



# Potato Progress

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## Managing Bacterial Lenticel Spot on Potatoes

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Bacterial lenticel spot is one manifestation of bacterial soft rot on potato which is initiated at tuber lenticels. Soft rot is a wet, mushy rot of plant tissues that progresses rapidly, especially when temperatures are warm. Lenticels are the pores in the tuber surface that allow for the exchange of oxygen and carbon dioxide during cellular respiration of the tuber.

Lenticel spot is caused by one or more species of *Pectobacterium* (formerly *Erwinia*). Other bacteria such as *Pseudomonas*, *Bacillus*, *Dickeya* and *Clostridium* species may also be involved. Soft rot bacteria produce enzymes that decompose the pectin in the cell walls of plants and this is the reason they are commonly referred to as 'pectolytic bacteria.' Substantial economic losses from soft rot and lenticel spot may occur on both processing and fresh market potatoes.

Lenticel spot symptoms may be observed in the field, but usually are most noticeable 4 to 10 days after harvest and packaging. Symptoms are characterized by tan to dark brown, circular, water-soaked spots or small lesions surrounding lenticels on the tuber surface (Fig. 1). Affected tissue usually does not extend deeper than about 4 millimeters into the tuber. Adjacent lesions may coalesce to form larger, irregularly shaped sunken lesions. Under moist conditions, the lesions enlarge, and can suddenly take on a puffy appearance due to the production of gas by respiring bacteria in the lenticel. Although infection of the lenticels can contribute to soft rot of the entire tuber, wounds and the stem end are other common points of entry for pectolytic bacteria into potato tubers. When soft rot develops, tuber flesh decays, becomes cream to tan colored, and sometimes there is a black border between healthy and rotting tissue. If conditions remain dry, lenticel spot lesions may become sunken, dry and hard (Fig. 2).

Soft rot bacteria originate from contaminated seed tubers, decaying seed pieces and plants in the field, infested field soil, and contaminated water and harvesting equipment (2). Lenticel infections occur in the field before harvest (1) or during washing of tubers after harvest. High numbers of soft rot bacteria are generally needed for infection. Environmental conditions in the field and after harvest that favor population increases of bacteria are crucial for the development of soft rot and lenticel spot (6). Wet field soils and warm temperatures before harvest plus moisture on tuber surfaces in storage or transit greatly favor disease development. Generally, tuber soft rot and lenticel spot caused by *Pectobacterium* occur at temperatures above 50°F, but 77 to 86°F is optimal. At higher temperatures, soft rot caused by other bacterial pathogens like *Clostridium*, *Pseudomonas* and *Bacillus*, often prevail.

Oxygen depletion and a build up of carbon dioxide around tubers are leading factors that promote the development of tuber soft rot and lenticel spot. Oxygen depletion reduces potato tubers' natural resistance to soft rot and a build up of carbon dioxide causes lenticels to enlarge (Fig. 3), providing entry sites for pectolytic bacteria. In addition, *Pectobacterium* species are facultative anaerobes (organisms that normally live in the presence of atmospheric oxygen, but capable of living without oxygen). If tubers in soil or storage are covered



Figure 1. Infection of tuber lenticels after washing

Figure 2. Hard rot surrounding tuber lenticels

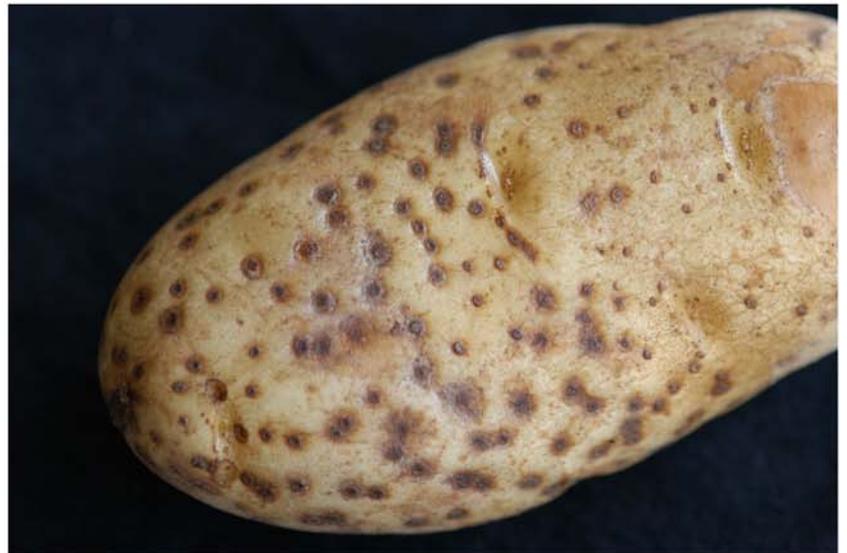


Figure 3. Enlarged lenticels on a tuber, resulting from exposure to excessively wet soil

with a thin film of water, depletion of oxygen and a build up of carbon dioxide result. Soil flooding, washing tubers, spraying tubers with fungicide solutions in water as they are placed in storage, and inadequate ventilation in storage and/or transit lead to moisture accumulation. All of these environmental conditions, individually or collectively, can be conducive to the development of tuber soft rot and lenticel spot.

Management tactics are centered on irrigation practices before harvest, handling of the crop during harvest, and sorting, storage and transit. The following are important in reducing the severity of bacterial lenticel spot:

1. Irrigation should be closely monitored before harvest to avoid excessive soil moisture. During the tuber maturation stage of growth, available soil moisture can decline to 70 to 75% before water is replaced through irrigation (3). This level of moisture will promote skin set. Available soil moisture in excess of 90% can lead to soft rot. Excessively dry conditions, with less than 65% available soil moisture should be avoided. Only mature tubers should be harvested. Tubers that are left in the soil for an adequate time after vine death to allow skin set to occur are less subject to wounding. Those harvested from green vines are more susceptible to postharvest soft rot. If possible, tubers should be harvested when soil temperatures are between 50 and 65°F. Tubers from low areas in fields should not be marketed if there is significant water logging from late season irrigation or heavy rains just prior to or during the harvest season.
2. Irrigation practices two weeks before harvest have a large effect on the development of bacterial lenticel infections. Most fields for fresh packing in the Columbia Basin are over-watered during this time. A water application is sometimes made prior to digging to help carry dirt up the harvester chain and reduce bruising. In addition to supplying extra water, a seal often forms on the soil surface. Carbon dioxide then increases around the respiring tubers. Oxygen is depleted and the natural resistance of the tuber to infection decreases. The lenticels enlarge and conditions favor the increase of pectolytic bacteria in the lenticels. Infection and colonization of the lenticel and surrounding tissues then occurs. High temperatures increase the build up of soft rot bacteria and increase infection. In the Columbia Basin, if a producer chooses to water fields prior to harvest in August, then care should be given to irrigate in the late afternoon to reduce the time that the soil surface is sealed. Tubers should then be dug early the next morning when temperatures are relatively cool. For example, it is suggested that digging begin at 2 am and finish by 9 am. Potato growers in western Washington have reported a benefit from harvesting before the heat of the day in late summer.
3. If soft rot is present at harvest, the tubers should be graded as they are washed and packaged or moved into storage. Storage conditions should be managed to promote wound healing for 10 to 14 days, and then the storage facility should be managed to prevent the accumulation of CO<sub>2</sub> and avoid condensation. Tubers should never be washed before being placed into storage. Moisture films left on the tuber surface promote the development of soft rot in the storage pile. Storage piles should be routinely monitored for wet spots, an indication of soft rot.
4. Before tubers are removed from storage they should be warmed before handling to minimize bruising and prevent condensation on their surfaces. If they are washed before processing or packing for market, they should not be submerged in flumes or dump tanks.
5. If a fluming system must be used to transport tubers in water, it should be cleaned and sanitized frequently. The flume water must be changed often. During fluming, tubers should not be submerged more than an inch or two or washed with high pressure nozzles because water pressure may force bacteria into lenticels and exacerbate the problem.

6. Clean, chlorinated water or water treated with an effective biocide should only be used for washing fresh-market potatoes on the packing line. Dirt in wash water will deactivate biocides. Wash water should not be re-circulated. (More information on disinfectants can be found in reference 5).
7. All equipment should be cleaned and sanitized to prevent the spread of bacterial pathogens.
8. It is very important that washed tubers be well dried before packaging. If a film of moisture is left on the tuber surface, it may lead to the development of bacterial soft rot during shipping and marketing. Some of the excess moisture on the tubers comes off during the running on the belt after washing. However, forced, hot air directed at tubers on the belt after washing is usually needed to adequately dry tubers.
9. Adequate ventilation is required for both storage and transit. Ventilated bag or shipping containers help to ensure complete drying. (For proper storage and transit of potato guidelines, see reference 4.)
10. It appears that the incidence of lenticel spot is more common for the thin-skinned, specialty potato cultivars suggesting that these potatoes are more susceptible to bacterial soft rot and lenticel spot. Special care should be taken to follow the suggestions listed above for these specialty tubers.

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