# *Dickeya* and *Pectobacterium* spp. Tuber Soft Rot, Blackleg and Stem Rot

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## Introduction

*Dickeya* spp. and *Pectobacterium* spp. (formerly classified in the genus *Erwinia*) are closely related bacteria that cause tuber soft rot, blackleg and aerial stem rot disease (Perombelon and Kelman, 1980, Stevenson et al., 2001). *Dickeya* and *Pectobacterium* have a wide host range, but don't appear to thrive on legumes or small grains. *Dickeya* and *Pectobacterium* produce enzymes that break down the pectin of plant cell walls that results in tissue maceration or decay, thus effecting tuber integrity (Perombelon and Kelman, 1980, Stevenson et al., 2001). Wet conditions are conducive to disease development, enabling these pathogens to aggressively attack tubers and stems, causing significant crop losses (Cappaert et al., 1988, Gudmestad et al., 1988, Stevenson et al., 2001).

*Dickeya* and *Pectobacterium* infected seed tubers causes tuber soft rot, blackleg or aerial stem rot and will result in a reduction in plant emergence, plant health and overall plant stand (Gudmestad et al., 1988, Stevenson et al., 2001). Tuber soft rot also causes losses in storage, transit and marketing (Bergey and Breed, 1982). Certain potato varieties can be stored long-term with a reduced risk of tuber breakdown from other pathogens but all potato varieties are prone to infection by *Dickeya* and *Pectobacterium*, with some varieties more susceptible (Gudmestad et al., 1988, Stevenson et al., 2001). Disease management strategies should be employed at planting, during the growing season, at harvest and in storage to reduce the impact of these pathogens. However, as with most potato diseases, an integrative approach is important to reduce yield losses.

## Symptoms

Tuber soft rot on infected potato exhibits small, cream to tan, water-soaked surface spots that progress inward (Figure 1). Decay can occur rapidly under moist conditions in storage due to the development of a film of water. These anaerobic conditions predispose tubers to soft rots. The bacteria that initiate the disease are odorless, although secondary infection by other organisms can cause an unpleasant odor. Soft rot of the potato seed piece can occur following planting and cause poor emergence or exhibit foliar symptoms post-emergence. Chlorotic symptoms (yellowing) may develop after the bacteria blocks the vascular system of the plant, eventually resulting in wilting of the potato plant. Additionally, stems and roots can become infected, leading to rot and eventually plant death.

Blackleg symptoms appear as black lesions at the base of the stem that can quickly girdle the stem as they expand upward. Unlike tuber soft rot, infected plant stems have a black appearance (Figure 2). Affected tissue becomes soft and water soaked under humid conditions. Infected stem lesions can rapidly expand causing brown to black decayed tissue that can affect the entire stem and eventually lead to plant death. Plant stems appear stunted and leaves of infected plants become chlorotic and tend to roll upward at the margin as the disease progresses. Under dry conditions, symptoms are expressed as yellow, stunted and wilted plants with

shriveled infected black tissue restricted to the area around the base of the stem near the soil surface.

*Dickeya* spp. or *Pectobacterium* spp. that cause aerial stem rot primarily enter the plant through wounds (created by cultivation, wind-blown sand, insect injury or hail) and leaf scars. Decaying stems appear slimy, mushy, water soaked and black (Figure 3). Similar to blackleg, under dry conditions, stems can desiccate, resulting in a dry, brownish to black shriveled stem. Other organisms can invade plant tissue quickly creating a characteristic unpleasant odor emanating from an infected field. Symptoms appear mid-season when the plant canopy is densest. Stem rot is most severe in fields with frequent overhead irrigation.

**Disease Cycle**

During planting, the bacteria that cause tuber soft rot, blackleg and aerial stem rot are disseminated on infected potato seed (Figure 4). the pathogens do not survive for extended periods in the soil (generally less than 2 years). The pathogens that cause tuber soft rot, blackleg and aerial stem rot can survive for long periods in plant debris, including potato tissue, and they may contaminate other seed by equipment that is not properly sanitized. Saturated soil causes tuber lenticels to enlarge; these serve as infection sites for the bacteria (Figure 4). Bacteria are transferred from infected plants to healthy ones by splash dispersal from rain events, wounding from hail, irrigation and insects (Figure 4). During storage, rotting tubers release moisture, which results in infection of previously healthy tubers (Figure 4) and infection from other pathogens can exacerbate tuber rot symptoms.

**Management Strategies**

Symptoms caused by *Dickeya* spp. and *Pectobacterium* spp. can be indistinguishable. Therefore, the first step in effective disease management is accurate identification and diagnosis. Effective culture and DNA-based detection methods are available for *Dickeya* and *Pectobacterium*. All varieties of potato are susceptible to infection by *Dickeya* spp. or *Pectobacterium* spp. throughout the growing season. Proper handling of tubers is particularly important. Therefore, every effort should be taken to avoid bruising and damage during planting and harvest, as well as during the loading of storage bins and shipping trucks to reduce risk of disease (Thornton and Bohl, 1998).

Seed sourced from potato certification programs carry less bacterial contamination and therefore losses from seed piece decay and blackleg are reduced. Inspect seed carefully during planting. Prior to receiving seed, clean and sanitize seed storage facilities thoroughly. Routinely disinfect seed cutting and handling equipment and make sure blades are sharp to ensure a smooth cut that heals quickly. It is important to use whole “B size” tubers whenever possible. If cutting seed, proper suberization is critical to avoid new infections. To minimize injury warm seed to at least 50 °F before handling and cutting, and prior to planting, promote rapid healing and reduced condensation. After careful unloading, store seed at 40 °F to 42 °F and 85 to 90% relative humidity (RH). Keep stored seed well ventilated. *Dickeya* and *Pectobacterium* thrive in water and under low-oxygen conditions, avoid irrigating fields if possible until plants have emerged.

Excessive irrigation and nitrogen can stimulate excessive vine growth, which can lead to increased aerial stem rot risk. The only chemical management option during the growing season is application of copper-based treatments to reduce the spread of bacteria to healthy plants by drying out symptomatic vines. However, treatment with copper is not curative and has shown

limited efficacy. Moreover, application of copper treatments interferes with DNA-based detection.

The condition of tubers during harvest and in storage never improves. Harvesting tubers after proper skin set and with a core temperature greater than 50 °F. decreases the risk of damage and subsequent infection by soft rot bacteria. Avoid harvesting wet fields. Promote rapid drying of wet potato tubers. Modifications to harvest equipment may help manage soft rot bacteria and other pathogens that enter through damaged tuber periderm. Tubers may show no evidence of disease going into storage and may not decay in storage if stored at properly. However, bacteria on asymptomatic tubers may survive and will likely cause and spread disease the next year if planted. Temperature gradients within the storage pile that promote condensation and wet areas should be eliminated. Monitor for soft rot of tubers in storage often. Daily monitoring of storage bins for high-risk areas with elevated temperature, moisture or both is essential for disease management. Remove rotten tubers during loading of storage bins and during removal from storage before marketing.

**Literature Cited**

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**Figure 1.** Tuber soft rot: Rotting tissue is mushy, slimy and water soaked; infected areas often turn brown or black around the rotting area upon exposure to air. (Michigan State University)

**Figure 2.** Blackleg symptoms progressing from the decaying seed piece to the base of the stem. (Michigan State University)

**Figure 3.** Aerial stem rot: Affected stem tissue becomes water soaked and turns brown to black under wet conducive conditions. (Michigan State University)

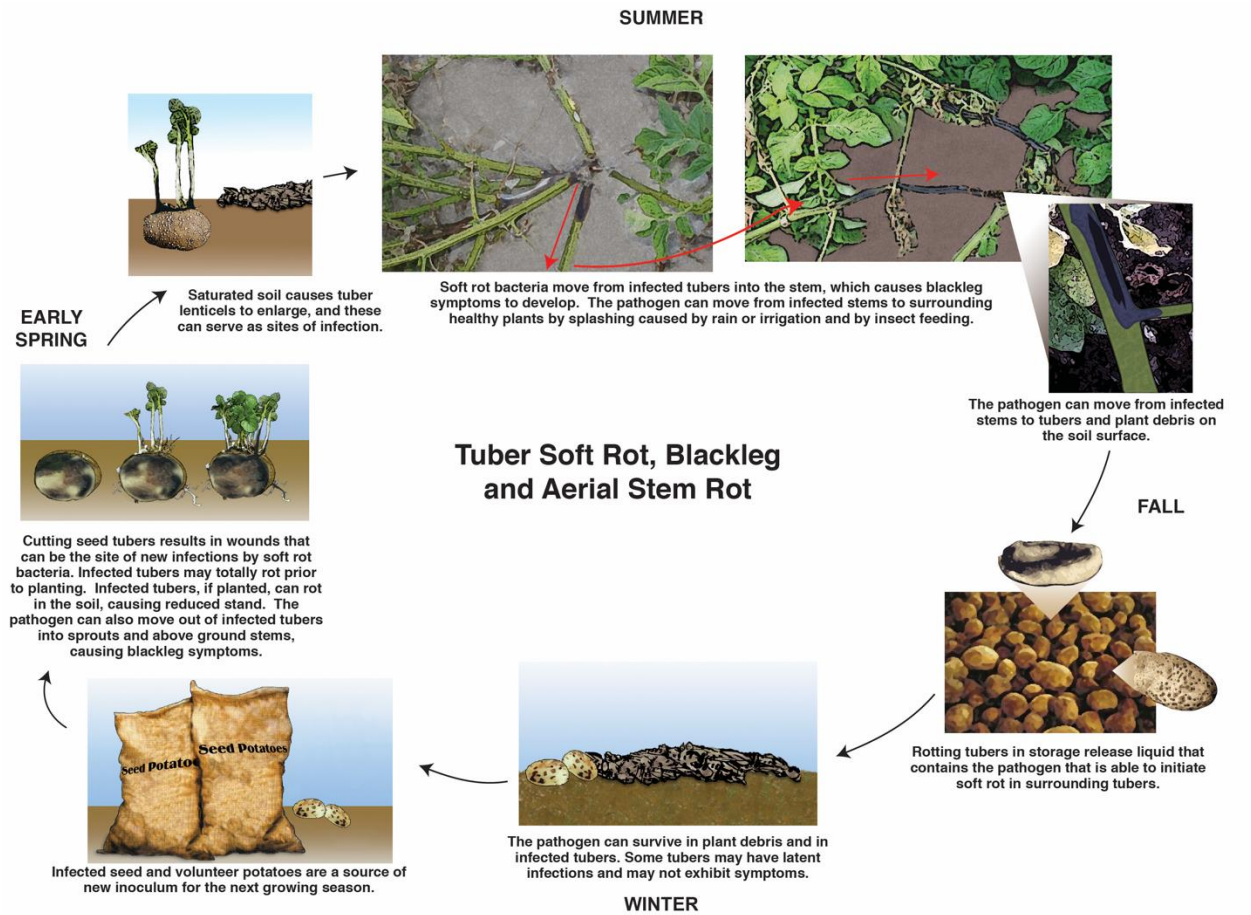


**Figure 4.** Disease cycle of tuber soft rot, blackleg and aerial stem rot. (Marlene Cameron, Michigan State University)