

A threat to our woodlands, heathlands and historic gardens

Phytophthora ramorum



Area around infected Rhododendron

What is it and where is it found?

Phytophthora ramorum is a serious fungus-like pathogen causing damage to a wide range of trees and plants in Europe and the USA.

In the EU, *P. ramorum* has been recorded as present in Belgium, Czech Republic (eradicated nursery finding), Denmark, Estonia, Finland, France, Germany, Ireland, Italy, Latvia, Lithuania, Luxembourg, the Netherlands, Poland, Portugal, Slovenia, Spain (including Mallorca), Sweden and the UK (including the Channel Islands). Elsewhere in Europe, *P. ramorum* has also been recorded in Norway and Switzerland.

In the USA, California and Oregon have been worst affected with numerous trees killed as a result of infection. It has also been found in a range of ornamental plants in nurseries in several US states and Canada.

The pathogen is considered to have been introduced separately and relatively recently to the USA and Europe, possibly from Asia. The pathogen exists as two separate mating types (A1 and A2) and sexual reproduction can only occur if these two types come together. If this mating system is functional, it would result in relatively long-lived spores and potentially, greater genetic variability, thereby making control of the disease much more difficult; however recent studies have suggested that this is an unlikely event. Of further concern is the resting spore (chlamydospore) stage that can survive in the soil and plant debris for many years.

PLANT DISEASE FACTSHEET

Why the concern and what are the hosts?

The disease has reached epidemic proportions in California and Oregon where it is causing widespread death of species of oak and tanoak trees and is commonly known there as 'Sudden Oak Death'. It has also been found on a wide range of other trees and plants native to North America. In the USA, the pathogen was originally considered a woodland disease, but since 2003 been impacting nursery plants in several US states. It has also been found in areas of Canada.

In the UK and Europe, the pathogen had been found predominantly on ornamental plants in nurseries in several European countries. However, it had also been found outside nurseries in a few managed gardens and semi-natural woodland areas on hardy shrubs (principally rhododendron) and affecting a number of trees in the UK (South West England being the worst affected area) and the Netherlands.

To date the full range of known ornamental hosts in the UK and Europe include species of *Arbutus*, *Calluna* (heather), *Camellia*, *Choisya*, *Cornus*, *Garrya*, *Ilex*, *Griselinia*, *Hamamelis* (witch-hazel), *Kalmia*, *Laurus* (laurel), *Leucothoe*, *Lonicera* (honeysuckle), *Magnolia*, *Michelia*, *Osmanthus*, *Parrotia*, *Photinia*, *Pieris*, *Rhododendron*, *Ribes*, *Syringa* (lilac), container grown *Taxus* (yew), *Umbellularia californica* (Californian bay laurel), *Vaccinium* and *Viburnum*. Most nursery findings have been on container-grown *Rhododendron*, *Viburnum* and *Camellia* plants.

However, the main threat is to tree species and other ecologically important plants, such as heathland species. In October 2003, an American southern red oak tree (*Quercus falcata*) was the first tree infected with *P. ramorum* in the UK coinciding with the first tree finding in the Netherlands on a northern red oak (*Quercus rubra*). There has since been findings in the UK on several other oak species (canyon live oak, coast live oak, holm oak, Japanese evergreen oak, turkey oak, sessile oak), as well as ash, camphor, chinquapin, coast redwood, European beech, eucalyptus, horse chestnut, goat willow, *Lithocarpus*, maple, *Nothofagus*, osmanthus, *Schima*, silver birch, sweet chestnut, sycamore, western hemlock and winter's bark.

In August 2009 severe infection of Japanese larch (*Larix kaempferi*) was found at a number of sites throughout south west England. Infected rhododendrons have been in close proximity to all infected UK trees (except some outbreaks on larch) to date. Experimental work has highlighted other tree species that could also be at risk from *P. ramorum* in the UK. These include Douglas fir (a natural host in the USA), Noble fir, Lawson cypress and Sitka spruce.

Initial UK surveys of *Vaccinium* species in heathland environments did not detect the pathogen. However, in December 2008, bilberry (*V. myrtillus*) was found infected by *P. ramorum* in woodland in Cornwall and has since been found at a number of locations in the wild. Laboratory tests have shown that some species of heather (*Erica* species) and Scottish heather (*Calluna vulgaris*) are susceptible to the pathogen. Scottish heather has been recorded as a natural host in mainland Europe (nursery finding), cowberry (*V. vitis-idaea*) was found infected on a UK nursery and huckleberry (*V. ovatum*) is a natural host in woodland in North America.

Several other hosts such as *Calluna*, *Pyracantha* and *Photinia* have been reported as natural hosts for *P. ramorum* from nurseries and Californian wood rose (*Rosa gymnocarpa*) has been reported as a natural wild host from the USA; although to date these hosts have not been found infected in the UK.

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

Experimental data on the susceptibility of tree and non-tree species is available at <http://www.defra.gov.uk/fera/plants/plantHealth/documents/testhost.pdf>

Further details of known natural hosts and experimental susceptibility can be found at <http://rapra.csl.gov.uk/>

What are its symptoms?

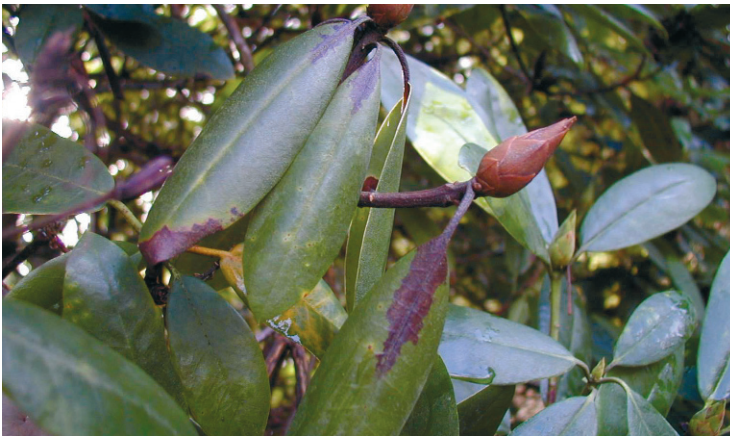
On *Rhododendron*

P. ramorum causes shoot/twig and leaf blight. Affected shoots or twigs develop a brown to black discolouration that can spread into the leaves via leaf petioles (leaf stalk). Leaf infection can also occur without twig infection; roots are unaffected. Symptoms can be similar to those caused by other fungal pathogens on *Rhododendron*, but their development can be more rapid.

Characteristic symptoms include blackening of the petiole leaf base and leaf tip that may extend along the mid-rib. Twig cankers can lead to wilting of shoots; in such cases leaves remain attached but may not develop any lesions.



Aerial dieback of *Rhododendron*



Blackening around the tips and mid-ribs of *Rhododendron* leaves



On *Viburnum*

Infection commonly occurs at the stem base causing wilting and then death. The pathogen may also cause brown to black leaf infections, especially on evergreen species and can also affect flowers. It has been isolated from roots associated with stem-base lesions, but root infection has not been proven.



Flower and foliage dieback on *Viburnum*

On *Pieris*

P. ramorum causes brown stem lesions that lead to aerial dieback and leaf symptoms as described on *Rhododendron*.



Foliage dieback on *Pieris*

On species of *Camellia*, *Griselinia*, *Kalmia*, *Magnolia*, *Laurus* (laurel), *Leucothoe*, *Syringa* (lilac) and *Umbellularia californica*

The pathogen usually only causes leaf infections. Leaf lesions are usually brown to black areas, typically occurring at the tip or edges of the leaves. On *Camellia* and *Magnolia*, some shoots have also been found infected leading to dieback.



***Kalmia* leaf blight**



***Leucothoe* leaf necrosis**



***Camellia* leaf blight**



Lilac leaf blight

On *Hamamelis* (witch-hazel) and *Parrotia*

Symptoms are similar to *Rhododendron*, mainly visible at the tip and edge of leaves and are usually delimited by the veins.

On *Vaccinium*

Symptoms caused by *P. ramorum* on *V. myrtillus* and *V. vitis-idaea* are similar. Necrotic brown stem lesions that occasionally can be seen in the form of bands are common on *Vaccinium* stems, and these can lead to shoot dieback or death as the disease progresses. Leaves can also be affected where black lesions can extend from the petiole end into the rest of the leaf. Severe infection will kill the plant.



Necrotic stem lesions and dieback of *Vaccinium*



Necrotic stem lesions on *Vaccinium*

On trees

The pathogen can affect just the bark (e.g. beech), or both bark, leaves and shoots (e.g. tanoak in California); it is also possible that some trees may be just leaf hosts (e.g. ash, which has susceptible leaves, but has not yet been found to have susceptible bark).

Bark infections appear most typically as large cankers that have brown to black discoloured outer bark that seep dark-red sap (commonly called 'bleeding cankers' or 'tarry spots'). These cankers usually occur on the lower portion of the trunk.

When the outer bark is removed mottled areas of necrotic (dead and dying) and discoloured inner-bark tissue with black 'zone lines' around the edges may be seen. Diseased areas may become colonised by bark beetles. When cankers girdle the trunk, death of the tree occurs. Death can be rapid such as in tanoak (*Lithocarpus densiflorus*) in the USA, or may take one or more years, such as in American *Quercus* species. Cankers do not extend below the soil line and do not appear to infect the roots.

Leaf infections most commonly appear as brown necrotic areas, often at the edge or tip of the leaf. On broadleaved tree hosts in Europe, leaf and shoot infections have been found on holm oak, ash, Winter's bark and sweet chestnut.



Stem lesions on *Nothofagus* sp. (southern beech)



Bleeding canker on *Quercus falcata* (southern red oak)



Inner bark stem lesions on *Nothofagus* sp.



Q. ilex (holm oak) infected foliage



Fraxinus excelsior (ash) infected foliage

On conifers

The pathogen causes a needle blight and dieback of young shoots of Douglas fir, coastal redwood and grand fir. However, natural infection of these species has not occurred in the UK. Needle infections, shoot dieback, branch and trunk cankers are typical symptoms observed on Larch. Infected shoot tips wither and wilt and infected needles appear blackened. Early needle abscission of infected needles also occurs.



Needle blight and dieback of larch shoots

How does it develop and spread?

The pathogen produces two different types of asexual 'spores': sporangia (involved in pathogen dispersal) and chlamydospores (involved in survival). Both types of spores, may be produced on leaves of susceptible hosts, but as yet have not been observed directly on bark cankers on trees. Leaf hosts are therefore an important source of inoculum for initiating tree infection. In the UK, quarantine controlled experiments have shown that the pathogen can survive in plant debris for at least three consecutive winters. However, comparisons with similar *Phytophthora* species indicate that *P. ramorum* could possibly survive for longer. It is thought to be dispersed locally by rain splash, wind-driven rain, irrigation or ground water. *P. ramorum* has been recovered throughout the year from plant debris, water courses and soil up to a depth of 15cm at infected sites. Long distance spread occurs by movement of contaminated plant material, possibly on growing media, and in soil carried on vehicles, machinery, as well as on footwear or possibly on animals.

What is being done?

Statutory action of eradication or containment is being taken whenever the pathogen is found. Measures include the destruction of affected plants, tracing of related stocks on horticultural plants moving in trade, and increased monitoring of imported host plants. Since 2001, Fera Plant Health and Seeds Inspectors and the Forestry Commission have conducted an intensive surveillance programme of nurseries, garden centres, ports, parks, gardens, and woodlands in England and Wales, inspecting annually around 3,000 commercial premises and around 2,000 parks, gardens and woodlands.



Fera Plant Health and Seeds inspector sampling *Rhododendron*



In-field test kits for *P. ramorum* diagnosis



Destruction of infected trees and plants

What you can do

Good cultural practice is key to effective control and management of *P. ramorum*. 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 ramorum 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/pRamorum.cfm>

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

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