

A serious threat to Lawson's cypress (*Chamaecyparis lawsoniana*) *Phytophthora lateralis*



Figure 1. Single infected mature Lawson's cypress tree
Photo courtesy of Forestry Commission (ref 2014314)

What is it and where is it found?

Phytophthora lateralis is a fungus-like plant pathogen which causes an often fatal disease of trees, mainly in the genus *Chamaecyparis*. Lawson's cypress (*C. lawsoniana*) is the primary host.

P. lateralis is commonly found on *C. lawsoniana* in forests in the native range of this tree species in southern Oregon and northern California. The pathogen is also found in Canada.

Typically, the main parts of the tree that becomes infected are the roots and stem base. The pathogen has occasionally been found to infect aerial parts.

P. lateralis is assumed to have been introduced to North America in 1923 from a then unknown origin. In 2008 it was detected in soil in forests of *Chamaecyparis obtusa* var. *formosana* (yellow cedar) in north-eastern Taiwan; this is now thought to be within the centre of origin of the pathogen.

In Europe, the first reported outbreaks of disease caused by *P. lateralis* occurred on nurseries in France (two outbreaks with a single origin) in 1996 and 1998, and later in the Netherlands in 2004. All three outbreaks are considered to be eradicated. Introduction to France is suspected to have been from North America but this has not been confirmed.

In 2010, France announced further outbreaks of *P. lateralis* on hedges of *C. lawsoniana* at several sites in Brittany in north-west France; these had shown signs of decline and mortality since 2005 although the cause was only confirmed in 2009. Several thousand trees have been affected. Trees have been felled but not

PLANT DISEASE FACTSHEET

replaced. The hedges were planted in the 1970s and assuming these were healthy at the time, it is thought that the pathogen may have been introduced subsequently through infected nursery plants, possibly through soil, in watercourses or by wind. However, the origin of the inoculum is not known.

Later in 2010, the Netherlands announced an isolated finding of *P. lateralis* on *C. lawsoniana* on a nursery on field-grown plants. This new outbreak is not connected to the 2004 Netherlands finding (later reported as 2005). The Plant Protection Service of the Netherlands is taking eradication action against the 2010 finding as well as implementing measures to prevent further spread.

In November 2010, scientists from Forest Research (the Forestry Commission (FC) research agency) sampled symptomatic *C. lawsoniana* trees in a country park near Glasgow in south-west Scotland and identified *P. lateralis* as present in mature (70-80 years old) trees. This was the first UK record of the pathogen. Investigations and action have been ongoing. By May 2011 there were a total of four confirmed outbreaks within less than 30 miles of each other, all affecting mature trees. These trees (including up to 100 symptomatic trees at the first site) have been felled and destroyed by burning. Containment measures have been imposed to try to prevent movement of *P. lateralis* from the known affected sites.

In July 2011 symptomatic *C. lawsoniana* trees in a forest park on the coast of County Down, Northern Ireland, were sampled and tested by scientists from the Agri-Food and Biosciences Institute (AFBI) and Forest Research and were found to be infected with *P. lateralis*.

The distribution of *P. lateralis* in the rest of the EU is unknown.

Why the concern, what are the hosts, are there any phytosanitary controls to limit the risk?

Until late 2010, *P. lateralis* had not been found in the UK. Its recent discovery is of concern due to the often fatal nature of infection on the main host, Lawson's cypress (*C. lawsoniana*). Other *Chamaecyparis* spp. that are named hosts are *C. formosensis* and *C. obtusa*. *Taxus brevifolia* (Pacific yew) is an occasional host in North America. The susceptibility of *Taxus baccata* (English or European yew) to *P. lateralis* is currently unknown. Symptomatic trees of *T. baccata* were detected at the first affected site in Scotland but these were tested by Forest Research scientists and found not to be infected with *P. lateralis*. In March 2011, containerised plants of *Thuja occidentalis* (white cedar) imported from mainland Europe with symptomatic foliage were tested by Scottish Government scientists at SASA (Science and Advice for Scottish Agriculture) and found to be infected with *P. lateralis*. Although Koch's' postulates have not yet been undertaken this appears to be a new host for the pathogen. Subsequently SASA also diagnosed *P. lateralis* on containerised plants of *C. lawsoniana*, also imported from mainland Europe.

Whilst imports of *Chamaecyparis* from third countries are banned under EU phytosanitary legislation, clearly this has not prevented the pathogen from entering the EU as demonstrated by the initial outbreaks in the late 1990s in France. The subsequent findings in the Netherlands and France and the recent findings in established plantings in Scotland and Northern Ireland may have been introduced from outside or even from within the EU; however the source of introduction in all of these cases is not known. Possible routes may have been on imported *T. brevifolia* (which is not banned entry from third countries), or, on soil associated with the roots of non-hosts originating in areas where the pathogen occurs. Another possible route could be with species that are natural hosts but which are not yet reported in the literature. This is particularly relevant because the status of the pathogen in Taiwan on species other than *C. lawsoniana* is unknown. In support of this hypothesis the first known interception of *P. lateralis* in the UK in March 2011 was on *T. occidentalis*, a species previously not reported as susceptible to infection by *P. lateralis*. The first site known to be affected in the UK (Scotland) was subject to a major replanting scheme over the past 5 years using plant material imported mainly from continental Europe and southern England. There have been no findings of *P. lateralis* in England to date, but movement from continental Europe may have been a route of introduction of *P. lateralis* to the Scottish site.

The pathogen could continue to enter the UK and may spread in the nursery trade through movement

of: infected host plants, contaminated growing media associated with non-host plants, or as a soil/water contaminant. Where movement is not associated with symptomatic host material it would not be detected. Should *P. lateralis* spread further into the wider environment it is likely to cause tree death amongst other plantings of *C. lawsoniana*, other *Chamaecyparis* species, and, maybe other species of trees and shrubs. Aerial spread is a possible route of movement of the pathogen in the local area.

Whilst *C. lawsoniana* is not an important forestry tree in Britain, it is a valued ornamental and where trees are planted in close proximity to watercourses this favours infection and spread (see 'How does it develop and spread' below). There is a risk of tree mortality in areas where *Chamaecyparis* spp. (particularly *C. lawsoniana*) and *Taxus brevifolia* are grown. Spread to and death of other species cannot be excluded.

To determine the threat posed by *P. lateralis*, a Pest Risk Analysis (PRA) was performed by the UK in 2006 when the pathogen was on the EPPO Alert List. As a result of an EPPO PRA also conducted in 2006, *P. lateralis* is now on the EPPO A1 list of pathogens recommended for regulation by EPPO member countries. Currently the pathogen is not regulated by the EU. In 2007, the UK requested that the pathogen be added to Annex IIAI of the EC Plant Health Directive on relevant host plants, and for the pathogen to be taken into account when reviewing measures on soil.

For more information see the UK Pest Risk Analysis at:

<http://www.fera.defra.gov.uk/plants/plantHealth/pestsDiseases/documents/lateralis.pdf>

and the EPPO PRA at:

http://www.eppo.org/QUARANTINE/Pest_Risk_Analysis/PRA_documents.htm

What are the symptoms?

Above-ground symptoms on infected trees include dieback of the foliage, stem and collar lesions, with resin bleeding from stem lesions. Further investigation of the root system will show root necrosis. The root/collar infection is described as 'tongue-like'; this can be observed by removal of the outer bark whereupon the phloem is necrotic, often cinnamon brown in colour, with a distinct margin between diseased and healthy tissue.

When roots and collars/stem bases are affected, foliage of infected trees initially appears slightly lighter in colour than that of healthy trees, later the foliage withers, turns bronze, and finally, light brown, concurrent with drying and darkening of the inner bark.

Aerial infection has rarely been reported in the literature. However, this was observed in the outbreaks in Brittany. Dead branches with small cankers occurred in the middle to lower part of the hedge canopy. Tissue beneath the cankers was brown with discolouration spreading down the affected branches. At one site this occurred in the absence of any root or collar lesions. Investigations at the first affected site in Scotland revealed similar aerial lesions on some of the trees, sometimes in the absence of basal lesions.

The imported infected *T. occidentalis* plants had foliar symptoms only.

Disease symptoms caused by *P. lateralis* can be confused with other infections such as those caused by *Phytophthora cinnamomi*, a pathogen which is already present on range of hosts in the UK and around the world and which was also detected at the first affected site in Scotland. This species of *Phytophthora* is known to be damaging to *C. lawsoniana*. Physical damage caused by heavy snow or drought may result in browning of the foliage but there will be no associated lesions.

Available images of symptoms caused by *P. lateralis* are mainly on mature trees. Images on nursery stock are rare because in the main affected areas of Oregon, the principal host, *C. lawsoniana* is not grown in nurseries anymore due to the devastation caused by the pathogen to this sector of the nursery industry



Figure 2. Aerial lesions on a mature Lawson's cypress
 Photo courtesy of Forestry Commission (ref 2014236)



Figure 3. Aerial lesion on a branch with bark removed
 Photo courtesy of Clive Brasier, Forest Research, UK



Figure 4. Stem lesions in the phloem (*C. lawsoniana*)
 Photo courtesy of Everett Hansen, Oregon State University, USA



Figure 5. Three to four-year old *C. lawsoniana* seedlings
 Photo courtesy of Everett Hansen, Oregon State University, USA

Figure 1 shows a single infected mature tree (behind a low beech hedge) at the first known site in Scotland. The tree had been killed by a basal lesion. Figure 2 shows aerial lesions on a tree at the same site and Figure 3 shows an aerial lesion on a branch exposed by removal of the bark. No images from the same sites were available showing the typical basal lesions visible when the bark is removed on mature trees, but a similar symptom is shown in Figure 3.

Figure 4 shows the diagnostic stem lesion in the phloem of *C. lawsoniana*. Roots were clipped off for the picture. The discoloration at the ground line is what is looked for in small trees during surveys in the USA. Figure 5 shows 3-4 year-old seedlings with early, fading green symptoms on the right of the picture.

How does it develop and spread?

Like other species of *Phytophthora*, *P. lateralis* produces infective spores known as zoospores which are contained in sporangia. The zoospores escape from sporangia in wet soil and swim through the surface water. Root tips of host plants become infected by the zoospores and the pathogen advances by hyphal growth into major roots. Spread up the trunk is usually limited to a distance of about twice the stem diameter as the crown dies and tissues dry. Zoospores can also move in watercourses, thus facilitating further spread.

P. lateralis also produces long-lived resting spores known as chlamydospores which if moved in soil allow the pathogen to spread either with host plants or as a contaminant, including in soil/soil-based growing media associated with non-host plants.

Aerial infection is rarely reported but was described in detail for the outbreaks in Brittany. Some of the isolates of *P. lateralis* obtained from symptomatic material produced deciduous sporangia in culture. These may have facilitated aerial dispersal of *P. lateralis* by wind. This phase of the lifecycle of *P. lateralis* has not been studied as it is primarily thought to be a root-infecting pathogen. However, aerial infection has been observed in Scotland.

What are we doing about it?

Although the pathogen is not currently regulated, until recently it was considered absent from the UK. Because of the potential for further introduction, and spread in the nursery trade, prior to the findings in Scotland, Fera's Plant Health and Seed Inspectors and Scottish Government Horticulture Inspectors commenced surveillance of nursery stock in 2010. To date *P. lateralis* has not been found in the nursery trade in England and Wales. SASA however recently confirmed the presence of the pathogen on plant material imported from mainland Europe in Scotland. Forest Research scientists are continuing to look in more detail at the recent outbreaks in Scotland. Eradication/containment action is ongoing with trace-back in process to try and identify the source of the outbreak.

Advisory information

If you suspect that there is an outbreak of *P. lateralis* on *Chamaecyparis* spp. or *Taxus brevifolia* on your premises this should be reported to the Fera Plant Health and Seeds Inspectors:

Tel.: 01904 465625

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

Web: www.defra.gov.uk/fera/plants/plantHealth

Or

The Forestry Commission Plant Health Service:

For enquiries north of the Humber/Mersey line:

Tree Health Diagnostic and Advisory Service

Forest Research

Northern Research Station

Roslin

Midlothian EH25 9SY

Tel: 0131 445 2176

Fax: 0131 445 5124

Email: ddas.nrs@forestry.gsi.gov.uk

For enquiries south of the Humber/Mersey line:

Tree Health Diagnostic and Advisory Service

Forest Research

Alice Holt Lodge

Farnham

Surrey GU10 4LH

Tel: 01420 23000

Fax: 01420 23653

Email: ddas.ah@forestry.gsi.gov.uk

Author

C. Sansford

The Food and Environment Research Agency (Fera). July 2010

© Crown copyright 2011

Acknowledgements

Factsheet reviewed by Joan Webber, Forest Research, UK.

Images supplied by the Forestry Commission, Clive Brasier, Forest Research, and Everett Hansen, Oregon State University, USA.

Information on the outbreaks in Scotland provided by Joan Webber and Sarah Green, Forest Research, UK.

Information on the detection of *P. lateralis* on imported *T. occidentalis* and *C. lawsoniana* supplied by Alexandra Schlenzig, Science and Advice for Scottish Agriculture (SASA), UK.

Information on the outbreaks in Northern Ireland provided by the Department of Agriculture and Rural Development (DARD), UK.