Pest Risk Analysis For *Phytophthora lateralis*

STAGE 1: PRA INITIATION

1. What is the name of the pest?

Phytophthora lateralis Tucker & Milbrath

2. What is the reason for the PRA?

The pathogen is on the EPPO Alert List and there were recent findings in the Netherlands (2004) and France (1990s).

3. What is the PRA area?

The United Kingdom.

STAGE 2: PEST RISK ASSESSMENT

4. Is the pest established in the PRA Area?

There have been no reports to indicate the pathogen is present in the UK. Inspection of *Chamaecyparis* spp. for third country exports is undertaken by the Plant Health and Seeds Inspectorate (for England and Wales) and to date no evidence of *P. lateralis* has been found. Since 1996, CSL has received *ca*. 40 samples of *Chamaecyparis* spp. for diagnostic purposes of which 4 were associated with several *Phytophthora* species (*P. cinnamomi*, *P. citricola* and one unidentified species) but no *P. lateralis* was detected.

5. Is there any other reason to suspect that the pest is already established in the PRA Area?

No.

6. What is the pest's EPPO Status?

The pathogen is on the EPPO Alert list.

7. What is the pest's EU Plant Health Directive status?

None. The pathogen is not listed in the Plant Health Directive (Anon., 2000).

8. What are its host plants?

Table 1 summarises the information on natural hosts published in the literature.

The main natural host with which the pathogen is associated is *Chamaecyparis lawsoniana* (Lawson cypress or Port Orford cedar) and numerous reports confirm this. *Taxus brevifolia* (Pacific yew) has also been reported as a host (DeNitto and Kliejunas, 1991). *Chamaecyparis formosensis* is listed as a host (CABI, 2006) but no further details are available for this report. Tucker and Milbrath (1942) reported one record of an infected stand of *Chamaecyparis obtusa* (Hinoki cypress). *Chamaecyparis* spp. belong to the family Cupressaceae and *T. brevifolia* to the family Taxaceae.

According to Hansen (E. Hansen, Oregon, USA, 2006, *personal communication*) published reports on hosts other than cedars (*C. lawsoniana* or *Chamaecyparis* spp.) and *T. brevifolia* are considered to be misidentifications. A range of explanations for this has been given but the most common appears to have been misidentification of another *Phytophthora*, namely, *Phytophthora gonapodyides.*

These reports are nevertheless included in this Pest Risk Analysis for completeness.

8.1 Natural hosts

Table 1. Hosts reported* to be naturally infected by *Phytophthora lateralis*

Name	Common Name(s)	Family	Disease	Reference
Actinidia chinensis	Kiwi	Actinidaceae	Associated with root, crown and collar rot	Robertson, 1982
Actinidia deliciosa	Kiwi	Actinidaceae	-	Pennycook, 1989**, Gadgil, 2005**
Catharanthus roseus	Madagascar periwinkle	Apocynaceae	Root rot	Abad *et al*., 1994
Chamaecyparis formosensis	Formosan cypress	Cupressaceae	-	CABI, 2006
Chamaecyparis lawsoniana	Lawson cypress, Port Orford cedar	Cupressaceae	Root and crown rot, also foliar infection	Tucker and Milbrath, 1942
Chamaecyparis obtusa	Hinoki cypress	Cupressaceae	Root and crown rot	Tucker and Milbrath, 1942
Juniperus horizontalis	Creeping juniper	Cupressaceae	Root rot	Abad *et al*., 1994
Kalmia latifolia	Mountain laurel	Ericaceae	Root rot	Abad *et al*., 1994
Photinia x fraseri	Fraser photinia	Rosaceae	Root rot	Abad *et al*., 1994
Rhododendron sp.	Rhododendron	Ericaceae	Isolated from the crown	Hoitink and Schmitthenner, 1974
Rhododendron sp. *(Azalea)*	Azalea	Ericaceae	Root rot	Abad *et al*., 1994
Taxus brevifolia	Pacific yew	Taxaceae	Crown rot	DeNitto and Kliejunas, 1991
Platycladus orientalis (syn. Thuja orientalis)	Oriental arborvitae Chinese thuja	Cupressaceae	-	Hall, 1991

*Hansen (E. Hansen, Oregon, USA, 2006, *personal communication*) considers that published reports on hosts other than cedars (*C. lawsoniana* or *Chamaecyparis* spp.) and *T. brevifolia* are misidentifications

**As cited in Farr *et al*., 2006. These records may be based on Roberson (1982).

8.2 Experimental

There are few published reports on the experimental susceptibility of plants and trees to *P. lateralis.* Those that exist are presented in Table 2.

Table 2. Plants tested and found to be susceptible to *Phytophthora lateralis* by experimentation

Host	Common name	Family	Disease	Reference
Rhododendron sp.	Rhododendron hybrid Purple Splendour	Ericaceae	Slight root damage	Hoitink and Schmitthenner, 1974
Pseudotsuga menziesii	Douglas fir	Pinaceae	Root infection of seedlings	Pratt *et al*., 1976
Cupressus nootkatensis	Alaskan Cedar	Cupressaceae	Seedling infection	Reviewed by Kliejunas, 1994

It is possible that the experimental inoculation of rhododendron by Hoitink and Schmitthenner (1974) may have been with a species of *Phytophthora* other than *P. lateralis* as Hansen (E. Hansen, Oregon, USA, 2006, *personal communication*) considers that this and other published reports on hosts other than cedars (*C. lawsoniana* or *Chamaecyparis* spp.) and *T. brevifolia* are misidentifications.

Only two tree species were tested and found to be susceptible to *P. lateralis* but only as seedlings.

9. What hosts are of economic and/or environmental importance in the PRA area?

9. 1 Economic

Naturally susceptible economically important hosts are present within the PRA area. *C. lawsoniana* is present in the UK. This species is regarded as the principal host of the pathogen, due to the extensive tree mortality the pathogen has caused in Pacific states of the USA. *C. lawsoniana* is not grown as a forestry species in the UK but is planted in amenity situations and is perhaps the most important conifer in the UK ornamental nursery plant trade; one estimate states that they account for a '*significant portion*' of the £29 million garden centre sales of conifers per year. This figure includes imports. It is estimated that there are *ca*. 20 members of the Association of British Conifer Growers (ABCG), many of who grow *C. lawsoniana*. (J. Tate, ABCG, 2006, *personal communication*). The Royal Horticultural Society Plant Finder Website (RHS, 2006) lists numerous suppliers of the plant.

T. brevifolia is known to have a variety of uses including wood, hedges and as an amenity and ornamental tree (CABI, 2006). However, it is not grown as a forestry species in the UK and is not widely used as an ornamental plant either. RHS (2006) only lists one supplier of the plant.

The remaining published reports of natural hosts listed in Table 1 are all ornamental species and have recently been considered to be misidentifications (E. Hansen, Oregon, USA, 2006, *personal communication*).

Some information on their relative economic importance is given below.

Rhododendron species are important in the ornamental nursery trade and in some managed landscapes such as parkland. RHS (2006) lists numerous retail suppliers for *Rhododendron* and *Azalea*.

RHS (2006) also lists numerous retail suppliers for *Juniperus horizontalis, Kalmia latifolia, Photinia x fraseri*, *Platycladus orientalis* and some suppliers for *Catharanthus roseus*. *Cupressus nootkatensis*, an experimentally susceptible species (as seedlings) is not listed in RHS (2006) but can found on various specialist conifer grower websites and is therefore assumed to be grown as an ornamental plant in the UK.

Pseudotsuga menziesii is experimentally susceptible and is therefore a potential host. It is an important forestry tree in the UK and Europe. It is present in plantations and its uses include timber, erosion control, shelterbelts and as an amenity tree. As a specimen tree it is present in parks and gardens (Preston *et al*., 2002). However, only seedlings of *Pseudotsuga menziesii* have been successfully infected in experiments (Pratt *et al*., 1976).

9.2 Environmental

C. lawsoniana is the main species in the natural environment affected by *P. lateralis* in its current range. It is not a species native to the UK and does not form part of any natural ecosystem. However, it is used in hedgerows, windbreaks and parks and is becoming increasingly widespread, particularly in the south. The experimentally susceptible host *P. menziesii* is also not native to the UK and is also not part of any natural ecosystem. (Preston *et al*., 2002).

Although there is some debate as to whether the record of *P. lateralis* on rhododendron is a misdiagnosis it is common in the UK and is often present as an understory plant in woodland (Preston *et al*., 2002).

Preston *et al.* (2002) indicate that other natural hosts listed in Table 1 are not widely grown in wild environments in the UK.

10. If the pest needs a vector, is the vector present in the PRA area?

No vector is needed.

11. What is the pest’s present geographical distribution?

The distribution of *P. lateralis* by country, the situation and the date of the first records are given below. The main natural distribution appears to be in forests in California and Oregon in the USA where the pathogen is considered to be an exotic introduction. Findings on nurseries occur in a number of locations in the USA and some of these may be misdiagnoses as indicated below.

Outside of the USA there have been isolated findings in France and the Netherlands which are considered to be eradicated. The reports on kiwi fruit trees in New Zealand may be misdiagnoses.

North America:	Canada: British Colombia (nursery, 1950s; Atkinson, 1965). USA: Washington (nursery, 1923) (Hansen *et al*., 2000); Oregon (forest, by 1940s) (Hansen *et al*., 2000); California (forest, by 1980s) (Kliejunas and Adams, 1981). States where published host records are the subject of debate are: Ohio (nursery, 1974) (Hoitink and Schmitthenner, 1974); Pennsylvania (nursery, 1974) (Hoitink and Schmitthenner, 1974); North Carolina (assumed to be nursery, 1990s) (Abad *et al*., 1994). There has been one published report in surface run-off water in Florida (2005) (Roberts *et al*., 2005).
Central America:	No record
South America:	No record
Caribbean:	No record
Europe:	Isolated reports on nurseries in the Netherlands in 2004 and France in the 1990s. These outbreaks are considered to be eradicated.
Africa:	No record
Asia:	No record
Oceania:	New Zealand (Roberson, 1982, Pennycook, 1989, Gadgil, 2005). These are all on kiwi fruit trees and may be misdiagnoses.

12. Could the pest enter the PRA area?

Yes. It is feasible for the pest to enter the PRA area, most probably through the trade in plants. This would be by plants other than *Chamaecyparis* species, which are prohibited from entry into the UK (and the EU) from countries outside of the EU (Anon., 2000).

There have been outbreaks in two other European countries (France, 1990s and The Netherlands, 2004), which, due to the prohibition on imports of *Chamaecyparis* species, probably arose from an introduction on other plant species or as a contaminant of soil or growing media associated with non-host plants. It was suggested that the original 1923 Seattle outbreak originated from the pathogen's introduction on non-host plants from France (Roth *et al*., 1972; as cited by Kliejunas and Adams, 1981 and Erwin and Ribeiro, 1996) but this is not supported by available information from France or the USA (Hansen *et al*., 2000). The original centre of origin for *P. lateralis* is presently unknown but it is speculated that the pathogen is of an Asian origin due to the resistance displayed by

Asiatic species of *Chamaecyparis* to the pathogen (Sinclair *et al*., 1987). Therefore plants imported from North America and Asia pose the greatest risk of entry. It is possible that the pathogen could be imported with symptomless host plants as it is suspected that some chemical treatments can suppress symptoms.

Chamaecyparis species could be imported under licence from some countries (specified in derogations) as naturally or artificially dwarfed plants (bonsai trees) as there are various derogations from certain provisions of Council Directive 2000/29/EC (Anon., 2000). These derogations state that the plants *should be free from harmful organisms not known to occur in the community*. However, risk from this pathway would be very small compared to entry on other host plants or on non-host plants in the soil or growing media. This is due to the considerable requirements for their entry, including the implementation of additional phytosanitary measures.

13. Could the pest establish outdoors in the PRA area?

Yes. In the USA and British Columbia (Canada), the pathogen exists in similar climates to the UK, it is feasible for the pathogen to establish in the UK in wild areas associated with known hosts (e.g. plantations and managed landscapes) as well as on plants grown outdoors on nurseries and in managed gardens. The disease has been observed in isolated outbreaks in France (1990s) and the Netherlands (2004) on *C. lawsoniana* in nurseries.

The pathogen's growth range of 3 to 25ºC (Hall, 1991) and ability to survive at low levels in frozen organic matter for at least 16 weeks (Ostrofsky *et al*., 1977) indicates that the organism could survive in a UK climate. As vegetative growth of the pathogen is inhibited above 30ºC (Tucker and Milbrath, 1942), occasional high summer temperatures in the UK could limit the ability of *P. lateralis* to complete its life cycle. However, chlamydospores and oospores of *P. lateralis* facilitate survival of high summer temperatures in the USA and this would also apply to a UK climate. Suitable humidity and/or moisture conditions for sporulation and zoospore production are also likely to occur in the UK.

P. lateralis is considered a poor saprophyte and currently appears to have a relatively narrow host range. A limitation of the potential for *P. lateralis* to establish would be the limited distribution of the principle host, *C. lawsoniana*. In the UK, *C. lawsoniana* is not in widespread use as a forestry tree, though it is becoming increasingly widespread and is sometimes recommended for under planting in plantations (Preston *et al*., 2002). In addition, Hansen (1985) states that where *C. lawsoniana* is present, it is usually planted in conditions conducive for disease spread.

As well as establishing in wild environments, the pathogen could establish outdoors on ornamentals produced in the nursery trade, either on *C. lawsoniana*, on other species of *Chamaecyparis* or on *T. brevifolia*.

Because of the recent suggestion that the remaining plant species listed as hosts in Table 1 may be misdiagnoses and because there are few published reports of the experimental susceptibility of other plant species it is not known whether *P. lateralis* has the potential to establish on other host species in the outdoor environment.

14. Could the pest establish in protected environments in the PRA area?

Cultivation under protected conditions possibly only occurs at the beginning of the production process for *Chamaecyparis* spp. raised from cuttings. Summer temperatures of such environments if not well-ventilated may not be conducive to the pathogen as its growth is entirely inhibited above 30ºC (Tucker and Milbrath, 1942).

15. How quickly could the pest spread within the PRA area?

Chamaecyparis species are common in the ornamental nursery plant trade in the UK. It is possible that the pathogen could spread with other plant species either as an infection on *T. brevifolia* or as a contaminant of associated soil or growing media. Therefore the pathogen could be distributed relatively quickly throughout the nursery industry via internal UK trade. Should the pest become established in Europe, trade with continental suppliers could see further introductions to the UK. It is difficult to check visually for the presence of the pathogen since it is usually associated with root infection and there is potential for symptom suppression with fungicide use.

Once established in the nursery trade, the pathogen may then also be capable of spreading into the wider environment and possibly cause tree death amongst plantings of *C. lawsoniana* or other *Chamaecyparis* species. Whilst *C. lawsoniana* is not an important forestry tree in Britain, it is a valued ornamental and is planted in situations conducive to disease spread (Hansen, 1985).

If *P. lateralis* did establish in the wild environment, it is likely that spread would be slow due to the lack of large continuous plantings of *C. lawsoniana*. Therefore, the threat to wild plants via *P. lateralis* is likely to come from many ‘escapes’ from the nursery industry rather than one escape into the wild environment. There was a gap of fifty years from the original nursery outbreak in Seattle before the pathogen was reported in Californian woodland, though it was reported in Oregon woodland in 1952. However, since the movement of plants in trade is arguably greater in the UK now, compared to trade in the USA then, comparisons with this timescale would be difficult.

16. What is the pest’s potential to cause economic and/or environmental impacts in the PRA area?

On the west coast of the USA, the pathogen has caused 100% death of trees in the native range of *C. lawsoniana*, and where there are high inoculum levels and suitable conditions for disease transmission, death of *T. brevifolia* trees also occurs. *P. lateralis* has caused considerable economic losses in the forestry industry and causes moderate environmental damage by reducing species richness by one or possibly two species (Hansen *et al*., 2000). The introduction of the pathogen also caused the collapse of the *Chamaecyparis* nursery industry in west coast USA because it could not be controlled. Where it is present in British Columbia, Canada, there is considerable cost in replacing dead trees in parks and gardens (Utkhede *et al*., 1997).

Should the pest become established in the UK it would be certain to cause economic losses for *Chamaecyparis* growers as the pathogen has the potential to cause a near complete mortality rate. This may result in many growers abandoning production of

Chamaecyparis altogether and seeking to produce other species. *C. lawsoniana* is not native to the UK, is not an important forestry tree and is not present as large continuous areas of woodland, unlike the Pacific west coast of the USA. Based on current knowledge concerning virulence to known natural hosts, it can be considered that the environmental impact of the pathogen in natural environments would be relatively low. Some economic costs may occur through replacing *C. lawsoniana* trees killed by *P. lateralis* in managed landscapes, parks and garden environments.

T. brevifolia is not an economically or environmentally important species in the UK and although it is a natural host in the USA, should it become infected in the UK the impact would be minor. *P. lateralis* is likely to cause losses of *T. brevifolia* only under favourable conditions including high levels of inoculum.
Because of the recent suggestion that published records on hosts other than *Chamaecyparis* spp, and *T. brevifolia* are misdiagnoses the impact on other plant and tree species is unknown.

17. What is the pest's potential as a vector of plant pathogens?

This is not applicable to this pathogen.

STAGE 3: PEST RISK MANAGEMENT

18. What are the prospects for exclusion from the PRA area?

There have been no reports of the pathogen in the UK to date, despite reports of limited outbreaks in the 1990s from France and the recent 2004 Dutch outbreak. Given the prohibition of imports of *Chamaecyparis* spp. from third countries, there are fair prospects for continued exclusion. However, it is possible that the pathogen could enter the UK on *T. brevifolia* or as a contaminant of soil or growing media associated with non-host plants. Until an investigation of the experimental susceptibility of the main ornamental and tree species imported from the USA and Asia is undertaken it is not known which other plant species have the potential to carry the pathogen into the UK.

19. If the pest enters or has entered the PRA area, what are the prospects of eradication?

The prospects for eradicating isolated outbreaks in nursery situations are good. The 2004 Dutch nursery outbreak was successfully eradicated using the same measures used for eradication of *Phytophthora ramorum* (J. Meffert, Netherlands, 2006, *personal communication*).

The prospects of eradicating the pathogen from non-nursery situations are poor. Hansen *et al*. (2000) states that once the pathogen has established in a forestry situation (i.e. *C. lawsoniana* woodland) it is virtually impossible to eradicate

20. What management options are available if eradication is not possible?

Several chemicals have been reported to be successful as soil drenches against *P. lateralis* when growing *C. lawsoniana*. These include chloropicrin (Foster and MacSwan, 1954), mancozeb, nabam and zineb (Atkinson, 1970). Mancozeb was found to be particularly effective having some residual fungitoxicity. Utkhede *et al*. (1997) found that a strain of *Enterobacter aerogenes* applied as a soil drench to naturally infected *C. lawsoniana* trees appeared to control the disease and led to an increase in tree growth.

In the UK, growers have a range of fungicides available for use on ornamental nursery stock. The active ingredients etridiazole, fosetyl-aluminium, metalaxly-M and propamocarb hydrochloride are registered for use as drench treatments against *Phytophthora* root rots (Anon., 2006). The target pathogen is mainly *P. cinnamomi* but other less common *Phytophthora* species can cause similar root rot symptoms to this pathogen. These fungicides may have efficacy against *P. lateralis.* Control is likely to be less effective in a field soil situation and chemical soil sterilisation with metham-sodium or dazomet may reduce levels of disease, but this is dependent on soil type, cultivation (if any) and the time of year of application. Fosetyl-aluminium is already widely used as a soil drench in UK ornamental conifer production as and when *Phytophthora* disease(s) become a problem. However, the use of some fungicides may only result in symptom suppression.

Cultural measures suggested for nursery situations are general good hygiene measures, prevention of the introduction or movement of infested soil or infected plant material. Avoiding the use of susceptible varieties is also recommended. More specifically, while investigating control methods for *P. lateralis* Hunt and O'Reilly (1984) found excellent survival and compatibility of scions of *C. lawsoniana* grafted to rootstocks of *C. formosensis* or *Chamaecyparis thyoides* over a two year observation period but grafting to *C. nootkatensis* or *Chamaecyparis pisifera* was unsatisfactory.

A range of cultural measures usually associated with good hygiene practices was recommended by the US federal agencies managing *P. lateralis* in the forest areas of Oregon, Washington and California in order to prevent further spread of the disease. These have been reviewed by Greenup (1998) and Hansen *et al*. (2000) and include: conducting forestry operations in summertime to reduce the chances of spore movement, cleaning of vehicles and equipment, wide spacing of susceptible hosts, growing hosts on sites unfavourable for disease spread, regulating the harvesting of *C. lawsoniana* timber, and road closures in infested areas. Special consideration was also given to the design of roads to ensure they were not conducive to spreading the disease.

A breeding programme to generate varieties of *C. lawsoniana* resistant to *P. lateralis* has also been commenced and has yielded promising results (Hansen *et al*., 2000).

CONCLUSION OF THE PEST RISK ANALYSIS

P. lateralis is absent from the UK and has the potential to enter on imported plant material (where permitted) and in associated soil or growing media from the USA and possibly from Asia which is thought to be the likely origin of the pathogen.

The main hosts of *P. lateralis* are *C. lawsoniana* and *T. brevifolia*; there have been one-off reports on other *Chamacyparis* species. Published records on other plant or tree species have recently been the subject of debate and for a range of reasons, are viewed by some as misidentifications, especially of *P. gonapodyides.* (E. Hansen, Oregon, USA, 2006, *personal communication*). There is therefore uncertainty in this PRA regarding the published (and potential) host range of *P. lateralis*; this requires experimental investigation to support the assessment of the risk of entry as well as establishment, economic impact and risk management.

Because imports of *Chamaecyparis* spp. from outside of the EU are prohibited with the exception of specific derogations for bonsai, the most likely pathways of entry are either as infected *T. brevifolia* or as a contaminant of soil or growing media associated with this host or with non-host plants.

P. lateralis has caused significant damage to the native population of *Chamaecyparis lawsoniana* and destroyed the cedar production industry in Washington and Oregon. The near 100% mortality rate of *P. lateralis* on *C. lawsoniana* makes this pathogen a considerable threat to amenity and nursery production of this host in the UK. However, whilst lethal to *C. lawsoniana*, *P. lateralis* does not seem to be as virulent on other hosts. For example, mortality of *T. brevifolia* has only been observed in areas where inoculum levels are high and conditions are optimum for pathogen spread and survival, e.g. riverbanks. The high level of mortality of *C. lawsoniana* may be related to the geographic isolation of the tree from the possible origin of the pathogen as Asiatic species of *Chamaecyparis* exhibit resistance (Sinclair *et al*., 1987).

It could be argued that as *C. lawsoniana* is not an important tree in the UK, either in the wild or in managed woodland that this would decrease the chance of the pathogen establishing. However, the temperature range for active growth, the optimum growth temperature and the survival of the pathogen in sub-zero conditions suggest that the organism is well suited to the UK climate, particularly as it survives under similar conditions in parts of the USA and British Columbia in Canada.

Since it is possible that the pathogen's host range is greater than currently known, if the pathogen is introduced to the PRA area in sufficient quantity or through continued introductions, the pathogen may establish on a range of plant and tree species. It could cause major problems to the populations of *C. lawsoniana* in managed landscapes and more importantly, should the pathogen become established in the nursery trade, the ornamental production of *C. lawsoniana*. Ultimately establishment of the pathogen could force nursery production of *C. lawsoniana* to be abandoned.

There is also potential for different *Phytophthora* species to hybridise with each other, potentially leading to changes in virulence and host range, ultimately creating new, unforeseen problems. This has been observed previously in the UK and resulted in a new species, *Phytophthora alni,* being recognised (Brasier, 2001).

In the absence of other data, specifically data determining the host range of *P. lateralis* with regards to UK species and on non-UK species imported from the USA and Asia, as well as data regarding the hybridisation potential of *P. lateralis* with *Phytophthora* species already present in the UK, it is recommended that consideration be given to surveys of known susceptible hosts to establish country freedom. If deemed appropriate, the listing of *P. lateralis* as a II/AI quarantine pest for the UK/EU with specific requirements for the relevant hosts and associated soil or growing media arising with these or with non-host plants produced in the affected areas of North America should be considered. This would continue to ensure country freedom.

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UNCERTAINTIES AND FURTHER WORK

Section of PRA	Uncertainties	Further work that would reduce uncertainties
Taxonomy	-Genetic variability and whether various strains of the pathogen exist which may be associated with particular hosts. For example, Hoitink and Schmitthenner (1974) reported that their isolates of *P. lateralis* from rhododendron had a different temperature range for growth than reported for other isolates. -The relationship between isolates found in North America and in Europe.	-DNA profiling of isolates from a range of hosts to assess genetic diversity and the possible existence of groupings of isolates with consideration to geographic origin.
Distribution	-Why *P. lateralis* is not more widespread in the USA	-Further information needed on factors favouring limited distribution in the USA, other than the natural distribution of its main host, *C. lawsoniana*
Hosts	-Host range of *P. lateralis*, particularly with regards to species native to the UK and *Chamaecyparis* species.	-Determining the pathogenicity of the pathogen for important UK native species.
Pathway	-Whether absence of symptoms is an indication of an absence of the pathogen. -The origin of the pathogen.	-Determination of a latency period on various hosts. Investigations of the symptom suppressive activity of various fungicides. -Information on origin of introductions into the USA, The Netherlands and France.
Establishment	-Whether the UK climate is suitable for the establishment of the pathogen.	-Use of climate comparison software to determine the climate similarities.
Spread	-Determining the rate of spread of the pathogen from nurseries to the natural environment.	-Epidemiological modelling.

Impact	-Whether post-introduction evolutionary change can increase virulence.	-Assess the ability of *P. lateralis* to hybridise with UK native Phytophthora species.
Management	-Control options for the pathogen in UK plantation and nursery situations.	-Efficacy of commonly used disease control measures on nurseries against *P. lateralis*.

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