Common Blueberry Diseases in Michigan
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Fungus Diseases

Mummyberry

Mummyberry is probably the most commonly known disease of blueberry. It is caused by the fungus *Monilinia vaccinii-corymbosi.*

Symptoms and Disease Cycle

Shoot blight is the first symptom seen after dormancy has broken (Fig. 1). Blighted shoots are the result of ascospore infection of emerging leaf buds. Ascospores of the fungus are dispersed from mushroom-like apothecia (Fig. 2) that form on last year's mummyberries which overwinter on and in the soil under the bushes. Conidiospores form on the blighted shoots (Fig. 3). These conidiospores infect the blossoms as they open.

Evidence of blossom infection does not appear until the fruit begins to ripen. Then, the berries begin to shrivel and turn a pinkish color (Fig. 4). These are "mummyberries," filled with the pathogenic fungus. They fall to the ground, shrivel, turn dark brown and become pumpkin-shaped. They serve as an inoculum source the following spring when apothecia form and the disease cycle begins again. Crop losses of 30 to 40% are experienced where no fungicidal control is practiced. There is no effective varietal resistance.

Control

Calcium cyanamid or dinitro chemicals applied to the soil does not effectively destroy apothecia. Applying fungicides to the bushes prebloom and during bloom can result in excellent control. Refer to the MSU Fruit Pesticide Handbook (Extension Bulletin E-154) for fungicides, rates and timing.

Fusicoccum (Godronia) Canker

This disease is serious in the northern Lower and the Upper Peninsula. If an east-west line is drawn through Grand Haven, the area north of this line will be where Fusicoccum canker is a problem. The area south of this line is where Phomopsis canker (discussed later) is a problem.

Fig. 1. Shoot blight phase of mummyberry disease.

Fig. 2. Mushroom-like apothecia that germinate from mummyberries on the ground in the spring. These contain ascospores which cause shoot blight.

Fig. 3. A blighted shoot showing the cream colored sporulation (arrow). This sporulation contains conidiospore masses. The conidiospores infect the blossoms, causing mummyberries to form.

Symptoms and Disease Cycle

This disease is caused by the fungus *Godronia cassandrae (Fusicoccum putrefaciens).* Infected stems (current season, 1-, 2-year old) develop elliptical, brownish-purple lesions 1 to 6 inches long (Fig. 5). The lesions are found in the lower third of the bush, especially in the crown area. They contain small black pimple-like fungal fruiting bodies called pycnidia. The pycnidia contain conidiospores that infect more canes when they are rain splashed. Infection eventually results in wilting and dieback of the whole stem, (usually in mid-summer) (Fig. 6), due to a damaged vascular system.

The disease cycle starts at about budbreak in the spring. Each rain causes the release and spread of conidiospores. Conidiospores infect current year canes as well as 1- and 2-year-old canes. Infections first appear as small, reddish areas on the stems, eventually developing into the previously described cankers. New infections continue to occur throughout the growing season each time it rains, until leaves drop in the autumn.

Fig. 4. Whitish pink mummyberries form among healthy blue fruit near harvest time.

Fig. 5. A stem canker caused by *Fusicoccum putrefaciens.*

Fig. 6. Stem wilt and dieback caused by Fusicoccum canker disease.

Control

Prune out and burn cankered stems. Use a fungicide spray program throughout the growing season. Refer to Extension Bulletin E-154 for fungicide rates and timing. There are no resistant varieties.

Phomopsis Canker

This disease is caused by the fungus *Phomopsis vaccinii.* Phomopsis canker occurs in the southern Lower Peninsula and in Indiana and Illinois. This disease can be devastating to bushes planted in low areas, where winter injury and spring frosts are a problem.

Symptoms and Disease Cycle

The cankers on 1-, 2-, and 3-year old stems are not as well-defined as those of Fusicoccum canker. A Phomopsis canker appears as an elongated, flattened canker (Fig. 7). An infected stem feels flattened. Older cankers are covered by small, pimple-like pycnidia (Fig. 8) which contain conidiospores. The conidiospores are spread by splashing rain. In the early stages of canker formation, current year stems may have 1- to 2-inch-long reddish-brownish areas. These areas are the beginning symptoms of phomopsis canker.

After the stems have been infected for a season, they will wilt during the summer months (Fig. 9). Under severe disease conditions it is common to see bushes with a half dozen or more wilting stems. The infectious conidiospores are spread each time rain occurs during the growing season from bud-break through about August 1. Winter injury and spring frost injury afford an entry point for infection.

Fig. 7. A stem canker caused by *Phomopsis vaccinii.*

Fig. 8. Pimple-like pycnidia (arrow) on a Phomopsis canker. These pycnidia contain infectious conidiospores.

Control

Prune out and burn infected cankers. Pruning cuts should be made as deep into the crown as possible to insure removing the canker. Use season-long fungicidal sprays. Use Extension Bulletin E-154 for fungicides, rates and timing.

Botrytis Blight

Botrytis blight, a sporadic disease, is caused by the fungus *Botrytis cinerea.* When conditions are favorable for the disease it can cause considerable crop loss.

Fig. 9. Stem wilt caused by Phomopsis canker.

Symptoms and Disease Cycle

The first symptom (seen in the spring) is a blossom cluster blight or blast (Fig. 10). This symptom is similar to the shoot blight caused by mummyberry disease, except that the blossom and cluster blight/blast caused by *Botrytis cinerea* does not have the cream-colored sporulation present. A week or two later, some leaves will show a dead or necrotic symptom (Fig. 11). Usually the disease doesn't progress any further. The fungus probably overwinters on old leaves and trash on the ground. Fungal structures called sclerotia may overwinter on twigs also.

Control

Although not specifically labeled for the control of Botrytis blight on blueberries, Benlate® plus captan sprays applied during bloom for the control of mummyberry disease will control Botrytis blight fairly well.

Anthracnose

Anthracnose is caused by *Colletotrichum gloeosporioides.* This disease is thought of as a post-harvest fruit rot, but infection has occurred much earlier than harvest. Crop losses may run as high as 10 to 20%.

Symptoms and Disease Cycle

The earliest symptom is the presence of a shoot blight (Fig. 12). Usually a few blossom clusters will turn brown or black. Spores are not formed on these blossom clusters. Later in the season when fruit are ripening and turning blue, the blossom end of the fruit will soften, pucker and exhibit some salmon-colored sporulation (Fig. 13). There are vast numbers of spores on each fruit and these spread to other fruit

Fig. 10. Blossom blight (arrow) caused by *Botrytis cinerea*.

Fig. 11. Leaf necrosis caused by *Botytris cinerea*.

Fig. 12. Shoot blight/blossom blight (arrow) phase of anthracnose.

on the bush by rain or after harvest, when one fruit touches another.

The fungus overwinters in and on twigs. If conditions are very warm and humid in the spring around blossom time, sporulation may occur on these twigs (Fig. 14). The spores cause blossom cluster blight, thus building up the level of inoculum. Some green fruit is infected if there is a lot of rain. The ripening fruit is the most susceptible tissue.

Control

If there is a recent history of this disease in a given field, use a well-timed, thorough fungicidal spray program. Use Extension Bulletin E-154 for specific fungicides, rates and timing.

Fig. 13. Fruit rot phase of anthracnose. Note puckered blossom end of fruit showing salmon colored sporulation.

Alternaria Fruit Rot

This disease is caused by *Alternaria* sp. The major effect is a leaky, watery fruit rot near harvest. In some seasons 20 to 30% crop loss can occur.

Symptoms and Disease Cycle

The earliest symptom is the presence of a blackish, dark-greenish sporulation on the blossom end of the fruit (Fig. 15). This appears a week or two before harvest. The causal fungus overwinters in and on the twigs and in debris on the ground. Infection occurs mainly after the fruit begins to ripen.

Control

Use Extension Bulletin E-154 for fungicides, rates and timing.

Fig. 14. Spore masses on overwintered anthracnose-diseased twigs.

Fig. 15. Blackish, dark greenish sporulation on fruit diseased with Alternaria fruit rot.

Fig. 16. Red leaf diseased leaves. Note reddish upper surface and whitish lower leaf surface.

Red Leaf Disease

Red leaf disease is caused by the fungus *Exobasidium vaccinii*. The disease seems to be increasing in importance. Not many plants in Michigan suffer from it, but where it exists, there is cause for concern. Bushes become systemically infected and must be removed and destroyed.

Symptoms and Disease Cycle

During the middle of summer, terminal leaves on some bushes will turn a reddish color (Fig. 16). The underside of these leaves will be whitish due to the development of fungus spores. Later, the leaves will turn black and dry up.

Control

Remove infected bushes and burn them. There is no fungicidal control available. If infected bushes are not removed and destroyed, the disease will spread to more bushes. Infected bushes are systemically infected and do not recover.

Powdery Mildew

Powdery mildew is caused by the fungus *Microsphaera vaccinii*. There is no real information regarding its economic importance in terms of yield loss. In years when crop load is light, the shoot growth is more succulent and as a result, powdery mildew causes more leaf damage.

Symptoms and Disease Cycle

During mid-July leaves are covered by a thin spider web-like fungus growth called mycelium. As a result, leaves become somewhat puckered (Fig. 17). Sometimes, in late summer, circular reddish-brown spots 1/8 to 1/4 inch in diameter appear on the top and underside of the leaves. Conidiospores grow from the mycelium and spread the disease throughout the field. During late summer and autumn, small round black fruiting bodies 1/32 to 1/16 inch in diameter develop on the surface of the webby fungal growth on the leaves. These fruiting bodies are called cleistothecia. The cleistothecia are a means of overwintering by the causal fungus. All cultivars are susceptible to powdery mildew. Jersey cultivar is the most susceptible.

Control

Benlate® sprays will keep powdery mildew in check. There are no specifically recommended fungicides for powdery mildew control.

Bacterial Diseases

Crown Gall

Crown gall is caused by the bacterium *Agrobacterium tumefaciens*. The bacteria enter the roots through wounds at planting time in the grower's field or in the nursery. The bacteria make tumors or galls that are evident on roots and sometimes in the crown area (Fig. 18). Infected plants are usually weak and stunted.

Control

Make sure that nursery plants are free of crown gall. At planting time, dip the plants in a suspension of hypovirulent *Agrobacterium* sp., marketed under the name of Galltrol® (or equivalent product). This will protect against infection by virulent resident crown gall bacteria.

Fig. 17. Powdery mildew infected leaves. Note puckered leaves with whitish fungus mycelium on the surface.

Fig. 18. Crown galls on a blueberry stem, caused by the soil bacterium, *Agrobacterium tumefaciens*.

Virus and Virus-Like Diseases

Shoestring

Shoestring disease is the most important virus disease of Michigan blueberries. It is present in a great number of fields in the west central part of lower Michigan, centered around the Holland/West Olive area. Annual losses are estimated at several million dollars due to bush and crop loss.

Symptoms and Disease Cycle

Shoestring is named for one of the symptoms associated with the disease; some leaves on infected bushes are strap-like (shoestring symptom) (Fig. 19). Usually a few clusters of leaves in the crown will show this symptom. Some will be misshapen in the form of crescents, or twisted (Fig. 20). The most reliable symptom is narrow, elongated reddish streaks, 1/4-to-1-inch or longer on current year and 1-year old stems (Fig. 21).

Often, the fruit on infected bushes is a reddish-purple color, instead of the normal blue color. The disease is spread

Fig. 19. Strap-shaped leaves associated with shoestring disease.

Fig. 20. Crescent-shaped and deformed leaves associated with shoestring disease.

Fig. 21. Elongated reddish streaks on blueberry stems. This is the most reliable symptom of shoestring disease.

from bush-to-bush by the blueberry aphid *Illinoia pepperii* (Fig. 22). There is a 2- to 4-year latent period in the field before an infected bush shows symptoms.

Control

Use disease-free planting stock. Blueberry cultivars such as Jersey, Rubel, Burlington, Earliblue, Rancocas, Weymouth, and Blueray are quite susceptible to the disease. Bluecrop has good field resistance and is planted where disease pressure is great.

In fields where infected bushes exist, the following control program should be followed: Inspect all bushes. Remove those showing symptoms, and replant with healthy stock. Keep the blueberry aphid down to near zero population by using well-timed aphicide sprays. Ground-applied sprays are much more effective than aerially-applied sprays. Apply the first spray in early to mid-June when the first aphids are found on the succulent shoot terminals growing from the crown. Apply follow-up sprays at two or three week intervals if aphids begin to increase. Good spray coverage is essential. Consult Extension Bulletin E-154 for insecticides and rates.

Fig. 22. The blueberry aphid, *Illinoia pepperi* (arrow) is the vector (spreader) of shoestring disease.

Necrotic Ringspot

This disease is caused by tobacco ringspot virus, and is a slow spreading nematode-spread virus. The vector is *Xiphinema americanum* (dagger nematode). The pattern of spread in the field is roughly circular. Areas within the field showing infection are "patchy." The perimeter of each circular area of infection spreads outward at the rate of about 1 meter per year.

Symptoms and Disease Cycle

The disease consists of roughly circular brown necrotic areas 1/16 to 1/8 inch in diameter on some of the older leaves (Fig. 23). Leaf deformity may also occur. On some cultivars, such as Concord and Stanley, the leaves on shoot terminals may be reduced in size and the shoot internodes are very short (Fig. 24). Jersey cultivar in general is resistant to necrotic ring spot disease, but it is commonly found in Stanley, Concord, Collins, Rubel, and Pemberton. Infected bushes are somewhat stunted and yield is poor.

Control

Test the soil for the presence of dagger nematodes (See MSU Extension Bulletin E-800 for directions on how to properly take soil samples) before planting. If dagger nematodes are present, then use a pre-plant soil fumigant. Consult Extension Bulletin E-154 for suggested soil fumigants and rates. In existing areas of infection, identify all infected bushes. After bush removal (including crowns and major roots) the soil must be worked for a full season. Fumigate in the autumn, by October 1, while the soil temperature is still above 55°F. Consult Extension Bulletin E-154 for soil fumigants and rates to be used. Use disease-free planting stock.

Fig. 23. Necrotic and deformed leaves on a bush diseased with Necrotic ringspot, caused by tobacco ringspot virus.

Fig. 24. Shortened stem internodes and small terminal leaves associated with necrotic ringspot disease on Concord and Stanley cultivars.

Blueberry Leaf Mottle

Blueberry leaf mottle is a newly described disease of high bush blueberry peculiar to Michigan. The disease has been found in a half-dozen fields in the western part of the state and in one field in the eastern part of Michigan.

Symptoms and Disease Cycle

The disease has been found only in Rubel and Jersey cultivars. The symptoms are the most severe on Rubel. The tops of the bushes are killed back and only scant regrowth occurs in the spring (Fig. 25). Leaf symptoms are severe on Rubel and include leaf distortion and mottling (Fig. 26). Yield is very poor on infected bushes. Jersey cultivar exhibits milder symptoms. Jersey exhibits stem dieback and shoot regrowth in the spring, but the leaves do not show the extreme deformity and mottling. The leaves are smaller and paler green than normal (Fig. 27). Mottling, if present, is hard to see on leaves of Jersey cultivar. Yield is greatly re-

Fig. 25. Stem dieback of Rubel cultivar infected with blueberry leaf mottle virus.

Fig. 26. Leaf distortion and mottling of Rubel cultivar infected with blueberry leaf mottle.

duced in infected Jersey bushes. There is potential for confusion between this disease and necrotic ringspot, because both diseases cause stem dieback. However, there are no necrotic leaf spots associated with blueberry leaf mottle disease.

The disease spreads fairly rapidly in plantings. Over a ten year period an infection can increase in a field from very few infected bushes to more than 50% infection. The disease is not associated with the dagger nematode or with aphids. There is a strong possibility that blueberry leaf mottle is spread from one bush to another via pollen. Diseased propagating wood is another possible means of spread.

Fig. 27. Small, pale leaves of Jersey cultivar infected with blueberry leaf mottle virus.

Control

Plant healthy virus tested stock. If the disease is already present in a planting, identify, remove and burn all infected bushes. Unfortunately, some infected bushes not showing symptoms will not be removed and will remain a reservoir host for spread of the virus via pollen to healthy bushes.

Mosaic

A virus-like entity is associated with the mosaic disease. Mosaic is found in older cultivars e.g. Concord, Stanley, Rubel, Cabot and Pioneer.

Symptoms and Disease Cycle

The symptoms consist of bright yellow and green mottling of leaves (Fig. 28) on stems of a given bush. In addition to the yellow-green mottling some leaves have a red component. Sometimes symptoms disappear from a stem only to reappear one or two years later. The means of spread are unknown at this time.

Identify, remove and burn all infected bushes. Replant with disease-free bushes.

Red Ringspot

Red ringspot is a very important disease in New Jersey. A similar (if not identical) disease also occurs in cranberries in that state. In Michigan, red ringspot is a potentially important disease but it does not actively spread under field conditions. However, it is spread through the use of diseased propagating wood. The main cultivars susceptible to red ringspot are Blueray, Burlington, Rubel, Darrow and Bluetta.

Fig. 28. Bright yellow and green mosaic symptoms on leaves of Rubel cultivar showing mosaic disease.

Symptoms and Disease Cycle

Red ringspots often appear on stems (Fig. 29). The most noticeable symptom appears on the leaves in August and September. Mature leaves exhibit circular reddish-brown spots 1/8 to 1/4 inch in diameter (Fig. 30). These spots will often have a green center. The leaves on the basal half of the stems show the most symptoms.

Fig. 29. Red ringspot stem symptoms on Blueray cultivar infected with red ringspot virus.

Fig. 30. Red, circular spots on leaves of Blueray cultivar infected with red ringspot virus.

Fig. 31. Fruit spot symptoms sometimes associated with red ringspot virus infection.

Fig. 32. Downward cupping and yellow margins of leaves on a stunt diseased bush.

Powdery mildew disease can also cause similar spots. However, powdery mildew spots go through the leaf, so that the underside is spotted also. Red ringspot lesions are only on the top side of the leaf. There is possible confusion because of a genetic disorder associated with the Bluetta cultivar. Dark, reddish spots can appear on this cultivar, which may be caused by either red ringspot virus or a genetic disorder. In this case, diagnostic tests such as the enzyme-linked immunosorbent assay (ELISA) are necessary to determine whether the symptoms are caused by the virus or by a genetic disorder. Fruit will sometimes exhibit bleached out circular blotches (Fig. 31), although this symptom is not always present. Yield is reduced on diseased bushes, but the extent of the reduction is not known. A mealy bug is suspected of spreading the disease in New Jersey.

Control

Remove and burn all bushes showing symptoms. Before removing Bluetta cultivar, take further confimatory tests. Replant with clean stock.

Stunt

Stunt is a serious disease in Michigan caused by a mycoplasma-like organism (MLO). An MLO is a pathogen that is in between a virus and a bacterium. Almost all cultivars are susceptible to stunt. Only Rancocas cultivar has resistance.

Symptoms and Disease Cycle

The disease causes a stunting of bushes. Leaf symptoms are the best evidence for disease diagnosis. Leaves show downward cupping and yellowish margins (Fig. 32). Normal green coloration of the leaf is usually retained along the midvein and lateral veins. Leaf size is usually reduced. Berries are smaller than normal on infected bushes. The sharpnosed leafhopper *(Scaphytopius magdalensis)* spreads this disease.

Control

Remove and burn infected bushes. The normal full-season insecticidal control program for blueberries usually keeps the leafhopper population in check. Replant with disease-free stock.

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