Bacterial Rots of Potato Tubers

PLANT DISEASE FACTSHEET

Symptoms of bacterial soft rot are similar whether caused by *Pectobacterium* or *Dickeya* species

Key facts

- Soft rots in stored potatoes can be caused by a number of bacterial pathogens
- *Pectobacterium* species (especially *P. carotovorum*) are particularly common
- Many of the pathogens will also cause disease symptoms in the haulm
- Crops grown from seed containing high levels of the bacteria may be at risk
- Problems are more likely during wet seasons, and on tubers harvested from wet soils
- Preventing tuber damage and ventilating stores to ensure rapid drying after loading and prevent condensation are extremely important
- No chemical controls are available
- Brown rot and ring rot are quarantine organisms and suspected cases must be reported

Introduction

A number of bacterial pathogens are capable of causing rots of potato tubers, most importantly during storage of the crop. The pathogen found most frequently in the UK is *Pectobacterium carotovorum* , but *Pectobacterium atrosepticum* and *Dickeya* species (abbreviated to spp.) may also be involved. These bacteria used to be known collectively as 'the soft rot erwinias'.

Tuber rotting can also develop following infection by the quarantine organisms *Ralstonia solanacearum* (brown rot) and *Clavibacter michiganensis* subsp. *sepedonicus* (ring rot). The majority of growers will, hopefully, never see either of these diseases, but should be aware of their symptoms.

The amount of bacterial disease that develops in a potato crop is strongly influenced by environmental factors such as soil moisture and temperature. However, the input of the grower at all stages of the crop is also critical. The key stages during which any decisions will have a profound influence on subsequent tuber health are choice of seed, harvesting/processing and loading/maintenance of the stored crop.

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The pathogens – symptoms and biology

Pectobacterium carotovorum* subsp. *carotovorum

This bacterium was formerly known as *Erwinia carotovora* subsp. *carotovora*. It is an unspecialised pathogen, capable of causing soft rots on a large number of plant species. It is an ubiquitous organism, which is almost always present on the surface, or in lenticels and wounds, of harvested potato tubers.

P. carotovorum may occasionally cause stem rotting but does not usually cause typical blackleg symptoms under UK conditions.

Infected seed tubers break down in the soil, releasing huge numbers of bacteria that can infect the daughter tubers via wounds or through lenticels, especially in wet soils. In this case subsequent rotting can develop at any point on the tuber. Especially if tubers are washed prior to marketing, a build-up of bacteria in the washing water can lead to large numbers of lenticel infections.

Infection via wounds or lenticels may result in a rapid soft rot or a more restricted area of hard brown tissue, depending on subsequent storage conditions. If moisture levels during storage are too high, leading to condensation on the tuber surface, then rapid multiplication of the bacteria leads to soft rotting, accompanied by an increase in temperature which itself is favourable for further decay. Rotting can spread in store by tuber to tuber contact. Tubers affected by fungal diseases, particularly blight, pink rot, *Pythium* leak and watery wound rot, will frequently succumb to secondary bacterial decay in storage.

Soft rot initiating via lenticel infections can be arrested by careful storage with good ventilation, resulting in the condition known as pit rot

Soft rotting bacteria may transmit from the seed tuber to infect progeny tubers via the stolons and spread through vascular tissues

Blackleg disease with dark coloured soft rot extending from the seed tuber up the stem

Pectobacterium atrosepticum

This is the blackleg pathogen, formerly known as *Erwinia carotovora* subsp. *atroseptica*. Symptoms of blackleg in the growing crop are seen initially as stunted plants with yellowing and wilted foliage. A soft, black decay develops at the stem base, and if the stem is cut across just above this it will be seen that the water-conducting (vascular) tissues are also stained black. Tuber rot symptoms are similar to those caused by *P. carotovorum.*

Infected seed tubers are the primary source of the pathogen, and daughter tubers can be colonised by a number of routes. The bacteria may invade through the stolon, causing a rot that spreads into the tuber from the heel end. Under favourable conditions this may spread rapidly as a greyish-white soft rot. During less favourable conditions for the pathogen the tuber may be able to limit its spread by forming a corky barrier – in this case the rot will have a clearly defined dark border and the tissues within it may dry out somewhat (although the bacteria may later break through the barrier leading to further rapid decay).

***Dickeya* species**
Formerly known as *Erwinia chrysanthemi*, this pathogen is favoured by higher temperatures than the *Pectobacterium* species. It is found predominantly during warm, wet seasons. *Dickeya dianthicola* causes a 'slow wilt' of the haulm, similar to those of blackleg but usually without the soft, black decay of the outer stem base. A newly emerging *Dickeya* species (proposed as *Dickeya 'solani'*) is more aggressive causing rapid wilting and stem soft rotting. Contaminated seed tubers are again the primary source of the pathogen. Tuber rot symptoms are very similar to those caused by *Pectobacterium*, including heel-end rots.

Other bacteria
Soft-rotted tubers often have a foul odour, but tubers that are affected solely by the bacteria described above are usually odour-free. These odours (and often a slimy consistency) develop as a result of the secondary invasion of the tuber by a range of other bacteria, including *Clostridium*, *Bacillus* and *Pseudomonas* spp.

The quarantine organisms – *Ralstonia solanacearum* and *Clavibacter michiganensis* subsp *sepedonicus*
Ralstonia solanacearum causes the disease of potatoes known as brown rot. Tuber symptoms begin as a brown discolouration of the vascular ring, visible when an affected tuber is cut open. A creamy bacterial exudate may ooze from the vascular tissue if a cut tuber is squeezed. Bacteria may also ooze from the eyes or the heel end of the tuber, causing soil to stick to it.

Favoured by warm conditions, *R. solanacearum* is spread on infected seed tubers, but can also cause long-term contamination of water courses by colonising the roots of woody nightshade (*Solanum dulcamara*). UK outbreaks have been associated with flooding or irrigation of potato crops from contaminated water sources.

Clavibacter michiganensis subsp. *sepedonicum* causes ring rot. Tuber symptoms are similar to those of brown rot, but the initial discoloration of the vascular ring is usually glassy and water-soaked rather than brown, and the ooze from the ring has a cheese-like consistency. External symptoms such as ooze from the eyes are also less common.

Potato brown rot bacteria oozing from eyes of tuber

Bacterial wilt caused by *Ralstonia solanacearum*

Ring rot with cheesy rotting of the vascular tissues

Symptoms of potato ring rot

Ring rot can spread under cooler conditions than brown rot. Seed tubers are the primary source of the disease. Stores, boxes and machinery can be contaminated by the bacteria which remain viable for long periods.

Suspected cases of either of these diseases must be reported to the relevant plant health authority.

Foliar symptoms of bacterial ring rot with wilting and interveinal chlorosis

Diagnosis

It is possible to test samples to predict the risk of potential problems developing on both seed and ware potatoes. A sample of 100 tubers can be tested for total numbers of soft rotting bacteria, giving a good indication of the risk of significant problems developing in stored ware. It is also possible from a 100 tuber sample to identify and quantify the amount of *P. atrosepticum* and *Dickeya* spp. present. This test, when carried out on seed, can give a useful indication of the potential risk to the crop from blackleg and slow wilt although, as stated previously, soil moisture and temperature conditions in the field are also major factors influencing disease development.

Potato wash water can also be tested, to predict and prevent problems with shelf-life of pre-packed ware.

Tuber samples (210 tubers) can be analysed for the presence of brown rot and ring rot.

If disease problems develop in the field or in the stored crop, samples of haulm or tubers can be tested for any of the bacterial pathogens.

The above tests are carried out using a range of techniques, including traditional isolations, fatty acid profiling, immunoflourescence, and DNA-based techniques (TaqMan® PCR and DNA sequencing). Please contact us for further details on any of the tests.

Preventative measures

- Source seed with great care. If in any doubt as to the health status, have the seed tested prior to planting
- Monitoring for blackleg, slow wilt and blight (particularly tuber blight) in the growing crop will give an indication of the potential for soft rotting in storage
- The risk of soft rots will be greatly increased if tubers are harvested from wet soils. Avoid poorly-drained fields, or take steps to improve the drainage
- Ensure that harvesting and handling equipment is properly calibrated to minimise tuber damage
- Consider testing tubers going into store to predict the soft rot risk. If you are supplying the pre-pack market, both tubers and wash water can be analysed to ensure maximum shelf life
- Rapid drying after loading and preventing condensation from forming on stored tubers, by appropriate manipulation of temperature and ventilation, is critical
- Monitor stores closely, and market the crop promptly if soft rots begin to develop

Control

No chemical controls are available for these diseases, either for the growing crop or the stored tubers.

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