

Phytophthora kernoviae

A new threat to our trees and woodlands

What is it and where is it found?

Phytophthora kernoviae is a new and potentially serious pathogen of woodland environments. The disease was first discovered in historic woodland gardens in the heart of Cornwall, where both large rhododendron bushes and beech trees appeared to be dying from an unknown cause. Further investigations by the Central Science Laboratory and Forest Research revealed a previously undescribed fungus-like organism. It has now been named *P. kernoviae* (derived from Kernow, the Cornish name for Cornwall where the organism was first observed), having previously been referred to as *Phytophthora* taxon C (PTC) and *P. kernovii*.

Since it was first seen in October 2003, there have been further findings in a small number of woodlands and gardens in Cornwall and south Wales. It has been found on a single nursery in Cheshire from which it has now been eradicated.



Canker on the trunk of a mature beech tree, next to an infected rhododendron

Photo courtesy of Forest Research

Why the concern and what are the hosts?

P. kernoviae was first detected during inspections for another pathogen, *Phytophthora ramorum* – the causal agent of sudden oak death. It was causing extensive leaf blight and dieback of rhododendron and large necrotic, occasionally bleeding, cankers on several beech trees. Laboratory testing confirmed that this new exotic pathogen was the primary cause of the symptoms. The extent of the damage to trees and shrubs and the apparent speed that symptoms develop at the affected sites indicate that this disease is a potentially serious threat to woodland environments.



As of May 2005, *P. kernoviae* has been found on *Fagus sylvatica* (European beech), *Rhododendron ponticum* (and *Rhododendron hybrids*), *Gevuina avellana* (Chilean hazelnut), *Liriodendron tulipifera* (tulip tree), *Magnolia stellata*, *Michelia doltsopa*, *Pieris* spp. *Drimys winteri* (winter's bark), *Quercus ilex* (holm oak) and *Q. robur* (English oak).

***P. kernoviae* – What are its symptoms?**

Shrub hosts:

Rhododendron (*R. ponticum*, *R. catawbiense*, *R. yakushimanum* + hybrids).

The majority of findings have been on *Rhododendron ponticum* and rhododendron hybrids. Early leaf symptoms include a blackening of the leaf petiole that often extends into the base of the leaf. This necrotic (dead and dying) lesion may progress further into the leaf tissue and in extreme cases affect the whole leaf. Occasionally, however, only blackening of the leaf tip is observed. Both old and young leaves appear to be affected equally and, unusually for a *Phytophthora* infection of rhododendron, leaves often fall within a few weeks of infection. Shoot dieback and cankers frequently occur and where these girdle the stem tissue, the leaves above the lesion wilt. In severe infections, the whole bush may be killed. Leaf and stem infections can be found at any height or position on a rhododendron bush.



Rhododendron shoot dieback and leaf necrosis

Photo courtesy of CSL



Rhododendron terminal shoot wilt (note blackening of midrib and leaf tip) Photo courtesy of CSL

***Pieris* spp. and *Michelia doltsopa*.**

Similar leaf blight symptoms to rhododendron are seen, but with no obvious dieback or cankers. Infection on *Michelia doltsopa* is characterised by necrotic leaf lesions on the leaves that progress along the leaf margins and into the tissue of the leaf blade. Necrotic leaf tissue is characteristically a dark black-brown colour. Typically lesions on leaves of *Pieris* species are a light tan to rusty brown colour. Necrosis progresses directly towards the central (midrib) vein, and along the vein, causing a visually striking leaf blight.



***Pieris* spp. leaf necrosis**

Photo courtesy of CSL



***Michelia doltsopa* leaf necrosis**

Photo courtesy of Forest Research

P. kernoviae – What are its symptoms?

Tree hosts:

European beech (*F. sylvatica*)

Initial symptoms are bleeding lesions on the trunk, and these may be found anywhere from ground level to up to 12m. The bleeding is usually dark brown to blue-black and similar to symptoms caused by *P. ramorum*. Underneath, orange-pink to pinky-brown active lesions in the inner bark are visible. Sometimes girdling of the entire tree can occur. Older lesions may appear sunken.

English oak (*Q. robur*)

Bleeding lesions on the trunk are similar to those on *F. sylvatica* but may be more difficult to see both internally and externally because of the thick outer bark ridges and outer bark plates of oak. Bleeding can occur from cracks between the bark ridges. Older cankers may not become sunken as with beech.



Bleeding lesion on English oak (*Q. robur*)

Photo courtesy of Forest Research



Bleeding canker on European beech (*F. sylvatica*)

Photo courtesy of CSL



Tulip tree (*Liriodendron tulipifera*)

Disease symptoms occur on foliage, shoots and the trunk. Multiple bleeding lesions are formed on the trunk from ground level up to 9m. Internal lesions range in colour from pale chocolate to dark chocolate to blue-black. Lesions tend to be limited in size (approx 15x20cm) and the bark becomes highly corrugated as a result of the multiple lesions. Lesions can also develop on leaves; these are fairly restricted to leaf-tips (approx 10-15mm length) and on the leaf margins. The necrotic tissue dries out to a dark black colour. Shoot dieback also occurs and infected shoots are defoliated.

Bleeding canker on the trunk of a Tulip tree (*Liriodendron tulipifera*)

Photo courtesy of Forest Research

***P. kernoviae* – What are its symptoms?**



Holm oak (*Q. ilex*)

Symptoms are entirely limited to severe necrotic leaf lesions and dieback of epicormic shoots (new shoots arising from near the base of the plant). There has been no evidence of sunken or bleeding cankers on the stems of infected trees.

Symptoms on holm oak leaf

Photo courtesy of CSL

Magnolia

Distinctive symptoms are found on infected foliage with infection occurring anywhere on the leaf surface. Multiple infections are evident as numerous dark brown necrotic patches, giving leaves a spotty appearance. There is a tendency for these necrotic spots to merge and develop towards the centre of the leaf (midrib), and as lesions become well developed leaves are noticeably mottled. The mottling may have angular edges and uninfected tissue between necrotic areas becomes chlorotic (yellowing). Infections that take place at the leaf margin cause it to collapse and form a hard, dry rim. The petioles (leaf stalk) can be infected and disease often progresses along the leaf base following petiole infection. Buds can also become diseased and turn light khaki-grey.



Multiple infections on magnolia

Photo courtesy of Forest Research

How does it develop and spread?

As *P. kernoviae* is a recently described species, our understanding and knowledge about its development, spread and survival is still limited. It produces similar reproductive structures to *P. ramorum*. Infective spores (zoospores) are contained within sporangia and can be spread locally from leaf to leaf and plant to plant via water splash, or in airborne mist droplets (based on *P. ramorum* dispersal studies). Under suitably moist conditions, each sporangium will release swimming zoospores, which penetrate susceptible host material. Infection is more likely via wounds or natural openings such as stomata and lenticels. The organism then grows through the infected tissue, killing plant cells in its path, and eventually resulting in the observed necrotic disease symptoms. Under suitable conditions, asexual reproduction then takes place and new sporangia are produced thus completing *P. kernoviae*'s life cycle. Local and long distance spread of the pathogen may also be by movement of contaminated plant material, growing media, and in soil carried on vehicles, machinery, footwear or animals.

Some *Phytophthora* species, including *P. ramorum*, survive unfavourable periods such as hot summers or cold winters as long-lived spores known as *chlamydospores*. These have not been observed with *P. kernoviae*, either in the field or laboratory. Another spore form – the sexual spore, or oospore – can also serve as a survival structure for a number of *Phytophthora* species. These are produced by *P. kernoviae* in the laboratory but so far have not been found in naturally infected plant material. Investigations continue into the method of survival by *P. kernoviae*.

What is being done?

To date *P. kernoviae* has only been observed at a limited number of sites in Cornwall, south Wales and Cheshire. Defra's Plant Health and Seeds Inspectorate and the Forestry Commission are carrying out extensive inspections for the presence of *P. kernoviae* as part of the current national survey for *P. ramorum*. Statutory action is taken whenever the pathogen is found. Measures include the destruction of affected plants, with tracing and inspection of any related stocks moving in trade.

To gain a better understanding of the disease, studies are being made into several aspects of the pathogen's epidemiology, such as host range, symptom expression and survival mechanisms. Studies of the genetic make up of the *P. kernoviae* isolates from each outbreak have shown that they are all very closely related, but distinct from *P. ramorum* and a range of other common *Phytophthora* species.

Keep a good look out

Phytophthora kernoviae is a notifiable pathogen. Statutory action is being taken to prevent its spread.

If you suspect the presence of this disease on your premises, you should immediately contact your local Defra Plant Health and Seeds Inspector or the PHSI HQ, York:

Tel: 01904 455174

Fax: 01904 455197

Email: planthealth.info@defra.gsi.gov.uk

web: www.defra.gov.uk/planth/ph.htm

If your premises is located in the Cornwall area, you can contact the local PHSI office direct on:

Tel: 01872 275063

Fax: 01872 275070

If you suspect the presence of the disease on trees you should contact the Forestry Commission Plant Health Service, Edinburgh.

Tel: 0131 314 6414

Fax: 0131 314 6148

web: www.forestry.gov.uk