

BITTER ROT OF APPLE

Bitter rot, caused by *Colletotrichum* spp., is the most important fruit rot disease of apples in Illinois. Bitter rot is also one of the most common and economically important diseases of apples worldwide. In the past 10 years, outbreaks of bitter rot were experienced in most of Illinois commercial apple orchards, causing up to 100% fruit losses. During 2019-2021, we conducted research to: (i) assess the incidence of bitter rot disease in commercial orchards in Illinois, (ii) identify fungal pathogens causing bitter rot disease, and (iii) determine the most effective fungicides for managing the disease.

Results of our studies showed 14 of 24, 20 of 30, and 21 of 33 orchards with bitter rot fruits in 2019, 2020, and 2021, respectively. Incidence of the symptomatic fruits ranged from 0.7 to 63% (mean 20%) in 2019; 1 to 100% (mean 27%) in 2020; and 0.7 to 100% (mean 20%) in 2021.

Symptomatic fruits were observed in most of the orchards in central and southern Illinois. Incidence of fruits with bitter rot symptoms in 'Empire', 'Golden Delicious', 'Honeycrisp', and 'Jonathan' apples was higher than other apple cultivars. Symptomatic fruits were collected from apple cultivars Braeburn, Cortland, Empire, Fuji, Gala, Golden Delicious, Goldrush, Granny Smith, Honeycrisp, Jonagold, Jonathan, McIntosh, and Red Delicious, and from 33 different orchards throughout the state and species of the pathogens was identified.



Figure 1. Bitter rot of apples in Illinois.

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Based on the cultural and molecular characteristics of 270 pathogen isolates, 136, 129, and 5 isolates were identified as *Colletotrichum fioriniae*, *C. siamense*, and *C. chrysophilum*, respectively. Thus, *C. fioriniae* and *C. siamense* were dominant species causing bitter rot of apples in Illinois.

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Effectiveness of seven commercially registered fungicides for use on apple trees was evaluated in the laboratory and in a 'Honeycrisp' orchard for managing bitter rot. Tested fungicides were benzovindiflupyr (Aprovia 0.83SC), captan (Captan 80 WDG), fluxapyroxad + pyraclostrobin (Merivon 4.18SC), potassium phosphite (ProPhyt 4.2SC), thiophanate-methyl (Topsin-M 70WSB), trifloxystrobin (Flint Extra 4.05SC), and zinc dimethyldithiocarbamate (Ziram 76DF). Aprovia 0.83SC, Captan 80 WDG, and Merivon 4.18SC were the most effective fungicides for management of bitter rot and other summer fungal diseases of 'Honeycrisp'. Incidence of bitter rot was the lowest in the plots sprayed with Merivon 4.18SC plus Captan 80WDG.



Figure 2. Lesions and fruiting bodies of the pathogen of bitter rot of apple.

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Symptoms

Fruit infections can occur from bloom to harvest. Fruit rot symptoms differ, depending on whether infection is initiated by ascospores from the sexual stage (*Glomerella cingulata*) or conidia of *Colletotrichum* spp. Initial symptoms produced by either strain are similar.

The rot begins as a small, light brown, circular lesion. On mature fruit, lesions may be surrounded by red halos. Lesions caused by *Colletotrichum* spp. remain circular and become sunken as they enlarge (Figure 1). When lesions reach about one inch (25 mm) in diameter, fruiting bodies of the fungus appear near the center of the lesion. Conidia are produced in acervuli, which occur in concentric circles around the point of infection (Figure 2). Acervuli are sparsely on some lesions and very dense on others. Under moist, humid conditions, the spore masses appear creamy and are salmon to pink.

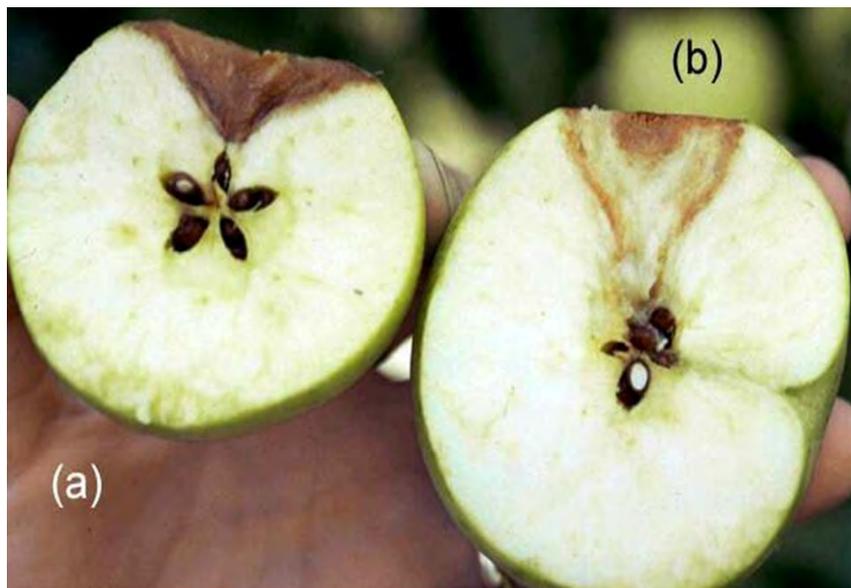


Figure 3. Apple fruit rots; left (a), bitter rot; right (b), white rot.

Lesions of bitter rot extend in a cone shape toward the core. In cross section, the lesion appears V-shaped (Figure 3). This is a reliable characteristic that can be used to distinguish bitter rot from white rot and black rot. The rotten area is brown but much firmer than areas affected by white rot. The number of lesions per fruit may vary from one to many. Infected fruit mummify, and some may remain attached to the tree through the winter.

Disease Cycle

The bitter rot fungi survive the winter in dead wood and mummified fruit that remain on the tree. Other inoculum sources include stems of fruit that were torn from them at harvest or fruit mummified by chemical thinners. Conidia produced in these overwintering sites are the primary inoculum source in the spring, although ascospore inoculum is important in some orchards. Conidia are spread primarily by rain. Ascospores are released by rain and are airborne. Temperature of 80 to 90°F are most favorable for disease development. Epidemics occur during prolonged periods of wet warm weather. Fruit infection can occur anytime from petal fall through harvest, but most infection occurs in the latter half of the season. Because of the large number of conidia produced in lesions on fruit and the rapid disease cycle, spread of the disease within the orchard can be very rapid.

Disease Management

Bitter rot is management by cultural practices and fungicide applications. Removing mummified fruit, dead wood and fire-blighted twigs is important to help control the disease. Removing diseased fruit from the tree during the growing season reduces the spread of the disease. Fungicides applied from blossom time until harvest on a 10- to 14-day schedule are effective if a good sanitation program is followed. In Illinois, application of Merivon 4.18SC plus Captan 80 WDG alternated with (i) ProPhyt 4.2SC plus Captan 80 WDG, (ii) Topsin-M 70WSB plus Captan 80 WDG, or (iii) Ziram 76DF plus Captan 80 WDG until two weeks to harvest are effective for controlling bitter rot of apples. Aprovia 0.83SC is effective fungicide for controlling this disease; however, its 30-day pre-harvest-interval (PHI) limits its use toward the end of the fruit season. For additional information on managing bitter rot of apples, refer to the “Midwest Fruit Pest Management Guide.”