



Monitoring and control of the potato brown rot bacterium in irrigation water

Potato brown rot poses a serious threat to GB potato production and continued vigilance is required to prevent its introduction and spread. Several isolated cases have occurred linked to the presence of the causative bacterium (*Ralstonia solanacearum*) in certain watercourses. Contaminated irrigation water is a potential source of infection, so this leaflet offers advice on the monitoring and control of the bacterium in irrigation water.

Summary

- The bacterium that causes brown rot has quarantine status in Europe.
- Isolated cases of brown rot have been found in potato and tomato crops in the UK.
- A number of watercourses have been found contaminated with the bacterium due to infection of woody nightshades (*Solanum dulcamara*) that naturally grows on river banks.
- Use of contaminated water for irrigation or spraying could spread the disease and is officially prohibited.
- Removal of infected nightshades is difficult and does not always result in eradication of the bacterium.
- A number of water treatments that can remove viable brown rot bacteria are summarised in this leaflet.

Background

Potato brown rot is caused by a bacterium (*Ralstonia solanacearum*) and can seriously damage potato production. This pathogen has quarantine status in Europe to restrict its spread. Isolated outbreaks in ware potato crops have occurred, in the UK – two in the Thames valley (in 1992 and 1995), one in Northamptonshire in 1999, one in Kent in 2000, one in Nottinghamshire in 2005 and one in Cornwall and Somerset in 2010. The same organism has also caused bacterial wilt disease in tomato crops in Bedfordshire (1997 and 1998). All except the 2010 outbreak, which was linked to infected imported seed potatoes, have been associated with contaminated water.

Similar sporadic outbreaks have been recorded in most EU member countries since 1989 and have resulted in official controls on infected crops and restriction on further planting in affected areas. The bacterium appears to have entered the EU in infected ware potatoes

imported from third countries. It has entered certain watercourses, possibly in industrial or municipal effluents containing potato washings, and become established in the weed host, woody nightshade (*Solanum dulcamara*), which commonly grows on river banks.

Transmission to potatoes and tomatoes has then resulted from irrigation with contaminated river water. Irrigation and spraying with water from watercourses designated as contaminated is therefore officially prohibited.

***Solanum dulcamara* and potato brown rot**



Fig. 1. Woody nightshade (*Solanum dulcamara*) growing in river water acts as a secondary host in which the pathogen can overwinter and multiply to further contaminate irrigation water supplies.



Fig. 2. Typically, infected tubers show discolouration and necrosis of the tuber vascular ring. Creamy bacterial slime oozes from the cut vessels and eyes.



Fig. 3. Infected plants may suffer from rapid wilting of potato foliage resembling water stress.

Pathogen detection

River water is tested by culturing the brown rot bacterium on selective growth media. Results are obtained within 3 days and the test routinely detects as few as two viable pathogen cells per ml of river water. Populations of the bacteria in the water vary according to the time of year, being highest in the warm months between June and September and falling below detectable levels in the winter (see Fig. 4). The bacteria can

be detected all year round in aquatic roots of infected woody nightshade plants, in which they survive the winter.

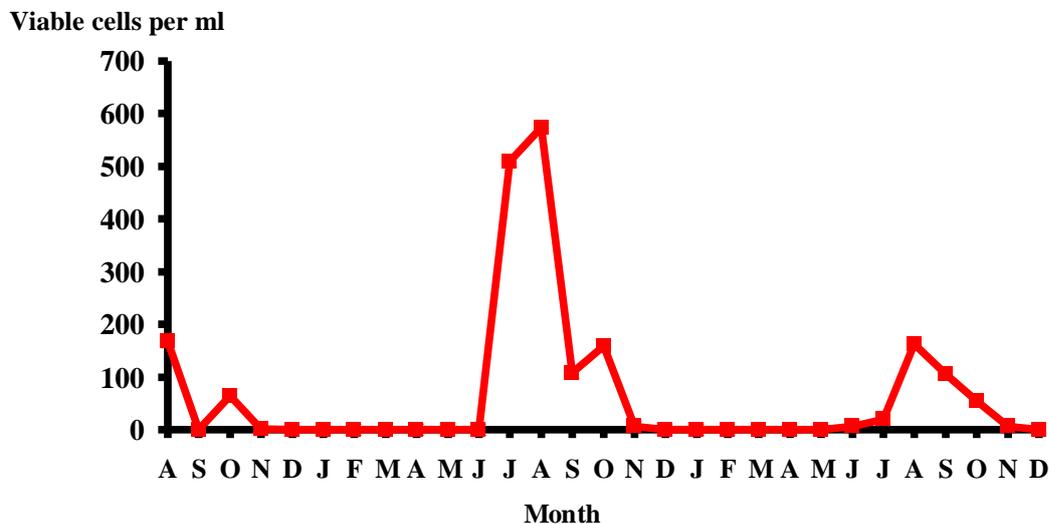


Fig. 4. Seasonal population dynamics of *R. solanacearum* in river water at a single point down-stream from infected *Solanum dulcamara*

Sampling of water for the detection of *Ralstonia solanacearum*

- Testing of river water can be arranged through your local APHA² area offices
- Samples of approximately 0.5 litres of water, collected at a depth of 30 cm into sterile bottles, should be kept cool and dark and be tested within 24 hours of collection.
- Sampling should preferably follow a period of several days without rainfall to avoid dilution effects.
- Detection is most reliable when river water temperatures exceed 15 °C.
- Regular sampling at multiple sampling points increases the reliability of detection of low and variable pathogen populations.
- Collect samples in the vicinity of woody nightshade plants.
- Small waterways/ditches with infected woody nightshade generally have the highest populations of *R. solanacearum*.
- Where relevant, target areas with warmer water such as downstream of outfalls from power stations, sewage treatment works or industrial effluent discharges.

Probability of infection

Strengthening of official controls and testing programmes in recent years has significantly reduced the risk of finding the potato brown rot bacterium in imported and EU-produced potatoes. Legislation⁴ has ensured that potatoes imported from certain third countries are grown only in areas recognised as free from the pathogen, that appropriate inspection and testing is performed, and that traders are registered and processors are approved to handle certain imported potatoes. No evidence has been found that the bacterium is currently entering watercourses in treated effluents from industrial or domestic sources.

Official measures³ ensure that regular surveys identify the limits of pathogen distribution within the EU and that irrigation of potatoes and other host crops (e.g. tomato and aubergine) with contaminated surface water is prohibited. The brown rot bacterium has been detected in only a small number of the many surveyed river systems in England. Details of rivers currently demarcated as contaminated can be found at: <https://www.gov.uk/guidance/plant-health-controls#quarantine-pests>.

The probability of infection of potatoes through use of contaminated river water is thought to be generally low since there have been few outbreaks of the disease, even in areas where watercourses were found to be contaminated. Outbreaks of the disease in the UK have mostly been associated with over-irrigation, flooding and/or poor drainage. Infection is more likely at an early growth stage, particularly if soil temperatures are warm (18-25 °C). However, it is important to note that latent (symptomless) infections can occur, particularly in cool growing seasons. In this way the pathogen can be unwittingly transported in harvested produce. This mode of spread is particularly dangerous for latently infected seed potato crops in which the bacterium can multiply and spread causing disease to develop in the following generation.

In some cases measures have been taken to remove infected *Solanum dulcamara* from waterways in which it has been found with a view to eradicating the pathogen altogether. Some degree of success was obtained for small watercourses with well-defined borders where all *Solanum dulcamara* was easily located and repeatedly spot-treated with glyphosate to ensure translocation of the herbicide to underground stolons to prevent subsequent regeneration. In such cases, river water downstream was found to remain free from *R. solanacearum* for two years following successful removal of the *S. dulcamara* and the watercourse could be de-demarcated. However, in other cases, especially involving larger river systems in high water table areas with many tributaries, side-ditches and flood plains, attempts to remove all *S. dulcamara* either failed or could not be attempted with existing resources. In such cases, rivers have remained continually demarcated.

It may be helpful to consider the following factors when assessing the case for an eradication programme:

- Knowledge of the hydrology of the watercourse concerned and channels, drains, streams feeding into it.
- Access to banks for treating woody nightshade.
- Size and scale of channel and the opportunity to achieve eradication within a realistic timeframe.
- Evidence that potato growers in the vicinity of the watercourse would experience substantial hardship if subject to an indefinite irrigation prohibition, for example because the geology of the area is not suitable for boreholes or winter reservoirs.
- Approvals remain in place to use relevant pesticides (e.g. glyphosate) near watercourses.
- Significant environmental restrictions (e.g. SSSIs) which may reduce the impact of a treatment programme, by preventing or limiting access to certain areas or during certain periods.
- Evidence of other factors which would reduce the prospects of achieving eradication, such as bacteria being fed into the watercourse from a known contaminated source that is not subject to treatment.
- Cost-benefit situation. Previous experience suggests a break even cost:benefit position if eradication can be achieved within 6 years.

Assessing risks

To assess the risks of spreading potato brown rot through irrigation of potatoes or other host crops:

- Contact your local APHA or check the DEFRA¹ website (<https://www.gov.uk/guidance/plant-health-controls#quarantine-pests>), for current information on contaminated watercourses from which irrigation is prohibited.
- Be especially vigilant during field and storage inspections for symptoms of potato brown rot and report suspect findings immediately to your local APHA office.
- Where irrigation is critical and surface water sources are known to be contaminated, consider alternative means of obtaining pathogen-free water for irrigation as indicated below. Seek advice from your local APHA and Environment Agency office before using any water treatment methods.

Validated methods to obtain pathogen-free water

A number of measures can be taken to ensure that irrigation water is free from the brown rot bacterium. Prior to opting for any of these measures, you must contact the local offices of APHA and the Environment Agency for further advice. In cases where watercourses have been designated as contaminated with the organism, any subsequent permission to irrigate using water abstracted from such watercourses must be licensed by APHA. This may include sampling and testing of the water before use. Irrigation of seed potato crops will not be permitted in such areas, regardless of any measures taken.

Winter abstraction and storage

Water abstracted during the winter months (e.g. from November to March, when pathogen populations are generally below detectable levels) can be stored and used for irrigation the following season. The pathogen is unable to multiply in storage lagoons during the winter provided they are kept free from host plants such as *Solanum dulcamara*. Care must be taken to avoid contact with any contaminated water sources during transport from the lagoon to the crop. It is important that the lagoon is kept free of hosts for the whole period that water is present and where there are any doubts about this use of the water for irrigation or spraying will not be permitted unless sampling and testing has confirmed that the pathogen cannot be detected.

Filtration

Ground water sources are likely to be pathogen-free due to the removal of bacteria during percolation through the soil. Filtration of water through reed-bed systems and slow sand filters has also been shown to remove contaminating bacteria.

Chemical disinfection

Chemical disinfection of water has been explored in the past and has been shown to effectively kill the brown rot bacterium. However these options have not been taken up to any great extent and their future use would need to be checked against Chemical Regulation Directorate and Environment Agency requirements.

Further advisory Information

For further information and general advice, please contact:

Dr John Elphinstone (Plant Bacteriologist), Fera Science Ltd., Sand Hutton, York, YO41 1LZ. Tel: 01904 462000, Email: john.elphinstone@fera.co.uk

For **England and Wales**, contact your local **APHA Plant Health and Seeds Inspector** or the **PHSI Headquarters**, Sand Hutton, York. Tel: 01904 405138
Email: planthealth.info@apha.gsi.gov.uk

For **Scotland**, contact your **local RPID officer**:
Email: hort.marketing@gov.scot

For **Northern Ireland**, contact the **DAERA Plant Health Inspection Branch**:
Tel: 0800 200 7847 Email: planthealth@daera-ni.gov.uk

For further advice regarding management or treatment of irrigation water contact your local Environment Agency office (<https://www.gov.uk/government/organisations/environment-agency>).

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Footnotes

1. Department for Environment, Food and Rural Affairs
2. Animal and Plant Health Agency
3. Council Directive 98/57/EC as amended by Directive 2006/63/EC 2014 on the control of *Ralstonia solanacearum*
4. Commission Implementing Decision 2011/787/EU of 29 November 2011 authorising Member States temporarily to take emergency measures against the dissemination of *Ralstonia solanacearum* (Smith) Yabuuchi *et al.* as regards Egypt (notified under document C(2011) 8618)