

Cranberry fruit rot diseases in Wisconsin

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Cranberry fruit rot occurs to a greater or lesser extent wherever cranberries are grown or stored. The general term “fruit rot” is sometimes used to describe the softening and deterioration of cranberry fruit, no matter what the cause of the problem. However, in this bulletin the focus will be on pathogenic fungi that cause cranberry fruit rot.

Fruit rot is usually subdivided into two categories: field rot, which occurs prior to harvest; and storage rot, which occurs after harvest. At least 13 species of fungi are known cranberry fruit rot pathogens (table 1), and several more species are suspected pathogens. Some species are considered exclusively field rot or storage rot pathogens, whereas others contribute to rot both in the field and in storage. The roles of other microbes, such as bacteria and viruses, are not known.

Fruit rot is sometimes called a “disease complex” because it is caused by multiple, interacting factors, many of which are not fully understood. In addition to the pathogen infecting a berry, the environment and length of time that the pathogen and fruit are in contact determine whether a berry will rot or remain sound (figure 1).

Although fruit rot diseases have descriptive names such as berry speckle, end rot, and yellow rot, it is usually not possible to determine the cause of rot based on symptoms alone (figure 2). One exception is the fruit rot stage of cottonball (figure 3). This bulletin will focus on fruit rots other than cottonball; for more information on cot-

Figure 1. Interacting factors that affect development of fruit rot disease.

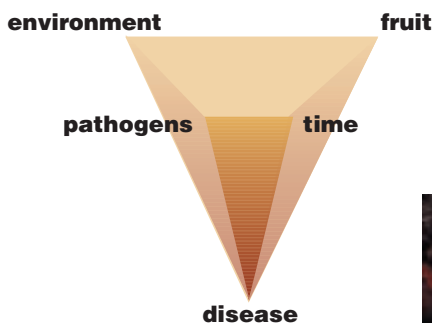


Table 1. Cranberry fruit rot diseases and their pathogens.

| disease | fungus | field rot | storage rot |
|---------------|---------------------------------------|-----------|-------------|
| bitter rot | <i>Colletotrichum acutatum</i> | ■ | |
| | <i>Colletotrichum gloeosporioides</i> | ■ | |
| cottonball | <i>Monilinia oxycocci</i> | ■ | |
| early rot | <i>Phyllosticta vaccinii</i> | ■ | |
| berry speckle | <i>Phyllosticta elongata</i> | ■ | ■ |
| blotch rot | <i>Phylospora vaccinii</i> | ■ | ■ |
| end rot | <i>Fusicoccum putrefaciens</i> | ■ | ■ |
| ripe rot | <i>Coleophoma empetri</i> | ■ | ■ |
| viscid rot | <i>Phomopsis vaccinii</i> | ■ | ■ |
| yellow rot | <i>Botrytis</i> sp. | ■ | ■ |
| black rot | <i>Allantophomopsis lycopodina</i> | | ■ |
| | <i>Allantophomopsis cytisporia</i> | | ■ |
| | <i>Strasseria geniculata</i> | | ■ |



Figure 2. Fruit rot in early September.

tonball, see Extension publication *Cottonball Disease of Cranberry* (A3194). To confirm the cause of a fruit rot problem, fungi usually need to be isolated from the fruit, and environmental and cultural factors must be considered.

Field rot

Typically, fewer than 7% of Wisconsin’s cranberries are affected by field rot. This figure is even lower if measured by weight rather than by number of berries since a rotten berry weighs less on average than a sound berry. Field rot is also low in Oregon, Washington, and southern Canada. In these regions, a crop destined to be processed or frozen shortly after harvest is usually not sprayed to control field rot. In Massachusetts and New Jersey, however, field rot is a limiting factor in cranberry production and can result in total crop loss if left unchecked.

The importance of different field rot pathogens varies among growing regions, within a growing region, and

even among different plantings on a single farm. However, at most sites tested in Wisconsin in the late 1990s, the primary field rot pathogen was *Physalospora vaccinii*. This fungus usually can be isolated from 40 to 60% of rotten fruit from a given site. However, *P. vaccinii* also is found in 10–30% of healthy fruit, indicating that its presence does not always lead to disease. *Fusicoccum putrefaciens* and *Coleophoma empetri* are also prevalent field rot pathogens in Wisconsin, especially in older beds. Often more than one fungus is found in a single rotten berry.

Storage rot

Storage rot is a problem in all regions where cranberries are stored before being sold as fresh fruit. Most storage rot pathogens infect fruit during the growing season and therefore are also capable of causing field rot (table 1). As is the case with field rot, the major storage rot pathogens vary significantly

from batch to batch. Environmental conditions and the length of time in storage also influence the development of rot.

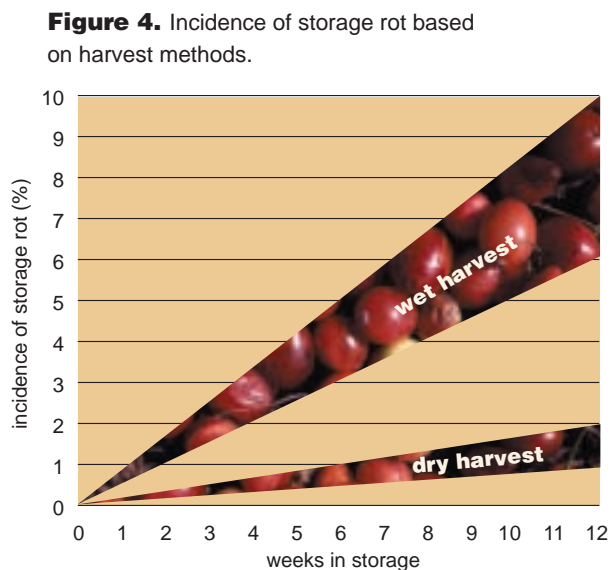
Harvest methods play a significant role in both the incidence of storage rot and the pathogens present. For example, a study in Wisconsin showed that the incidence of rotten fruit after 12 weeks in storage ranged from 6 to 10% for fruit that was “wet harvested” by machine but was only 1–2% for fruit harvested by dry hand raking (figure 4). The range of fungi isolated from rotten fruit was greater for the wet harvest than the dry harvest method. *Fusicoccum putrefaciens*, a fungus that grows well at lower temperatures, and *Physalospora vaccinii* were common in rotten fruit regardless of harvest method. Certain other fungi, such as *Coleophoma empetri*, both species of *Allantophomopsis*, and yeasts, were common in wet-harvested fruit but rare or absent in dry-raked fruit.

Disease cycles

Most of the cranberry fruit rot fungi have not been studied extensively, so many details of their disease cycles are unknown. However, three general disease cycles have been proposed based on which tissues a fungus inhabits throughout the year and when a fungus infects cranberry fruit.



Figure 3. Yellow berries with tan stripes or blotches distinguish cottonball from other fruit rot diseases.



Type I. This group includes fungi that overwinter in older tissues, such as woody stems and dead leaves at the soil surface. Fungal fruiting bodies develop in the spring, and spores of some species infect newly elongating shoots. Infections that lead to fruit rot occur during bloom, early fruit set, and possibly later. Fungi in this group include *Colletotrichum gloeosporioides*, *Colletotrichum acutatum*, *Fusicoccum putrefaciens*, and *Phomopsis vaccinii*.

Type II. This group includes fungi that persist in living leaves as “latent” infections and then develop fruiting bodies as the leaves die. Infections that lead to fruit rot probably occur during early fruit set and later. Members include *Coleophoma empetri*, *Phyllosticta elongata*, *Phyllosticta vaccinii*, and *Physalospora vaccinii*.

Type III. This group includes fungi that overwinter in living and dead leaves and stems, and infect fruit primarily during harvest. Spores are released in floodwaters and infect fruit through wounds made by harvest machinery. Disease incidence is directly related to the length of time that fruit remain in floodwater during harvest. Members include the black rot fungi, *Allantophomopsis cytisporae*, *A. lycopodina*, and *Strasseria geniculata*.

Other disease cycles. In addition to the three main types of disease cycles, some fungi associated with cranberry fruit rot are common inhabitants

of soil or live on many different plant species. These fungi could overwinter and sporulate on various other host plants prior to infecting cranberry fruit. Such fungi include species of *Alternaria*, *Botrytis*, *Cladosporium*, *Epicoccum*, *Penicillium*, *Trichoderma*, and yeasts.

The role of fruit, both healthy and rotten, as an overwintering and sporulation site for fruit rot pathogens is probably minor, because most fruit are removed at harvest. Even if fruit remained in the bed during the winter, they would be greatly outnumbered by dead leaves and therefore contribute relatively little to fruit rot inoculum the following season. Nearly all fruit rot pathogens can be found at low levels in healthy fruit at harvest time. However, *Phyllosticta elongata*, which causes a minor defect known as berry speckle, can be found in 60–100% of healthy fruit at harvest time.

Disorders that resemble fruit rot

Certain environmental stresses can lead to fruit deterioration in the absence of pathogens.

Sunscald. In the field, sunscald appears as circular or oval-shaped tan lesions on the surface of the fruit directly exposed to sunlight. In advanced cases, entire fruit turn yellow and soft (figure 5). Sunscald is most common in newly planted beds and areas



Figure 5. Sunscald in late August.

of established beds where vine growth is sparse and soil temperatures high.

Hail. The appearance of hail-damaged fruit varies depending on the size of hail stones and the developmental stage at which injury occurred. Berries develop scar tissue over the indentations caused by hail (figure 6). This scar tissue is hard and dry, distinguishing it from soft, water-soaked fruit rot lesions caused by fungal pathogens. Fungicides are not recommended after a storm with damaging hail.

Physiological breakdown. In refrigerated storage, physiological or “sterile” breakdown of fruit causes symptoms similar to symptoms of fungal storage rot. Berries become soft, rubbery, and dull in appearance. Red pigment from the berry skin leaches into the normally white fruit pulp. Physiological breakdown is worst at 33–34°F.

Disease management

Chemical control

The management of fruit rot diseases varies among growing regions and depends on how fruit will be marketed.

Processed fruit. In Wisconsin, Oregon, Washington, and southern Canada, where the incidence of field rot



Figure 6. Berries damaged by hail.

is low, fungicides usually are not needed on fruit that will be processed. By contrast, in Massachusetts and New Jersey, where field rot problems are severe, growers apply broad-spectrum fungicides (e.g., chlorothalonil, ferbam, fixed copper, mancozeb) four to six times per year to nearly all cranberry acreage. Infections that lead to field rot usually occur from late bloom through fruit set, so sprays at this stage are most important.

Fresh-market fruit. For fresh-market fruit, the role of fungicides in reducing storage rot is unclear. Most studies show slight reductions in storage rot incidence when fruit are treated two or more times during the growing season. However, fruit damaged during harvest deteriorate quickly in storage regardless of fungicides applied during the growing season.

In Wisconsin, chlorothalonil applied during bloom has been shown to reduce fruit set by 20–60%. Mancozeb applied to young fruit diminishes fruit color slightly. Thus, the costs and potential side effects should be considered before using fungicides for field rot or storage rot control. For specific information on using fungicides, including products and rates, see the most current version of Extension publication *Cranberry Pest Management in Wisconsin* (A3276).

Cultural practices

Cultural practices that enhance soil drainage and drying of foliage will help minimize pathogen inoculum levels, infection, and fruit rot development in the field and in storage. Excessive nitrogen fertilization, which promotes growth of a dense canopy, should be avoided. Vine overgrowth should be removed by pruning.

Sanding during the winter, a cultural practice done to enhance root development and improve vine vigor, may reduce fruit rot by burying dead leaves that are a source of fruit rot inoculum.

Resistance of different cranberry cultivars to fruit rot is not well understood and is complicated by the fact that so many different fungal species cause fruit rot. Studies have not demonstrated that certain cultivars are consistently more resistant to field rot than other cultivars. In storage, cultivars differ in “keeping quality,” but apparently this is determined more by physiological fruit traits rather than infection by pathogens.

Storage rot and physiological breakdown can be reduced by carefully handling fruit during harvest, minimizing the time that fruit remain in water, drying fruit prior to storage, and by storing fruit at temperatures of 36–39°F.

Additional information

From University of Wisconsin-Extension, Cooperative Extension:

- *Cottonball Disease of Cranberry* (A3194)
- *Cranberry Pest Management in Wisconsin* (A3276)
- *Fungal Leaf Spot Diseases of Cranberry in Wisconsin* (A3711)

Other publications:

- *Upright Dieback and Viscid Rot*. Wisconsin State Cranberry Growers Association, Wisconsin Rapids, WI.
- *Compendium of Blueberry and Cranberry Diseases*. 1995. F. L. Caruso and D. C. Ramsdell, eds. APS Press, St. Paul, MN. 87 pp. Descriptions and color photographs of diseases and other disorders.
- *Cranberry Fruit Rot in the Northeast: A Complex Disease*. 1998. P. V. Oudemans, F. L. Caruso, and A.W. Stretch. *Plant Disease* vol. 82, no. 11, pp. 1176–1184. A review of cranberry fruit rot research through the late 1990s.

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