EUROPEAN AND MEDITERRANEAN PLANT PROTECTION ORGANIZATION
ORGANISATION EUROPEENNE ET MEDITERRANEENNE POUR LA PROTECTION DES PLANTES

13-18716

Pest Risk Management for

Phytophthora kernoviae and Phytophthora ramorum

September 2013

EPPO
21 Boulevard Richard Lenoir
75011 Paris
www.eppo.int
hq@eppo.int

This risk management section follows the EPPO Standard PM 5/3(5) *Decision-support scheme for quarantine pests* (available at http://archives.eppo.int/EPPOStandards/pra.htm) and uses the terminology defined in ISPM 5 *Glossary of Phytosanitary Terms* (available at https://www.ippc.int/index.php).
This document was first elaborated by an Expert Working Group and then reviewed by core members and by the Panel on Phytosanitary Measures and if relevant other EPPO bodies. It was finally approved by the Council in September 2013.

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13-18716 (12-18185, 12-18008)

Pest risk management for *P. kernoviae* and *P. ramorum* (Stage 3 of a Pest Risk Analysis)

The pest risk management document was prepared during two meetings of an Expert Working Group.
Meeting dates: 2012-02-01/02 & 2012-03-28/30.
The EWG was composed of:

CLARKE Matthew (Mr)	Department of Agriculture, Food and the Marine, Horticulture & Plant Health Division, Administration Building, Backweston Campus, Celbridge, Co. Kildare, Ireland
GUITIAN CASTRILLON Jose Maria (Mr)	Tecnologias y Servicios Agrarios, S. A. - TRAGSATEC, C/Julian Camarillo, 4a. 2-d, 28037 Madrid, Spain
HERRERO Maria Luz (Ms)	Bioforsk-Norwegian Institute for Agricultural and Environmental Research, Høgskoleveien 7, N-1432 Ås, Norway
HEUNGENS Kurt (Mr)	Institute for Agricultural and Fisheries Research (ILVO), Plant Unit - Crop Protection Research Area, Burg. Van Gansberghelaan 96 bus 2, 9820 Merelbeke, Belgium
SLAWSON David (Mr)	Food & Environment Research Agency, Sand Hutton, YO41 1LZ York, United Kingdom
STEEGHS Maarten (Mr)	Plant Protection Service, P.O. Box 9102, 6700 HC Wageningen, Netherlands
SZKUTA Grazyna (Ms)	Main Inspectorate of Plant Health and Seed Inspection - Central Laboratory, Zwirki and Wigury St. 73, 87-100 Torun, Poland
WERRES Sabine (Ms) (second meeting only)	Julius Kuehn Institute (JKI), Federal Research Centre for Cultivated Plants Institute for Plant Protection in Horticulture and Forests (GF), Messeweg 11/12, D - 38104 Braunschweig, Germany

EPPO Secretariat
PETTER Françoise (Ms)

Note: The measures recommended for _P. kernoviae_ and _P. ramorum_ are the same. Although it may occur that the justification for measure is based on information available for one of the two pathogens only, the EWG considered that their biology is sufficiently similar for the same measures to be recommended.

7.01 Is the risk identified in the Pest Risk Assessment stage for all pest/pathway combinations an acceptable risk?

No

Pathways considered during pest risk management for both pests

- Pathway 1 Plants for planting (excluding seeds and fruit) of known susceptible hosts
- Pathway 2 Soil as a contaminant (e.g. on footwear, machinery, etc.)
- Pathway 3 Susceptible (isolated) bark or wood chips not intended for burning
- Pathway 4 Soil/growing medium (with organic matter) as a commodity
- Pathway 5 Natural spread
- Pathway 6 Plants for planting (excluding seeds and fruit) of non-hosts
- Pathway 7 Wood of host plants
- Pathway 8 Foliage or cut branches (for ornamental purposes) of susceptible foliar hosts

General comment on the host plants

A list of host plants for both pests on 2012-07-01 is presented in Appendix 1 however new hosts are regularly identified and it is advised to look at lists which are regularly updated (e.g. Fera http://www.fera.defra.gov.uk/plants/plantHealth/pestsDiseases/phytophthora and for *P. ramorum* USDA APHIS http://www.aphis.usda.gov/plant_health/plant_pest_info/pram)

The EWG considered that in the host plant list, hosts presenting higher risks could be identified and that risk managers may consider if regulation should only focus on such higher risk plants.

The characteristics of high risk plants are:

- High sporulators (first criteria and sufficient on its own to classify a plant on the high risk level)
- Highly susceptible
- High volume of trade

For *P. ramorum* examples of plant genera presenting a higher risk of introduction and spread are:
Camelia, Rhododendron, Viburnum, Pieris, Larix, Vaccinium.

For *P. kernoviae* examples of plant genus/species presenting a higher risk of introduction and spread are:
Rhododendron, Vaccinium, Drimys, Quercus ilex, Magnolia, Michelia.

Pathway 1 Plants for planting of host plants (except seeds) of *P. ramorum/P. kernoviae*

Note: this pathway includes introduction of plants by private individuals.

Plants for planting may also be imported into or moved within the EPPO region by individuals for their personal use. This includes internet purchases, bringing back plants from trips abroad and "plant hunters" who collect exotic material from the natural environment often for introduction into botanic gardens and plant collections, or as material for development of new commercial varieties.

Plants introduced in these ways also pose a risk of introducing *P. ramorum* and *P. kernoviae* into an area. Therefore, the measures below also apply to such cases. In addition, these plant movements must also comply with any other relevant legislation and certification, such as requirements for phytosanitary certificates (or plant passport for EU countries) or scientific licences where a phytosanitary certificate cannot be issued e.g. plants collected from the wild.

New consideration included in these recommendations compared to measures currently in place for *P. ramorum* in EPPO Countries regulating the pest.

The occurrence of infections in tall sporulating hosts (Larch) for *P. ramorum* needs to be taken into account in terms of spread capacity of the pest. Consequently the EWG decided to include a 'buffer zone' concept for *P. ramorum* and *P. kernoviae*. In particular infections on sporulating hosts close to places of production, especially infections on tall sporulating hosts, such as larch, were considered to justify additional phytosanitary measures compared to those already in place in some EPPO member countries.

Key evidence used to set an appropriate distance was provided by Webber (2010). Very high sporulation from an infected stand of larch (*Larix kaempferi*) resulted infection of beech, chestnut, hemlock, Douglas fir, Nothofagus, rhododendron, silver birch and Lawson's cypress within a distance of 100m. Although spore monitoring conducted during this study showed that inoculum could be detected at low levels at a distance of up to 1 km from the infected area the data show that infections only occurred within a distance of 100 metres.

For sporulating 'shrub' hosts (e.g. rhododendron), the weight of evidence is that the majority of plants become infected when situated within 10 m of an infected host, usually within 5 m. For this reason, a distance of 10 m was recommended for sporulating shrub hosts.

In summary, the recommended distances of the buffer zone are at least:

- 10 metres around host shrubs e.g. rhododendron
- 100 metres around host trees e.g. larch.

These distances should be adapted to local circumstances.

7.06 Is the pathway that is being considered a commodity of plants and plant products?

Yes **Go to 7.09**

7.09 If the pest is a plant, is it the commodity itself?

No (the pest is not a plant) **go to 7.10**

Existing phytosanitary measures

7.10 Are there any existing phytosanitary measures applied on the pathway that could prevent the introduction of the pest?

Yes **if appropriate, list the measures and identify their efficacy against the pest of concern and go to 7.11**

Level of uncertainty: Low

In this section existing measures in countries such as North African countries or Central Asian countries were not taken into account as the risk of establishment in these areas is low.

Phytophthora ramorum

Existing measures in EPPO member countries.

Measures for the import of host plants in EPPO countries

EU provisional emergency phytosanitary measures were established in 2002 (Commission Decision 2002/757/EC, as amended 2004 and 2007) (EU, 2002, 2004, 2007) to prevent the introduction and spread of *P. ramorum* within the Community. Similar measures have also been adopted in other member countries e.g. Norway, Switzerland, Turkey.

Non-specific measures that exist in the EU Plant Health Directive (2000/29/EC) (EU, 2000) for plants for planting which consequently apply to *P. ramorum* host plants are detailed in Appendix 2.

Efficacy of measures:

- *EU provisional emergency phytosanitary measures* (Commission Decision 2002/757/EC, as amended 2004 and 2007)

These measures target specifically hosts originating from the United States of America. Since the introduction of the emergency measures in 2002 there have been no reported interceptions of *P. ramorum* on plants from the USA. Imports of Rhododendron plants from the USA to EU countries have taken place between 2002 and 2011 (however as data is recorded in kg this makes it difficult to relate it to a number of plants). The emergency measures refer to the main hardy ornamental hosts that are likely to move the pathogen. The listed susceptible host plants comprise only 38 genera (i.e. those that are known in the USA) and is therefore not fully comprehensive; at the time of completion of this Pest Risk Management part, there were at least 75 known susceptible genera (North America plus Europe) and the number of new genera and species continues to grow (for host plants see Appendix 1).

- *Non-specific measures in the EU Plant Health Directive* (2000/29/EC) (EU, 2000):

Since the area/s of origin are unknown, it is also important to evaluate the efficacy of the general measures in the EU Plant Health Directive (2000/29/EC) (EU, 2000) against *P. ramorum*).
Unspecified genera of trees and shrubs from third countries excluding European and Mediterranean Countries require a phytosanitary certificate with an additional declaration under the EU Plant Health Directive (2000/29/EC) kgrown in nurseries and have been inspected at appropriate time before export to guarantee the absence of symptoms of fungi. This would not guarantee the absence of *P. ramorum* in a latent stage.
Some genera are prohibited (Annex IIIA) (*Abies, Pseudotsuga*) whilst other are prohibited except in either a dormant and/or leaf-less state (*Castanea, Quercus, Prunus, Rosa, Photinia*);
All deciduous trees and shrubs for planting (except seeds and plants in tissue culture) from the USA must be dormant and free of leaves (Annex IVA1, point 40), but this would not be expected to be fully effective for dieback hosts where shoots/stems are infected with *P. ramorum*. Most annual and biennial plants, naturally or artificially dwarfed plants and herbaceous perennials for planting also require a phytosanitary certificate with additional declarations (Annex IVA1, point 41, 43 and 44 – see Appendix 2).

Measures for movement of host plants within EPPO countries

EU countries, Norway and Switzerland
Measures are in place for movement of plants within European Union countries and Switzerland. Similar Measures are also in place for the movement of plants from European Union countries to Norway with additional specific requirements for host plants originating from Germany and the Netherlands.
The EU provisional emergency phytosanitary measures (Commission Decision 2002/757/EC, as amended 2004 and 2007) also include measures regarding the movement of susceptible nursery plants (*Rhododendron, Viburnum and Camellia*). Plants should either originate from an area where the pest is known not to occur (i.e. a pest-free area) or must be found free from *P. ramorum* after inspections carried out in the nurseries at least twice during the growing season at appropriate time when plants are in active growth. For EU countries and Switzerland, if requirements are met, a "plant passport" is delivered to allow these plants to circulate within the EU territory. Additional measures are specified in case *P. ramorum* is detected (e.g. elimination of infested plants and associated growing media and plant debris within 2 metres and retention measures for other susceptible plants in a radius of 10 m).
The Commission Decision also calls for all EU member states to undertake surveys for *P. ramorum* and disseminate the results.

The EFSA scientific opinion (EFSA, 2011) states that "*An analysis of the effect of these measures on the prevalence of P. ramorum during the period 2004 to 2006 showed a reduction in the percentage of inspections positive for P. ramorum and a reduction in the number of outbreaks at nurseries (Slawson et al., 2008). However, the continued findings of the pathogen in nurseries and in woodlands, notably on Japanese larch in UK, indicated that the phytosanitary measures have not been completely effective*".[1]
Later in the opinion it is stated that "*Since control measures were adopted, there has been a decrease in the number of P. ramorum nursery reports, both in California (APHIS, 2011) and, generally, in EU states (FVO survey, 2010), including the UK. Uncertainty remains about whether this pattern is a mere association (which would imply that a decrease in P. ramorum occurrences in the plant trade would have happened anyway, even without control*

[1] The EWG considered that there is no evidence showing that the epidemic on Larch can be related to a lack of efficacy of measures on nursery plants.

measures) or whether there is a causal relationship between control measures and decreased nursery reports (which would imply that without control measures, the occurrence of P. ramorum would not have declined as it did). However, one can reasonably infer the positive impact of management options included in control measures adopted in the EU because the total number of occurrences of the disease have progressively decreased since 2007 (400 in 2007 versus 290 in 2010) and the number of interceptions decreased gradually, as well, from 46 in 2007 down to 17 in 2010. The specific situation observed in UK where the number of occurrences has increased was mainly caused by an epidemic development of the disease on Japanese larch (Figure 19 see below)".
Note: FVO is the Food and Veterinary Office.

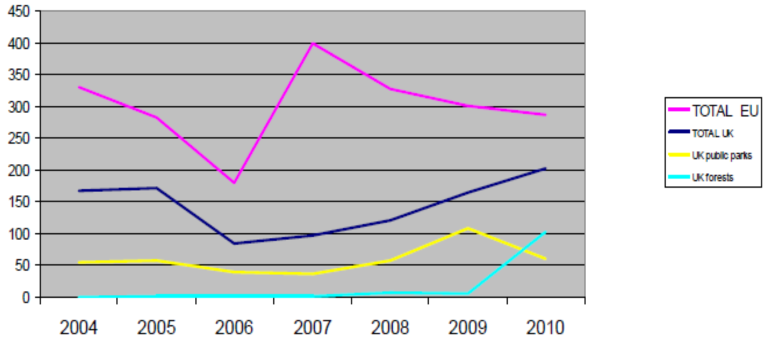
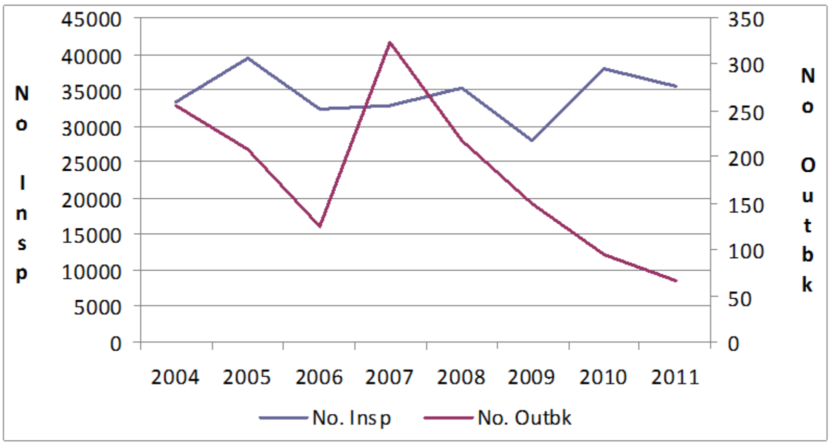


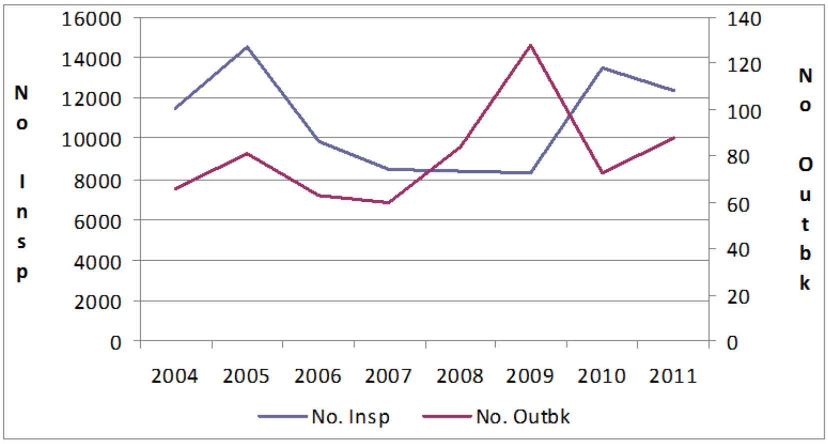
Figure 19: Number of *Phytophthora ramorum* outbreak sites since 2004 in the EU and in the UK only (FVO survey, 2010).

The EWG noted that this graph shows not more than 50% decrease in the number of outbreaks, between 2007 and 2010 and is difficult to interpret as it groups outbreaks in natural environment/parks and places of production. In the UK where data exist on the percentage of positive inspections at places of production, there has been a reduction of over 90% between 2002 and 2011 (from around 3% to < 0.2%) of the number of positive detections. This reduction in nurseries and garden centres is shown in the graph below (FVO report to the Standing Committee on Plant Health, 2012-02-21). Graphs are also provided for green sites and forest sites.

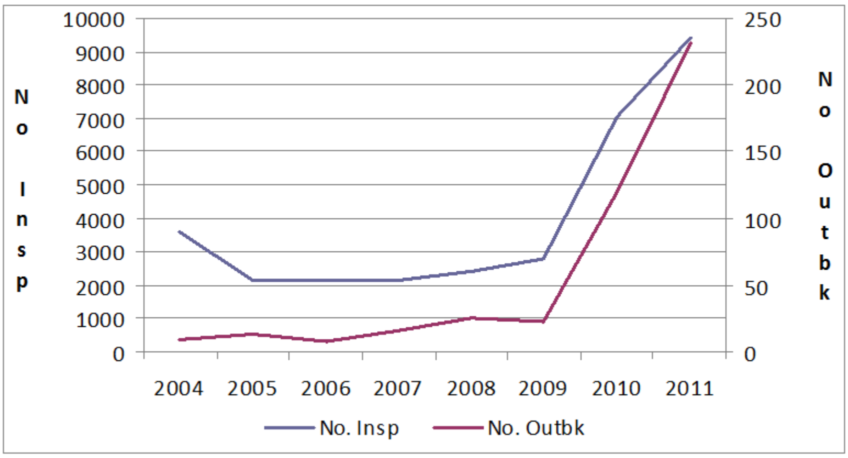
P. ramorum - inspections/findings in nurseries and garden centres (FVO, 2012)



P. ramorum - inspections/findings in green sites (FVO, 2012)



P. ramorum - inspections/findings in forest sites (FVO, 2012)



In Norway, a special certification program is required for plants originating from Germany and the Netherlands. The nurseries must specifically qualify to take part in the program. The program includes i.e. at least 3 field inspections (the last of these must take place at the end of the growing season) with obligatory sampling and testing (also in cases where there are no typical symptoms) and a pre-export inspection shortly before export. Since 2008, when these measures were implemented, the number of interceptions has decreased considerably, indicating that the additional measures have had a positive effect. However *P. ramorum* has been detected during the last years in nurseries and garden centres and it is suspected that the source of infection is with imported plants (findings in plants which had been imported the same season) most probably latently infected or with weak or diffuse symptoms.

P. ramorum can survive latently in the root ball of *Rhododendron* for at least 8 months and in one controlled experiment up to 2 years (Vercauteren *et al*., 2012). Measures in place in the EU, Norway and Switzerland will not allow the detection of such latent infections.

Other EPPO countries
For other countries only Israel and Turkey have measures in place for *P. ramorum*. The requirements included in the Turkish regulation are similar to the EU requirements.

Phytophthora kernoviae
Measures for the import of host plants in EPPO countries
The measures described above are not appropriate for *P. kernoviae* as they do not apply to New Zealand, the only country other than the UK and Ireland where *P. kernoviae* has been reported. In addition hosts plants differ.
General measures exist in the EU plant health directive for plants for planting (Appendix 2) but as already noted for *P. ramorum*, inspection of plants is not sufficient for the detection of latent infections.
After the report of *P. kernoviae* in New Zealand and after the FVO mission to the UK in April 2008 systematic testing of imported host plants has been established in the UK but it is not known if such systematic testing is performed at import in other EPPO countries.

As far as the EPPO Secretariat is aware, no specific measures are in place in other member countries for this pest.

Measures for movement of host plants within EPPO countries
Measures to prevent movement of *P. ramorum* on Rhododendron will help detect *P. kernoviae* in this genus. In United Kingdom, an intensive survey programme is in place for *P. kernoviae.* However, it cannot be excluded that some asymptomatic plants would escape detection (in particular if it behaves like *P. ramorum,* which can survive latently in the root ball of *Rhododendron* for at least 8 months (Vercauteren *et al*., 2012).

7.11 Are the measures likely to change in the foreseeable future?
No judgement **go to 7.12**

7.12 Do you conclude that other measures should be considered?
Yes **go to 7.13**

Identification of appropriate risk management options
Options at the place of production
Detection of the pest at the place of production by inspection or testing
7.13 Can the pest be reliably detected by visual inspection at the place of production?
Could be considered in a Systems Approach **possible measure: visual inspection at the place of production**
Level of uncertainty: Low

The pests cannot be detected by visual inspection alone since symptoms are not unique. Similarly, although symptoms are likely to be expressed on susceptible aerial plant parts during active growth (the incubation period is considered relatively short), the pathogen could be present but undetectable visually as infections on roots, as cryptic infections in buds or leaf scars, or symptoms could be suppressed by the use of fungicides. The pests may also be present as spores in the growing media.
This measure can be considered in combination with testing (see next question).

7.14 Can the pest be reliably detected by testing at the place of production?
Could be considered in a Systems Approach **possible measure: specified testing at the place of production**

Level of uncertainty: Low

Symptomatic plant material: Yes
Symptomatic plant material can be tested on-site by inspectors using *Phytophthora* genus-specific lateral flow devices (LFDs). However, these do not identify any potential pathogen to species level. DNA-based (PCR) on-site methods (e.g. SmartCycler) can specifically detect and identify *P. ramorum/P. kernoviae* but this approach is not routinely used by official inspection services. Laboratory testing is therefore required in almost all situations for species identification; a variety of different methods can be used that have a relatively high degree of reliability (DNA-based methods; isolation of the pathogen in culture). The presence of inhibitors in some wood can cause difficulties to DNA-based (PCR) testing.

Asymptomatic plant material: No
Testing asymptomatic material is problematic although DNA-based methods (PCR) can be used to test asymptomatic samples of limited size due to the high sensitivity of these methods; testing a reliable sample is problematic.

Soil, growing media (and water): Yes
Testing can be done on soil, growing media (and water) *in situ* or in the laboratory by baiting methods (e.g. with rhododendron leaves), or with PCR methods (although baiting can be done in situ, the confirmatory test is done in the laboratory). In such case testing will help in establishing the status of the place of production.

Prevention of infestation of the commodity at the place of production
7.15 Can infestation of the commodity be reliably prevented by treatment of the crop?
Yes in a Systems Approach **possible measure: specified treatment of the crop**

Chemical or non-chemical treatments are not considered completely reliable in preventing infection of plants for planting but the application of preventive treatments can help avoid foliar infection. Treatments can mask symptoms leading to the unintentional distribution of infected plants. Consequently extra safeguard should be recommended such as prohibition on fungicide use for a period before dispatch in order for possible symptoms to develop.
Level of uncertainty: Medium

7.16 Can infestation of the commodity be reliably prevented by growing resistant cultivars*?*
No. There are no breeding programmes, no known immune cultivars of susceptible species and no identified sources of resistance for use in future breeding programmes. Some Rhododendron cultivars have shown a low susceptibility (De Dobbelaere, 2010) which can contribute to the reduction of the disease.
Level of uncertainty: Low

7.17 Can infestation of the commodity be reliably prevented by growing the crop in specified conditions (e.g. protected conditions such as screened greenhouses, physical isolation, sterilized growing medium, exclusion of running water, etc.)**?**
Yes: specified conditions are:
- there is no source of infection on the place of production or nearby,
- plants should be produced from non-infected initial plant material,
- the plants are grown in growing media free from the pathogen,
- stringent hygienic measures are taken to prevent introduction of the pathogens from other sources,
- plants are irrigated with water free from the pests.

Level of uncertainty: Medium

7.18 Can infestation of the commodity be reliably prevented by harvesting only at certain times of the year, at specific crop ages or growth stages?
No. Not relevant.
Level of uncertainty: Low

7.19 Can infestation of the commodity be reliably prevented by production in a certification scheme (i.e. official scheme for the production of healthy plants for planting)?
Could be considered in a Systems Approach **possible measure: certification scheme**
Yes. Domestic certification schemes for plants for planting of susceptible hosts and best management practices are likely to reduce the risk of infestation. The measures to be implemented are described in 7.21.

<u>Establishment and maintenance of pest freedom of a crop, place of production or area</u>
7.20 Based on your answer to question 4.01 select the possible measures based on the capacity for natural spread.

In a nursery environment: Very low rate of spread
In a nursery setting the natural spread is generally limited to local splash-dispersal within a few metres (Heungens *et al.*, 2010*)*. In the case of presence of tall sporulating hosts spread is expected to be further (see paragraph on *Presence of tall sporulating hosts* below). Heungens *et al.,* 2010 have shown that no aerial detection of *P. ramorum* with a spore sampler occurred, whereas there was evidence for *P. ramorum* dispersal via water films at a distance of several meters. The role of splash- and irrigation water in leading to *P. ramorum* dispersal in nursery settings was also underlined by Neubauer *et al*. (2006) and by Tjosvold *et al*. (2006).

In a non-nursery environment with no tall sporulating hosts: Very low rate of spread
In mixed evergreen forests in California, rain-splash dispersal of *P. ramorum* 10–15 m has been detected (Davidson *et al.*, 2005).

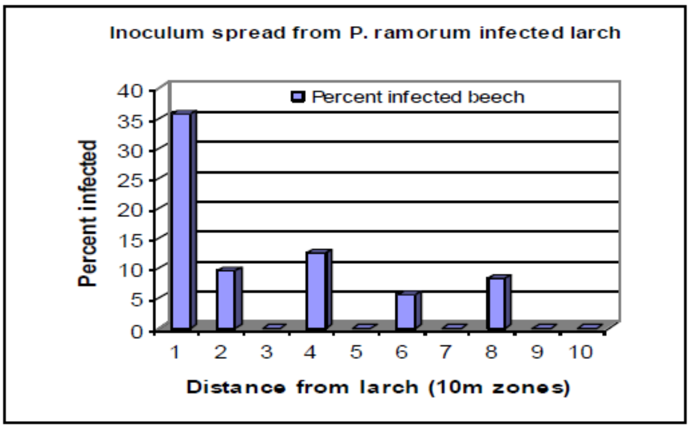
Text from the UK PRA for *P. kernoviae* (Sansford, 2008) states that:
'Studies in two woodlands in Cornwall where both P. ramorum and P. kernoviae were present affecting a naturalised understorey of R. ponticum as well as a number of trees including beech (F. sylvatica) showed that 9 out of 12 trees with lesions caused by P. kernoviae were <u>within 2 m of an infected rhododendron,</u> in many cases being in direct contact with the foliage. It was assumed that zoospores or sporangia were splash-dispersed from the rhododendron foliage onto the tree stems and that the spores penetrated the bark leading to infection and

symptom development. Where affected trees were not in close proximity to the rhododendrons it was suggested that wind-driven inoculum in mist and/or rain had led to tree stem infection (*Brown et al*., 2006).
Spore dispersal was also studied in a large garden with infected plants in situ (Turner *et al*., 2007). In this study, dispersal of both *P. ramorum* and *P. kernoviae*, was confirmed in December 2006 at a distance of more than 50 m from infected plants but at very low level; this coincided with a period of wet, windy weather. In addition, in this study it was noted that traps placed in an open area between eradicated woodland and an infected area detected longer distance spore dispersal of up to 50m.
Chastnager *et al*. (2008) recorded that conifer bait plants placed below infected Californian Bay Laurel were infected within a distance of 4.4 m. Turner (Fera, pers comm., 2012) reported on-going research in the UK which showed that rhododendron bait plants placed below infected rhododendron plants were infected within 5 m and that spores were trapped up to 10m.

From these data, the EWG considered that the majority of infections from shrub species such as rhododendron occur within a distance of 10 metres.

Presence of tall sporulating hosts: Low rate of spread
Infestations from tall sporulating trees (as is the case with Larch) might lead to dispersal over longer distances. Webber *et al*. 2010 studied the impact of the presence of infected *L. kaempferi* on nearby susceptible tree species as derived from a field assessment of mature 30 m tall beech (*F. sylvatica*) growing next to a compartment of 30 m tall infected *L. kaempferi*. Bleeding cankers were visible on at least a third of the beech trees in a 10m wide zone immediately neighboring the larch (Fig. 10). Most of these stem cankers occurred at between 7-11m above ground-level. However, at increasing distance from the larch, the proportion of beech with bleeding cankers decreased (Fig. 10).

Fig 10 from Webber *et al.*, 2010. Percentage of *P. ramorum* infected beech (*Fagus sylvatica*) at increasing distances from larch (*L. kaempferi*) also infected with *P. ramorum.*



Very high sporulation was recorded from this infected stand of larch (*L. kaempferi*) which, in addition to beech, resulted in infection of sweet chestnut, hemlock, Douglas fir, *Nothofagus*, rhododendron, silver birch and Lawson's cypress within 100m (Defra Project PDMP 1; http://www.fera.defra.gov.uk/plants/plantHealth/pestsDiseases/phytophthora/documents/prPkResearchJul09.pdf).

Although spore monitoring conducted during this study showed that inoculum could be detected at low levels at a distance of up to 1 km from the infected area the **data show that the majority of infection occur within a distance of 100 metres**.

From these data, the EWG considered that the majority of infections from tall sporulating trees hosts such as mature larch occur within a distance of 100 metres, and so, measures should take into account the environment of the places of production i.e. the presence and height of sporulating hosts. This distance should be adapted to local circumstances.

Other cases of longer spread distance
Longer-distance natural spread by turbulent air over several kilometres is thought to occur more rarely and under certain weather conditions. There is also the potential for longer-distance natural spread over about a kilometre via

inoculum in watercourses, wind-blown infected debris, or through movement of contaminated soil/debris on the feet of animals; these are less significant pathways of natural spread though.

Level of uncertainty: Medium

7.21 Can pest freedom of the crop, place of production or an area be reliably guaranteed?

The Panel on Phytosanitary Measures considered that measures proposed for pest freedom of the crop, place of production or area will address most risks (see maximum distance of spread in 7.20) provided that suitable surveillance, monitoring and testing regimes are in place (see below for details on those measures).

The EWG considered that the uncertainty was low for pest freedom of the crop or of the place of production given the experience with the current measures in place in some EPPO countries.

However, the level of uncertainty was considered Medium for area freedom because of the fact that surveillance needs to be intensive to guarantee it.

OPTION 1: AREA FREEDOM (ISPM 4)

Area freedom should be confirmed by official surveys of susceptible plants at places of production and the natural environment.

Verification of area freedom is achieved by visual inspections of host plants at places of production and in the natural environment carried out during the growing season preferably after suitable conditions (e.g. rainy periods for plants grown outside) and laboratory testing of any suspicious plants. Testing of water courses is recommended for detecting *P. ramorum* in wider areas (the method has been used successfully for *P. ramorum* but evidence is limited for *P. kernoviae*).

Inspections can focus on plants such as rhododendron that are considered to act as good 'indicator' plants of the presence of *P. ramorum /kernoviae*. In forests, inspection should also focus on Larch.

Level of uncertainty: medium

OPTION 2: PLACE OF PRODUCTION FREEDOM

The establishment of a place of production freedom requires that a buffer zone is established around the place of production. The exact limit of the buffer zone should be evaluated by the NPPO based on factors such as the height of the sporulating host plants, the sporulation potential on these hosts and the vegetation in the vicinity of the place of production. Recommended distances are 10 metres for shrubs and up to 100 metres in case of presence of tall sporulating hosts such as mature Larch.

Place of production freedom can be guaranteed when:

Situation 1 (no infection in the buffer zone)

- Plants for planting arriving at the place of production are free from the pathogens.

and

- No infection is found on the place of production and within the buffer zone (see above)

Or

Situation 2 (infection detected in the buffer zone)

- Plants for planting arriving at the place of production are free from the pathogens.

and

- No infection is found on the place of production.
- In the case of an infection of a host plant in the buffer zone (unless there is evidence that the plant does not sporulate)[2]:
    - Elimination of the infested host plant(s) and any other adjacent hosts plants unless there is evidence that they do not sporulate,
      and

[2] *Note:* known sporulating hosts include
For *P. ramorum*: *Camellia* sp., *Larix* sp., *Pieris* sp., *Rhododendron* sp., *Vaccinium* sp., *Viburnum* sp.
For *P. kernoviae: Drimys* sp., *Magnolia* sp., *Michelia* sp., *Quercus ilex*, *Rhododendron* sp., *Vaccinium* sp.

- Establishment of a demarcated area consisting of at least the area within 10 meters from the infected plant(s) (or 100 metres in case of a tall hosts)
  and
- Host plants on the place of production in the demarcated area should be held for 3 months of active growth after the time of destruction of the infested host plant(s) and inspected twice before release. Laboratory testing of any suspicious plants should be carried out. Inspection of other host plants on the same place of production should be performed as well. Baiting on water, root ball/growing media on the premises is recommended.
  and
- Hosts plants in the demarcated area should not have received any treatment with anti-Phytophthora fungicides during this period.

Additional measures recommended for implementation by growers as part of good production practices include:

- Retention of host plants coming from outside the nursery in an isolated area under conditions suitable for symptom expression for 6 weeks (e.g. high humidity, no fungicide treatments)
- Ensure irrigation water is pest free
- Implementation of hygienic measures
- Implementation of safe disposal of waste
- Implementation of proper drainage

Verification of pest freedom of a place of production freedom is achieved by:

- Visual inspections of host plants in the place of production and the buffer zone carried out during the growing season preferably after suitable conditions (e.g. rainy periods for plants grown outside) and laboratory testing of any suspicious plants.
  - In the place of production, at least two inspections should be carried out for high risk hosts and at least one inspection on the other hosts.
  - In the buffer zone at least one inspection should be carried out on the high risk hosts.

Some additional verification measures can be implemented such as:

- Testing of irrigation and drain water
- Testing of root balls and substrates

Level of uncertainty: Low

OPTION 3: PEST FREEDOM OF THE CROP

Crop here should be interpreted as the plants produced on the place of production and intended to form the consignment to be certified.

This option also requires that a buffer zone is established around the place of production. The exact limit of the buffer zone should be evaluated by the NPPO based on factors such as the height of the sporulating host plants, the sporulation potential on these hosts and the vegetation in the vicinity of the place of production. Recommended distances are 10 metres for shrubs and up to 100 metres in case of presence of tall sporulating hosts such as mature Larch.

Pest freedom of the plants for planting can be guaranteed when:

- The plants have been produced in a pest free place of production (see option 2)
  Or
- Plants for planting arriving on the place of production are free from the pathogens.
  and
- In case of an infection on other plants within the place of production the following measures should be implemented:

Plants grown in container

Infected plants, other plants[3], associated growing media and plant debris within a 2-m radius (this should be increased for tall trees) should be destroyed. Disinfection measures should be taken on the container standing area. Containers should either be destroyed or sterilized.

Field grown plants

Infected plants, other plants, soil attached to roots and plant debris within a 2-m radius (this should be increased for tall trees) should be destroyed. No host plants should be grown in the soil for a period of at least four years. Alternatively soil can be removed to a depth of 0.5 metre[4]. It should be disposed of safely or sterilized or covered with a water proof barrier to prevent re-infection. These measures are supported by studies conducted in UK (Turner *et al*., 2008) and Belgium (Vercauteren *et al*. 2012) which have shown that the pest is able to survive outside for at least 28 and 33 months on different types of substrate (UK and Belgium study respectively). In California *P. ramorum* could be detected at depths down to the hard pan ranging from 15 to 45 cm (Yakabe & MacDonald, 2010).

All host plants within a 10 m radius of the infected plants (to be increased in the case of tall plants) plus any remaining plants from the same lot as the diseased plants should be held for further assessment. Release of these plants is allowed following two negative visual inspections during 3 months of active growth and no treatment that could suppress symptoms should be applied during the quarantine period for all susceptible plants under quarantine. During that period, plants should preferably remain *in situ* but in exceptional situations where there is a high risk of spread the NPPO may authorise their transfer under official control to another area. If an infection is found in the new area, all plants moved may need to be destroyed unless traceability on initial order of the plants is ensured.

Note that when an infection is also detected in the buffer zone (as defined above) the measures as described in the section pest free place of production apply in addition to those implemented at the place of production.

Trace back and trace forward of associated plant material is critical.
Additional measures strongly recommended when the source of an infection has not been identified.
Investigation should be conducted in the nursery by drain water and root ball baiting tests.
Inspection of the entire place of production including all host plants.

Verification of pest freedom of the plants is achieved by:

- Visual inspections of host plants in the place of production and the buffer zone carried out during the growing season preferably after suitable conditions (e.g. rainy periods for plants grown outside) and laboratory testing of any suspicious plants.
    - In the place of production, at least two inspections should be carried out for high risk hosts and at least one inspection on the other hosts.
    - In the buffer zone at least one inspection should be carried out on the high risk hosts.

Some additional verification measures can be implemented such as:

- Testing of irrigation and drain water
- Testing of root balls and substrates

Level of uncertainty: Low

Options after harvest, at pre-clearance or during transport

<u>Detection of the pest in consignments by inspection or testing</u>

7.22 Can the pest be reliably detected by a visual inspection of a consignment at the time of export, during transport/storage?

No.

The pathogens cannot be detected by visual inspection alone since symptoms are not unique. Similarly, although symptoms are likely to be expressed on susceptible aerial plant parts during active growth (the incubation period is considered relatively short), the pathogen could be present but undetectable visually as infections on roots, as cryptic infections in buds or leaf scars, or symptoms could be suppressed by the use of fungicides. The pathogen may also be present as spores in the growing media and cannot be visually detected.

[3] The EWG recommends that non-host plants should be destroyed in a 2 metre radius as well because the growing media could be infected by the pathogens. Alternatively the growing media can be removed and destroyed.

[4] This depth is recommended in the Practical Guide for the Nursery Stock and Garden Centre Industry, DEFRA 2005

Level of uncertainty: Low

7.23 Can the pest be reliably detected by testing of the commodity?

Could be considered in a Systems Approach **possible measure: specified testing of the consignment**

Symptomatic plant material: Yes

Symptomatic plant material can be tested. Laboratory testing is therefore required in almost all situations for species identification; a variety of different methods can be used that have a relatively high degree of reliability (DNA-based methods; isolation of the pathogen in culture).

Asymptomatic material: No

Testing asymptomatic material is problematic although DNA-based methods (PCR) can be used to test asymptomatic samples of limited size due to the high sensitivity of these methods; testing a reliable sample is problematic.

Other substrates (soil and growing media): Yes

Testing can also be done with other substrates: soil, growing media by baiting methods (e.g. with rhododendron leaves), or with PCR methods.

Level of uncertainty: Medium

Removal of the pest from the consignment by treatment or other phytosanitary procedures

7.24 Can the pest be effectively destroyed in the consignment by treatment (chemical, thermal, irradiation, physical)?

No. The pests cannot be effectively destroyed by chemical or other means applied to plants for planting. Fungicides cannot be considered to be completely reliable and few have curative properties. Heat treatments have been investigated for use with key plant genera, but have not proved completely reliable at temperatures which do not damage the plants themselves (Jennings, 2008). The pests are very persistent, especially due to their ability to produce chlamydospores (*P. ramorum*) or oospores (*P. kernoviae*).

Level of uncertainty: Low

7.25 Does the pest occur only on certain parts of the plant or plant products (e.g. bark, flowers), which can be removed without reducing the value of the consignment?

No. For plants for planting, the pests can potentially infect a variety of plant parts, depending on the plant species. Some hosts only develop symptoms on leaves (leaf blight): although leaves could be removed in such cases, especially for deciduous hosts, it is possible that cryptic infections could remain in leaf scars or buds, as shown for magnolia with *P. kernoviae* (Denman, 2007); removal of leaves from evergreen hosts would reduce the value of the plants. For hosts that develop symptoms on both leaves and shoots (dieback), removal of leaves is not likely to be effective in ensuring freedom from the pathogen since it could persist as shoot infections; such infections may be cryptic or not easily detected, especially on woody stems. For hosts which do not develop leaf or shoot symptoms but only develop symptoms on bark (bleeding canker), removal of woody parts with bark would damage the plant.

Finally *P. ramorum* is known to infect roots as well, and roots cannot be removed.

Level of uncertainty: Low

7.26 Can infestation of the consignment be reliably prevented by handling and packing methods?

No. Not relevant for plants for planting of hosts plants.

Level of uncertainty: Low

Options that can be implemented after entry of consignments

7.27 Can the pest be reliably detected during post-entry quarantine?

Yes (partly). **possible measure: import of the consignment under special licence/permit and post-entry quarantine**

Based on visual detection of suspicious symptoms on host plants and laboratory testing. Post-entry quarantine would allow time for the development of symptoms in asymptomatic material as the incubation period is relatively short (symptoms can develop within 2 weeks if the conditions are conducive; for treated plants, six weeks is recommended). However there is a possibility that not all latent infection will result in symptom development within such period. Root ball testing is then advised.

An option could be to prolong the post-entry quarantine and require systematic testing of root ball.

It should be noted that keeping the plants apart from other plants on the nursery is a good plant production practice that should be implemented by importers.
Level of uncertainty: Medium

7.28 Could consignments that may be infested be accepted without risk for certain end uses, limited distribution in the PRA area, or limited periods of entry, and can such limitations be applied in practice?
No. Not applicable for plants for planting, since planting is the only end-use.
Level of uncertainty: Low

7.29 Are there effective actions that could be taken in the importing country (surveillance, eradication, containment) to prevent establishment and/or economic or other impacts?
No: surveillance in particular in semi natural or natural environment is difficult and resource intensive.
EPPO countries should inspect all plants for planting (particularly trees and shrubs) imported from countries where *P. ramorum/ P. kernoviae* is known to occur, followed by destruction and safe disposal of any plants found to be infected with *P. ramorum/P. kernoviae.* This would help prevent the introduction of *P. ramorum* lineages not already present in the EPPO region (NA1, NA2 and unknowns) and the further introduction of isolates of the EU1 lineage or of *P. kernoviae*. However, asymptomatic plants will not be detected.

Surveillance can be done to detect the pest as early as possible **but are complementary measures to other measures.**

Continued surveillance and eradication/containment measures on nurseries within the EPPO region would also continue to reduce further establishment and spread of the pathogen throughout the region with trade in plants for planting and should be established.
Surveillance of semi-natural or natural environments to detect outbreaks and appropriate eradication/containment measures would also reduce further establishment and spread to new areas within the EPPO region, as well as minimizing impacts in those areas where the pathogen has established but this is resource intensive. Eradication in such environment has proven extremely difficult if not impossible.

Measures that can be implemented to eradicate or contain the pests are presented in Appendix 4.
Level of uncertainty: Low

Evaluation of risk management options
This section evaluates the risk management options selected and considers in particular their cost effectiveness and potential impact on international trade.

7.30 Have any measures been identified during the present analysis that will reduce the risk of introduction of the pest? List them.
Yes. Listed in the order of previous positive responses:

Q.	Standalone	Systems Approach	Possible Measure	Uncertainty
7.13		X	Visual inspection at the place of production	Low
7.14		X	Specified testing at the place of production	Low
7.15		X	Specified treatment of the crop	Medium
7.17	X		Specified growing conditions of the crop	Medium
7.19			Certification scheme (see question 7.21)	
7.21	X		Pest-free area.	Medium
7.21	X		Pest-free place of production, “crop freedom”	Low
7.22		X	Visual inspection of the consignment	Low
7.23		X	Specified testing of the consignment	Medium
7.27	X		Import of the consignment under special licence/permit and post-entry quarantine	Medium

7.31 Does each of the individual measures identified reduce the risk to an acceptable level?
No

7.32 For those measures that do not reduce the risk to an acceptable level, can two or more measures be combined to reduce the risk to an acceptable level?
No
Absence of the pest cannot be guaranteed by inspection or testing of the consignment alone and if these two measures are combined as the risk of presence of latent infections is too high. Inspection and testing are included in the set of measures recommended for the designation of a pest free place of production or pest free crop.
Level of uncertainty: Low

7.34 Estimate to what extent the measures (or combination of measures) being considered interfere with international trade.
None of the measures involve the banning of any plants for planting so the measures do not interfere directly with international trade. **Phytosanitary measures are already in place in some EPPO Member countries for the movement of plants for planting that are hosts of *P. ramorum*. However, a new concept of "buffer zone" is introduced in the measures recommended in this document. Restrictions of movement of plants for planting are imposed for host plants located within a 10 m radius of the infected plants (including situation where the infected plant is situated outside of the place of production). This buffer zone is increased to a 100 m radius for situations where a tall sporulating host is found infected. The new concept of a buffer zone and the increased distance for tall sporulating hosts is likely to have an impact on the nursery trade within the EPPO region.**
Visual inspections and testing of symptomatic plants at the place of production may delay the movement of plants; this may lead to loss of contracts with the importer.
Post-entry quarantine would affect importers ability to move or trade plants and this may also lead to the possible loss of contracts; impacts will vary with the timing and length of the post-entry quarantine period.
Pest-free area or place of production is already a requirement for imports of susceptible plants from the USA and is a common requirement for plants for planting.
Level of uncertainty: Medium

7.35 Estimate to what extent the measures (or combination of measures) being considered are cost-effective, or have undesirable social or environmental consequences.
The cost-effectiveness of the measures on imports of plants for planting (hosts) in exporting and importing countries have not been evaluated.
The main costs for imports of plants for planting are associated with inspections, sampling and testing in the exporting country and surveillance, sampling, testing and eradication and containment measures for outbreaks in the importing country. Outbreaks on nurseries will incur costs for individual growers through the destruction of infected plant material and any other related measures; costs will be related to the value and quantity of the plants concerned. Where material is held or destroyed there is potential for loss of contracts with customers either directly or through loss in confidence.
However, preventive measures are considered cost effective compared to eradication and containment measures for outbreaks in historic gardens, parks or '*public greens*', semi-natural or natural environments (including woodlands).
Level of uncertainty: Medium

7.36 Have measures (or combination of measures) been identified that reduce the risk for this pathway, and do not unduly interfere with international trade, are cost-effective and have no undesirable social or environmental consequences?
Yes

7.38 Have all major pathways been analyzed (for a pest-initiated analysis)?
No **Analyze the next major pathway**

Pathway 2 – Soil as a contaminant (e.g. on footwear, machinery, etc.)

7.06 Is the pathway that is being considered a commodity of plants and plant products?
No **Go to 7.03**

7.07 Is the pathway that is being considered the entry with human travellers?
Yes
The EFSA scientific Opinion states that "*The pathogen has been found on shoes and bicycles (tested, both in USA and UK, SOD 3rd Science Symposium; see also McNeill et al., 2011)*".

In areas where the pest is present, recommended prevention measures include:

- Restriction of access to infected areas or notices for public access.
- Cleaning of footwear, bikes or machinery leaving an infected area and public awareness campaigns on these requirements (including at airports and ports).

7.08 Is the pathway being considered contaminated machinery or means of transport?
Yes **Go to 7.29**
The EFSA scientific Opinion states that felling operation within hotspots is posing a higher risk.
Strict hygiene (cleaning or disinfection of machinery/vehicles) is required to prevent further spread from felling operations.

7.29 Are there effective measures that could be taken in the importing country (surveillance, eradication) to prevent establishment and/or economic or other impacts?
No: surveillance in particular in semi natural or natural environment is difficult and resource intensive.
Surveillance can be done to detect the pest as early as possible **but are complementary measures to other measures.**
Continued surveillance and eradication/containment measures on nurseries within the EPPO region would also continue to reduce further establishment and spread of the pathogen throughout the region with trade in plants for planting and should be established.
Surveillance of semi-natural or natural environments to detect outbreaks and appropriate eradication/containment measures would also reduce further establishment and spread to new areas within the EPPO region, as well as minimizing impacts in those areas where the pathogen has established but this is resource intensive. Eradication in such environment has proven extremely difficult if not impossible.

Measures that can be implemented to eradicate or contain the pests are presented in Appendix 4

Level of uncertainty: Low

if yes **Possible measures: internal surveillance and/or eradication campaign**
Go to 7.30

Evaluation of risk management options: Soil as a contaminant

7.30 Have any measures been identified during the present analysis that will reduce the risk of introduction of the pest? List them.

If yes **Go to 7.31**

Yes. Listed in the order of previous positive responses:

- Cleaning of footwear, bikes or machinery leaving an infected area and public awareness campaigns on these requirements (including at airports and ports).
- Cleaning or disinfection of machinery/vehicles

7.31 Does each of the individual measures identified reduce the risk to an acceptable level?
Yes
Level of uncertainty: Low

7.34 Estimate to what extent the measures (or combination of measures) being considered interfere with international trade.

The measures do not interfere with international trade.

With respect to imports of used agricultural or forestry machinery or vehicles, the requirement for cleaning/decontamination prior to export will incur a cost for the exporter but the benefit is a reduction in the risk of further entry of *P. ramorum/P. kernoviae* into the EPPO region.

Level of uncertainty: High

7.35 Estimate to what extent the measures (or combination of measures) being considered are cost-effective, or have undesirable social or environmental consequences.

Measures applied to travellers are likely to be considered socially undesirable in particular in the EU, but these requirements are in place in a generic form in third countries such as New Zealand, where for example, declarations have to be made on arrival of '*biosecurity risk items*' including soil, water, articles with soil attached or equipment use with soil.

http://www.customs.govt.nz/nr/rdonlyres/75fd14e8-59b5-4e97-92bb-d73e87de5e62/0/arrivalcardmar2008.pdf

Such declarations are followed up at the point of entry and can require shoes to be cleaned before onward travel within the country.

Level of uncertainty: Medium

7.36 Have measures (or combination of measures) been identified that reduce the risk for this pathway, and do not unduly interfere with international trade, are cost-effective and have no undesirable social or environmental consequences?

Yes

Level of uncertainty: Medium

7.38 Have all major pathways been analyzed (for a pest-initiated analysis)?

If no **Go to 7.01 to analyze the next major pathway**

Pathway 3 Susceptible (isolated) bark or wood chips (not intended for burning)

Note: the risk from wood chips is related to the possible presence of bark. The text in this section only provides information for wood chips when this is considered to differ from bark.

7.07 Is the pathway that is being considered a commodity of plants and plant products?
Yes **Go to 7.09**

7.09 If the pest is a plant, is it the commodity itself?
No (the pest is not a plant) **go to 7.10**

Existing phytosanitary measures
7.10 Are there any existing phytosanitary measures applied on the pathway that could prevent the introduction of the pest?

Yes for bark **if appropriate, list the measures and identify their**
No for wood chips **efficacy against the pest of concern and go to 7.11**
Level of uncertainty: Low

P. ramorum
Yes. Measures exist but are not complete (in particular not all known hosts are covered).

EU countries have pre-existing measures specific for imports of isolated bark under the emergency phytosanitary measures laid down for *P. ramorum* in 2002 (2002/757/EC as amended 2004 and 2007), (EU, 2002, 2004 and 2007) as follows:

> *Susceptible isolated bark of* Acer macrophyllum *Pursh*, Aesculus californica *(Spach) Nutt.*, Lithocarpus densiflorus *(Hook. &Arn.) Rehd.*, Quercus *spp. L. and* Taxus brevifolia *Nutt.'*
> *Susceptible bark originating in the United States of America shall not be permitted entry in the Community.*

Hosts on which cankers can be observed are presented in Table 1. No cankers are observed on *Acer macrophyllum*, *Aesculus californica*. Phytosanitary measures are in place for *P. ramorum* on bark from the USA for the majority of canker hosts (excluding *Toxicodendron diversilobum*, Pacific poison oak, which is unlikely to be harvested).

Norway and Switzerland have measures in place similar to those of the EU. In Turkey, although *P. ramorum* is listed as a regulated pest, phytosanitary measures are requested for wood but not for bark.

Non-specific measures for bark that exist in the EU Plant Health Directive (2000/29/EC) (EU, 2000) are listed in Appendix 3 and detailed after (such measures are also in place in other EPPO countries such as Norway Switzerland and Turkey). Bark of *Castanea* is prohibited entry into the EU from third countries. Bark of *Quercus* spp. (other than cork oak, *Q. suber*) is prohibited entry from North America. Thus, in addition to the emergency phytosanitary measures, *P. ramorum* is also constrained from entering on bark of *Castanea* spp. from the USA, and on bark of *Castanea* spp. and *Quercus* spp. from Canada. Isolated bark of conifers requires either fumigation or heat treatment at 56°C for 30 minutes before it can enter the EU (or countries with EU like phytosanitary regulation) from non-European countries. The efficacy of these treatments against cankered bark is unknown. Tubajika *et al*. (2008) found that a treatment at 56°C for 30 minutes might not be adequate to kill *P. ramorum* in wood of tanoak (*L. densiflorus*). However, the results were inconclusive, particularly because the detection of *P. ramorum* in the controls was low.

It should be noted that not all host trees (e.g. *Larix*) and not all origins are covered in these measures. No measures are required for internal movement of bark between the EU countries.

The EWG considered that measures should target all tree hosts which exhibit symptoms of bark cankers. The list for *P. ramorum* and *P. kernoviae* is presented below:

Table 1. Tree canker hosts of *P. ramorum* (compiled from Forest Research and Fera)

Latin name	Family	Common name	Symptom	Location(s)	References
Abies grandis	Pinaceae	Grand fir	Trunk canker*	USA (outdoor) - foliar and dieback; UK (outdoor) - canker and foliar	COMTF (undated); Forest Research records (late 2009)
Abies procera	Pinaceae	Noble fir	Trunk canker	Ireland, outdoor. Symptoms described as 'branch dieback'	Department of Agriculture, Fishereries and Food, Ireland (September, 2010)
Acer pseudoplatanus	Aceraceae	Sycamore	Trunk canker	UK (outdoor)	Forest Research records
Aesculus hippocastanum	Hippocastanaceae	Horse chestnut	Trunk canker	UK (outdoor)	Forest Research records
Betula pendula	Betulaceae	Silver birch	Trunk canker	UK (outdoor)	Forest Research records (October 2009)
Castanea sativa	Fagaceae	Sweet chestnut	Trunk canker*	UK (outdoor)	Denman *et al*. (2005)
Castanopsis orthacantha	Fagaceae			UK (outdoor)	Forest Research records
Chaemaecyparis lawsoniana	Cupressaceae	Lawson's cypress	Trunk canker	UK (outdoor)	Forest Research records (November 2009)
Cinnamomum camphora	Lauraceae	Camphor tree	Trunk canker*	UK (outdoor)	Forest Research records
Fagus sylvatica	Fagaceae	Beech	Trunk canker*	UK (outdoor), Netherlands (outdoor)	Forest Research records, RAPRA (2003)
Larix kaempferi	Pinaceae	Japanese larch	Trunk canker*	UK (outdoor), Ireland (outdoor)	Forest Research records (2009) and Department of Agriculture, Fishereries and Food, Ireland (July 2010)
Larix decidua	Pinaceae	European larch	Trunk canker*	UK (outdoor)	Forest Research records (2011)
Notholithocarpus densiflorus	Fagaceae	Tanoak	Trunk canker*	USA (outdoor)	Garbelotto *et al.* (2003)
Nothofagus obliqua	Fagaceae	Roble beech	Trunk canker	UK (outdoor)	Forest Research records
Quercus acuta	Fagaceae	Japanese evergreen oak	Trunk canker	UK (outdoor)	Forest Research records
Quercus agrifolia	Fagaceae	Coast live oak	Trunk canker	USA (outdoor)	Garbelotto *et al.* (2003)
Quercus cerris	Fagaceae	Turkey oak	Trunk canker*	UK (outdoor)	Forest Research records
Quercus chrysolepis	Fagaceae	Canyon live oak	Trunk canker	USA (outdoor)	Murphy & Rizzo (2003)
Quercus falcata	Fagaceae	Southern red oak	Trunk canker	UK (outdoor)	Brasier *et al*. (2004a)
Quercus kelloggii	Fagaceae	Californian black oak	Trunk canker	USA (outdoor)	Garbelotto *et al.* (2003)
Quercus parvula var. *shrevei*	Fagaceae	Shreve oak	Trunk canker	USA (outdoor)	Garbelotto *et al.* (2003)

Latin name	Family	Common name	Symptom	Location(s)	References
Quercus petraea	Fagaceae	Sessile oak	Trunk canker	UK (outdoor)	Forest Research records (
Quercus rubra	Fagaceae	Northern red oak	Trunk canker	Netherlands (outdoor)	RAPRA database Webber (2008)
Schima argentea	Theacae		Trunk canker	UK (outdoor)	Forest Research records
Taxus brevifolia	Taxaceae	Pacific yew	Trunk canker*	USA (outdoor)	COMTF (undated)
Toxicodendron diversilobum	Anacardaceae	Pacific poison oak	Trunk canker*	USA (outdoor)	Rizzo (2003)
Tsuga heterophylla	Pinaceae	Western hemlock	Trunk canker*	UK (outdoor)	Forest Research records (September 2009)

* also recorded as a foliar host

Table 2 Tree canker hosts of *P. kernoviae* (compiled from Forest Research and Fera)

Latin name	Family	Common name	Symptom	Location(s)	References
Fagus sylvatica	Fagaceae	Beech	Trunk canker	UK (outdoor), Netherlands (outdoor)	Forest Research records, RAPRA (2003)
Liriodendron tulipifera	Magnoliaceae	Tuli tree	Trunk canker *		Forest Research records (2005)
Quercus robur	Fagaceae	Sessile oak	Trunk canker	Netherlands (outdoor)	Forest Research records (2005)

* also recorded as a foliar host

P. kernoviae

There are no pre-existing management or phytosanitary requirements for *P. kernoviae* on bark imported into the PRA area from New Zealand.

There are requirements in the EC emergency measures for *P. ramorum* for ‘‘susceptible bark’ of the same tree hosts originating in the USA as listed in the wood pathway to be prohibited entry to the EU.

Separately, the EC Plant Health Directive prohibits isolated bark of *Castanea* (N.B. *C. sativa* is only reported as a foliar host) from all third countries and isolated bark of *Quercus* from North America; also, Annex IVAI has requirements related to isolated bark of conifers originating in non-European countries but see paragraph on *P. ramorum*).

7.11 Are the measures likely to change in the foreseeable future?
No judgement **go to 7.12**

7.12 Do you conclude that other measures should be considered?
Yes **go to 7.13**

Identification of appropriate risk management options
Options at the place of production
Detection of the pest at the place of production by inspection or testing

7.13 Can the pest be reliably detected by visual inspection at the place of production?
Yes but should be considered in a Systems Approach **possible measure: visual inspection at the place of production**

The pests cannot be detected by visual inspection alone since symptoms are not unique it should be complemented by testing. In addition inspecting the tree canopy is difficult. Some hosts such as Larch exhibit typical symptoms.
Level of uncertainty: Medium

7.14 Can the pest be reliably detected by testing at the place of production?

Yes but should be considered in a Systems Approach **possible measure: specified testing at the place of production**

Symptomatic plant material: Yes
Symptomatic bark can be tested on-site by inspectors using *Phytophthora* genus-specific lateral flow devices (LFDs). However, these do not identify any potential pathogen to species level. DNA-based (PCR) on-site methods (e.g. SmartCycler) can specifically detect and identify *P. ramorum/ P. kernoviae* but this approach is not routinely used by official inspection services. Laboratory testing is therefore required in almost all situations for species identification; a variety of different methods can be used that have a relatively high degree of reliability (DNA-based methods; isolation of the pathogen in culture). The presence of inhibitors in some wood e.g. larch can cause difficulties to DNA-based (PCR) testing.

Asymptomatic plant material: No
Testing asymptomatic material is problematic although DNA-based methods (PCR) can be used to test asymptomatic samples of limited size due to the high sensitivity of these methods; testing a reliable sample is problematic.

Level of uncertainty: Medium

<u>Prevention of infestation of the commodity at the place of production</u>

7.15 Can infestation of the commodity be reliably prevented by treatment of the crop
No. Chemical or non-chemical treatments are not considered completely reliable in preventing infection of trees and treatments of forestry grown species is not feasible.
Level of uncertainty: Low

7.16 Can infestation of the commodity be reliably prevented by growing resistant cultivars*?*
No. There are no breeding programmes, no known immune cultivars of susceptible species and no identified sources of resistance for use in future breeding programmes.
Level of uncertainty: Low

7.17 Can infestation of the commodity be reliably prevented by growing the crop in specified conditions (e.g. protected conditions such as screened greenhouses, physical isolation, sterilized growing medium, exclusion of running water, etc.)**?**
No. The commodity originates from trees grown outside.
Level of uncertainty: Low

7.18 Can infestation of the commodity be reliably prevented by harvesting only at certain times of the year, at specific crop ages or growth stages?
No. The pathogen can potentially infect plant material all-year round, depending on environmental conditions and is believed to be able to survive in the host for several months to years.
Level of uncertainty: Low

7.19 Can infestation of the commodity be reliably prevented by production in a certification scheme (i.e. official scheme for the production of healthy plants for planting)?
No. Not relevant.
Level of uncertainty: Low

<u>Establishment and maintenance of pest freedom of a crop, place of production or area</u>

7.20 Based on your answer to question 4.01 select the possible measures based on the capacity for natural spread.

In a non-nursery environment with no tall sporulating hosts: Very low rate of spread
Level of uncertainty: Medium

In mixed evergreen forests in California, rain-splash dispersal of *P. ramorum* 10–15 m has been detected (Davidson *et al.*, 2005).

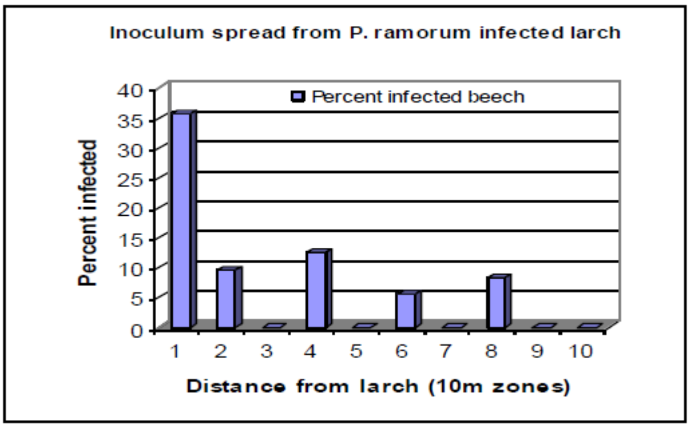
Text from the UK PRA for *P. kernoviae* (Sansford, 2008) states that:
'Studies in two woodlands in Cornwall where both P. ramorum and P. kernoviae were present affecting a naturalised understorey of R. ponticum as well as a number of trees including beech (F. sylvatica) showed that 9 out of 12 trees with lesions caused by P. kernoviae were within 2 m of an infected rhododendron, in many cases being in direct contact with the foliage. It was assumed that zoospores or sporangia were splash-dispersed from the rhododendron foliage onto the tree stems and that the spores penetrated the bark leading to infection and symptom development. Where affected trees were not in close proximity to the rhododendrons it was suggested that wind-driven inoculum in mist and/or rain had led to tree stem infection (Brown et al., 2006).
Spore dispersal was also studied in a large garden with infected plants in situ (Turner *et al.*, 2007). In this study, dispersal of both *P. ramorum* and *P. kernoviae*, was confirmed in December 2006 at a distance of more than 50 m from infected plants but at very low level; this coincided with a period of wet, windy weather. In addition, in this study it was noted that traps placed in an open area between eradicated woodland and an infected area detected longer distance spore dispersal of up to 50m.

From these data, the EWG considered that the majority of infections from shrub species such as rhododendron occur within a distance of 10 metres.

Presence of tall sporulating hosts: Low to medium rate of spread
Level of uncertainty: Medium
Although there is not study to confirm this, the EWG considered that in a continuous tall host plant environment spread may be faster than in a place of production of plants for planting.

Infestations from tall sporulating trees (as is the case with Larch) might lead to dispersal over longer distances. Webber *et al.* 2010 studied the impact of the presence of infected *L. kaempferi* on nearby susceptible tree species has been derived from a field assessment of mature 30 m tall beech (*F. sylvatica*) growing next to a compartment of 30 m tall infected *L. kaempferi*. Bleeding cankers were visible on at least a third of the beech trees in a 10m wide zone immediately neighboring the larch (Fig. 10). Most of these stem cankers occurred at between 7-11m above ground-level. However, at increasing distance from the larch, the proportion of beech with bleeding cankers decreased (Fig. 10).

Fig 10 from Webber *et al.* 2010 Percentage of *P. ramorum* infected beech (*Fagus sylvatica*) at increasing distances from larch (*L. kaempferi*) also infected with *P. ramorum.*



Very high sporulation was recorded from this infected stand of larch of larch (*L. kaempferi*) which, in addition to beech, resulted in infection of sweet chestnut, hemlock, Douglas fir, *Nothofagus,* rhododendron, silver birch and Lawson's cypress within 100m (Defra Project PDMP 1; http://www.fera.defra.gov.uk/plants/plantHealth/pestsDiseases/phytophthora/documents/prPkResearchJul09.pdf).

Although spore monitoring conducted during this study showed that inoculum could be detected at low levels at a distance of up to 1 km from the infected area the **data show that the majority of infection occur within a distance of 100 metres**.

From these data, the EWG considered that the majority of infections from tall sporulating trees hosts such as mature larch occur within a distance of 100 metres.

Other cases of longer spread distance
Longer-distance natural spread by turbulent air over several kilometres is thought to occur more rarely and under certain weather conditions. There is also the potential for longer-distance natural spread over about a kilometre via inoculum in watercourses, wind-blown infected debris, or through movement of contaminated soil/debris on the feet of animals; these are less significant pathways of natural spread though.

7.21 Can pest freedom of a place of production or an area be reliably guaranteed?
Yes.
Area could be reliably guaranteed with suitable surveillance, monitoring and testing regimes in place. Place of production freedom was not considered a feasible option for a forestry environment (given the difficulty of surveillance of forest trees)

AREA FREEDOM (ISPM 4)
Area freedom should be confirmed by official surveys of susceptible plants at places of production and the natural environment.

Verification of area freedom is achieved by visual inspections of host plants at places of production and in the natural environment carried out during the growing season preferably after suitable conditions (e.g. rainy periods for plants grown outside) and laboratory testing of any suspicious plants. Testing of water courses is recommended for detecting *P. ramorum* in wider areas (the method has been used successfully for *P. ramorum* but evidence is limited for *P. kernoviae*).

Inspections can focus on plants such as rhododendron that are considered to act as good 'indicator' plants of the presence of *P. ramorum /kernoviae*." In forests, inspection should also focus on Larch.

Level of uncertainty: Medium

Options after harvest, at pre-clearance or during transport
Detection of the pest in consignments by inspection or testing
7.22 Can the pest be reliably detected by a visual inspection of a consignment at the time of export, during transport/storage?
No.
The pathogens cannot be detected by visual inspection alone since symptoms are not unique.
Level of uncertainty: Low

7.23 Can the pest be reliably detected by testing of the commodity (e.g. for pest plant, seeds in a consignment)?
No.
The pathogen could potentially be detected by testing bark, but this is not considered practical or reliable given the volume of material that is likely to be imported and the need for representative samples.
Level of uncertainty: Low

Removal of the pest from the consignment by treatment or other phytosanitary procedures
7.24 Can the pest be effectively destroyed in the consignment by treatment (chemical, thermal, irradiation, physical)?
Yes
The EFSA scientific opinion states that "*composting has been considered as an effective treatment option for sanitation of P. ramorum infected plant material (Garbelotto, 2003; Swain et al., 2002, 2006; Aveskamp and Wingelaar, 2005)"*.
Swain *et al*. (2006) showed that a 1-hour exposure at 55°C was required to no longer detect *P. ramorum* in wood chips and cankered stems of coast live oak (*Q. agrifolia*). The EWG considered that if the temperature is sufficient for wood chips it should be appropriate for bark.
Level of uncertainty: Low

7.25 Does the pest occur only on certain parts of the plant or plant products (e.g. bark, flowers), which can be removed without reducing the value of the consignment?
No
Bark is the commodity.
Level of uncertainty: Low

7.26 Can infestation of the consignment be reliably prevented by handling and packing methods?
No.
Not relevant for susceptible isolated bark.
Level of uncertainty: Low

Options that can be implemented after entry of consignments
7.27 Can the pest be reliably detected during post-entry quarantine?
No.
The pathogen could potentially be detected by testing bark, but this is not considered practical or reliable. Post-entry quarantine is not appropriate for a plant product.
Level of uncertainty: Low

7.28 Could consignments that may be infested be accepted without risk for certain end uses, limited distribution in the PRA area, or limited periods of entry, and can such limitations be applied in practice?
No
It may be impractical to enforce prohibition of use in the nursery or landscaping industries. Limited periods of entry are not appropriate as the pathogen can infect all year round.
Level of uncertainty: Medium

7.29 Are there effective actions that could be taken in the importing country (surveillance, eradication, containment) to prevent establishment and/or economic or other impacts?
No: surveillance in particular in semi natural or natural environment is difficult and resource intensive.
Surveillance can be done to detect the pest as early as possible **but are complementary measures to other measures.**

Surveillance of semi-natural or natural environments to detect outbreaks and appropriate eradication/containment measures would also reduce further establishment and spread to new areas within the EPPO region, as well as minimizing impacts in those areas where the pathogen has established but this is resource intensive. Eradication in such environment has proven extremely difficult if not impossible.

Measures that can be implemented to eradicate or contain the pests are presented in Appendix 4

Level of uncertainty: Low

Evaluation of risk management options
This section evaluates the risk management options selected and considers in particular their cost effectiveness and potential impact on international trade.

7.30 Have any measures been identified during the present analysis that will reduce the risk of introduction of the pest? List them.
Yes. Listed in the order of previous positive responses:

Q.	Standalone	Systems Approach	Possible Measure	Uncertainty
7.13		X	visual inspection at the place of production	Low
7.14		X	specified testing at the place of production	Low
7.21	X		Pest-free area	Medium
7.24	X		Treatment of the consignment	Low

7.31 Does each of the individual measures identified reduce the risk to an acceptable level?
No
Only pest pest-free area and treatment of the consignment can reduce the risk to an acceptable level. Visual inspection and testing at the place of production are not sufficient.
Level of uncertainty: Low

7.33 For those measures that do not reduce the risk to an acceptable level, can two or more measures be combined to reduce the risk to an acceptable level?
No
Absence of the pest cannot be guaranteed by inspection or testing of the consignment alone and if these two measures are combined as the risk of presence of latent infections is still high.
Level of uncertainty: Low

7.34 Estimate to what extent the measures (or combination of measures) being considered interfere with international trade.

Level of uncertainty: High
The EWG had no data on the current trade to make this evaluation
However, it was noted that that the measures are not complete e.g. not all tree hosts that exhibit bark cankers are covered, including larch (revised lists of tree hosts which exhibit symptoms of bark cankers were compiled for *P. ramorum* and *P. kernoviae*), not all origins are covered in these measures, no measures are required for internal movement of susceptible wood between the EU countries and no measures exist for *P. kernoviae.*
As a conclusion some interference cannot be excluded.

7.35 Estimate to what extent the measures (or combination of measures) being considered are cost-effective, or have undesirable social or environmental consequences.
The cost-effectiveness of the measures being considered has not been calculated but as measures already exist for imports of susceptible bark from the USA there would be no additional social or environmental consequences.
Level of uncertainty: Low

7.36 Have measures (or combination of measures) been identified that reduce the risk for this pathway, and do not unduly interfere with international trade, are cost-effective and have no undesirable social or environmental consequences?
Yes **go to 7.38**

7.39 Have all major pathways been analyzed (for a pest-initiated analysis)?
No **Analyze the next major pathway**

Pathway 4 – Susceptible wood

The EWG considered that this pathway presents a lower risk than bark because of the intended use. Risk would mainly arise if the logs are stored outside and in humid conditions

7.06 Is the pathway that is being considered a commodity of plants and plant products?
Yes **Go to 7.09**

7.09 If the pest is a plant, is it the commodity itself?
No (the pest is not a plant) **go to 7.10**

Existing phytosanitary measures
7.10 Are there any existing phytosanitary measures applied on the pathway that could prevent the introduction of the pest?

Yes **if appropriate, list the measures and identify their efficacy against the pest of concern and go to 7.11**

Level of uncertainty:	**Low**	Medium	High

P. ramorum
Yes.
Measures exist but are not complete (in particular not all known hosts are covered see pathway 3)

In the EU countries there are pre-existing measures specific for imports of susceptible wood under the emergency phytosanitary measures laid down for *P. ramorum* in 2002 (2002/757/EC as amended 2004 and 2007), (EU, 2002, 2004 and 2007) as follows:

Under Article 3 of the emergency measures:

- *Susceptible plants and* ***susceptible wood*** *may only be introduced into the territory of the Community if they comply with the emergency phytosanitary measures laid down in points 1a (susceptible plants) and* ***2*** *(****susceptible wood****) of the Annex* [see below] *to the Decision and if they are inspected on entry into the Community for the presence of non-European isolates of the harmful organism, in accordance with Article 13(1)(a) of Directive 2000/29/EC, and found free from the harmful organism in this inspection.*

- *The provisions specified in points 1a and* ***2*** *of the Annex to the Decision (see below) shall apply only to susceptible plants and* ***susceptible wood*** *originating in the United States of America destined for the Community and leaving on or after 1 November 2002.*

- *The measures laid down in Part A, Section I (3) of Annex IV* [of the EC Plant Health Directive, 2000/29/EC; EU, 2000] *as regards wood of* Quercus *L., including wood which has not kept its natural round surface, originating in the United States of America, shall not apply to susceptible wood of* Quercus *L. which satisfies the requirements of point* ***2(b)*** *of the Annex to the Decision.*

Under Article 1 of the emergency measures:

Susceptible wood is defined in paragraph 3 as:

- ***Susceptible wood*** *of Acer macrophyllum Pursh, Aesculus californica (Spach) Nutt., Lithocarpus densiflorus (Hook. & Arn.) Rehd., Quercus spp. L. and Taxus brevifolia Nutt.*

Specific requirements for wood in the Annex :

2. *Susceptible wood originating in the United States of America may only be imported into the Community if, it is accompanied by a certificate referred to in Article 13 (1) of Directive 2000/29/EC:*
   (a) *stating that it originates in areas in which non–European isolates of the harmful organism is known not to occur. The name of the area shall be mentioned on the certificate under the rubric 'place of origin'; or*

(b) issued after official verification that the wood has been stripped of its bark and:
(i) that it has been squared so as to remove entirely the rounded surface; or
(ii) that the water content of the wood does not exceed 20% expressed as a percentage of the dry matter, or
(iii) that the wood has been disinfected by an appropriate hot-air or hot-water treatment;

or

(c) in the case of sawn wood with or without residual bark attached, if there is evidence by a mark 'Kiln-dried', 'KD' or another internationally recognised mark put on the wood or on its packaging in accordance with current commercial usage, that it has undergone kiln-drying to below 20 % moisture content, expressed as a percentage of dry matter, at time of manufacture, achieved through an appropriate time/temperature schedule.

With respect to the list of susceptible wood, *Acer macrophyllum*, *Aesculus californica* are listed but they are not canker hosts (see Table 1); the remaining species are. *P. ramorum* is constrained from entering on wood from the USA on the majority of canker hosts (excluding *Toxicodendron diversilobum*, Pacific poison oak, which is unlikely to be harvested).
Similar measures are in place in other EPPO countries such as Norway Switzerland and Turkey.

Non-specific measures that exist in the EU Plant Health Directive (2000/29/EC) (EU, 2000) and that apply to wood of hosts of *P. ramorum*. Many of these are for specific pests of wood (i.e. Annex IVAI, Articles 1.1, 1.2, 1.5, 1.6, 1.7); 1.5 only refers to material from Russia, Kazakhstan and Turkey which are not considered to be countries where *P. ramorum* may occur. However, the requirements for imports of wood under these articles have various options some of which <u>may</u> affect *P. ramorum*. However, their efficacy is untested (kiln-drying below 20% moisture, fumigation or chemical pressure impregnation) with some doubt over the efficacy of heat treatment to 56°C for 30 minutes (see pathway 3). Annex IVAI, Article 3 has requirements for *Quercus* spp. from the USA but, as alluded to in the emergency phytosanitary measures for *P. ramorum*, this does not apply to imports of wood of *Quercus* from the USA if it complies with Annex 2(b) of the emergency measures. Annex IVAI, Article 2 is for wood packaging material (no genera specified) and Article 7.2 is for wood chips, particles, sawdust, shaving, wood waste and scrap of *Quercus* from the USA.

There are no measures for the internal movement of wood between EU countries

P. kernoviae

- Requirements for wood coming from New Zealand

EU countries have no pest-specific requirements for wood of susceptible species coming from New Zealand. Phytosanitary requirements for wood susceptible to *P. ramorum* only relates to wood originating from the USA and is specific to *Acer macrophyllum, Aesculus californica, Lithocarpus densiflorus, Quercus spp.* and *Taxu sbrevifolia*.

The EU Plant Health Directive 2000/29 includes requirements for wood of *Quercus* spp. but only for wood originating from the US (see above).

According to the UK PRA for *P. kernoviae* (Sansford, 2008) consignments of timber of *P. radiata* exported from New Zealand to the UK were all declared as kiln-dried. Two of the accompanying phytosanitary certificates showed treatment of 40 hours at 85°C. No details of the thickness of the timber were given but if this was less than the normal thickness of 5.1cm it was assumed (but not scientifically proven) that such a treatment would render *P. kernoviae* non-viable.

7.11 Are the measures likely to change in the foreseeable future?
No judgement **go to 7.12**

7.12 Do you conclude that other measures should be considered?
Yes **go to 7.13**

Identification of appropriate risk management options
Options at the place of production
<u>Detection of the pest at the place of production by inspection or testing</u>

7.13 Can the pest be reliably detected by visual inspection at the place of production?
Yes but should be considered in a Systems Approach **possible measure: visual inspection at the place of production**
The pests cannot be detected by visual inspection alone since symptoms are not unique it should be complemented by testing. In addition inspecting the tree canopy is difficult. Some hosts such as Larch exhibit typical symptoms.
Level of uncertainty: Low

7.14 Can the pest be reliably detected by testing at the place of production?
Yes but should be considered in a Systems Approach **possible measure: specified testing at the place of production**

Symptomatic plant material: Yes
Symptomatic tree material can be tested on-site by inspectors using *Phytophthora* genus-specific lateral flow devices (LFDs). However, these do not identify any potential pathogen to species level. DNA-based (PCR) on-site methods (e.g. SmartCycler) can specifically detect and identify *P. ramorum/ P. kernoviae* but this approach is not routinely used by official inspection services. Laboratory testing is therefore required in almost all situations for species identification; a variety of different methods can be used that have a relatively high degree of reliability (DNA-based methods; isolation of the pathogen in culture). The presence of inhibitors in some wood e.g. larch can cause difficulties to DNA-based (PCR) testing.

Asymptomatic plant material: No
Testing asymptomatic material is problematic although DNA-based methods (PCR) can be used to test asymptomatic samples of limited size due to the high sensitivity of these methods; testing a reliable sample is problematic.

Level of uncertainty: Medium

<u>Prevention of infestation of the commodity at the place of production</u>
7.15 Can infestation of the commodity be reliably prevented by treatment of the crop
No. Treatment of forestry-grown species of tree to prevent infection of the stems is not feasible.
Level of uncertainty: Low

7.16 Can infestation of the commodity be reliably prevented by growing resistant cultivars*?*
No. There are no breeding programmes, no known immune cultivars of susceptible species and no identified sources of resistance for use in future breeding programmes.
Level of uncertainty: Low

7.17 Can infestation of the commodity be reliably prevented by growing the crop in specified conditions (e.g. protected conditions such as screened greenhouses, physical isolation, sterilized growing medium, exclusion of running water, etc.)**?**
No. The commodity originates from trees grown outside.
Level of uncertainty: Low

7.18 Can infestation of the commodity be reliably prevented by harvesting only at certain times of the year, at specific crop ages or growth stages?
No. The pathogen can potentially infect plant material all-year round, depending on environmental conditions.
Level of uncertainty: Low

7.19 Can infestation of the commodity be reliably prevented by production in a certification scheme (i.e. official scheme for the production of healthy plants for planting)?
No. not relevant
Level of uncertainty: Low

<u>Establishment and maintenance of pest freedom of a crop, place of production or area</u>

7.20 Based on your answer to question 4.01 select the possible measures based on the capacity for natural spread.
In a non-nursery environment with no tall sporulating hosts: Very low rate of spread

Level of uncertainty: Medium

In mixed evergreen forests in California, rain-splash dispersal of *P. ramorum* 10–15 m has been detected (Davidson *et al.*, 2005).

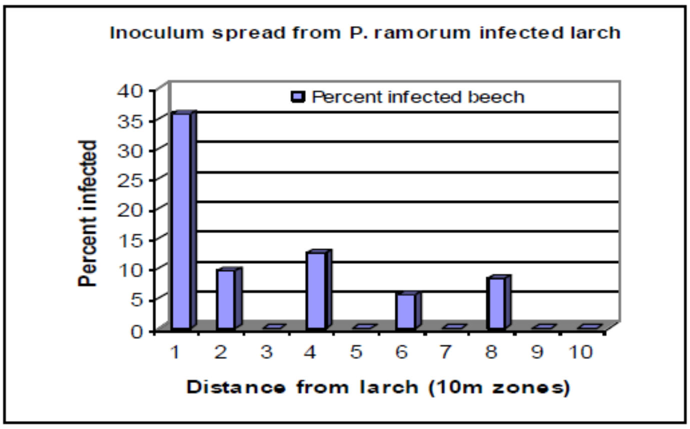
Text from the UK PRA for *P. kernoviae* (Sansford, 2008) states that:
'Studies in two woodlands in Cornwall where both P. ramorum and P. kernoviae were present affecting a naturalised understorey of R. ponticum as well as a number of trees including beech (F. sylvatica) showed that 9 out of 12 trees with lesions caused by P. kernoviae were *within 2 m of an infected rhododendron,* *in many cases being in direct contact with the foliage. It was assumed that zoospores or sporangia were splash-dispersed from the rhododendron foliage onto the tree stems and that the spores penetrated the bark leading to infection and symptom development. Where affected trees were not in close proximity to the rhododendrons it was suggested that wind-driven inoculum in mist and/or rain had led to tree stem infection (Brown et al., 2006).*
Spore dispersal was also studied in a large garden with infected plants in situ (Turner *et al.*, 2007). In this study, dispersal of both *P. ramorum* and *P. kernoviae* was confirmed in December 2006 at a distance of more than 50 m from infected plants but at very low level; this coincided with a period of wet, windy weather. In addition, in this study it was noted that traps placed in an open area between eradicated woodland and an infected area detected longer distance spore dispersal of up to 50m.

From these data, the EWG considered that the majority of infections from shrub species such as rhododendron occur within a distance of 10 metres.

Presence of tall sporulating hosts: Low to medium rate of spread
Level of uncertainty: Medium
Although there is not study to confirm this, the EWG considered that in a continuous tall host plant environment spread may be faster than in a place of production of plants for planting.

Infestations from tall sporulating trees (as is the case with Larch) might lead to dispersal over longer distances. Webber *et al.* 2010 studied the impact of the presence of infected *L. kaempferi* on nearby susceptible tree species has been derived from a field assessment of mature 30 m tall beech (*F. sylvatica*) growing next to a compartment of 30 m tall infected *L. kaempferi*. Bleeding cankers were visible on at least a third of the beech trees in a 10m wide zone immediately neighboring the larch (Fig. 10). Most of these stem cankers occurred at between 7-11m above ground-level. However, at increasing distance from the larch, the proportion of beech with bleeding cankers decreased (Fig. 10).

Fig 10 from Webber *et al.* 2010 Percentage of *P. ramorum* infected beech (*Fagus sylvatica*) at increasing distances from larch (*L. kaempferi*) also infected with *P. ramorum.*



Very high sporulation was recorded from this infected stand of larch of larch (*L. kaempferi*) which, in addition to beech, resulted in infection of sweet chestnut, hemlock, Douglas fir, *Nothofagus*, rhododendron, silver birch and Lawson's cypress within 100m (Defra Project PDMP 1; http://www.fera.defra.gov.uk/plants/plantHealth/pestsDiseases/phytophthora/documents/prPkResearchJul09.pdf).

Although spore monitoring conducted during this study showed that inoculum could be detected at low levels at a distance of up to 1 km from the infected area the **data show that the majority of infection occur within a distance of 100 metres**.

From these data, the EWG considered that the majority of infections from tall sporulating trees hosts such as mature larch occur within a distance of 100 metres.

Other cases of longer spread distance

Longer-distance natural spread by turbulent air over several kilometres is thought to occur more rarely and under certain weather conditions. There is also the potential for longer-distance natural spread over about a kilometre via inoculum in watercourses, wind-blown infected debris, or through movement of contaminated soil/debris on the feet of animals; these are less significant pathways of natural spread though.

7.21 Can pest freedom of the crop, place of production or an area be reliably guaranteed?

If no	**Possible measure identified in question 7.20 would not be suitable.**

Yes. Area could be reliably guaranteed with suitable surveillance, monitoring and testing regimes in place. Place of production freedom was not considered as feasible option for a forestry environment (given the difficulty of surveillance of forest trees)

AREA FREEDOM (ISPM 4)

Area freedom should be confirmed by official surveys of susceptible plants at places of production and the natural environment.

Verification of area freedom is achieved by visual inspections of host plants at places of production and in the natural environment carried out during the growing season preferably after suitable conditions (e.g. rainy periods for plants grown outside) and laboratory testing of any suspicious plants. Testing of water courses is recommended for detecting *P. ramorum* in wider areas (the method has been used successfully for *P. ramorum* but evidence is limited for *P. kernoviae*).

Inspections can focus on plants such as rhododendron that are considered to act as good 'indicator' plants of the presence of *P. ramorum /kernoviae*." In forests, inspection should also focus on Larch.

Level of uncertainty: Medium

Options after harvest, at pre-clearance or during transport

Detection of the pest in consignments by inspection or testing

7.22 Can the pest be reliably detected by a visual inspection of a consignment at the time of export, during transport/storage?

No.

Wood will not show any unique symptoms.

Level of uncertainty: Low

7.23 Can the pest be reliably detected by testing of the commodity (e.g. for pest plant, seeds in a consignment)?

No.

The pathogen could potentially be detected by testing wood, but this is not considered practical or reliable given the volume of material that is likely to be imported and the need for representative samples.

Level of uncertainty: Low

Removal of the pest from the consignment by treatment or other phytosanitary procedures

7.24 Can the pest be effectively destroyed in the consignment by treatment (chemical, thermal, irradiation, physical)?

Not known.

The efficacy of such treatments is not known and the efficacy of heat treatments for wood of a range of species is untested.

Swain *et al*. (2006) showed that a 1-hour exposure at 55°C was required to no longer detect *P. ramorum* in wood chips and cankered stems of Coast live oak (*Q. agrifolia*). Although there is not specific data the EWG considered that such treatment may be sufficient to eliminate the pests in the first 3 cm.
Kiln drying is effective for other pathogens (e.g. *C. fagacearum*). Although it is mentioned as a measure in the EU emergency decision no specific data could be sourced on the efficacy of kiln drying for *P. ramorum* or *P. kernoviae*.
Level of uncertainty: High

7.25 Does the pest occur only on certain parts of the plant or plant products (e.g. bark, flowers), which can be removed without reducing the value of the consignment?
Yes
Information from the UK PRA on *P. kernoviae* (Sansford, 2008):
Brown and Brasier (2007) state that 'total removal of phloem and outer bark from tree stems is a recommended protocol for preventing national and international spread of quarantine organisms such as *P. ramorum* and *P. kernoviae* on transported wood products'. They recommend that where excision is used for control this should also include removal of affected xylem. Currently according to IPPC (2010) 'bark-free wood' is 'wood from which all bark excluding the vascular cambium, ingrown bark around knots, and bark pockets between rings of annual growth has been removed'. This therefore does not include removal of the xylem. Brown and Brasier (2007) suggest that as *Phytophthora* spp. can remain viable up to 25mm into the xylem a minimum removal of 3cm of outer sapwood would be needed which may not be practicable. They suggest it may be preferable to destroy the infected tree stems when dealing with a quarantine issue such as *P. kernoviae*".
Level of uncertainty: Low

7.26 Can infestation of the consignment be reliably prevented by handling and packing methods?
No. Not relevant for susceptible wood.
Level of uncertainty: Low

Options that can be implemented after entry of consignments
7.27 Can the pest be reliably detected during post-entry quarantine?
No. The pathogen could potentially be detected by testing wood, but this is not considered practical or reliable. Post-entry quarantine is not appropriate for a plant product.
Level of uncertainty: Low

7.28 Could consignments that may be infested be accepted without risk for certain end uses, limited distribution in the PRA area, or limited periods of entry, and can such limitations be applied in practice?
No limiting the end use or period of entry is difficult to implement in practice.
Level of uncertainty: Medium

7.29 Are there effective actions that could be taken in the importing country (surveillance, eradication, containment) to prevent establishment and/or economic or other impacts?

No: surveillance in particular in semi natural or natural environment is difficult and resource intensive.

Surveillance can be done to detect the pest as early as possible **but are complementary measures to other measures.**

Surveillance of semi-natural or natural environments to detect outbreaks and appropriate eradication/containment measures would also prevent further establishment and spread to new areas within the EPPO region, as well as minimizing impacts in those areas where the pathogen has established but this is resource intensive. Eradication in such environment has proven extremely difficult if not impossible.
Measures that can be implemented to eradicate or contain the pests are presented in Appendix 4

Level of uncertainty: Low

Evaluation of risk management options
This section evaluates the risk management options selected and considers in particular their cost effectiveness and potential impact on international trade.

7.30 Have any measures been identified during the present analysis that will reduce the risk of introduction of the pest? List them.

Yes. Listed in the order of previous positive responses:

Q.	Standalone	Systems Approach	Possible Measure	Uncertainty
7.13		X	visual inspection at the place of production	Low
7.14		X	specified testing at the place of production	Low
7.21	X		Pest-free area	Medium
7.24	X		Treatment of the consignment (55°C for one hour extrapolated from data on wood chips)	Low
7.25	X		Removal of 3 cm of outer sapwood	Low

7.31 Does each of the individual measures identified reduce the risk to an acceptable level?

No

Only pest pest-free area, treatment of the consignment and removal of 3 cm of outer sapwood can reduce the risk to an acceptable level. Visual inspection and testing at the place of production are not sufficient.

Level of uncertainty: Low

7.32 For those measures that do not reduce the risk to an acceptable level, can two or more measures be combined to reduce the risk to an acceptable level?

No

Absence of the pest cannot be guaranteed by inspection or testing of the consignment alone and if these two measures are combined as the risk of presence of latent infections is still high.

Level of uncertainty: Low

7.34 Estimate to what extent the measures (or combination of measures) being considered interfere with international trade.

For EU countries, controls on imports of wood already exist under the emergency phytosanitary measures for *P. ramorum* for known canker hosts from the USA (EU, 2002, 2004 and 2007), and under the EC Plant Health Directive (2000/29/EC; EU, 2000) for imports of wood of *Quercus* spp. from the USA and imports of conifers from various countries including the USA and Canada and some Asian countries (China, Korea, Taiwan). A requirement for a pest-free area for wood would not interfere with international trade as pest-free area is a requirement for *P. ramorum* for susceptible wood originating in the USA, as an alternative to treatment.

However, it was noted that that the measures are not complete e.g. not all tree hosts that exhibit bark cankers are covered, including larch (revised lists of tree hosts which exhibit symptoms of bark cankers were compiled for *P. ramorum* and *P. kernoviae*), not all origins are covered in these measures, no measures are required for internal movement of susceptible wood between the EU countries and no measures exist for *P. kernoviae.*

As a conclusion some interference cannot be excluded.

Level of uncertainty: Medium

7.35 Estimate to what extent the measures (or combination of measures) being considered are cost-effective, or have undesirable social or environmental consequences.

The cost-effectiveness of the measures being considered has not been calculated but as measures already exist for imports of susceptible wood from the USA there would be no additional social or environmental consequences as there are currently no other known areas of origin for *P. ramorum* where wood may become infected (i.e. no other countries which could be specified in the legislation).

Level of uncertainty: High

7.36 Have measures (or combination of measures) been identified that reduce the risk for this pathway, and do not unduly interfere with international trade, are cost-effective and have no undesirable social or environmental consequences?

Yes

7.10 Have all major pathways been analyzed (for a pest-initiated analysis)?
No **Analyze the next major pathway**

Pathway 5 Natural spread

7.02 Is natural spread one of the pathways?
Note: Natural spread includes movement of the pest by flight (of an insect), wind or water dispersal, transport by vectors such as insects or birds, natural migration, rhizomial growth.

Yes but natural spread by air, water or animal vectors is currently not a major pathway and is only considered to move the harmful organism locally.

If yes **go to 7.03**
7.03 Is the pest already entering the PRA area by natural spread or likely to enter in the immediate future?
No **go to 7.04**
7.04 Is natural spread the major pathway?
No

If no **go to 7.05**
7.05 Could entry by natural spread be reduced or eliminated by control measures applied in the area of origin?
Yes and it can also be combined with measures in the country of import in case of an outbreak.
Measures that can be implemented to eradicate or contain the pests are presented in Appendix 4.

Pathway 6 Plants for planting of non-host plants (except seeds)

The risk presented by the entry of non-host plants was considered lower. The risk is linked to the presence of infested growing media attached to non-host plants or the presence of plant debris on growing media.

Based on the measures identified for host plants, the EWG considered that the measures to be recommended for non-host plants for planting are the following.
Plants for planting of non-host plants should either:

- **originate from an area free from *P. ramorum* or *P. kernoviae* (see pathway 1)**
  or
- **originate from a place of production free from *P. ramorum* or *P. kernoviae* (see pathway 1)**
  or
- **be free from growing media.**
  or
- **grown in specified conditions (see below)**

Justification of the option grown in specified conditions
7.17 Can infestation of the commodity be reliably prevented by growing the crop in specified conditions (e.g. protected conditions such as screened greenhouses, physical isolation, sterilized growing medium, exclusion of running water, etc.)**?**
If yes or could be considered in a Systems Approach **possible measure: specified growing conditions of the crop**

Yes.
Contamination of growing media used for planting non-host plants at places of production in areas where the pathogen occurs could be prevented by a combination of measures. These include: growing plants in containers rather than directly in the soil; growing plants on benches to prevent splash-dispersal of spores contaminating the ground; growing plants under protection and away from host plants to minimise the risk of contamination; ensuring that other sources of contamination are minimised or removed in nurseries, e.g. preventing contamination of growing media during storage and use, ensuring water supplies are free of the pathogen by appropriate treatment especially where irrigation water is recycled (e.g. sand filtration) and other measures which would reduce spread of the pathogen in nurseries (e.g. not using over-head irrigation; appropriate hygiene and disinfestations measures etc).

The physical removal of plant debris during the growing period would be one important measure that would reduce the risk of contamination by *P. ramorum.*
Level of uncertainty: Low

Other measures that were evaluated but not considered suitable are
Treatments: Plants in growing media cannot be treated.
Post entry quarantine is not reliable as the plants are non-hosts.

Pathway 7 – Soil/growing medium (with organic matter) as a commodity
Soil/ growing medium as a commodity should originate either

- **from an area free from the *P. ramorum* or *P. kernoviae***

or

- **from a place of production free from *P. ramorum* or *P. kernoviae* (see pathway 1)**

or

- **be treated by heat or chemicals**

Yes, in part. The pathogen could potentially be destroyed in soil or growing media by heat treatment or sterilization methods, however this is not considered practical for large quantities.

The EFSA Scientific opinion (EFSA, 2011) makes several statements regarding the treatments of soil/growing media which are cited below

- *Yakabe and MacDonald (2008) determined the effectiveness of chemicals as potential soil treatments and reported that only chloropicrin, metam sodium, iodomethane and dazomet were efficient to kill viable propagules in treated soil but the use of these compounds is banned or will soon be banned in many countries.*

- *Heat treatment effective but not practical (as pointed out by RAPRA), 50 degrees specific for soil (Linderman and Davis, 2008a)*

- *In heat treatments of P. ramorum-infested soil, the pathogen was still detectable after more than 40 days at 30 and 22 °C. However, only 3 days of soil heating above 40 °C made the pathogen no longer detectable (Yakabe and MacDonald, 2010). Linderman and Davis (2008a) also investigated fumigation treatments that effectively sterilize the soil as a means of eradicating P. ramorum from soil or potting media.*

Pathway 8 – Foliage or cut branches (for ornamental purposes) of susceptible foliar hosts
The EWG group agreed with the conclusion of the RAPRA PRA that the level of risk of establishment from *P. ramorum* arising from these commodities is low, given the end-use. Measures have been identified in the RAPRA PRA but the EWG considered them difficult to implement in practice. The EWG agreed that regulation of this pathway may not be justified and considered that it does not seem proportionate to the risk. However, it was recognised that host foliage is moving within and between EPPO countries. Therefore national measures prohibiting harvest of host foliage from infested places should be established as part of measures to prevent spread from an outbreak.

Consider the relative importance of the pathways identified in the conclusion to the entry section of the pest risk assessment
Note: the relative importance of the pathways is an important element to consider in formulating phytosanitary regulation. Regulation of pathways presenting similar risks should be consistent.
The order of importance of the pathways is

- Plants for planting (excluding seeds and fruit) of known susceptible hosts
- Soil as a contaminant (e.g. on footwear, machinery, etc.)
- Susceptible (isolated) bark or wood chips not intended for burning
- Wood of host plants
- Natural spread

- Plants for planting (excluding seeds and fruit) of non-hosts
- Soil/growing medium (with organic matter) as a commodity

All the measures or combination of measures identified as being appropriate for each pathway or for the commodity can be considered for inclusion in phytosanitary regulations in order to offer a choice of different measures to trading partners. In addition to the measure(s) selected to be applied by the exporting country, a phytosanitary certificate (PC) should be required.

Conclusion of Pest Risk Management
Summarize the conclusions of the Pest Risk Management stage.
The summary of the risk management is presented in doc **13-18715**

Uncertainties in the risk management section.

- The potential for spread in asymptomatic roots of host plants
- The potential for spread in a continuous tall host plant environment,
- The significance of asymptomatic sporulation is uncertain,
- The potential for spread in growing media (not demonstrated in practice so far).
- The efficacy of phytosanitary treatments that are routinely prescribed for bark and wood are not known.
- The potential for spread from infected bark and wood to host plants is not known; spread from bark is more likely than from wood.

Appendix 1 host lists

Fera list of natural hosts for *Phytophthora ramorum* with symptom and location Updated July 2012 (see footnote)

Latin name	Family	Common name	Damage type*			Location(s)	References
			F	D	C		
Abies alba	Pinaceae	European silver fir		√		Ireland (outdoor) - single forest tree, crown dieback.	Forest Service, NPPO, Ireland, (August 2011).
Abies concolor	Pinaceae	White fir	√			USA (outdoor)	COMTF (undated)
Abies grandis	Pinaceae	Grand fir	√	√	√	USA (outdoor) - foliar and dieback; UK (outdoor) - canker and foliar	COMTF (undated); Forest Research records (late 2009)
Abies procera	Pinaceae	Noble fir		√	√	Ireland (outdoor) - forest tree symptoms described as 'branch & crown dieback'.	Forest Service, NPPO, Ireland (September, 2010).
Abies magnifica	Pinaceae	Red fir	√	√		USA (outdoor)	COMTF (undated)
Acer circinatum	Aceraceae	Vine maple	√			USA (outdoor)	COMTF (undated)
Acer davidii	Aceraceae	Striped bark maple	√			Canada (nursery)	COMTF (undated)
Acer laevigatum	Aceraceae	Evergreen maple	√			UK (outdoor)	Forest Research records
Acer macrophyllum[1]	Aceraceae	Big leaf maple	√			USA (outdoor)	Garbelotto *et al*. (2003)
Acer pseudoplatanus[1]	Aceraceae	Sycamore			√	UK (outdoor)	Forest Research records
Adiantum aleuticum[1] [syn. Adiantum pedatum]	Polypoidiaceae	Western maidenhair fern	√			USA (outdoor)	Vettraino *et al*. (2006)
Adiantum jordanii[1]	Polypoidiaceae	California maidenhair fern	√			USA (outdoor)	COMTF (undated)
Aesculus californica[1]	Hippocastanaceae	Californian buckeye	√	√		USA (outdoor)	Garbelotto *et al*. (2003)
Aesculus	Hippocastanace	Horse chestnut			√	UK (outdoor)	Forest Research records

Latin name	Family	Common name	Damage type*			Location(s)	References
			F	D	C		
hippocastanum[1]	ae						
Arbutus menziesii[1]	Ericaceae	Madrone	√	√		USA (outdoor)	Garbelotto *et al*. (2003)
Arbutus unedo	Ericaceae	Strawberry tree	√	√		Guernsey (nursery), Spain (nursery)	CSL records, COMTF (undated)
Arctostaphylos columbiana	Ericaceae	Hairy manzanita	√	√		USA (outdoor)	COMTF (undated)
Arctostaphylos manzanita[1]	Ericaceae	Manzanita	√	√		USA (outdoor)	Garbelotto *et al*. (2003)
Arctostaphylos uva-ursi	Ericaceae	Kinnikinnik, bearberry	√			USA (nursery)	COMTF (undated)
Ardisia japonica	Mysinaceae	Japanese ardisia, Maleberry	√			Canada (nursery)	COMTF (undated)
Betula pendula	Betulaceae	Silver birch			√	UK (outdoor)	Forest Research records (October 2009)
Calluna vulgaris[1]	Ericaceae	Heather		√		Poland (nursery)	Orlikowski & Szkuta (2004)
Calycanthus occidentalis	Calycanthaceae	Spicebush, western sweetshrub	√			USA (outdoor)	COMTF (undated)
Camellia spp.[1]	Theacae	Camellia	√	√		UK (nursery and outdoor), France (nursery), Spain (nursery), USA (nursery and outdoor), Canada (nursery)	Beales *et al*. (2004b), Husson (personal communication), Pintos Varela *et al*. (2003), COMTF (undated), CFIA records
Camellia			√			Ireland (outdoor)	NPPO Ireland
Castanea sativa[1]	Fagaceae	Sweet chestnut	√	√	√	UK (outdoor). Ireland (outdoor) -forest tree, leaf blight & dieback.	Denman *et al*. (2005). Forest Service, NPPO, Ireland.
Castanopsis orthacantha	Fagaceae	-	√	√		UK (outdoor)	Forest Research records
Ceanothus thyrsiflorus	Rhamnaceae	Blue blossom, Californian lilac	√	√		USA (outdoor)	COMTF (undated)
Cercis chinensis	Fabaceae	Redbud	√			Canada (nursery) Nov 2007	CFIA March 2008

Latin name	Family	Common name	Damage type*			Location(s)	References
			F	D	C		
Chaemaecyparis lawsoniana	Cupressaceae	Lawson's cypress			√	UK (outdoor)	Forest Research records (November 2009)
Choisya sp.			√			Ireland (outdoor)	NPPO Ireland
Choisya ternata "Aztec Pearl"	Rutaceae	Mexican orange	√			UK (nursery)	CSL Records (February 2008)
Cinnamomum camphora	Lauraceae	Camphor tree	√		√	UK (outdoor)	Forest Research records
Cinnamomum sp.	Lauraceae	-				Canada (nursery)	CFIA records
Clintonia andrewsiana	Liliaceae	Andrew's clintonia bead lily	√			USA (outdoor)	COMTF (undated)
Cornus capitata	Cornaceae	Bentham's dogwood	√			UK (outdoor)	PHSI, CSL Records
Cornus kousa	Cornaceae					Canada (nursery)	CFIA records (2008)
Cornus kousa x *cornus capitata* "Norman haddon"	Cornaceae		√			UK (outdoor)	Forest Research records
Corylopsis spicata	Hamamelidaceae	Spike winter hazel	√			Canada (nursery)	CFIA records
Corylopsis (species to be confirmed)	Hamamelidaceae		√			UK (outdoor)	Fera records (July 2010)
Corylus cornuta	Betulaceae	California hazelnut		√		USA (outdoor)	Murphy & Rizzo (2002)
Cotoneaster(large leaf variety)[1]	Rosaceae		√			UK (outdoor)	Fera records (April 2010)
Daphniphyllum glaucescens	Daphniphyllaceae		√	√		Canada (nursery)	CFIA records
Distylium myricoides	Hamamelidacea	Myrtle-leafed	√			Canada (nursery)	CFIA records

Latin name	Family	Common name	Damage type*			Location(s)	References
			F	D	C		
	e	distylium					
Drimys winteri	Winteraceae	Winter's bark	√	√		UK (outdoor)	CSL records
Dryopteris arguta	Dryopteridiaceae	Californian wood fern, coastal woodfern	√			USA (outdoor)	COMTF (undated)
Eucalyptus haemastoma	Myrtaceae	Scribbly gum	√			UK (outdoor)	Forest Research records
Euonymus kiautschovicus	Celastraceae	Spreading euonymus, creeping strawberry bush	√	√		Canada (nursery)	CFIA records
Fagus sylvatica[1]	Fagaceae	Beech	√		√	UK (outdoor). Netherlands (outdoor). Ireland (outdoor) - forest trees.	Forest Research records. RAPRA (undated). Forest Service, NPPO, Ireland.
Frangula californica[1] [syn. *Rhamnus californica*]	Rhamnaceae	Californian coffeeberry, California buckthorn	√	√		USA (outdoor)	Garbelotto *et al.* (2003)
Frangula purshiana[1] *[syn. Rhamnus purshiana]*	Rhamnaceae	Cascara	√			USA (outdoor)	Vettraino *et al*. (2006), Goheen *et al*. (2002b)
Fraxinus excelsior[1]	Oleaceae	Ash	√			UK (outdoor)	Forest Research records
Fraxinus latifolia	Oleaceae	Oregon ash	√			USA (outdoor)	COMTF (undated)
Garrya elliptica	Garryaceae	Silk tassel bush	√			UK (nursery)	CSL records
Gaultheria shallon[1]	Ericaceae	Salal, Oregon wintergreen	√			Canada (nursery), UK (nursery)	CFIA records, CSL records
Gaultheria procumbens	Ericaceae	Many, including wintergreen	√				Fera records (November 2009)

Latin name	Family	Common name	Damage type*			Location(s)	References
			F	D	C		
Griselinia littoralis[1]	Cornaceae	New Zealand privet	√	√		UK (outdoor)	Giltrap *et al.* (2006)
Griselinia littoralis			√			Ireland (outdoor)	NPPO Ireland
Hamamelis mollis	Hamamelidaceae	Chinese witch hazel	√	√		UK (nursery)	CSL records
Hamamelis virginiana[1]	Hamamelidaceae	Virginian witch hazel	√	√		UK (nursery and outdoor)	Giltrap *et al.* (2004)
Hamamelis x *intermedia (H. mollis x H. japonica)*	Hamamelidaceae	Hybrid witch hazel	√			Canada (nursery)	Anon. (2006a)
Heteromeles arbutifolia[1]	Rosaceae	Toyon	√	√		USA (outdoor)	Garbelotto *et al.* (2003)
Hydrangea seemanni	Hydrangeaceae	Hydrangea	√			UK (outdoors)	Fera records (May 2010)
Ilex aquifolia	Aquifoliaceae	European holly	√			UK (outdoor)	CSL records (December 2008)
Ilex latifolia	Aquifoliaceae	Tarajo holly	√			UK (nursery)	Fera records (Dec. 2010)
Ilex purpurea	Aquifoliaceae	Oriental holly	√			Canada (nursery)	APHIS records
Kalmia angustifolia	Ericaceae	Sheep laurel	√	√		UK (nursery)[2]	CSL records
Kalmia latifolia[1]	Ericaceae	Mountain laurel	√	√		UK (outdoor and nursery), Slovenia (nursery)	CSL records, RAPRA (undated)
Kalmia latifolia			√			Ireland (outdoor)	NPPO Ireland
Kalmia sp.	Ericaceae	Species not presently known				Canada (nursery)	CFIA records
Larix kaempferi[1]*/Larix/Larix decidua/Larix* x *eurolepis*	Pinaceae	Japanese larch/larch/European larch/Hybrid larch	√	√	√	UK (outdoor). Ireland (outdoor) - forest trees, *L. kaempferi* only.	Forest Research records (August 2009) and Forest Service, NPPO, Ireland (July 2010). (See also EPPO Reporting Service 2011, no. 5, 2011/13 for *L. decidua* and UK EU survey return 2010/2011 for *Larix* x *eurolepsis* respectively but no dates when recorded).

Latin name	Family	Common name	Damage type*			Location(s)	References
			F	D	C		
Laurus nobilis[1]	Lauraceae	Bay laurel	√			UK (nursery)	CSL records
Leucothoe axillaris	Ericaceae	Fetter-bush, dog hobble	√			Canada (nursery)	COMTF (undated)
Leucothoe fontanesiana[1]	Ericaceae	Drooping leucothoe	√			UK (nursery), France (nursery)	CSL records, Husson (personal communication)
Lithocarpus densiflorus[1]	Fagaceae	Tanoak	√	√	√	USA (outdoor)	Garbelotto *et al*. (2003)
Lithocarpus glabra	Fagaceae		√			UK (nursery)	CSL Records (December 2008)
Lonicera hispidula[1]	Caprifoliaceae	Californian honeysuckle	√			UK (nursery)[2], USA (outdoor)	Garbelotto *et al*. (2003), CSL records
Loropetalum chinense	Hamamelidacea e	Loropetalum	√			Canada (nursery); USA (nursery),	APHIS records; COMTF (undated)
Magnolia sp.			√			Ireland (outdoor)	NPPO Ireland
Magnolia acuminata	Magnoliaceae		√			UK	Fera records (August 2009)
Magnolia delavayi	Magnoliaceae		√			UK (outdoors)	Fera records (June 2010)
Magnolia denudata	Magnoliaceae	Lily Tree	√			Canada (nursery); UK (outdoor)	CFIA records; FR records
Magnolia denudata x *salicifolia*	Magnoliaceae	Magnolia hybrid	√			UK (outdoor)	Forest Research records
Magnolia figo (Michelia figo	Magnoliaceae	Banana magnolia (Banana shrub)	?			USA (nursery)	APHIS May 2008
Magnolia grandiflora[1]	Magnoliaceae	Magnolia	√			UK (nursery and outdoor), USA (nursery), Canada (nursery)	CSL records, COMTF (undated)
Magnolia kobus	Magnoliaceae	Kobus magnolia	√			Canada (nursery)	CFIA records
Magnolia salicifolia	Magnoliaceae	Anise magnolia	√			UK (outdoor)	Forest Research records
Magnolia stellata[1]	Magnoliaceae	Star magnolia	√	√		UK (nursery and outdoor)	Giltrap *et al*. (2006)

Latin name	Family	Common name	Damage type*			Location(s)	References
			F	D	C		
Magnolia x *loebneri*[1] (*M. kobus & M. stellata*)	Magnoliaceae	Loebner magnolia	√	√		UK (nursery and outdoor)	Giltrap *et al.* (2006)
Magnolia x *soulangeana* (*M. liliiflora x M. denudate*)	Magnoliaceae	Saucer magnolia	√	√		UK (nursery)	CSL records
Mahonia aquifolium	Berberidaceae	Holly leaved barberry Oregon grape	√			Canada (nursery)	CFIA (Aug 2007)
Maianthemum racemosum [syn. Smilacina racemosa]	Liliaceae	False Solomon's seal	√			USA (outdoor)	COMTF (undated)
Manglietia insignis	Magnoliaceae	Red lotus tree	√			Canada (nursery)	APHIS records
Michelia cavalieri	Magnoliaceae	Michelia	√			Canada (nursery)	CFIA records
Michelia doltsopa[1]	Magnoliaceae	Michelia	√			UK (outdoor).	Forest Research records. RAPRA (undated).
Michelia doltsopa[1]	Magnoliaceae	Michelia	√			Ireland (outdoor)	Forest Service, NPPO, Ireland.
Michelia foveolata	Magnoliaceae	Michelia	√			Canada (nursery)	CFIA records
Michelia maudiae[1]	Magnoliaceae	Michelia	√			UK (outdoor), Canada (nursery)	CSL records, APHIS records
Michelia wilsonii	Magnoliaceae	Michelia	√			Canada (nursery)	APHIS records
Nerium oleander	Apocynaceae	Oleander	√			USA (nursery)	COMTF (undated)
Nothofagus obliqua	Fagaceae	Roble beech			√	UK (outdoor)	Forest Research records
Osmanthus decorus	Oleaceae	Osmanthus	√			Canada (nursery), UK (outdoor)	RAPRA (undated), Fera records (April 2010)
Osmanthus delavayi	Oleaceae	Delavay osmanthus	√			USA (nursery), UK (outdoor)	COMTF (undated); Forest Research records

Latin name	Family	Common name	Damage type*			Location(s)	References
			F	D	C		
Osmanthus fragrans	Oleaceae	Sweet olive	√	√		USA (nursery), Canada (nursery)	COMTF (undated), CFIA records
Osmanthus heterophyllus[1]	Oleaceae	Holly osmanthus	√			UK (nursery), USA (nursery)	CSL records, COMTF (undated)
Osmorhiza berteroi	Apiaceae	Sweet cicely	√			USA (outdoor)	COMTF (undated)
Parakmeria lotungensis	Magnoliaceae	Eastern joy lotus tree	√			Canada (nursery)	APHIS records
Parrotia persica[1]	Hamamelidacea e	Ironwood	√	√		UK (outdoor), Canada (nursery)	Hughes *et al*. (2006b), CFIA records
Photinia x *fraseri*[1] (P. glabra x P. serrulata)	Rosaceae	Fraser photinia	√			Poland (outdoor)	Orlikowski & Szkuta (2004)
Photinia fraseri			√			Ireland (outdoor)	NPPO Ireland
Physocarpus	Rosaceae	Ninebark				Canada (nursery)	CFIA 2007
Picea sitchensis	Pinaceae	Sitka spruce		√		Ireland (outdoor) - single young forest tree, shoot tip dieback.	Forest Service, NPPO, Ireland. EPPO Reporting Service 2011, no. 5. 2011/111
Pieris floribunda x *japonica*[1]	Ericaceae	Mountain andromeda	√	√		USA (nursery)	Parke *et al*. (2004)
Pieris formosa[1]	Ericaceae	Himalaya andromeda	√	√		UK (outdoor and nursery)	Inman *et al*. (2003)
Pieris japonica x *formosa*[1]	Ericaceae	Ornamental pieris	√	√		UK (nursery), USA (nursery)	CSL records, Parke *et al*. (2004)
Pieris japonica[1]	Ericaceae	Japanese pieris	√	√		UK (nursery and outdoor), France (nursery), Germany (nursery and outdoor), Poland (nursery), USA (nursery)	CSL records, RAPRA (undated), Husson (personal communication),Orlikowski & Szkuta (2004), Parke *et al*. (2004)
Pieris sp.	Ericaceae	Species not presently known	√			Canada (nursery)	CFIA records
Pieris sp.			√			Ireland (outdoor)	NPPO Ireland

Latin name	Family	Common name	Damage type*			Location(s)	References
			F	D	C		
Pittosporum undulatum	Pittosporaceae	Victorian box	√			USA (outdoor)	Hüberli *et al*. (2006)
Prunus laurocerasus 'Nana'	Rosaceae	Dwarf English Laurel	√			USA (nursery), UK outdoors	COMTF (undated), Fera records (December 2010)
Prunus lusitanica	Rosaceae	Portuguese laurel cherry	√			Canada (nursery)	COMTF (undated)
Pseudotsuga menziesii[1]	Pinaceae	Douglas fir	√	√	√	USA (outdoor) - foliar and dieback, UK (outdoor) - stem canker	Davidson *et al*. (2002), Forest Research records (February, 2010)
Pyracantha koidzumii	Rosaceae	Formosa firethorn	√			Canada (nursery)	Briere *et al*. (2005)
Quercus acuta	Fagaceae	Japanese evergreen oak			√	UK (outdoor)	Forest Research records
Quercus agrifolia[1]	Fagaceae	Coast live oak			√	USA (outdoor)	Garbelotto *et al*. (2003)
Quercus cerris[1]	Fagaceae	Turkey oak	√		√	UK (outdoor)	Forest Research records
Quercus chrysolepis[1]	Fagaceae	Canyon live oak		√	√	USA (outdoor)	Murphy & Rizzo (2003)
Quercus falcata[1]	Fagaceae	Southern red oak			√	UK (outdoor)	Brasier *et al*. (2004a)
Quercus ilex[1]	Fagaceae	Holm oak	√	√		UK (outdoor)	Denman *et al*. (2005)
Quercus kelloggii[1]	Fagaceae	Californian black oak			√	USA (outdoor)	Garbelotto *et al*. (2003)
Quercus parvula var. *shrevei* [1]	Fagaceae	Shreve oak			√	USA (outdoor)	Garbelotto *et al*. (2003)
Quercus petraea	Fagaceae	Sessile oak			√	UK (outdoor)	Forest Research records
Quercus phillyraeoides	Fagaceae	Ubame oak	√			Ireland	Department of Agriculture, Fisheries and Food, Ireland (May, 2010)
Quercus robur	Fagaceae	English oak/pedunculate			√	UK (Scotland) (outdoors)	Forestry Commission, Scotland (August 2011)

Latin name	Family	Common name	Damage type*			Location(s)	References
			F	D	C		
		oak					
Quercus rubra	Fagaceae	Northern red oak			√	Netherlands (outdoor)	
Rhododendron spp. [1]	Ericaceae	Rhododendron	√	√		UK (nursery and outdoor), Belgium (nursery), Finland (nursery), France (nursery and outdoor), Germany (nursery and outdoor), Ireland (nursery and outdoor), Italy (nursery), the Netherlands (nursery and outdoor), Norway (outdoor), Poland (nursery), Slovenia (nursery), Spain (nursery), Sweden (nursery), Switzerland (nursery), Canada, (nursery), USA (nursery and outdoor)	CSL records, De Merlier *et al*. (2003), RAPRA (undated), Husson (personal communication), Cahalane (2004), Gullino *et al*. (2003), de Gruyter & Steeghs (2006), Orlikowski & Szkuta (2002), Žerjav *et al*. (2004), Morajelo & Werres (2002), Goheen *et al*. (2002a), Anon. (2006a), COMTF (undated), Garbelotto *et al*. (2003)
Ribes laurifolium	Grossulariaceae		√			UK (nursery)	CSL records Feb 2008
Rosa gymnocarpa[1]	Rosaceae	Californian wood rose	√			USA (outdoor)	Hüberli *et al.* (2004)
Rosa rugosa	Rosaceae	Rugosa rose	√			Canada (nursery)	APHIS records
Rosa spp. (several different cultivars)	Rosaceae	Rose	√			Canada (nursery)	APHIS records
Rubus spectabilis	Rosaceae	Salmonberry	√			USA (outdoor)	Goheen *et al.* (2002b)
Salix caprea[1]	Salicaceae	Goat willow/sallow	√	√		UK (nursery) [2]	CSL records
Sarcococca hookeriana var. *dignya*	Buxaceae	Himalyan sweet box	√	√		UK (outdoors)	SASA records (June 2009)
Schima argentea	Theacae	-			√	UK (outdoor)	Forest Research records
Schima wallichii	Theacae	Chinese guger tree	√			UK (outdoor)	CSL records; Forest Research records
Sequoia	Taxodiaceae	Coast redwood	√	√		USA (outdoor), UK (outdoor)	Maloney *et al.* (2002), CSL records (Aug-

Latin name	Family	Common name	Damage type*			Location(s)	References
			F	D	C		
sempervirens[1]							08)
Syringa sp.	Oleaceae	Not identified to species level				Canada (nursery), France (nursery)	CFIA records, Husson (personal communication)
Syringa vulgaris[1]	Oleaceae	Lilac	√	√		UK (outdoor and nursery)	Beales *et al*. (2004a)
Taxus baccata[1]	Taxaceae	Yew	√	√		UK (nursery)	Lane *et al.* (2004)
Taxus brevifolia	Taxaceae	Pacific yew	√	√	√	USA (outdoor)	COMTF (undated)
Taxus sp.	Taxaceae		√			Canada (nursery), France (nursery)	CFIA records, Husson (personal communication)
Taxus x *media(T. baccata x T. cuspidata)*	Taxaceae	Anglojap yew			√	Netherlands (nursery)	de Gruyter & Steeghs (2006)
Torreya california	Taxaceae	California nutmeg	√	√		USA (outdoor)	COMTF (undated)
Toxicodendron diversilobum	Anacardaceae	Pacific poison oak	√		√	USA (outdoor)	Rizzo (2003)
Tsuga heterophylla	Pinaceae	Western hemlock	√	√	√	UK (outdoor)	Forest Research records (September 2009)
Trientalis latifolia[1]	Primulaceae	Western star flower	√			USA (outdoor)	Hüberli *et al*. (2003)
Umbellularia californica[1]	Lauraceae	Californian bay laurel	√			UK (outdoor), USA (outdoor)	CSL records, Garbelotto *et al.* (2003)
Vaccinium intermedium	Ericaceae		√	√		UK (nursery)	Fera records (November 2010)
Vaccinium ovatum[1]	Ericaceae	Californian huckleberry	√	√		USA (outdoor)	Garbelotto *et al.* (2003), Goheen *et al*. (2002a)
Vaccinium myrtillus	Ericaceae	Bilberry		√		UK (outdoor)	CSL records (woodland Jan.09). **Found on open heathland for the first time in Nov. 2010 (Fera records)**

Latin name	Family	Common name	Damage type*			Location(s)	References
			F	D	C		
Vaccinium vitis-idaea	Ericaceae	Cowberry	√			UK (nursery)	CSL records (Oct. 2008)
Vaccinum spp.			√			Ireland (outdoor)	NPPO Ireland
Vancouveria planipetala	Berberidaceae	Redwood ivy	√			USA (outdoor)	COMTF (undated)
Viburnum spp.[1]	Caprifoliaceae	Viburnum	√	√		UK (nursery and outdoor), Belgium (nursery), the Czech Republic (nursery), France (nursery), Germany (nursery), Ireland (nursery), the Netherlands (nursery), Norway (outdoor), Slovenia (nursery and outdoor), Spain (nursery), Switzerland (nursery and outdoor), Canada (nursery), USA, (nursery).	Lane *et al*. (2003), Cahalane (2004), De Merlier *et al*. (2003), Běhalová (2006), Werres *et al*. (2001), Pintos Varela *et al*. (2004), Žerjav *et al*. (2004), Heiniger *et al*. (2004), RAPRA (undated), COMTF (undated), Anon. (2006a) Parke *et al*. (2004).

*F = Ramorum leaf blight (including petiole), D = Ramorum dieback, C = Ramorum canker

[1] Koch's postulates have been successfully completed for this host. NB Koch's postulates for Gaultheria shallon could only be completed on wounded leaves on the whole plant.

[2] These records refer to interceptions on nursery stock where the information has been recorded. The country given is where the infected plant was found but the plants were originally grown in another country that is not named in this list.

Fera list of natural hosts of *Phytophthora kernoviae* with symptom and location Updated July 2012 (see footnote)

Latin name	Family	Common name	Type of infection	Location(s)	Reference
Annona cherimola	Annonaceae	Cherimoya/ Custard apple	Shoot and fruit necrosis	NZ	MAF, NZ, 2006
Aesculus hippocastanum	Hippocastanaceae	Horse chestnut	Leaf infection	UK	Fera record, October 2009
Castanea sativa	Fagaceae	Sweet chestnut	Leaf infection	UK	Fera record, November 2009
Drimys winteri[2]	Winteraceae	Winter's bark	Foliage necrosis	UK	CSL records
Drimys winteri	Winteraceae	Winter's bark	Foliage	Ireland	NPPO Ireland
Fagus sylvatica[2]	Fagaceae	Beech	Bleeding canker	UK	Brasier *et al.* (2005)
Gevuina avellana[2]	Proteaceae	Chilean hazelnut	Leaf infection	UK	Forest Research records
Hedera helix	Araliaceae	Ivy	Stem infection	UK	Forest Research records
Ilex aquifolium 'Variegata'	Aquifoliaceae	Variegated holly	Leaf infection	UK	CSL records
Leucothoe fontanesiana	Ericaceae	Drooping leucothoe	Leaf infection	UK	Fera record, May 2010
Liriodendron tulipifera[3]	Magnoliaceae	Tulip tree	Bleeding canker and leaf infection	UK	Brasier *et al.* (2005)
Lomatia myricoides	Proteaceae		Leaf infection	UK	CSL records 2008
Magnolia amoena[2]	Magnoliaceae	-	Leaf infection	UK	Forest Research records

Latin name	Family	Common name	Type of infection	Location(s)	Reference
Magnolia brooklynensis	Magnoliaceae	Evamaria Cucumber Tree	Leaf infection	UK	CSL records
Magnolia cylindrica[2]	Magnoliaceae	Yellow mountain magnolia	Leaf spot and bud blast	UK	Forest Research records
Magnolia delavayi[2]	Magnoliaceae	Chinese evergreen magnolia	Leaf blight	UK	CSL records; Forest Research records
Magnolia Gresham hybrid 'Joe McDaniel'[2]	Magnoliaceae	-	Leaf infection	UK	Forest Research records
Magnolia Gresham hybrid 'Sayonara'[2]	Magnoliaceae	-	Leaf infection	UK	Forest Research records
Magnolia kobus[2]	Magnoliaceae	Kobus magnolia	Bud base death	UK	Forest Research records
Magnolia Leonard Messel2 = 'Magnolia kobus x Magnolia stellata'	Magnoliaceae	-	Leaf spot and bud blast	UK	Forest Research records
Magnolia liliiflora[2]	Magnoliaceae	Lily magnolia	Leaf spot	UK	Forest Research records
Magnolia mollicomata 'Lanarth' = M. campbelli var. mollicomata 'Lanarth'x M. liliiflora	Magnoliaceae	Vulcan Campbell's magnolia	Leaf infection and stem tip dieback	UK	Forest Research records
Magnolia salicifolia	Magnoliaceae	Anise magnolia	Leaf infection	UK	CSL records; Forest Research records
Magnolia sargentiana[2]	Magnoliaceae	-	Leaf infection	UK	CSL records
Magnolia sprengeri[2]	Magnoliaceae	-	Leaf infection	UK	CSl records
Magnolia stellata[2]	Magnoliaceae	Star magnolia	Leaf infection	UK	Forest Research records
Magnolia wilsonii[2]	Magnoliaceae	Wilson's Magnolia	Foliage necrosis and blossom blight	UK	Forest Research records
Magnolia x soulangeana[2]	Magnoliaceae	-	Leaf spot	UK	Forest Research records

Latin name	Family	Common name	Type of infection	Location(s)	Reference
Michelia doltsopa[2]	Magnoliaceae	-	Leaf infection	UK	Beales *et al.* (2006)
Pieris formosa[2]	Ericaceae	-	Leaf infection	UK	Brasier *et al.* (2005)
Pieris japonica[2]	Ericaceae	-	Leaf infection	UK	Beales *et al.* (2006)
Podocarpus salignus	Podocarpaceae	-	Shoot tip wilt, Foliar blight	UK	Forest Research records
Prunus laurocerasus	Rosaceae	Cherry laurel	Leaf infection and stem dieback	UK	CSL records
Quercus ilex[2]	Fagaceae	Holm oak	Leaf necrosis	UK	Brasier *et al.* (2005)
Quercus robur	Fagaceae	English oak	Bleeding canker	UK	Brasier *et al.* (2005)
Rhododendron spp.[1],[2]	Ericaceae	Rhododendron	Shoot dieback and leaf infection	UK, Ireland	Brasier *et al.* (2005), CSL Records. NPPO Ireland.
Sequoiadendron giganteum	Cupressaceae	Giant sequoia	Leaf and stem necrosis	UK	CSL records, Aug. 2008
Vaccinium myrtillus[2]	Ericaceae	Bilberry	Leaf infection and stem lesions	UK	CSL records 01/11/2007

[1]*P. kernoviae* on Rhododendron spp was first reported from Ireland (forest) in December 2008, further outdoor findings in 2009 and 2011.
[2]Koch's postulates successfully completed for this host
[3]Koch's postulates for Liriodendron tulipfera are completed for leaf infection only.

Appendix 2
Non-specific measures in the EU Plant Health Directive (2000/29/EC) (EU, 2000) that relate to plants originating from outside the Community. (known hosts of *P. ramorum* and *P. kernoviae* are indicated in bold)

Annex	Article	Description	Measure
IIIA	1	Plants of ***Abies*** Mill., *Cedrus* Trew, *Chamaecyparis* Spach, *Juniperus* L., *Larix* Mill., *Picea* A. Dietr., *Pinus* L., ***Pseudotsuga*** Carr. and *Tsuga* Carr., other than fruit and seeds.	Prohibited from Non-European countries
IIIA	2	Plants of ***Castanea*** Mill., and ***Quercus***L., with leaves, other than fruit and seeds.	Prohibited from Non-European countries
IIIA	9	Plants of *Chaenomeles* Ldl., *Cydonia* Mill., *Crateagus* L., *Malus* Mill., ***Prunus*** L., *Pyrus* L., and ***Rosa*** L., intended for planting, other than dormant plants free from leaves, flowers and fruit.	Prohibited from Non-European countries
IIIA	9.1	Plants of ***Photinia*** Ldl., intended for planting, other than dormant plants free from leaves, flowers and fruit.	Prohibited from USA, China, Japan, the Republic of Korea and Democratic People's Republic of Korea
IIIA	18	Plants of *Cydonia* Mill., *Malus* Mill., ***Prunus*** L. and *Pyrus* L. and their hybrids, and *Fragaria* L., intended for planting, other than seeds.	Without prejudice to the prohibitions applicable to the plants listed in Annex III A (9), where appropriate, prohibited from non-European countries, other than Mediterranean countries, Australia, New Zealand, Canada, the continental states of the USA
IVA1	39	Trees and shrubs, intended for planting, other than seeds and plants in tissue culture, originating in third countries other than European and Mediterranean countries.	Without prejudice to the provisions applicable to the plants listed in Annex III(a)(1), (2), (3), (9), (13), (15), (16), (17), (18), Annex III(B)(1) and Annex IV(A)(I)(8.1), (8.2), (9), (10), (11.1), (11.2), (12), (13.1), (13.2), (14), (15), (17), (18), (19.1), (19.2), (20), (22.1), (22.2), (23.1), (23.2), (24), (25.5), (25.6), (26), (27.1), (27.2), (28), (29), (32.1), (32.2), (33), (34), (36.1), (36.2), (37), (38.1) and (38.2), where appropriate, official statement that the plants: are clean (i.e. free from plant debris) and free from flowers and fruits, have been grown in nurseries, have been inspected at appropriate times and prior to export and found free from symptoms of harmful bacteria, viruses and virus-like organisms, and either found free from signs or symptoms of harmful nematodes, insects, mites and fungi, or have been subjected to appropriate treatment to eliminate such organisms.
IVA1	40	Deciduous trees and shrubs, intended for planting, other than	Without prejudice to the provisions applicable to the plants listed in Annex III(A)(2), (3), (9),

		seeds and plants in tissue culture, originating in third countries other than European and Mediterranean countries.	(15), (16), (17) and (18), Annex III(B)(1) and Annex IV(A)(I), (11.1), (11.2), (11.3), (12), (13.1), (13.2), (14), (15), (17), (18), (19.1), (19.2), (20), (22.1), (22.2), (23.1), (23.2), (24), (33), (36.1), (38.1), (38.2), (39) and (45.1) where appropriate, official statement that the plants are dormant and free from leaves.
IVA1	41	Annual and biennial plants other than Gramineae, intended for planting, other than seeds, originating in countries other than European and Mediterranean countries.	Without prejudice to the provisions applicable to the plants, where appropriate, listed in Annex III(A)(11), (13), and Annex IV(A)(I)(25.5), (25.6), (32.1), (32.2), (32.3), (33), (34), (35.1) and (35.2) official statement that the plants: have been grown in nurseries, are free from plant debris, flowers and fruits, have been inspected at appropriate times and prior to export, and – found free from symptoms of harmful bacteria, viruses and virus-like organisms, and – either found free from signs or symptoms of harmful nematodes, insects, mites and fungi, or have been subjected to appropriate treatment to eliminate such organisms.

Annex	**Article**	**Description**	**Measure**
IVA1	43	Naturally or artificially dwarfed plants intended for planting other than seeds, originating in non-European countries.	Without prejudice to the provisions applicable to the plants listed in Annex III(A)(1), (2), (3), (9), (13), (15), (16), (17), (18), Annex III(B)(1), and Annex IV(A)(I)(8.1), (9), (10), (11.1), (11.2), (12), (13.1), (13.2), (14), (15), (17), (18), (19.1), (19.2), (20), (22.1), (22.2), (23.1), (23.2), (24), (25.5), (25.6), (26), (27.1), (27.2), (28), (32.1), (32.2), (33), (34), (36.1), (36.2), (37), (38.1), (38.2), (39), (40) and (42), where appropriate, official statement that: (a) the plants, including those collected directly from natural habitats, shall have been grown, held and trained for at least two consecutive years prior to dispatch in officially registered nurseries, which are subject to an officially supervised control regime, (b) the plants on the nurseries referred to in (a) shall: (aa) at least during the period referred to in (a): – be potted, in pots which are placed on shelves at least 50 cm above ground, – have been subjected to appropriate treatments to ensure freedom from non-European rusts: the active ingredient, concentration and date of application of these treatments shall be mentioned on the phytosanitary certificate provided for in Article 7 of this Directive under the rubric «disinfestation and/or disinfection treatment». – have been officially inspected at least six times a year at appropriate intervals for the

			presence of harmful organisms of concern, which are those in the Annexes to the Directive. These inspections, which shall also be carried out on plants in the immediate vicinity of the nurseries referred to in (a), shall be carried out at least by visual examination of each row in the field or nursery and by visual examination of all parts of the plant above the growing medium, using a random sample of at least 300 plants from a given genus where the number of plants of that genus is not more than 3 000 plants, or 10% of the plants if there are more than 3 000 plants from that genus, – have been found free, in these inspections, from the relevant harmful organisms of concern as specified in the previous indent. Infested plants shall be removed. The remaining plants, where appropriate, shall be effectively treated, and in addition shall be held for an appropriate period and inspected to ensure freedom from such harmful organisms of concern, – have been planted in either an unused artificial growing medium or in a natural growing medium, which has been treated by fumigation or by appropriate heat treatment and has been of any harmful organisms, – have been kept under conditions which ensure that the growing medium has been maintained free from harmful organisms and within two weeks prior to dispatch, have been: – shaken and washed with clean water to remove the original growing medium and kept bare rooted, or – shaken and washed with clean water to remove the original growing medium and replanted in growing medium which meets the conditions laid down in (aa) fifth indent, or – subjected to appropriate treatments to ensure that the growing medium is free from harmful organisms, the active ingredient, concentration and date of application of these treatments shall be mentioned on the phytosanitary certificate provided for in Article 7 of this Directive under the rubric «disinfestation and/or disinfection treatment». (bb) be packed in closed containers which have been officially sealed and bear the registration number of the registered nursery; this number shall also be indicated under the rubric *additional declaration* on the phytosanitary certificate provided for in Article 7 of this Directive, enabling the consignments to be identified.

Annex	Article	Description	Measure
IVA1	44	Herbaceous perennial plants, intended for planting, other than seeds, of the families Caryophyllaceae (except *Dianthus* L.), Compositae (except *Dendranthema* (DC.) Des Moul.), Cruciferae, Leguminosae and **Rosaceae** (except *Fragaria* L.), originating in third countries, other than European and Mediterranean countries	Without prejudice to the requirements applicable to plants, where appropriate, listed in Annex IV(A)(I)(32.1), (32.2), (32.3), (33) and (34) official statement that the plants: have been grown in nurseries, and are free from plant debris, flowers and fruits, and have been inspected at appropriate times and prior to export, and found free from symptoms of harmful bacteria, viruses and virus-like organisms, and either found free from signs or symptoms of harmful nematodes, insects, mites and fungi, or have been subjected to appropriate treatment to eliminate such organisms.
VB1	1	Plants intended for planting originating outside of the community	Require inspection in country of origin or the consignor country before being permitted to enter the community.

Annex	Article	Description	Measure
IVA1	34	**Soil and growing medium**, attached to or associated with plants, consisting in whole or in part of soil or solid organic substances such as parts of plants, humus including peat or bark or consisting in part of any solid inorganic substance, intended to sustain the vitality of the plants, originating in: Turkey Belarus, Georgia, Moldova, Russia, Ukraine, (0J L 236) Non-European countries other than Algeria, Egypt, Israel, Libya, Morocco, Tunisia	Official statement that: the growing medium, at the time of planting, was: – either free from soil, and organic matter, or found free from insects and harmful nematodes and subjected to appropriate examination or heat treatment or fumigation to ensure that it was free from other harmful organisms, or subjected to appropriate heat treatment or fumigation to ensure freedom from harmful organisms, and since planting: either appropriate measures have been taken to ensure that the growing medium has been maintained free from harmful organisms, or within two weeks prior to dispatch, the plants were shaken free from the medium leaving the minimum amount necessary to sustain vitality during transport, and, if replanted, the growing medium used for that purpose meets the requirements laid down in (a).

Appendix 3. Pre-existing measures in the EU Plant Health Directive (2000/29/EC) (Anon., 2000) that relate to susceptible isolated bark as a commodity.

Annex	Article	Description	Measure
IIIA	5	Isolated bark of ***Castanea*** Mill.	Prohibited from third countries
	6	Isolated bark of ***Quercus*** L., other than *Quercus suber* L.	Prohibited from North American countries
IVAI	7.3	Isolated bark of conifers (Coniferales), originating in non-European countries	Official statement that the isolated bark: (a) has been subjected to an appropriate fumigation with a fumigant approved in accordance with the procedure laid down in Article 18.2. There shall be evidence thereof by indicating on the certificates referred to in Article 13.1.(ii), the active ingredient, the minimum bark temperature, the rate (g/m3) and the exposure time (h), or (b) has undergone an appropriate heat treatment to achieve a minimum core temperature of 56^{o}C for at least 30 minutes, the latter to be indicated on the certificates referred to in Article 13.1.(ii). (added by 2004/102/EC)

Appendix 4. Measures to be taken in case of an outbreak in places other than places of production.

Where *P. ramorum* is detected on any plants at places other than places of production (i.e. the public green - parks and gardens, woodland etc.), countries should take appropriate measures to at least contain the pest, including removal of as much as possible infected plant material to reduce the inoculum pressure.

Experience has shown that outbreaks in the public green (parks and gardens) and in woodland are more difficult to eradicate than outbreaks on nurseries and garden centres. When only a few plants were infected then eradication was achieved successfully, and in these cases, it is strongly recommended that prompt eradication is taken. However, where large areas of plants were infected e.g. rhododendron, larch and vaccinium, experience has shown that control measures are likely to be required over a number of years, and it is uncertain whether or not complete eradication is achievable. In these cases, containment to prevent further spread may be the more appropriate course of action.

On confirmation of *P. ramorum* on plants or trees growing in the public green (parks and gardens) or in woodland, the action required should take account of the risks posed at each site, including:

- Scale of the outbreak (number of plants including trees affected).
- Risk of further spread (e.g. plant movements, public access, water).
- Conservation value of the habitat e.g. ancient woodland.
- Heritage value if a park or garden.
- Situation (topography, gradient etc.).

The decision should then be taken on whether eradication should be attempted or instead containment only is possible. Countries are recommended to consider application of the following measures (note: some measures are applicable to all sites whilst the control measures will depend on whether the objective is eradication or containment):

2.1 <u>Prohibition on movement of susceptible plants, plant parts (including trees) and soil/growing media (all sites)</u>

No known susceptible plants, parts of plants, including foliage, flowers, waste from pruning, dead plant material, wood and soil/used growing media to be moved from the site without a prior official authorization.

2.2 <u>Phytosanitary measures to prevent spread of the pest (all sites)</u>

A set of phytosanitary measures to prevent spread of the pest should be agreed with a National Plant Protection representative. These measures will require a degree of flexibility to take account of site differences but should include at least:

(a) A regular programme of cleaning to remove plant debris from the surface of paths and standing areas.
(b) Safe disposal of all waste susceptible plants and plant material by burning or deep burial.
(c) Repair and maintenance to the physical structure of the footpaths e.g. where possible gravelling of mud paths.
(d) Restrictions on access to contaminated areas, e.g. cordoning-off or re-routing of footpaths to avoid contaminated areas.
(e) Hygiene measures for employees and contractors including cleaning and disinfection of footwear and machinery before leaving the site.
(f) Some restraint on the movement of dogs or domestic stock, e.g. for parks and gardens open to the public, all dogs to be kept on short leads.
(g) Erection of information signs to alert the public of the presence of the disease and include advice relevant to the site e.g.

- Keep to paths.
- Keep dogs on leads.
- Do not remove plant material (including wood) from the site.

- Clean footwear, animals, equipment (e.g. mountain bikes) before visiting other sites.

2.3 Control measures

2.3.1 Small number of infected shrubs e.g. in a park or garden

Where only a few shrubs are infected, for example in a park or garden, measures similar to those required for plants grown in the soil at commercial premises will be required.

(i) Require destruction of:

- all infected plants;
- all host plants from an appropriate *cordon sanitaire* around an infected plant (for small shrubs, a radius of at least 2 m may be sufficient but for larger plants a radius of 10 m may be required.
- all plant debris/leaf litter under the plant(s)
- whole plants, including the roots plants should be destroyed to prevent re-growth. Where this is not possible, re-growth will need to be controlled by repeated cutting or with appropriate herbicide treatment.

(ii) Acceptable methods of destruction include:

- Burning either *in situ* or at a commercial incinerator.
- Deep burial (to a depth of at least 0.5 m) either *in situ* or at a local authority approved landfill site. Burial *in situ* must take account of local drainage and must be accompanied by a restriction not to grow susceptible plants on or within a 4 m radius of the burial site for at least 4 years.
- Composting under official control and using a controlled composting system in which it is possible to demonstrate that the temperatures and duration required to kill *P. ramorum* have been achieved.

(iii) Measures should be taken to prevent re-infection at the site. These measures may include:

- Prohibit planting of susceptible plants in the cleared area for 4 years or
- Removal and deep burial of soil (0.5 m depth from at least a 2m radius around an infected plant) or
- Based on results with other *Phytophthora* species, steam or chemical treatment may be attempted as an alternative to removal.

2.3.2 Small number of infected trees (e.g. in park, garden or woodland where the understorey is infected)

Where a small number of trees have become infected in park, garden or woodland where the understorey is infected, felling or pruning of infected trees will be required according to the following guidelines:

<u>Trees with foliar infection only:</u> fell and destroy **or** prune and monitor if infection is clearly limited to parts of the tree e.g. suckers.
<u>Trees with limited bark lesions:</u> excise and destroy the affected bark and a strip of healthy bark at least 3cm wide beyond the lesion, and monitor.
<u>Trees with extensive bark lesions</u>: fell and destroy by an acceptable method.

- If felling and destruction is required, the preferred method is to cut and burn the whole tree on site. Alternatively, if the trunk and main branches are required for commercial purposes, consideration may be given to debarking before removal and processing.

- The bark and all remaining parts of the tree must be destroyed by an acceptable method.

2.3.3 Large number of infected shrubs e.g. rhododendron understorey in a woodland

Representative(s) of the National Plant Protection in association with the landowner, will need to implement a large-scale clearance programme, often involving the use of commercial contractors.

(i) Require destruction of:

- all infected plants;
- all host plants from an appropriate *cordon sanitaire* around an infected plant (at least 10 m but at least 100m if mature larch is infected). More often, it is simplest and most effective to require destruction of designated areas or all of the understorey.

- whole plants, including the roots plants should be destroyed to prevent re-growth. Where this is not possible, re-growth will need to be controlled by repeated cutting or with appropriate herbicide treatment.

Note: Plant debris/leaf litter under the plant(s): experience has shown that it is impractical and very expensive to attempt removal and destruction of all plant debris/leaf litter in these situations. Therefore, its removal and destruction is not required.

(ii) Acceptable methods of destruction include:

- Burning *in situ*.
- Deep burial to a depth of at least 0.5 m either *in situ* or at a local authority approved landfill site.
- Consideration may have to be given to chipping and leaving the chipped material *in situ* but away from footpaths etc.

(iii) Measures should be taken to prevent re-infection at the site. For such large-scale sites, the only practicable measures are restrictions on replanting of susceptible species in the cleared area for 4 years.

2.3.4 Woodland/forest

The approach is to fell and clear all confirmed infected or symptomatic host plants (on which the pathogens sporulates) from a site and, in addition, clearance of a buffer zone of non symptomatic host plants, on which the pathogen could sporulate, for an agreed distance around the confirmed infected or symptomatic host plants.

(i) Require felling and clearance of:

- all infected plants;
- all host plants from an appropriate *cordon sanitaire* around an infected plant (at least 100 m).

Note: Plant debris/leaf litter under the trees: experience has shown that it is impractical and very expensive to attempt removal and destruction of all plant debris/leaf litter in these situations. Therefore, its removal and destruction is not required.

(ii) Acceptable methods of destruction include:

- Burning *in situ*.
- Consideration may have to be given (e.g. when trees are small and have not attained any commercial value) to chipping and leaving the chipped material *in situ* but away from footpaths etc.
- ***Alternatively in the case of a mature woodland with considerable commercial value, processing of the timber may be permitted under official control and under strict phytosanitary restrictions to eliminate risk of spread.***

(iii) Measures should be taken to prevent re-infection at the site. For such large-scale sites, the only practicable measures are restrictions on replanting of susceptible species in the cleared area for 4 years.

2.3.5 Heathlands (open habitats featuring plants such as *Vaccinium* spp. and *Calluna* spp.)

Evidence on the most effective way to manage outbreaks in open heathland situations is not as well supported as garden or woodland situations.

(i) Require destruction of:

- all infected plants;
- all host plants from an appropriate *cordon sanitaire* around an infected plant (at least 10 m).

(ii) Acceptable methods of destruction include:
- Burning *in situ*
- Treatment with an appropriate herbicide

(iii) Prevention of re-infection is only likely to achieved by prevention of re-growth by repeat burning or treatment with appropriate herbicide treatment.

NOTE: Sites where only containment is possible e.g. because the scale is considered beyond the means of the landowner or Government

Whilst complete eradication will not be attempted, elimination of key sporulating hosts will be required under official control in certain circumstances e.g. to ensure containment, to reduce inoculum pressure, to protect the public (from falling trees) or to protect important or valuable specimens.

These measures may include:

(i) Removal and destruction of infected plants adjacent to the footpath(s).
(ii) Removal and destruction of infected plants that are deemed to be unsafe e.g. large shrubs or trees in the public green.
(iii) Removal and destruction of sporulating hosts (e.g. large shrubs or trees) which pose a risk to neighbouring plants (e.g. those directly in the drip line or beyond).
(iv) Pruning out and destruction of infected branches e.g. when an ornamental plant is of particular heritage value.
(v) Fungicide treatment to either reduce inoculum or to protect valuable specimens.

2.4 <u>Surveillance (all sites)</u>

2.4.1 The site and its surroundings should be inspected visually at least twice a year to provide confirmation that either *P. ramorum/P. kernoviae* has been eradicated or, if only containment has been required, that the disease situation is not increasing to levels where containment is compromised.

2.4.2 Supplementary baiting of water and soil are useful methods to monitor for the continued presence of *P. ramorum/P. kernoviae*.