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UNIVERSITY OF KENTUCKY — COLLEGE OF AGRICULTURE

Plant Pathology Fact Sheet

Fruit Rots of Grape

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Kentucky's typically wet springs and warm, humid summers favor the development of several fruit rots of grape. These include anthracnose, bitter rot, black rot, Botrytis bunch rot, ripe rot, and sour rot.

Anthracnose

Grape anthracnose, also known as "bird's eye rot," results in the loss of fruit quality and quantity. In addition, vines may become infected and weakened. This disease can be very destructive once it becomes established in a vineyard.

Symptoms and Signs

Anthracnose of grape occurs on shoots, fruit stems, leaves, petioles, and tendrils, as well as berries. Only fruit symptoms will be discussed here.

Fruit clusters are susceptible to infection anytime prior to flowering through veraison (the stage when the berries begin to ripen). Initially, small, reddish circular spots develop on infected fruit. These spots enlarge to an average diameter of ¼ inch and may become slightly sunken. The centers of the spots turn whitish gray and become surrounded by narrow reddish-brown to black margins. This distinguishing symptom often resembles a bird's eye (Figure 1), thus the alternative name for the disease. Lesions may extend into the pulp and cause the fruit to crack. Fungal fruiting bodies (acervuli), which eventually develop in the lesions, exude a pinkish mass of spores (conidia) during wet weather.

Figure 1. Typical "bird's eye" symptom due to Anthracnose

Cause and Disease Development

Anthracnose is caused by the fungus *Elsinoe ampelina*. This organism survives

in vineyards as overwintering survival structures (sclerotia) present in infected shoots. In the spring, during prolonged wet periods, the sclerotia germinate to produce abundant spores (conidia) which are spread by splashing rain to newly growing tissues. Conidia germinate and infect succulent tissue when free moisture in the form of rain or dew is present. Once the disease is established other fungal structures (acervuli) form on diseased tissues and produce conidia during periods of wet weather. Secondary infections occur when conidia are spread to other susceptible tissues.

Heavy rainfall and warm temperatures are ideal for disease development and spread. Although conidia can infect over a wide range of temperatures (from 36°F to 90°F), the higher the temperature, the faster the disease develops.

Bitter Rot

This disease is appropriately named for the bitter taste it imparts to infected berries. The unpleasant flavor carries over to wine and other value-added products made from the diseased fruit.

Figure 2. Infected fruit covered with acervuli of the Bitter Rot fungus.

Symptoms and Signs

Bitter rot is primarily a disease of ripening fruit; immature fruit are not affected. In addition to fruit, susceptible tissues include leaves, tendrils, stems, and fruit clusters. Fruit symptoms begin as a brownish water-soaked spot. As the fungus continues to invade the fruit, the lesion expands rapidly and a soft rot develops. Tiny, black fungal structures (acervuli) appear as specks in the rotted area, often forming concentric circles. Eventually the rotted fruit becomes covered with acervuli (Figure 2), dries up, and shrivels into a black mummy.

Cause and Disease Development

The bitter rot fungus, *Greeneria uvicola* (synonym *Melanconium fuligineum*), overwinters on stem lesions, in grape mummies, and as a saprophyte in plant debris. Spores (conidia) are released from acervuli during warm, wet weather and spread via splashing rain. The fungus initially invades fruit pedicels where it remains latent until the berry ripens. Once the fungus invades the berry, secondary spores are formed within 4 days.

Black Rot

Black rot is the most prevalent and important grape disease in Kentucky. Without an adequate disease control program, both home and commercial grape production statewide is often severely limited. While the disease affects all green tissues, including leaves and vines, only the fruit rot phase will be discussed here.

Symptoms and Signs

Fruit symptoms start as light brown soft spots on immature fruit. These spots rapidly enlarge to involve the entire berry. Affected grapes then shrivel into black, wrinkled mummies which either drop to the ground or remain in the cluster (Figure 3). The mummies are covered with dark fungal fruiting bodies known as pycnidia (Figure 3, left).

Cause and Disease Development

The pathogen, *Guignardia bidwellii*, survives

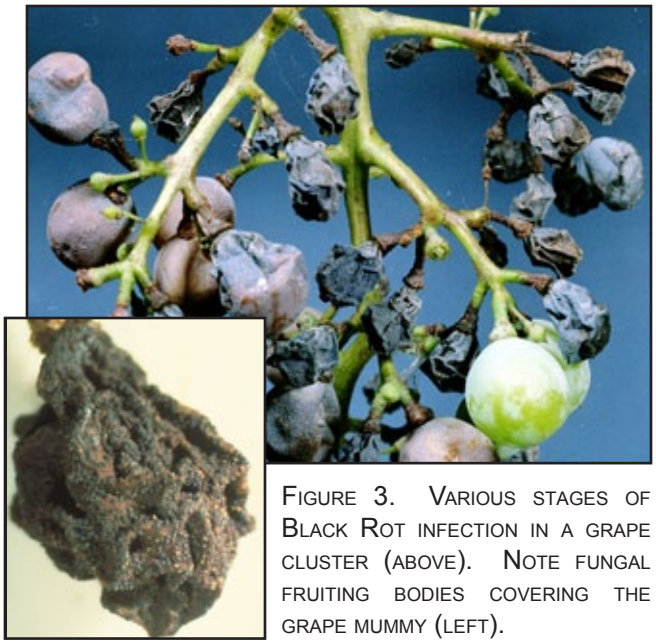

Figure 3. Various stages of Black Rot infection in a grape cluster (above). Note fungal fruiting bodies covering the grape mummy (left).

the winter as fungal fruiting bodies (pycnidia and perithecia) in mummies, fallen leaves, and stem lesions. Spore production starts in the spring as temperatures increase and wet weather settles in. Spring rains trigger the release of airborne ascospores from overwintering perithecia and/or rain-splashed conidia from overwintering pycnidia. Spores germinate and penetrate vulnerable tissues when surface moisture is present. After infection, symptoms generally take about 2 weeks to develop.

Once the fungus has become established in susceptible tissue, it starts producing secondary spores capable of initiating new infections. This cycle of spore production and infection continues the rest of the season whenever environmental conditions are favorable. Mummies allowed to hang on the vine can continue to discharge ascospores and conidia throughout the growing season. Generally, berries are no longer susceptible to black rot after veraison.

Botrytis Bunch Rot

Botrytis bunch rot occurs wherever grapes are grown. While field losses can be particularly severe on grape cultivars with tight, closely packed clusters of fruit, all varieties are susceptible. The disease pathogen also causes a decay of fresh market grapes in storage.

Symptoms and Signs

Early season *Botrytis* infections can cause blossom blight and result in significant crop losses. The most common symptom on fruit is a soft, watery decay of ripening berries. Initially one or a few berries within the bunch may be affected. Healthy berries become infected when the fungus spreads from adjacent diseased berries. *Botrytis* can spread rapidly throughout the cluster until the entire bunch is decayed. Under moist conditions, infected fruit may be covered with a tan or gray growth of fungal mycelium and spores (Figure 4).

Figure 4. Botyrtis Bunch Rot. Tan fungal growth is present on several infected berries.

Infected berries of white cultivars become brown and shriveled while those of purple cultivars develop a reddish color. Decayed berries eventually shrivel and fall to the ground as hard mummies.

Cause and Disease Development

The bunch rot pathogen, *Botrytis cinerea*, is a fungus capable of attacking many different kinds of plants and is able to thrive on dead plant material as a saprophyte. This fungus overwinters as dark-colored fungal survival structures (sclerotia) that are resistant to adverse weather conditions. Sclerotia may

form in grape mummies, in dead grape tissues, on many other host plants, and in other organic debris present in and around the vineyard. In short, the fungus is generally always present in the vineyard. Sclerotia germinate in the spring and produce spores (conidia) that are spread to susceptible tissues via air currents.

Although germinating conidia may penetrate directly into ripe berries, the fungus usually first gains a foothold by colonizing injured or dead tissue (such as dead flower parts) prior to infecting healthy tissue. Using the dead tissue as a food base, the fungus invades the just-forming berry.

Once the berry has been penetrated, the *Botrytis* organism may lie dormant until the fruit begins to ripen. The increased sugar and decreased acid levels of ripening berries provide a favorable environment for fungal growth. Berries may also become infected closer to harvest via wounds. Tissue injured by hail, wind, birds, other diseases, and insects is readily colonized by *Botrytis*. Berry swelling during ripening in tightly packed clusters causes pressure that can also rupture the berries and create a wound site.

Warm, moist weather favors rapid symptom development. Moisture in the form of fog or dew and temperatures of 59°F to 77°F are ideal for conidia production and infection. Rainfall is not required for disease development, although periods of rainfall are highly conducive to disease.

Ripe Rot

As the name implies, ripe rot is a disease that occurs on ripened berries at or near harvest. Ripe rot can be a particularly devastating disease of muscadine grapes whenever warm, humid weather prevails. The ripe rot pathogen causes fruit rots on a number of other fruit and vegetable crops as well.

Figure 5. The Ripe Rot fungus produces fruiting bodies that exude salmon-colored spores.

Symptoms and Signs

Circular, uniformly brown lesions develop on ripening fruit and eventually cover the entire berry. Tiny black fruiting bodies (acervuli) form in the diseased tissue and exude masses of salmon-colored to pink spores (Figure 5). Once the entire berry is rotted, it may drop to the ground or remain on the vine as a mummy.

Cause and Disease Development

Ripe rot is caused by the fungus *Glomerella cingulata* (imperfect stage: *Colletotrichum gloeosporioides*). This fungus overwinters in fruit mummies and infected fruit stems. Spores (conidia) are released in the spring and spread via splashing or blowing rain. While infections can occur at any time, even when the fruit is still immature, decay does not begin until the fruit ripens. Abundant conidia are produced on rotting fruit and spread to other ripe fruit. Heavy losses can occur when frequent rains, coupled with warm temperatures, occur during harvest.

Sour Rot

Sour rot, also known as sour bunch rot, is a disease complex that affects both grape yield and wine quality. Cultivars with tight clusters and thin skins tend to be more susceptible to this late season disease.

Figure 6. Sour Rot results in a soft, watery rot.

Symptoms and Signs

Symptoms of sour rot (Figure 6) may be mistaken for Botyrtis bunch rot since both diseases begin as a soft watery rot. However, the lack of typical *Botrytis* fungal growth on the fruit surface and the presence of an obvious vinegar odor are indicative of sour rot. As the rot progresses, berries leak juice and collapse while the decay spreads throughout the fruit cluster.

Cause and Disease Development

A number of bacteria, yeasts, and decay fungi have been associated with sour rot. Wounds resulting from insects, other fungal diseases, hail, birds, etc. provide an entry point for these undesirable organisms. Fruit flies, which are attracted to the injured fruit, lay eggs and multiply rapidly. These insects can then carry and spread the sour rot decay organisms to other fruit.

Disease Management

Planting site

• A new vineyard should be established in a site with inherently good air circulation and drying characteristics.

• Avoid low lying, poorly drained sites.

Cultivar selection

• Grape cultivars vary in their susceptibility to fruit rots. Whenever possible select cultivars with some resistance or tolerance in order to help reduce disease pressure.

• Some fruit rots, such as Botrytis bunch rot and sour rot, are generally more of a problem on tight clustered, thin-skinned cultivars.

Production practices

• Orient vineyard rows toward the prevailing winds in order to facilitate drying.

• Select a training system and leaf removal practices that promote drying of plant tissues and increase sunlight penetration. Opening up the canopy also improves fungicide spray penetration, thus, reducing disease losses.

• Good weed management will also aid in promoting drying.

• Provide protection against insects and birds which may injure the fruit.

• Schedule irrigation so that foliage and fruit will dry as quickly as possible. If any of these diseases become established in the planting, overhead irrigation should be avoided.

Sanitation

• Prune out and destroy (remove from the vineyard) diseased shoots, cluster stems, and berries during the dormant season. Remove mummies remaining on the vine, as well as those on the ground. Sanitation is very important in reducing the primary inoculum of many of these diseases.

• Do not allow black rot mummies to remain hanging on the vine during the growing season. Mummies on the ground are a source of inoculum early in the season; however, mummies on the vine continue to produce inoculum throughout the summer.

• Eliminate wild grapes near the vineyard so they do not serve as a reservoir for the disease. This may be difficult in wooded areas, but wild grapes should at least be removed from fence rows.

Fungicides

Refer to *Midwest Commercial Small Fruit and Grape Spray Guide* (ID-94) or *Disease and Insect Control Programs for Homegrown Fruit in Kentucky, Including Organic Alternatives* (ID-21) for specific fungicide names, timing, and applications rates.

• *Anthracnose*

Apply a dormant application of liquid lime sulfur in early spring, followed by applications of foliar fungicides during the growing season.

• *Botrytis bunch rot*

Begin fungicide applications at bloom time. As fruit clusters begin to close, be prepared to make additional fungicide applications, especially in tight-clustered varieties.

• *Black rot*

Fungicide sprays are an important component to a successful black rot management program, especially in an established vineyard. Fungicides for black rot control are either protective or eradicative; both types require proper timing of application to be effective.

Protectant fungicides are generally first applied at bud break (after 1/2-inch of new shoot growth) and continued through berry maturity. Early season sprays must be applied enough times so that rapidly-growing, susceptible tissue is always protected.

Vines not protected early in the season may become infected and result in inoculum build-up which could infect the berries later in the season. First spray applications can often wait until just before bloom or longer if an eradicant fungicide is used or if black rot is not traditionally a problem in the vineyard.

Generally, eradicant fungicides must be applied within a certain time period after infection in order to be effective.

• *Bitter rot*

Following a fungicide spray program to control other grape diseases generally will also effectively manage bitter rot. However, because bitter rot affects maturing fruit it is important that that these protectant sprays continue past veraison. If bitter rot is a threat, pre-harvest applications of Captan may be beneficial.

• *Sour rot*

There are no chemicals effective specifically for sour rot. Following a season-long fungicide program that controls other grape diseases will also aid in the management of sour rot.

Additional Resources

Grape disease management advice can be found in the following publications available at County Extension offices, as well as on the Internet.

• Black Rot of Grape, PPFS-FR-S-16 (University of Kentucky, 2012)
http://www.ca.uky.edu/agcollege/plantpathology/ext_files/PPFShtml/PPFS-FR-S-16.pdf

• Disease and Insect Control Programs for Homegrown Fruit in Kentucky, Including Organic Alternatives, ID-21 (University of Kentucky)
http://www.ca.uky.edu/agc/pubs/id/id21/id21.pdf

• Midwest Small Fruit and Grape Spray Guide, ID-94 (University of Kentucky et al.) *2 MB file*
http://www.ca.uky.edu/agcollege/plantpathology/ext_files/PPFShtml/ID-94.pdf

- Midwest Small Fruit Pest Management Handbook, B-861 (University of Kentucky et al.) *73 MB file*
http://www.ca.uky.edu/agcollege/plantpathology/ext_files/PPFShtml/MwSmFruitPMHandbook.pdf

- Midwest Grape Production Guide (Ohio State University) *5 MB file*
http://www.ca.uky.edu/agcollege/plantpathology/ext_files/PPFShtml/MwGrapeGuide.pdf

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Photos: Clemson-USDA CES, Bugwood.org (Figures 1, 2 & 3-grape cluster); Cheryl Kaiser (Figure 3-mummy); John Hartman (Figure 4); Turner Sutton, North Carolina State University (Figure 5); & Annemiek Schilder, Michigan State University (Figure 6).
