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report on
PLANT
DISEASE

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BROWN ROT OF STONE FRUITS

Brown rot, one of the most common and destructive diseases of stone fruits in Illinois, is caused by the fungus *Monilinia fructicola*. Brown rot affects peaches, nectarines, plums, prunes, sweet and sour cherries, apricots, almonds, and Japanese quince. Ornamental and wild species of the genus *Prunus* are also damaged. Brown rot occurs throughout the world wherever stone fruits are grown, being most severe in areas where spring and summer rains are frequent. Different species of *Monilinia*, including *M. fructicola*, *M. Laxa*, and *M. fructigena* have reported the causal of brown rot in stone fruit producing areas.

The greatest loss from brown rot results from the fruit rotting in the orchard, in storage and transit, and at the market. Reduction of yield also occurs as a result of blossom blight and twig cankers, both causing indirect loss by providing inoculum for fruit infections. Before effective fungicides were available, it was not unusual in a wet season for commercial orchardists to lose more than 50 percent of their crop. In unsprayed home orchards, losses of 50 percent or more of the fruit are quite common.

Figure 1. Symptoms of brown rot disease of stone fruits.

Symptoms

The brown rot fungus infects the blossoms, fruit spurs, twigs, small branches, and fruit. Symptoms, much the same on all stone fruit, may develop on a few or all of these plant parts during the growing season.

Blossom blight. Rapidly enlarging brown spots appear on the flower petals, stamens, and pistils. Entire infected flowers suddenly wilt, turn brown, wither, and are later covered with tan-gray spore tufts in humid weather with dead parts clinging to the flower stem for an indefinite period (Figure 1). On apricot, plum, and prune, all blossom parts are susceptible. Apricot is most susceptible to blossom blight, followed in order by prune, sweet cherry, peach, sour cherry, and plum. Blossom blight on peach is not common in the eastern United States.

For further information concerning diseases of fruit trees, contact Mohammad Babadoost, Extension Specialist in Fruit and Vegetable Diseases, Department of Crop Sciences, University of Illinois at Urbana-Champaign.

Twig blight. The brown rot fungus often grows from both blighted blossoms and rotted fruit into the fruit spur, twigs, and small branches (Figure 1). On twigs and smaller branches, oval or elliptical cankers are formed that are usually brown, sunken, and definite in outline. Gum commonly oozes out at the edge of the cankered surface during wet periods, especially on apricots. Scattered, tan-gray spore tufts also appear on the bark surface under wet and humid conditions. Twig blight results when a canker completely encircles a twig or branch. The leaves often wilt, turn dull green, then a light brown, wither, and die but remain attached to the blighted twigs.

Fruit infecton. One to several, small, round, light brown spots form on a fruit as it approaches maturity. In warm and most weather, the rot spread rapidly in all directions. Within 2 or 3 days, the entire fruit may become semiwatery and decayed, and turn a light brown (Figure 1). Numerous, tannish gray spore tufts break through the fruit skin, giving it a powdery appearance. The spore tufts are scattered or often arranged in concentric rings around the infection center, usually some type of wound or insect injury. Sometimes, the entire surface of the fruit is covered with tan to gray spore tufts of conidiophores and conidia of the brown rot fungus. The completely rotted fruit retains its form, but later shrinks and becomes a dry, distorted mummy with a corrugated surface (Figure 1). Infected fruit will continue to rot after harvest with the mycelium of the fungus attacking healthy fruit in contact with infected ones. Healthy fruit may also be infected at any time between harvest and consumer usage. A few rotted fruit usually remain firmly attached to the tree, gradually drying into firm, black, encrusted mummies, however, most rotted fruit fall to the ground where they also form mummies.

Disease Cycle

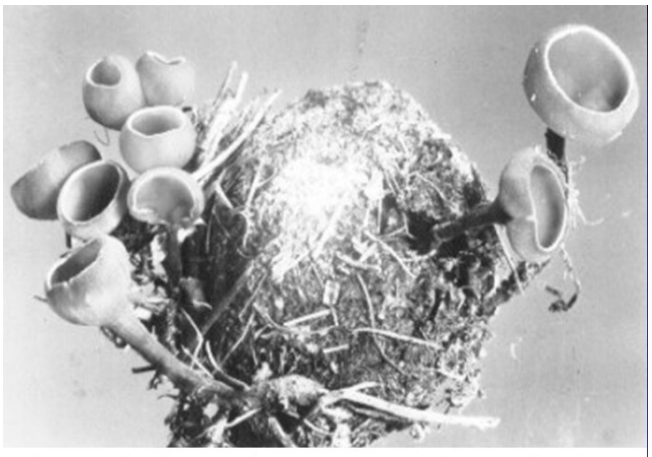

Figure 2. A peach mummy with apothecia.

The brown rot fungus overwinters in Illinois in three ways: (1) mummified fruit that drop to the ground and are partially or completely covered by moist soil or debris; (2) mummified fruit that hang on the tree; and (3) twig and branch cankers produced the preceding year. The mycelium from all three sources will produce spores (conidia or ascospores) that infect the blossoms and young shoots. At about blossom time, a fallen mummified fruit produces up to 20 or more small, tan, cuplike structures on slender stalks that are called apothecia (Figure 2, 3a, and 4). As an apothecium matures, it becomes thicker and the "cup" opens to a bowl-like disc 1/8 to 1/2 inch in diameter (2 to 12 millimeters) across the top. The inner or upper surface of each apothecium (Figure 3b) is lined with thousands of cylindrical, spore-containing sacs (asci) interspersed with paraphyses. Each ascus contains eight microscopic, one-celled, oval ascospores (Figures 3c and 3d). At this stage, upon wetting, the slightest disturbance or air movement will cause an apothecium to forcibly discharge a "puff" of ascospores. These are visible to the naked eye as a gray cloud. The ascospores are carried by air currents to the open or unopened blossoms and young shoots, infecting them if they remain wet with dew or light rain for 5 hours or longer. The infected blossoms soon wilt, and tan-gray another spore producing structures (sporodochia), composed largely of chains of summer spores (conidia), develop on the outside of the flower shuck (Figures 3e and 3f). If the infected blossom does not drop off, the fungus grows through the pedicel into the fruit

spur and twig and forms a canker. The apothecia disintegrate soon after bloom and do not contribute directly to infection of the fruit at or harvest.

Chains of colorless, one-celled, oval to lemon shaped conidia are soon produced on the newly cankered twig surface during moist periods, at a relative humidity of 85 percent or more, throughout May and June. These summer spores are easily detached, and, like the ascospores, are mainly windborne. They are also splashed by rain or carried by insects to the growing fruit. It takes only three to five twig cankers on each tree during warm, wet, humid weather to produce hundreds of thousands of conidia that later may result in a widespread rotting of the fruit. Following spring and summer rainy periods, mummified fruit in the trees become covered with masses of conidia that may later result in blossom blight, twig cankers, or fruit rot. Although the flesh of young fruit is very susceptible to brown rot infection, it has such a tough cuticle and epidermis that the germ tubes of the conidia do not normally penetrate young fruit keeping it fairly safe from infection. However, penetrations can take place through stomata on rare occasions.

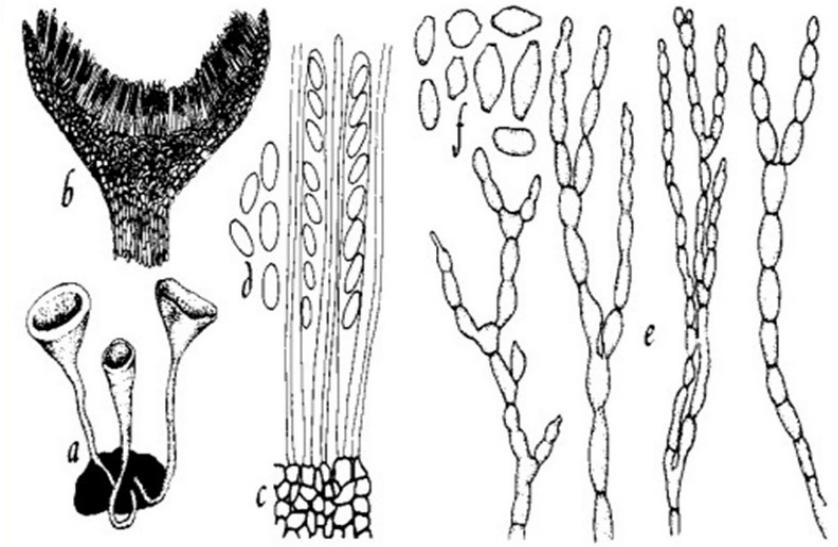

Figure 3. Monilinia fructicola: a, a fruit mummy with apothecia; b, an apothecium; c, asci with ascospores; d, ascospores; e, conidiophores bearing conidia; and f, conidia.

The brown rot fungus grows intercellularly at first and through the secretion of enzymes causes the maceration and browning of infected tissues. As the fungus advances it produces short hyphae which group together, push outward through the epidermis and form conidial tufts on the already decayed area which can then be carried away and infect other susceptible plant parts. The brown rot fungus does not usually infect the young leaves or bark directly, except on plums and sometimes cherries.

Many different kinds of injuries provide entry points for brown rot conidia. The plum curculio, tarnished plant bug, stink bugs, oriental fruit moth, dried fruit beetles, and other insects commonly produce entry wounds. Conidia can also enter through hail wounds, limb rubs, twig punctures, and fruit cracks–as well as a variety of picking and packing injuries. Widespread wounding is the chief cause of the rapid buildup of brown rot as the fruit begin to mature. Growers should realize that brown rot conidia are practically everywhere during the fruit ripening period with infection almost certain to occur if the weather is moist and the fruit skin is broken

Brown rot conidia can germinate and infect at temperatures of 40º to 90ºF (4º to 32ºC). Spore germination, infection, disease development, and spore production are most rapid between 55º and 80ºF (13º and 27ºC) with an optimum of 75ºF (24ºC). The hours of wetting necessary for blossom infection decreases from 18 hours at 50ºF (10ºC) to 5 hours at 77ºF (25ºC). As much brown rot will

develop in peaches held one day at 75ºF (24ºC) as in peaches held 3 days at 50ºF (10ºC), 7 days at 41ºF (5ºC), or 25 days at 32ºF (0ºC).

Disease Management

Sanitation. This is very important in controlling brown rot. All dropped and rotted fruit should be picked up promptly and destroyed; remove all mummies from the trees. Prune out all cankers and blighted twigs after the last picking and during the dormant season. Overripe or rotting fruit in the packing shed should be carefully removed and destroyed right away. Use only clean containers to harvest and pack fruit.

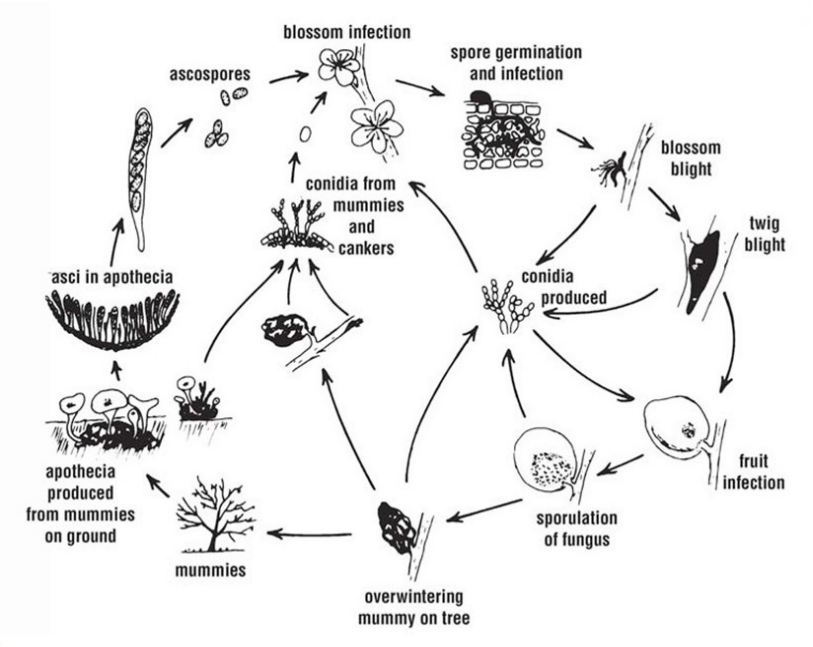

Figure 4. Life cycle of brown rot of stone fruits.

Cultural practices. Open-center pruning is important to insure complete spray coverage and fast drying of spray on the foliage and fruit. Clean cultivation, such as disking prior to bloom, will destroy the apothecia and reduce the chances of ascospore and conidial production by mummified fruit on the ground. Removal of wild or neglected stone fruit trees and brush surrounding the orchard is beneficial.

Spray applications. The most important sprays for brown rot control are (1) those applied from the time the blossom buds show pink until the petals fall and (2) those for the 3-week period immediately before harvest or when fruit begins to color. Starting when the blossom buds turn pink, apply two to four sprays at 4- to 5-day intervals. Thorough spray coverage is essential. Controlling insects is important for effective brown rot control. Commercial orchardists should follow the spray schedule for peaches, nectarines, apricots, plums, and cherries as given in the Midwest Fruit Pest Management Guide (https://ag.purdue.edu/hla/Hort/Documents/ID-465.pdf). Home fruit growers should follow the spray program for stone fruits outlined in the Illinois Pest Management for the Home Landscape. When brown rot has build up, the schedules should be started earlier and additional sprays made at closer intervals. **NOT** use insecticides that may kill pollinating insects during the bloom period.

Varieties. Experienced fruit growers avoid growing certain thin-skinned and soft-flesh cultivars that are especially susceptible to brown rot. Modern varieties that ripen uniformly, do not bruise readily, and remain firm after harvest are more resistant than older ones. Japanese and American cultivars of plums appear to be less susceptible than European cultivars. No cultivar of any stone fruit is immune to brown rot; nectarines are especially susceptible to brown rot.

Harvesting and packing. Fingernail scratches, stem punctures, skin abrasions, bruising of overripe fruit, and container wounds all contribute to invasion by brown rot fungus. This is true in the orchard and especially in the packing shed. Careful handling of fruit at all times and immediate hydrocooling followed by refrigeration (as close to 32ºF or 0ºC, as possible) are essential. Other techniques that reduce decay are calcium coating of fruit, fungicidal dips, wax-fungicide treatments, and spraying the fruit with a fungicide while grading.