composed partly of grape bark tissue and partly of fungus tissue. The stroma contains fungal fruiting bodies called "perithecia" whose ascospores are shot out from autumn through May whenever the temperature is above freezing and rainfall occurs.

Fig. 7. Symptoms of Eutypa dieback include stunted shoots and yellowed leaves cupped upward.

Fig. 8. "Stroma" of the Eutypa fungus. Note the pimple-like perithecia (arrow) containing ascospores which are ejected from autumn to May.

Fig. 9. Fruiting bodies of the Phomopsis fungus on an infected cane.

Very small amounts of rain will trigger ascospore release. The spores are windborne and infect pruning wounds on the vines. When sawing through a diseased arm or trunk, a dark pie-shaped area of diseased wood is often present. It is unusual that the disease is infective during the winter months instead of the summer.

It takes two to three years after infection for symptoms to show, and four or five years for stroma to form. There is no known varietal resistance to this disease.

Control

Removal and burning of diseased arms or the entire vine is recommended. Sometimes a new vine can be trained from a sucker. However, these often show disease symptoms after a few years. Double-trunking has also been successfully done. If one trunk becomes diseased, it can be cut off leaving the other which may remain disease-free for some time.

Fig. 10. Leaf symptoms of Phomopsis leaf and cane spot disease appear as small angular dead spots.

Recently a label registration has been granted for the use of Benlate® 50W fungicide during the dormant season. Spray vines after pruning, but before any rain occurs. Benlate® 50W should be used at 2 lb. per acre as a thorough-coverage spray (about 100 gal. water per acre). This fungicide application will protect the pruning wounds from ascospore infection. The pruning season appears to be the only time when infection occurs.

Phomopsis Leaf and Cane Spot Disease

This disease is caused by the fungus *Phomopsis viticola*. Symptoms were originally thought to be part of the "dead-arm" disease. It was not until the mid-1970s that this confusion was rectified.

Symptoms and Disease Cycle

The fungus overwinters in the canes producing fruiting bodies (Fig. 9). Spores infect new leaves in the spring during rainy weather. The leaf symptoms appear in early to mid-June as small angular dead spots (Fig. 10). The lower leaves are the first to show infection. Later in the season, canes, tendrils, leaf petioles and even cluster stems may show elongated, brownish or purplish lesions ¼ inch long (Fig. 11). If the disease is severe, the fungus enters the grape berries, probably through the pedicel (berry attachment to the cluster stem). Mechanical harvesting will often shake many berries off the vine ahead of the machine, causing considerable crop loss.

'Niagara' grape is very susceptible to this disease. 'Concord' is less susceptible, but where fungicidal control has been lacking, losses can occur.

Control

One or two fungicide sprays applied at the 1-inch shoot length stage and again at the 4 to 6 inch shoot length stage (first black rot spray) will usually give good control. For specific fungicides and rates, consult the MSU Fruit Pesticide Handbook (Extension Bulletin E-154).

Crown Gall

This is a bacterial disease caused by *Agrobacterium tumefaciens*. The main symptom consists of galls formed on the roots, crowns and/or trunks (Fig. 12). Crown gall can arrive or spread in a vineyard by several means. Once established, the bacteria can live in the soil for many years.

Infection of grapevines can occur directly through root wounds or as the result of bacteria being rain-splashed onto upper portions of the plant. The bacteria can also be spread by shears during the pruning process. Sometimes nursery stock will arrive already infected with crown gall thus, inoculating the soil into which it is planted. The vines can become weakened and stunted if severely infected.

Control

Reject planting stock with galls or suspicious swellings. Dipping roots and crowns before planting into a suspension of a hypovirulent strain of *Agrobacterium* sp. such as Galltrol® will protect against infection by resident crown gall bacteria at the planting site. Disinfect shears between cuts when pruning vines are known to be infected with crown gall.

Fig. 11. Elongated dark lesions of Phomopsis on cluster stem and along leaf veins.

Fig. 12. Galls on trunk as a result of crown gall bacterial infection.

Fig. 13. Missing vines indicate an infection center for peach rosette mosaic virus. Dead vines have been removed.

Fig. 14. Peach rosette mosaic virus infected vines are often umbrella-shaped.

Peach Rosette Mosaic Virus Disease

'Concord' and 'Catawba' grapevines are infected with peach rosette mosaic virus (PRMV) in a large percentage of vineyards in Michigan. (See Table 1 for a listing of susceptible varieties.) This virus is soil-borne and is spread from plant to plant by the root-feeding dagger nematode (*Xiphinema americanum*). Dandelion, curly dock and carolina horsenettle are weed hosts for the virus.

Symptoms

Where the disease exists, there are "holes" in the vineyard (Fig. 13). Infected vines are usually umbrella-shaped (Fig. 14) because the virus causes the canes to grow somewhat crookedly. Internodes are shorter than normal (Fig. 15) and leaves are distorted (Fig. 16). Berry cluster shelling (Fig. 17) will occur on vines that have been infected for several years.

The virus is seed-borne in grapes. The practice of spreading grape pomace in the vineyard should be halted, because this can reintroduce the virus into the vineyard. The dagger nematode will spread the virus from infected grape seedings to healthy vines. 'Niagara' and 'Delaware' grapevines are less susceptible to PRMV than are 'Concord' and 'Catawba' varieties.

Control

Control of this disease includes preplant soil fumigation of vineyard sites to kill the dagger nematode vector. If diseased vines are present in an established vineyard, all infected vines will need to be identified and removed. The soil should then be tilled for one growing season. Fumigate late-summer or autumn soil prior to replanting with certified virus-tested clean stock. See MSU Extension Bulletin E-806 "Vineyard Preparation for Nematode and Virus Disease Control" and the MSU Fruit Pesticide Handbook (Extension Bulletin E-154) for further recommendations concerning control by soil fumigation. New information on the use of superimposed

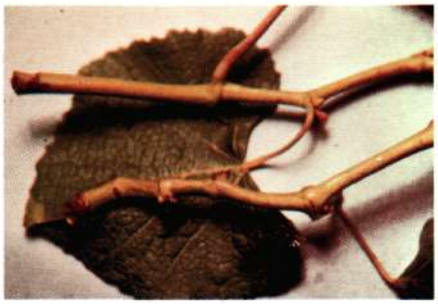

Fig. 15. Shortened cane internodes caused by peach rosette mosaic virus.

Fig. 16. Distorted leaf of peach rosette mosaic virus-infected vine.

Fig. 17. Berry cluster shelling occurs on vines that have been infected with peach rosette mosaic virus for several years. Note small fruit cluster.

Fig. 18. Tomato ringspot or tobacco ringspot virus infection causes yellow stunted leaves and shoots. (Healthy vine on left and diseased on right.)

shallow (8 inch) plus deep (3 feet) soil fumigation for the control of PRMV will soon be available.

Tomato Ringspot and Tobacco Ringspot Disease

French hybrid grapevines (especially blue-fruited varieties) are susceptible to infection by these two viruses. The symptoms are the same regardless of which virus causes the disease. Tomato ringspot (TmRSV) is more prevalent than tobacco ringspot virus.

Symptoms

Leaves on infected canes are yellow and smaller than normal, vines appear stunted (Fig. 18) and internodes are abnormally shortened (Fig. 19). Vines lose vigor and will often die of winter injury if infected with either virus. The dagger nematode, *Xiphinema americanum* spreads this disease by feeding on the roots of infected weeds (chickweed, dandelion, plantain and others) or grapevines and then feeding on the roots of healthy vines.

Control

See control section for peach rosette mosaic virus.

Fig. 19. Abnormally shortened internodes of tomato ringspot or tobacco ringspot virus infected grapevines.

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