

Potato late blight

What is it?

Potato late blight is an extremely serious plant disease caused by the pathogen *Phytophthora infestans*. It's an oomycete, which are often described as 'water moulds' and are closely related to algae, not fungi as originally thought.

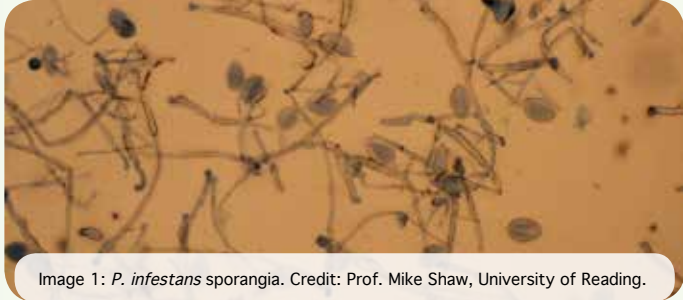


Image 1: *P. infestans* sporangia. Credit: Prof. Mike Shaw, University of Reading.

What are the symptoms?

P. infestans infects potatoes and tomatoes. In the early stages, dark spots appear on leaves and stems. Then, white mould appears under the leaves (Image 2) and the whole plant can quickly collapse.



Image 2: *P. infestans* leaf symptoms. Credit: Prof. Mike Shaw, University of Reading.

Infected tubers develop dark patches that are brown beneath the skin and then rapidly decay into mush.

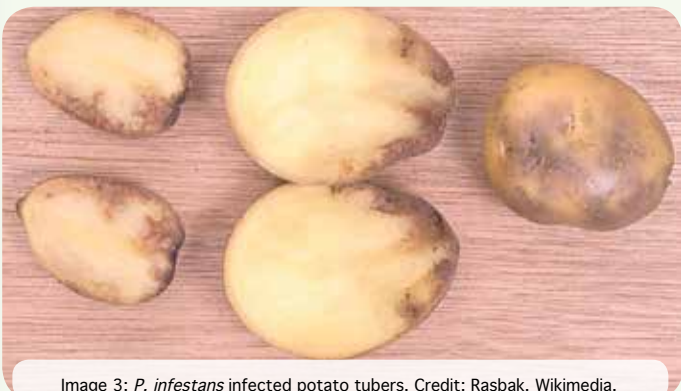


Image 3: *P. infestans* infected potato tubers. Credit: Rasbak, Wikimedia.

Why is it important?

P. infestans was the pathogen that caused the Irish potato famine (1845-57); one of the worst disease epidemics in history. The pathogen destroyed the staple crop of the Irish population: the potato. This resulted in death of over a million people and the emigration of another million.



Image 4: This sketch shows Skibbereen, west Cork, in 1847 during the famine. It was drawn by James Mahony and commissioned by the Illustrated London News Potato famine.

Research shows the *P. infestans* strain (HERB-1) that caused the famine is likely to now be extinct. The active strains today are increasingly variable and aggressive. *P. infestans* is still a threat to global food security causing worldwide losses of potatoes exceeding \$5 billion annually.

How does it infect?

P. infestans produces spore pockets called sporangia (Image 5), which under wet and cool conditions release swimming spores called zoospores. Zoospores can move through water and soil, and over leaves to find new host plants.

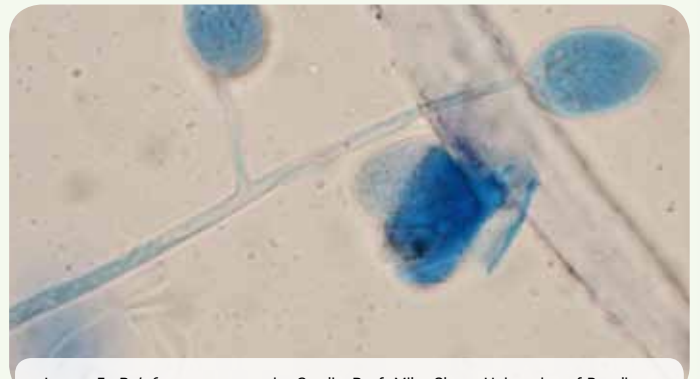


Image 5: *P. infestans* sporangia. Credit: Prof. Mike Shaw, University of Reading.

When spores come into contact with a host plant they germinate, by forming a tube which can penetrate the leaf surface.

Image 6 shows *P. infestans*, which scientists have tagged with green fluorescent protein. *P. infestans* is growing from the leaf surface between the plant cells, sticking small feeding structures into individual cells as it grows towards the stomata, where the sporangia emerge. The chlorophyll in chloroplasts is red under UV light (smaller red blobs). The larger brighter red blobs are the plant cell nuclei.



Image 6: *P. infestans* growing in between plant cells. Credit: Paul Birch and Petra Boevink, James Hutton Institute.

Masses of white sporangia are blown to healthy plants and the disease cycle continues.

Potato tubers become infected when sporangia are washed from infected leaves into the soil. Potatoes form cracks and turn a brown colour. Bacteria enter and cause the potatoes to rot.

How does it survive?

P. infestans also produces oospores, which have thick walls and help the pathogen survive overwinter on dead plant material and in the soil. It's then ready to re-infect new crops when they're planted.

How does it adapt?

Oospores are sexual, and allow mating between different strains. This mating increases the diversity of the pathogen's genes; helping it to adapt to new conditions and changes in host plants.

Which conditions?

In ideal conditions, *P. infestans* can complete its life cycle in just five days. Sporangia start to form when temperatures are above 10°C and humidity is over 75% for more than two days. Rain washes spores from infected leaves into the soil; where they infect potato tubers. Wind can help spread spores over long distances.

Potato farmers keep a keen eye out for these ideal conditions to prompt them to try to stop the disease. They can use prediction and monitoring programmes to tell them when there's a high disease risk.

What can stop it?

1. Farming practises

Farmers can try to avoid the disease by removing and destroying infected potato tubers and planting disease free seeds.

2. Fungicides

Fungicides can be used to prevent infections. The choice of fungicide depends on the strains of *P. infestans* that are found locally. However, spraying fungicides can be expensive and there is concern that some *P. infestans* populations could be becoming resistant to some fungicides.

3. Resistance

Potatoes resistant to *P. infestans* are ideal. Unfortunately, there are many *P. infestans* strains and so it's difficult to produce a potato which is resistant to all strains.

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