# A threat to our woodlands, heathlands and historic gardens

# *Phytophthora kernoviae*

PLANT DISEASE FACTSHEET

**Canker on the trunk of a mature beech tree, next to an infected rhododendron.** Photo courtesy of Forest Research

## What is it and where is it found?

*Phytophthora kernoviae* is a serious plant pathogen causing diseases of trees and shrubs in UK woodlands, heathlands and managed gardens. The pathogen was first discovered in October 2003 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 Fera and Forest Research revealed a previously undescribed fungus-like organism. It has now been named *Phytophthora kernoviae* (derived from Kernow, an old Cornish name for Cornwall).

Since it was first detected, there have been findings in woodlands, heathlands, gardens and a small number of nurseries principally in South West UK; however there have also been findings in Scotland, Ireland and New Zealand. Historic records suggest it has been in New Zealand since at least the 1950s.

## Why the concern and what are the hosts?

*P. kernoviae* was first detected during official surveys for another plant pathogen, *Phytophthora ramorum*. *P. kernoviae* was causing extensive leaf blight and dieback of rhododendron and large necrotic, occasionally bleeding cankers on several beech trees. The pathogen is also causing damaging symptoms to bilberry (*Vaccinium myrtillus*) in heathland and woodland. Ornamental plants and trees in historic managed gardens have also become infected. The extent of the damage to trees, shrubs and heathland plants and the apparent speed of infection at the affected sites show that this pathogen is a serious threat to woodland, heathland and garden environments.

Forestry Commission

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The Food and Environment Research Agency

As of April 2010, *P. kernoviae* has been found infecting and in some cases killing the foliage of *Rhododendron ponticum* (and *Rhododendron* hybrids), *Drimys winteri, Gevuina avellana* (Chilean hazelnut), *Hedera helix, Ilex aquifolium, Liriodendron tulipifera* (tulip tree), *Lomatia myricoides*, *Magnolia* spp. *Michelia doltsopa, Pieris formosa, P. japonica, Podocarpus salignus, Prunus laurocerasus, Quercus ilex* (holm oak), *Sequoidendron giganteum* and *Vaccinium myrtillus*. It has also been found to infect mature bark on trees of *Fagus sylvatica* (European beech) and *Quercus robur* (English oak), although currently only about 70 trees have been found with this form of infection. In New Zealand, the custard apple tree (*Annona cherimola*) is also a host.

## What are its symptoms?

### Shrub hosts:

***Rhododendron* (*R. ponticum, R. catawbiense, R. yakushimanum and hybrids*)**
The majority of findings have been on *R. 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 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. 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.

***Pieris spp. Michelia doltsopa, Hedera helix, Ilex aquifolium* and *Prunus laurocerasus***
Similar leaf blight symptoms to *Rhododendron* are seen. Infection on *M. doltsopa* is characterised by drip tip 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 and along the midrib vein causing a visually striking leaf blight. To date, only stem infection has been observed on *H. helix*; dark necrotic lesions on leaves of *I. aquifolium* and both leaf infection and stem dieback on *P. laurocerasus*.

**Rhododendron shoot dieback and leaf necrosis**

**Rhododendron terminal shoot wilt (note blackening of midrib and leaf tip)**

***Pieris* spp leaf necrosis**

***Michelia doltsopa* leaf necrosis**

***Vaccinium myrtillus***

In November 2007, *P. kernoviae* was found for the first time on *Vaccinium myrtillus* (Bilberry) in Cornwall. Since then *P. kernoviae* affecting this host has been detected at a further four separate sites in Cornwall and is spreading across the affected areas. The pathogen has also been found affecting bilberry on the Isle of Arran. Early symptoms include necrotic black-brown lesions on the leaves as well as on the green stems of plants. When infection is severe on a site, then patches of brown necrotic *Vaccinium* are visible amongst healthy plants. Infection can be distributed throughout an affected area or may follow paths. Severe infection will kill the plants.

**Necrotic stem lesions on Vaccinium**

## Tree hosts:

**European beech *(F. sylvatica)***

Beech is the main species of tree affected by *P. kernoviae*. 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 trunk can occur and the tree is killed. Older lesions may appear sunken.

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

**English oak *(Q. robur)***

Stem bleeding lesions 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 occurs from cracks between the bark ridges from the underlying infected tissue, but the thickness of the bark prevents older cankers from becoming sunken as with beech.

**Bleeding lesion on English oak *(Q. robur)*.**
Photo courtesy of Forest Research

**Tulip tree (*Liridodendron tulipifera*)**
Only one diseased tree has been found to date but disease symptoms can occur on foliage, shoots and 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 (approximately 15x20cm) and the bark becomes highly corrugated as a result of the multiple lesions. Lesions can also develop on leaves; there are fairly restricted to leaf-tips (approximately 10-15mm in 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 *(Liridodendron tulipifera)***
Photo courtesy of Forest Research

**Holm oak (*Q. ilex*)**
Severe necrotic leaf lesions and dieback associated entirely with epicormic shoots. No evidence of sunken or bleeding cankers has been observed.

**Symptoms on holm oak leaf**

***Magnolia* spp.**
Distinctive symptoms are found on infected foliage. Infection occurs anywhere on the leaf surface and multiple infections are evident as numerous dark brown necrotic patches, giving leaves a spotty appearance. There is a tendency for the necrotic spots to merge and develop towards the midrib. Leaves become conspicuously mottled when lesions are well developed. The mottling may have angular edges and uninfected tissue between necrotic areas becomes chlorotic. Infections that take place at the leaf margin cause the margin to collapse and form a hard dry rim. The petioles 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

The most recently-updated list of known hosts is available on the Fera website at http://www.defra.gov.uk/fera/plants/plantHealth/documents/kernhost.pdf

## How does it develop and spread?

*P. kernoviae* produces similar reproductive structures to *P. ramorum*. Infective spores (zoospores) are contained within sporangia and can be transported from leaf to leaf and plant to plant via rain-splash, wind-driven rain, mist, irrigation or possibly in ground water. 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, 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.

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 naturally infected plants.

Long distance spread occurs by movement of infected plant material, also, possibly in growing media, and in soil carried on vehicles, machinery, footwear or on animals.

## What is being done?

Fera'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 primarily include the destruction of affected plants, with tracing and inspection of any related stocks moving in trade, and increased monitoring of imported host plants and wood.

Further research into the pathogen's epidemiology (including it's effects on *Vaccinium*) and management of the organisms in parks and gardens is currently underway.

Studies of the genetic make up of *P. kernoviae* isolates from each UK outbreak have shown that they are all identical, but distinct from *P. ramorum* and a range of other common *Phytophthora* species.

## What you can do

Good cultural practice is key to effective control and management of *P. kernoviae*. Follow these simple practical steps when dealing with susceptible plants to reduce disease risk:

- Monitor - familiarise yourself with the disease and its host range so that you are able to recognise symptoms promptly.
- Husbandry - clean and disinfect secateurs and tools regularly with an appropriate product. Take care when handling plants as a wounded leaf can be more susceptible to infection, especially if weather conditions are favourable to disease infection. Prune susceptible host plants in dry weather.
- Watering – if possible water plants in the morning rather than at night. Ensure that potted plants are not standing in water for any length of time.
- Plant spacing – good air movement helps to combat disease spread.

## Keep a good look out

*Phytophthora kernoviae* is a notifiable pathogen and statutory action is being taken to prevent its introduction and spread.

If you suspect the presence of this disease on your premises, in England and Wales, you should immediately contact your local Fera Plant Health and Seeds Inspector or
Tel: 01904 465625
Email: planthealth.info@fera.gsi.gov.uk
Web: http://www.fera.defra.gov.uk/plants/plantHealth/pestsDiseases/pKernoviae.cfm

Or, in Scotland contact the SEERAD Horticulture and Marketing Unit, Edinburgh:
Tel: 0131 244 6303
Email: hort.marketing@scotland.gsi.gov.uk
Web: www.scotland.gov.uk

Or, in Northern Ireland contact the DARDNI helpline:
Tel: 028 9052 4999
Web: www.dardni.gov.uk

In England, Wales and Scotland, if you suspect the presence of the disease on trees you should contact the Forestry Commission Plant Health Service, Edinburgh:
Tel: 0131 3146414
Web: www.forestry.gov.uk

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