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Brown Rot on Peach and Other Stone Fruits

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Introduction

Brown rot is one of the most destructive diseases of peach and nectarine in Virginia, and also occurs on other stone fruits such as apricot, cherry, and plum. When environmental conditions favor this disease, crop loss can be devastating.

Symptoms

Although brown rot damage in Virginia is typically observed on fruit (figure 1), the fungus may also infect blossoms and shoots. Blighted blossoms turn brown and stick to shoots in a gummy matrix in which gray to tan fungal spore masses are produced.

Figure 1. Brown rot on peach fruits. (Photo by A.B. Groves)

Brown Rot Overview

- Brown rot is a common and destructive disease of stone fruits in Virginia.
- Most commercial stone fruit cultivars are susceptible to brown rot.
- In Virginia, injury caused by the brown-rot fungus typically is observed on fruit, but the fungus may also infect blossoms and shoots.
- Controlling brown rot in a humid climate typically requires the use of cultural practices that reduce fungal inoculum and conditions favorable for fungal growth and infection (e.g. removal of fruit mummies, opening up tree canopy, etc.) along with fungicide treatments.
- To be effective, fungicides must be applied before infection occurs.
- Monitoring stone fruit crops for symptoms of blossom blight two weeks after bloom is recommended to determine if a preventative spray program for fruit protection should be implemented.
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Shoots infected by the brown rot fungus develop sunken, brown, elliptical cankers (figure 2) that may become gummy. Cankered areas usually are restricted to new shoots and typically occur as the disease advances from infected blossoms. Gray to tan fungal spore masses may be produced in cankered areas. If a canker girdles a shoot, the shoot will die and leaves will turn brown, but remain attached to the branch for a few weeks (figure 3).

Figure 2. Blighted blossom and shoot and twig canker on a peach tree. Note the fungal sporulation within the twig canker. (Photo by A.R. Biggs, West Virginia University.)

Figure 3. Leaves dying on a nectarine shoot that has been girdled by the brown rot fungus and symptomatic fruit. (Photo by K.S. Yoder.)

Symptoms on ripening peaches and nectarines may first appear as small circular spots that enlarge or coalesce. On mature fruit, these lesions develop and enlarge rapidly. When environmental conditions favor disease development, ripe fruits may rot completely within two days. Tan to gray spore masses are often evident on rotting fruit (figure 4). Diseased fruits typically shrivel and turn brown to black, either dropping to the ground or remaining attached to the tree. These tough shriveled fruits, termed mummies, are the major source of overwintering fungal inoculum (figure 5).

Figure 4. The brown rot fungus sporulating on a mature peach. (Photo by K.D. Hickey.)

Figure 5. Fruit mummies, such as these peach mummies, are the most significant source of overwintering brown rot fungal inoculum. (Photo by K.S. Yoder.)

Symptoms on immature sweet cherries may be small (3/16 inch to 3/4 inch in diameter) red-haloed spots or sunken, necrotic spots, up to approximately 1/4 inch in diameter. Symptoms on mature cherries are similar to those on peaches and nectarines (figure 6). Fur-like clusters of gray to tan spore masses develop on plums colonized by the brown rot fungus.

Figure 6. The brown rot fungus sporulating on a mature sour cherry. (Photo by K.S. Yoder).

Disease Cycle

In Virginia, the brown rot fungus, Monilinia fructicola, most commonly overwinters on fruit mummies on the tree (figure 7), in infested crop debris on the ground, and in twig cankers. Sporulation of the fungus is favored by moderate temperatures (55° to 77°F) and wet weather. Spread of the fungal spores to new infection sites occurs by wind and rain-splash. Insects, such as honeybees or beetles, may also transport the fungal inoculum to new infection sites.

Figure 7. Fruit mummies clinging to a peach tree. (Photo by A.B. Groves)

Infections by the brown rot fungus may begin early in the growing season on blossoms and/or new shoots. Blossoms of stone fruit species differ in their susceptibility to this fungus, with apricot being the most susceptible followed by sweet cherry, peach, sour cherry, and plum. Both temperature and the length of time blossoms are wet affect blossom blight incidence. Blossom infection on peach and cherry can occur over a very broad range of temperatures (32° to 86°F), but is optimum from 72° to 77°F. However, when the weather is wet for 24 hours or more, brown rot fungus infection is most likely to occur, regardless of the temperature.

Blossom blight is a concern even when outbreaks are not severe enough to significantly reduce the fruit crop directly. Blossom blight may lead to twig cankers. Fungal spores produced on blossoms and cankers can cause more infections on ripening fruit and shoots. The cankered shoots serve as a bridge in the disease cycle, allowing the brown rot fungus a means of survival during and between growing seasons, in addition to producing spores for future fruit infections. When cankers do not girdle and kill the shoot, the fungus can overwinter and produce spores in the canker over a period of several years. Brown rot twig infection also makes twigs susceptible to additional disease problems by more destructive canker-causing organisms, such as the fungus *Leucostoma*.

Generally, stone fruits become more susceptible to brown rot as fruits ripen. Humid or wet conditions favor sporulation and infection by the brown rot fungus, so when these conditions are present during fruit ripening, serious brown rot outbreaks may occur. During favorable environmental conditions, large numbers of spores are produced on diseased fruits; these spread and infect ripening fruit. Fruits injured by oriental fruit moths, Japanese or green June beetles, other insects, or hail are very susceptible to infection by the brown rot fungus. Harvested fruit also is commonly contaminated with spores of the brown rot fungus, and this can result in infection during storage, especially if fruits were injured during harvest.

Green fruit is generally not susceptible to infection by the brown rot fungus. However, brown rot can occur on green fruit when it is:

- thinned after the pit hardens and left on the ground
- injured by insects, hail, birds, or other means
- freeze-injured or stunted and remains on the tree

Brown rot on green fruit is a serious problem because large amounts of fungal inoculum can be produced on diseased fruit. The inoculum produced may spread and infect ripening fruit.

The sexual life cycle of brown rot is rarely observed in Virginia, but may be confirmed by the presence of dime-size, cup-shaped, stalked fungal structures called apothecia (figure 8). These are produced on fruit mummies on the ground, or mummies slightly buried under the soil. These tiny structures produce copious quantities of inoculum. Signs of apothecia under stone fruit trees are cause for serious concern and indicate that proper sanitation practices are not being followed.

Figure 8. The dime-size sexual structures (apothecia) of the brown rot fungus, which are growing on a fruit mummy, are rarely observed in Virginia. (Photo by A.R. Biggs, West Virginia University.)

Other sources of brown rot inoculum include early-maturing stone fruit cultivars that may harbor inoculum for infections on later maturing fruit cultivars. For example, disease may progress and inoculum levels may increase on earlier ripening crops, such as cherries; this inoculum may then be available to infect later ripening crops, such as peaches, nectarines, and plums. This can also occur when inoculum produced on earlier ripening cultivars of the same fruit, such as peach, infects later ripening ones nearby. Also, ornamental flowering stone fruit species, such as ornamental plum or quince, and wild stone fruit species in the area, may provide inoculum for new infections on stone fruit trees. In any of these situations, when weather conditions are conducive to brown rot development and a progression of inoculum-production occurs, starting with the earliest ripening stone fruit and progressing to the latest ripening one(s) in an area, a brown rot epidemic is likely.

Control

In regions with humid climates, such as Virginia, adequate control of brown rot will typically require both cultural and chemical controls.

Cultural

Sanitation practices that reduce the amount of fungal inoculum are integral to brown rot control. Most important is removing as much infected plant material as possible to reduce overwintering fungal inoculum. Pruning practices that promote good air circulation and sunlight penetration into the tree canopy also can help to prevent conditions that favor infection and development of the brown rot pathogen.

During the dormant season, remove all fruit mummies to reduce pre-bloom inoculum-production. This may be easier to do with peaches, which have large mummies, in contrast to cherries, which have smaller, less conspicuous mummies.

Prune out weak or dead wood in the spring, taking care to remove any cankered shoots.

Open up the tree canopy by careful pruning. This will increase sunlight penetration, which reduces the length of the wetting period in the canopy and improves fruit coloring. Open canopies also allow better fungicide coverage, which improves fungicide efficacy.

When thinning fruit, take the following precautions:

- Thin fruit so that mature fruits will not touch. Areas of contact between fruit provide ideal environments for disease and insect pests and favor prolonged wetting.
- Remove stunted fruit, which may be more susceptible to brown rot and will add little to fruit production.
- Peach or nectarine fruits that are thinned before the pit-hardening stage of development can be left on the ground beneath the tree, since fruit at this stage will decompose rapidly and not serve as sporulation sites for the fungus.
- If peach or nectarine fruit is thinned after the pit hardens, remove thinned fruit from the site.

Harvest fruit carefully and try to avoid injuries that predispose the fruit to brown rot during storage.

Research in California associated excess nitrogen with increased susceptibility to brown rot, so follow recommended rates for nitrogen application and do not apply excess amounts.

Monitoring

Monitor stone fruit crops for symptoms of blossom blight a couple of weeks after bloom. If symptoms are evident, an earlier preventative fungicide spray program for brown rot may be warranted. Also monitor trees for insects that injure fruit, such as Japanese or June beetles, to determine if levels of insects or fruit injury warrant implementation of control tactics for insects. Also, check fruit for injury after hailstorms.

Resistance and Susceptibility

Most commercial stone fruit cultivars are susceptible to infection by the brown rot fungus if favorable conditions occur during the three-week ripening period. During the stone fruit ripening period in Virginia (June to September), weather conditions typically vary much from year to year. Other factors that favor severe brown rot outbreaks, such as hailstorms or insect injury, also vary from year to year, causing a cultivar to appear resistant one year, but very susceptible the next.

In general, nectarines are more susceptible than peaches, and sweet cherries are more susceptible than tart cherries, because of their tendency to crack as they swell during the pre-harvest period. Some of the cracking may be directly due to absorption of moisture from rain, which also favors the spread of and infection by spores of the brown rot fungus. The following peach cultivars have been reported to be less susceptible to brown rot: Elberta, Glohaven, and Babygold No. 5. Peach cultivars reported as highly susceptible are: Belle of Georgia, Coronet, Early East, Hale Harrison Brilliant, Halehaven, Maybelle, Mayflower, Raritan Rose, Redbird, Southhaven, and Summercrest.

Chemical

Fungicides must be applied before brown rot infection occurs (i.e. preventatively). During the bloom period, preventative sprays to protect blossoms from infection should begin when pink begins to show in the flower buds. If the long term forecast predicts springtime conditions that will be cold and rainy, applying a systemic fungicide both at pink (i.e. just before bloom) and during bloom is necessary to protect flowers and shoots from infections. This is to prevent brown rot infections on flowers and shoots that would result in abundant fungal inoculum for later infections of fruit. Preventative treatments during the three-week pre-harvest period are very important for fruit-rot control. Repeated applications typically are required up to one week before harvest to protect fruit, depending primarily on the wetness of the growing season.

For details on recommended fungicide products, application rates and timings:

- Home growers should refer to the *Spray Schedule for Cherries, Nectarines, Peaches, Plums, and Prunes* in the *Home Fruit Section of the current Virginia Pest Management Guide for Home Grounds and Animals*, Virginia Cooperative Extension publication 456-018 for fungicide recommendations for management of brown rot (https://pubs.ext.vt.edu/456/456-018/456-018.html) or available through your local Virginia Cooperative Extension office, (http://www.ext.vt.edu/offices/). This spray schedule is designed to control many common pest problems that occur on stone fruits in Virginia. Fungicide options are much more limited for home growers than for commercial growers. In years with severe infection pressure, fungicides available for home growers might not provide adequate control against brown rot. Note that some fungicide products are at-risk for development of pesticide resistance. When a pest, such as the brown rot fungus, develops resistance to a fungicide product, the fungicide is no longer effective against the pathogen. To avoid development of pesticide resistance in the brown rot fungus to an at-risk-fungicide product heed fungicide product label instructions that: 1) Limit the number of applications that may be applied during a growing season and 2) advise alternating the at-risk-fungicide with a broad-spectrum fungicide OR tank-mix the at-risk-fungicide with a broad spectrum fungicide .
- Commercial growers should refer to the current Virginia, West Virginia and Maryland Cooperative Extension Spray Bulletin for Commercial Tree Fruit Growers[1], Virginia Cooperative Extension publication 456-419 (http://pubs.ext.vt.edu/456/456-419/456-419.html), for optimum schedules and products to control brown rot and other diseases. Be aware that the brown rot fungus can develop resistance to several classes of fungicides, and avoid exclusive use of the "at-risk" classes during the most critical parts of the season.

[1]*Precautionary note: A strain of the brown rot fungus present in Virginia is resistant to benzimidazole fungicides (e.g. Topsin-M, 3336 WP, and generics). To avoid developing resistant populations, mix non-benzimidazole fungicides with benzimidazole fungicides. If you suspect resistance to benzimidazole fungicides, contact your local Virginia Cooperative Extension agent or the product manufacturer.*

Diagnosing the Disease

The Virginia Tech Plant Disease Clinic can diagnose this disease and other plant diseases. Refer to the Plant Disease Clinic website (https://bit.ly/VTplantclinic) for the current diagnostic form, fees, and instructions on collecting an appropriate diagnostic sample and submitting samples to the Plant Disease Clinic.

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Scan to visit the Plant Disease Clinic website

https://bit.ly/VTplantclinic

Refer to the current Virginia Pest Management Guide for Home Grounds and Animals (VCE Publication 456-018), https://pubs.ext.vt.edu/456/456-018/456-018.html, for details on the proper use of pesticides.

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