

Phytophthora ramorum

A threat to our trees, woodlands and heathlands

What is it and where is it found?

Phytophthora ramorum is a serious fungus-like pathogen causing damage to trees and a range of native plants in California and Oregon, USA. It is now also affecting a range of ornamental plants in several US states and Canada.

In Europe, it has been found in many countries including Belgium, Denmark, France, Germany, Italy, the Netherlands, Norway, Poland, Republic of Ireland, Slovenia, Spain, Sweden, Czech Republic and the UK including the Channel Islands. It has mainly affected ornamental plant species in nurseries. However, it has also been found on a few trees and in some established plantings of shrub hosts (mainly rhododendron) in a limited number of countries.

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. To date, all UK isolates have been the A1 mating type, as have most European isolates, although a single A2 mating type isolate has been found on the continent. All North American woodland isolates have been of the A2 mating type but European A1 isolates have been found on plants in nurseries in North America.



P. ramorum – What are its symptoms?

On *Rhododendron*, *P. ramorum* causes shoot/twig and leaf blight. Affected shoots or twigs develop a brown to black discoloration 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.

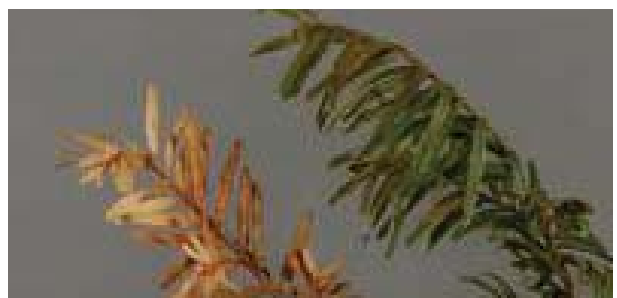
On *Viburnum*, infection commonly occurs at the stem base causing wilting and then death. The pathogen may also cause brown to black leaf infections, especially on evergreen species and can also affect flowers. It has been isolated from roots associated with stem-base lesions, but root infection has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



On *Pieris*, it causes brown stem lesions that lead to aerial dieback and leaf symptoms as described on rhododendron.



On *yew*, symptoms are a needle blight of the young foliage resulting in an aerial dieback.



P. ramorum – What are its symptoms?

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*, 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.

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.

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.

P. ramorum – What are its symptoms?



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



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



Inner bark stem lesions on *Nothofagus* sp.

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.



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.

Why the concern and what are the hosts?

The disease has reached epidemic proportions in California where it is causing widespread death 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 America. In the USA, the pathogen was originally considered a woodland disease but it has also been found damaging nursery plants in several US states and Canada.

To date the full range of known ornamental hosts in the UK and Europe include species of *Arbutus*, *Calluna* (heather), *Camellia*, *Griselinia*, *Hamamelis* (witch-hazel), *Kalmia*, *Laurus* (laurel), *Leucothoe*, *Lonicera* (honeysuckle), *Magnolia*, *Osmanthus*, *Parrotia*, *Photinia*, *Pieris*, *Rhododendron*, *Syringa* (lilac), container grown *Taxus* (yew), *Umbellularia californica* (Californian bay laurel) 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, a southern red oak tree (*Quercus falcata*), a native American species, was the first tree infected with *P. ramorum* in the UK. There have since been findings in the UK on several other oak species (holm oak, turkey oak, sessile oak), as well as ash, European beech, horse chestnut, sweet chestnut, sycamore and Winter's bark. Infected rhododendrons have been in close proximity to all infected UK trees 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, maple spp., Noble fir, Lawson cypress and Sitka spruce.

Initial UK surveys of *Vaccinium* spp. in heathland environments did not detect the pathogen. However, some species are considered to be at high risk, especially bilberry (*Vaccinium myrtillus*), which has been shown to be highly susceptible in laboratory tests. Thus infected bilberry could potentially be a source of inoculum where it occurs in close proximity to susceptible trees. Also susceptible in laboratory tests were some species of heather (*Erica* spp.) and Scottish heather (*Calluna vulgaris*). Scottish heather has been recorded as a natural host in mainland Europe and huckleberry (*Vaccinium ovatum*) is a natural host in North America.

A full list of known hosts in the UK, Europe and North America is available on the Defra website at <http://www.defra.gov.uk/plant/newsitems/suscept.pdf>
Further details of known natural hosts, along with experimental data on the susceptibility of potential hosts is available at <http://rapra.csl.gov.uk/>

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 two 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 15 cm at infected sites. Long distance spread occurs by movement of contaminated plant material, growing media, and in soil carried on vehicles, machinery, footwear or animals.

What is being done?



Statutory action 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, Plant Health and Seeds Inspectorate have conducted an intensive surveillance programme of nurseries, garden centres, ports, parks, gardens and woodland in England and Wales; inspecting annually around 3,000 commercial premises and around 2,000 parks, gardens and woodlands. The first national survey of over 1,000 woodland sites was completed by the Forestry Commission in April 2004 and no infection was found. Further, less intensive, surveys are being carried out each year around the country and reports can be viewed on the Forestry Commission website.

Defra, the Forestry Commission, the Horticultural Development Council and European Union have commissioned research to investigate the biology, epidemiology and management of *P. ramorum*. The key findings from UK research to date are given in a separate information leaflet. This and more detailed information is available on the Defra Plant Health website.

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 Plant Health and Seeds Inspector or the PHSI HQ, York:

Tel: 01904 455174

Fax: 01904 455197

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

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

Or, in **Scotland** contact the SEERAD Horticulture and Marketing Unit, Edinburgh:

Tel: 0131 244 6303

Fax: 0131 244 6449

Email: hort.marketing@scotland.gsi.gov.uk

Website: www.scotland.gov.uk

Or, in **Northern Ireland** contact the DARDNI helpline:

Tel: 028 9052 4999

Website: 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 314 6414

Fax: 0131 314 6148

Website: www.forestry.gov.uk/planthealth