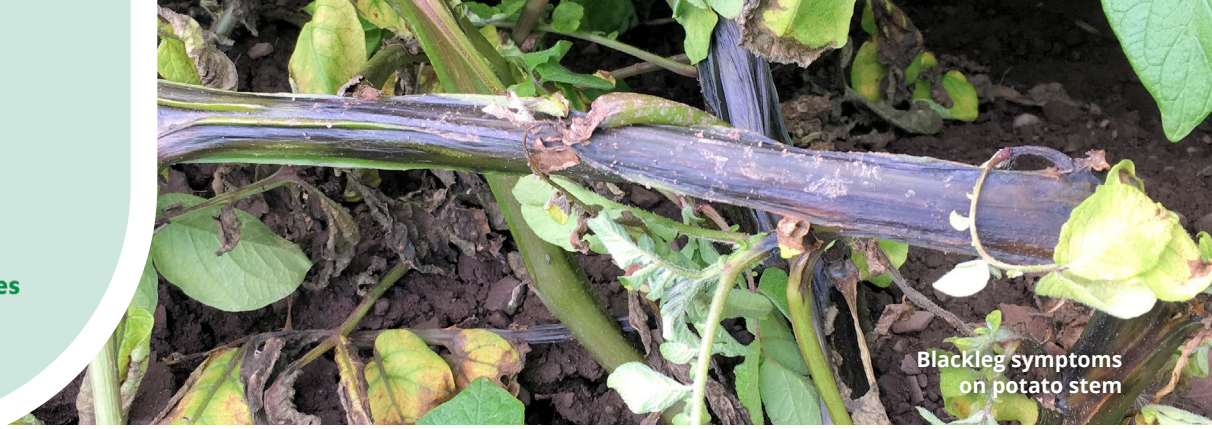
Bacterial Plant Diseases Programme

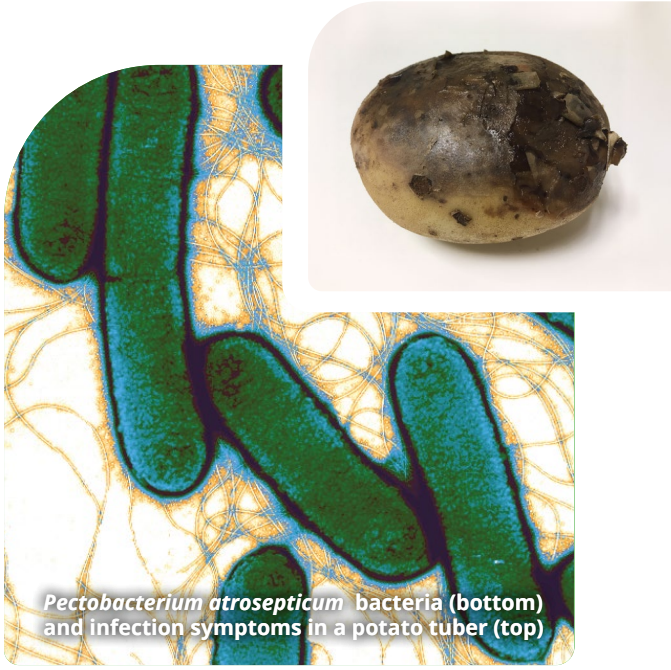

Blackleg symptoms on potato stem

PROTECTING POTATOES BY ESTABLISHING HOW BLACKLEG SPREADS AND WHEN IT THRIVES

Potato blackleg is poorly understood and hard to control

Potato is the second most important staple food crop in the UK. Potatoes are nutritious, filling and inexpensive. However, they are also vulnerable to many pests and diseases. A major issue for UK potato growers is blackleg disease caused by a bacterium called *Pectobacterium atrosepticum* (Pba). This disease causes tubers to rot and the lower stems to turn black.

Globally, financial losses from blackleg disease are estimated at £50M per year. There are few means of controlling infection besides stringent seed quality control measures. Even with these measures, infections still occur. It is not fully clear how potatoes become infected with Pba. However, we do know that certain conditions, for example over-watering, increase the chance of blackleg infections.


Pectobacterium atrosepticum bacteria (bottom) and infection symptoms in a potato tuber (top)


Collecting soil samples at the James Hutton Institute

Our research studied how Pba infects, spreads and how cultivation methods affect disease

To understand the impact of irrigation on disease levels, we conducted field trials comparing different watering regimes and used DNA screening to track the abundance of Pba and other bacteria in soil and on roots.

Insects and aerosols were gathered and tested to observe their possible role in Pba spread between crops. Root exudates were screened in an attempt to identify compounds linked to resistance and susceptibility.

Bacteriocins (proteins isolated from other *Pectobacterium species*) that can kill Pba when in close contact were identified.

Using light sheet and confocal microscopy and fluorescently-labelled Pba, the movement of bacteria in and around mechanically-wounded plant root tissues was analysed.

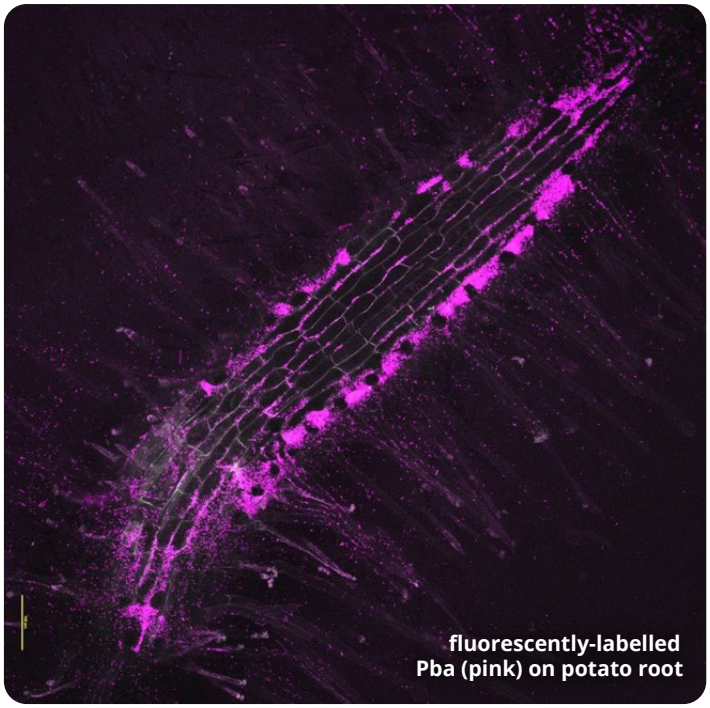
We developed basic models to help track the movement of Pba across Scotland over a number of years.

Discoveries

We have found potential vectors, infection mechanisms and biocontrol options for Pba

- Potato seed stocks that carry Pba, even at very low levels, are more likely to develop blackleg infection as irrigation is increased during the growing season.
- However, withholding irrigation increased common scab symptoms (from another bacteria called *Streptomyces scabies*) so irrigation needs to be finely balanced.
- There is some evidence that Pba may be vectored by wasps.
- Physical damage to the roots allows Pba to enter and infect the plant tissues suggesting an alternative route of infection (in addition to seed potatoes).
- We identified potato root exudates that correlate with Pba resistant and susceptible varieties offering a potential quick screen for potato breeders.
- Bacteriocins (proteins isolated from other *Pectobacterium* species) can reduce potato infection by Pba and may offer a useful option for disease control.


Growing potatoes


fluorescently-labelled Pba (pink) on potato root

Recommendations

We recommend a future research focus on how Pba spreads and possible biocontrol options.

- Focus on reducing Pba levels in seed stocks to control potato blackleg, and by better management of irrigation
- Investigate whether free-living nematodes in the field are causing root damage that allows Pba to infect plant tissues.
- Test barrier methods, such as netting, over growing potatoes to help establish whether wasps and other insects are transmitting the bacterium.
- Develop further research and trials on promising biocontrol options.

For more information contact:
Prof Ian Toth - email: ian.toth@hutton.ac.uk

To explore the underlying research visit
https://bacterialplantdiseases.uk/des-bl/

Keating, C. et al (preprint) Balancing the scales: Impact of irrigation and pathogen burden on potato blackleg. https://www.biorxiv.org/content/biorxiv/early/2023/07/13/2023.07.13.548922.full.pdf

Bacterial Plant Diseases Programme

An interdisciplinary research consortium working together to understand bacterial plant diseases to protect UK farms, forests and gardens.

www.bacterialplantdiseases.uk

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