POST-HARVEST DECAY

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Post-harvest decay can cause severe losses in peaches. Monetary losses are especially high because all production, harvest, and packing costs have already been invested in the fruit. Aside from direct losses due to product loss, there are important indirect losses a packer can suffer. Key among them are price discounting and/or loss of repeat sales due to suspect fruit quality in a given year, or a general loss of reputation, which can last several years.

If decay occurs, it is not enough to know the fruit rotted or was moldy. Accurate diagnosis of which disease or diseases were involved is imperative so specific corrective measures can be taken. The post-harvest diseases southeastern peach packers may encounter are brown rot, Rhizopus and Gilbertella rots, sour rot, gray mold rot, and bitter rot. Brown rot and Rhizopus rot are the region's most common post-harvest peach rots, they occur to some extent every year. Controlling these diseases requires a coordinated program of rapid cooling, low temperature storage and transit, gentle handling, sanitation, and fungicides.

BROWN ROT

Brown rot is the most important post-harvest decay disease of peaches. The brown rot fungus, *Monilinia fructicola* (Wint.) Honey, attacks the blossoms, aborted fruit or "buttons," insect-injured or otherwise damaged green fruit, and, most importantly, mature ripening fruit (Figure 1). Research shows thatthe majority of the spores attacking fruit of mid- and late-season peaches come from infected wild plums, overripe fruit of off-type varieties, late thinned fruit, buttons, and damaged green fruit. This continuum of infection sources means control programs must protect fruit through each period of vulnerability to provide adequate brown rot control and assure post-harvest quality**.** Latent (invisible) infections of immature fruit can serve as a source of inoculum for subsequent fruit rot. Latent infections are more likely when infection pressure due to blossom blight and infected aborted fruit is high. Latent infections are usually few in number but, where they occur, they are important. Insect damaged or otherwise injured green fruit can be lost to brown rot. Research on plums suggests that fruit-to-fruit contact predisposes fruit to infection by *M. fructicola*,probably due to prolonged wetness following dew events.The brown rot control strategy currently considered economically and environmentally sound is to apply pre- and post-harvest fungicides to prevent new infections and suppress latent infections instead of 6 to 10 or more applications during the green fruit phase.

Figure 1. Brown rot on a mature peach. Pre-harvest infections continue to spread during and after harvest.

Figure 2. Brown rot mummy.

The flesh of brown-rotted peaches becomes watersoaked and brown but remains more or less firm. Tan to gray spore masses form, often in concentric rings, on the surface of infected areas. Brown rot can be distinguished from *Rhizopus* and *Gilbertella*, with experience, by how readily the skin of rotted flesh slips. The skin of Rhizopus and Gilbertella infected fruit slips easily, whereas the skin of fruit with brown rot does not. After the fruit is completely decayed, brown rot shrivels into a mummy (Figure 2). Mummies carry the brown rot fungus through the winter.

Post-harvest, the brown rot fungus is spread in hydrocoolers used to remove field heat and in water dumps used to reduce bruising. It is important to continously sanitize hydrocoolers and dump tanks. In bins or cartons, brown rot can spread by simply growing from fruit to fruit at points where peaches contact one another. A single rotted peach can destroy a carton of peaches without any help from wind or insect-borne spores or infested cooling or dump systems. The brown rot fungus can germinate and cause disease between 32° and 90°F. Cold temperatures, however, greatly reduce the rate of acute and latent infections, which slows both hydrolysis or breakdown of post-harvest fungicides and disease spread from fruit to fruit.

See the brown rot chapter for a complete discussion of brown rot disease cycle and epidemiology.

RHIZOPUS ROT

Rhizopusrot is primarily caused by *Rhizopus stolonifer* (Ehr. ex. Fr.) Vuill. It is the second leading cause of post-harvest decay in peaches. It is frequently found closely associated with *Gilbertella persicaria* (E. D. Eddy) Hesseltine, *Mucor* species, and other *Rhizopus* species. Rhizopus rot is generally a problem of fully mature and ripe fruit at point of sale or after purchase. It is important that cooling and handling systems be continuously sanitized to prevent contamination of fruit surfaces. The pathogen enters the peach only through an injury. Careful fruit handling to avoid cuts and bruises is an important factor in Rhizopus rot control. Fruit diseased with *Rhizopus* quickly decompose. The skin of infected fruit readily slips. The flesh becomes brown, very soft, and soon collapses. The surface becomes covered with coarse black fungal growth (Figure 3). At temperatures above 50°F, the disease can quickly spread through an entire bin or carton of peaches. Spore germination and disease development will not occur below 45°F. Rapidly cooling peaches below 45°F, preferably to 32 to 33°F, is a key to Rhizopus rot control. Cool temperatures do not kill ungerminated spores, but a post-harvest fungicide treatment will ensure Rhizopus rot control should the fruit warm above 45°F.

Figure 3. Rhizopus rot on peach.

Chinese scientists have used the yeast antagonist *Pichia membranefaciens*, isolated from wounds of peach fruit, to completely control the pathogen when applied as washed cell suspension into nectarine wounds artificially inoculated with *Rhizopus* spores. The practical importance of this biological control agent remains to be determined**.**

GRAY MOLD ROT

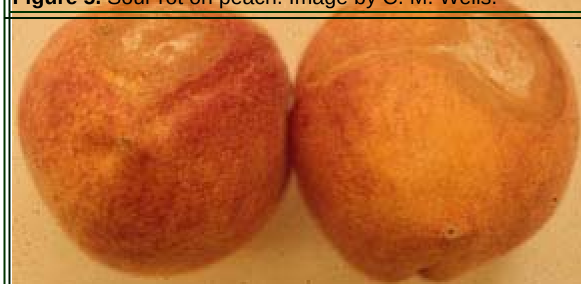
Figure 4. Gray mold on peach.

Gray mold rot, caused by *Botrytis cinerea* Pers. ex. Fr., occasionally causes losses in peaches. Gray mold causes a brown, somewhat firm decay of the flesh. The skin over the diseased flesh slips away with a slight touch. The decay surface finally becomes covered with gray-brown fungal growth (Figure 4). Gray mold occurs more commonly during wet and somewhat cooler-than-normal harvest seasons (70° to 80°F daily maxima). Gray mold is rare in the southeastern United States due to high temperatures. The disease will develop, though slowly, at 32°F. Careful handling to minimize injuries, sanitizing cooling and dump systems, and the use of an effective fungicide provide excellent gray mold control.

SOUR ROT

Sour rot, caused by *Geotrichum candidum* Lk. ex Fr., causes periodic problems in the Southeast. It is often associated with injured or split pit peaches. Spores may reach the injured fruit on vinegar flies feeding in the injuries, or by passing the peaches through contaminated dump or hydrocooler water. Peaches affected by sour rot have a characteristic sour odor and are often covered with pasty, yeast-like fungal growth (Figure 5). Fluid dripping from infected fruit ruins other fruit below. Spore germination and disease development do not occur below 36°F. At 60°F, the disease can spread very rapidly in packed peaches. Careful handling to avoid injuries and

Figure 5. Sour rot on peach. Image by C. M. Wells.



sorting to remove injured or split pit peaches are important in sour rot control. Use of chlorinated hydrocooler and dump water also aid sour rot control.

ANTHRACNOSE

Figure 6. Anthracnose on peach. Image by N. E. McGlohon.

Anthracnose is caused by two species of the fungus *Colletotrichum*, *C. acutatum* J. H. Simmonds and *C. gloeosporioides* (Penz. & Sacc. in Penz.). World-wide in distribution, the disease was an important problem in the Southeast from 1945 to 1955, but it occurs only occasionally today. Varieties vary in susceptibility.The fungus forms latent infections in many hosts, including peach. Disease development starts at final fruit maturation, beginning as a small more or less circular brown spot on the fruit. Spots slowly enlarge, but rarely exceed 1 inch in diameter. The tissue beneath the lesion dries and collapses, leaving a cavity 1/8 to 1/4 inch into the flesh (Figure 6). When pressed firmly, the rotted flesh will separate from healthy tissue. It is sometimes referred to as pocket rot. In later stages, pink or creamy white spore masses may be presentin concentric rings. Spore germination and disease development do not occur below 40°F. Symptoms are generally present at harvest, but infections easily go undetected in less mature fruit, hence its discussion here as a post-harvest decay organism. The fungus has a wide host range, including legumes, herbaceous annuals, and perennials. Blue lupine has been associated with increased incidence of the disease.

The control strategy is to determine blocks or varieties that have an anthracnose problem. In these blocks, select an effective fungicide and use it, at a minimum, in the last six sprays before harvest.

POST-HARVEST DECAY CONTROL

- Use a good pre-harvest fungicide program to prevent disease buildup in the orchard. This program is critical for control of brown rot and suppresses some of the minor diseases as well.
- A good insect control program will prevent insect damage and infestations by driedfruit beetles, which may carry brown rot spores to injured fruit. Brown rot epidemics spread by driedfruit beetles are nearly impossible to control with fungicides.
- Supervise harvest, transport, and packing to minimize fruit injuries due to careless handling.
- Remove cull fruit from the packing house and dispose of it as far as possible from the packing house or orchard.
- Spores of the post-harvest decay fungi may be carried from the orchard as surface contamination on the fruit. Continuously sanitize and monitor hydrocooler and dump water to avoid buildup of these spores. Water changes should be made daily, even where a conscientious sanitation procedure is used. Alternatively, use of forced-air cooling is recommended.
- Quickly cool the fruit to 32° to 33°F. Maintain this temperature during handling and storage and take all steps to ensure this temperature is maintained in transit to the terminal market. Peach fruit between 38° and 55°F experience chilling injury, and such fruit will have a greater propensity to experience post-harvest rot problems. The activity of all decay organisms is greatly reduced or stops below 38°F.

SANITATION, DUMPING, AND FIELD HEAT REMOVAL

Prompt removal of field heat is an essential step in peach packing. To reduce injury when fruit are dumped, a water dump is often used. Traditionally in the Southeast, hydrocoolers have been used to remove field heat. A hydrocooler consists of a tunnel, approximately 100 feet long, in which the fruit is treated with 32°F water as 20-bushel field bins slowly advance through the tunnel. Both the water dump and the hydrocooler must be continuously sanitized to avoid spreading inoculum from infected fruit to healthy fruit. Traditionally, chlorine has been used as the sanitizing agent, either from chlorine gas or sodium hypochlorite. Recently, systems using ozone or direct generation of free oxygen radicals and copper ions have been marketed, but the compatibility, safety, and effectiveness of these systems for peach and other stone fruits has not been demonstrated. Dry dumps and forced-air cooling to remove field heat are less prone to spread of post-harvest decay. The disadvantage in forced-air cooling is the greater length of time, from 30 minutes (hydrocooling) to 24 hours (forced air), required to remove field heat, and the increased cold storage space required with forced-air systems.

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