Ministry for Primary Industries
Manatū Ahu Matua

Pest risk analysis: Phellinus noxius from all countries

Version 2.0
22 July 2016

ISBN: 978-1-77665-289-1 (online)

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While the format of this document has been updated in July 2016,
the scientific content is as of June 2011

Approved for general release

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Version information

Version number	Comments	Date of release
1.0	Peer-reviewed and current at date of release	21 June 2011
2.0	Updated format but scientific content remains the same	22 July 2016

New Zealand is a member of the World Trade Organisation and a signatory to the Agreement on the Application of Sanitary and Phytosanitary Measures ("The Agreement"). Under the Agreement, countries must base their measures on an International Standard or an assessment of the biological risks to plant, animal or human health.

This document provides a scientific analysis of the risks associated with *Phellinus noxius* on all pathways. It assesses the likelihood of entry, exposure, establishment and spread of *Phellinus noxius* in relation to imported plant commodities and assesses the potential impacts of those organisms should they enter and establish in New Zealand. The document has been internally and externally peer reviewed and is now released publicly. Any significant new science information received that may alter the level of assessed risk will be included in a review, and an updated version released.

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1.1 Purpose

Phellinus noxius (brown root rot) is a fungus found on the roots of trees, which cuts off water and nutrient supply to the crown causing tree death. Eighteen different host genera listed in the Import Health Standard schedules are reported to be hosts of *P. noxius*. Fourteen of these may be imported into New Zealand as whole plants (including roots). Genera imported as whole plants include *Acacia, Nerium, Artemesia, Camellia, Eucalyptus, Ficus, Rosa, Salix, Ulmus, Erythrina, Cinnamomum, Michelia, Fraxinus and Melaleuca.*

The purpose of this risk analysis is to assess the risks associated with *P. noxius* to New Zealand and consider options for managing these risks. This analysis will be used to consider whether changes to the Import Health Standard schedules are needed for the genera listed above, and if necessary develop a Risk Management Proposal in order to support any amendments made to the Import Health Standard schedules.

1.2 Summary

Phellinus noxius is mostly found on tropical tree species, in countries with tropical and subtropical climates. Avocado, pear, grape and eucalyptus are hosts, and it is found in avocado plantations in Australia.

The likelihood of *P. noxius* entering New Zealand on rooted nursery stock is considered to be low and on budwood is considered to be negligible, as all reports are of it being found on roots and the trunks of trees, rather than branches or shoots which are used for the production of budwood. The likelihood of exposure is considered to be moderate in limited areas of New Zealand, as nursery stock will be planted and *P. noxius* spreads by contact of healthy roots with infected roots in the soil and, more rarely, by airborne basidiospores. Because it is found in tropical and subtropical climates, the likelihood of establishment is considered to be moderate in northern areas of New Zealand where the winters are mildest. The likelihood of spread is considered to be high. The potential economic impact within New Zealand is considered to be low, with possible effects on New Zealand's avocado and pear industries, the viticulture industry, and on eucalyptus plantations. The environmental consequences are considered to be moderate in limited areas of New Zealand. Pest-free place of production and pest-free areas are considered possible measures to control *P. noxius*.

1.3 Scope

In this analysis the risk of *P. noxius* entering, establishing from imported nursery stock and causing unwanted impacts on New Zealand is examined. Such nursery stock is equivalent to plants for planting (IPPC 2010) and is defined as "*Living plants and parts thereof, including seeds and germplasm, intended to remain planted, to be planted or replanted*". This analysis is undertaken for budwood and rooted plants, not seeds and tissue culture as there is no evidence to suggest *P. noxius* could be associated with the latter two commodities.

When assessing the risks, this report does not include current risk management practices in New Zealand, and assumes production methods used by nurseries overseas in growing and preparing their plants for export do not include specific risk management activities for *P. noxius*. The possible impacts of post entry quarantine and other existing basic conditions under the nursery stock standard are examined in the risk management section.

The likelihood that *P. noxius* could enter New Zealand on wood products or wood packaging was also considered briefly (Appendix 1).

1.4 Hazard identification

Scientific name: *Phellinus noxius* (Corner) G.H. Cunningham (1965) (Basidiomycota: Basidiomycetes: Hymenochaetales: Hymenochaetaceae)
Other relevant scientific names: *Fomes noxius* Corner, 1932
Common name: Brown root rot

1.4.1 New Zealand status

Phellinus noxius is not known to be present in New Zealand. It is not recorded in the Plant Pest Interception Network (PPIN 2010), recorded as absent from the region in Landcare NZFungi (2010). The United States Department of Agriculture (USDA) Systematic Botany and Mycological Fungal Database (2010) lists a number of records for New Zealand and cite Cunningham (1965). This is incorrect as all the material for *P. noxius* listed by Cunningham is from Australia or the Pacific, not from New Zealand (Ridley 2001, Cunningham 1965). Furthermore, some of the hosts reported from New Zealand do not occur in New Zealand, and most of them, even if present, would unlikely grow here as they are tropical (e.g. cacao (*Theobroma cacao*), kapok (*Ceiba pentandra*)).

1.4.2 Biology

P. noxius causes a root rot of many tree species. Although it occurs in native forests in its current range, it is most damaging in plantations of forest trees and important fruit and commodity crops such as breadfruit, rubber, cocoa, and oil palm (Pegler and Waterston 1968). It is also known to cause serious damage to amenity trees (Hodges and Tenorio 1984).

New infection centres may be initiated when tree plantations are established on cleared forest (native in its existing range) in which the fungus is present. Infection occurs when roots of the planted trees make contact with stumps or other woody debris that contain the fungus. Further spread from the initial infection centres is through root contact. Airborne basidiospores produced in fruiting bodies on dead or dying trees or stumps can also initiate new infections on freshly cut stump surfaces or through wounds on living trees, with subsequent spread by root contact (Ridley 2001, Ivory 1987). The fungus produces an asexual spore state (Chang 1996) in culture, but such spores have not been observed in the field; moreover, it is not known what role they may play in the spread of the fungus. The fungus can survive for up to 2 years in infected wood placed in the soil and it was recovered from the roots of trees 10 years after their death (Chang 1996, Ridley 2001).

The fungus often produces a characteristic brownish mycelial sheath on the bark surface of infected trees (Hodges and Tenorio 1984). On large trees, this sheath may extend for 2 m or more above the root collar. Mycelium of the fungus grows radially into the tree from the sheath and may reach the heartwood of large trees (Chang in USDA 2000, Ridley 2001).

The fungus acts as a heart rot fungus in *Acacia mangium* in Malaysia without any external sheath (Lee and Zakaria 1993). Infection is thought to be by basidiospores entering through pruning wounds and broken branches. It is not known if this represents a different strain of the fungus or a particular response by this host (Ridley 2001).

1.4.3 Plant associations

Phellinus noxius has been reported on more than 200 plant species representing 59 families (Ann et al. 2002). Hosts are mostly tropical tree species and include cacao, coffee, tea, timber trees (Hodges and Tenorio 1984) and rubber (*Hevea brasiliensis*) (Nandris et al. 1987). It is more common on hardwood species, but also known on conifers (e.g. hoop pine *Araucaria cunninghamii*) (I. Hood pers. comm. 2011). It has been found in rain forests in American Samoa (Brooks 2002). Amenity trees can be affected (Ann et al. 2002) and are affected very commonly in some places such as Brisbane (I. Hood, pers. comm. 2011). Avocado, pear, grapes, and eucalyptus are hosts (Ann et al. 2002). See appendix 2 for further hosts.

1.4.4 Plant parts affected

Roots, root collar and lower stem of trees are affected.

1.4.5 Geographic distribution

P. noxius is widespread among tropical countries in Southeast Asia, Africa, Oceania, Central America, Caribbean (Ann et al. 2002) (Appendix 3).

1.4.6 Hazard identification conclusion

Phellinus noxius is found on and in the roots and trunks of many plant species in many countries, including species that can be imported into New Zealand from countries where the fungus occurs. *P. noxius* is not believed to be present in New Zealand, and is considered a hazard for the purposes of this risk analysis.

1.5 Risk assessment

1.5.1 Entry assessment

1.5.1.1 Budwood:

While *P. noxius* causes leaves to wilt, there is no evidence that the fungus is found in the leaves, branches or shoots, as references describe *P. noxius* on the roots and trunk of trees. For example Hodges and Tenorio (1984) found that in larger trees (30-40cm dbh) the mycelial crust may extend up the trunk 2 metres, but in smaller trees it seldom extends higher than 80cm. When bark is removed from living trees, the height of the dead and discoloured areas of cambium generally corresponds to that of the external mycelial crust (Hodges and Tenorio 1984). So it is considered unlikely that the shoots and new growth from which budwood cuttings are taken would be contaminated with *P. noxius* mycelia.

The likelihood of *P. noxius* entering New Zealand on budwood is therefore considered to be negligible.

1.5.1.2 Rooted plants:

Plants can be infected in two ways – through the roots coming into contact with infected roots or wood parts in the soil, or through airborne basidiospores coming into contact with freshly cut stumps or wounds and then infecting the plant (Ridley 2001).

For plants to become infected via basidiospores, there would need to be infected plants in the area producing basidiospores and those basidiospores would then need to be transported to and land on wounds on the nursery stock. This does not appear to be a common method for plants to become infected with *P. noxius*. In Taiwan the fungus rarely produces basidiocarps on diseased trees in the field (Ann et al. 2002) and because of the rarity of sporophores in plantations the prevalence of infection from spores in rubber plantations is low (Nandris et al. 1987).

It is unclear whether smaller plants like those used for nursery stock traded internationally would become infected. *P. noxius* is mostly described attacking trees. On one hand Chang and Yang (1998) surveyed *P. noxius* in Taiwan, and found it on 60 hosts, comprising 57 woody plants and three annual herbaceous plants. Of these 60 hosts, they found *P. noxius* on trees of all ages. However Lee and Zakariah (1993) in their study of infections of *Acacia mangium* found that it did not attack trees younger than 7 years. Also Hodges and Tenorio (1984) found that small (4-10cm dbh) flame trees (*Delonix regia*) were infected. It is uncertain whether plants smaller than 4cm dbh would become infected. Plants can be infected for a long time before showing signs of infection; once visible signs of infection are present, tree death usually follows (Moore 2010).

There are also contradictory opinions on whether *P. noxius* would spread through nursery stock. Ridley (2001) states that the biology of *P. noxius* suggests that it would either arrive in New Zealand as a pathogen in rooted nursery stock growing in a potting medium or as a decay fungus in wood products or wood packaging material. Ann and others (2002) state that the way new infection centres of brown root rot are established is still undetermined, but that it is likely that *P. noxius* is introduced into new areas on trees infected in the nursery then planted into the landscape. However Ridley (2001) says that there is no evidence that *P. noxius* colonises its hosts when they are grown in containers in a nursery.

Rooted plants established in pots:
If plants are grown in pots in the nursery, they would be unlikely to come into contact with infected roots. There is some likelihood for roots growing out of the base of pots to come into contact with infected roots. There is also some likelihood that plants may become infected through contact with basidiospores, but production of basidiospores is not common.

Rooted plants transferred to pots:
Plants can be grown in the ground, dug up, have the soil removed and be put in containers with a growing medium. Most natural infections arise when forest (native in the current range) containing infected trees is cut down and plantations are planted over the top. Depending on the nursery and type of plant, it is not uncommon for plants to be propagated in soil rather than pots. However it is not known how frequently these nurseries occur in areas where there are infected plants, and how often this results in infected nursery stock. It is not considered likely. Nursery trees extracted from beds in infected soil and transplanted into pots for export are considered here as a pathway for the movement of *P. noxius* in trade, but this pathway is considered to be uncommon.

Given that:

- It has a large variety of hosts so may come in on many species of plants;
- Rooted nursery stock may become infected if grown in the ground and transplanted into pots for export;
- Small plants may be able to be infected without showing symptoms;
- Rooted plants grown in the ground in infected areas and then transported to New Zealand are not considered to occur commonly;

The likelihood of entry is considered to be low and therefore non negligible.

1.5.2 Exposure assessment

P. noxius has a pan-tropical distribution, whether this is natural or the result of human activity is unknown (pers. com. GS Ridley). *P. noxius* is a high temperature organism with optimal growth near 30ºC and none at 8ºC, and it is geographically restricted to tropical and subtropical areas (Ann et al. 2002). Dry soil conditions may be more favourable to the survival of *P. noxius* (Chang and Yang 1998), although it is found in rainforests (Nandris et al. 1987, Brooks 2002). New Zealand's climate varies from warm subtropical in the far north to cool temperate in the far south. So *P. noxius* is unlikely to establish in most of New Zealand, but may establish in the far north. In Kerikeri, a town in the far north, typical summer day time maximum air temperatures range from 22ºC to 26ºC, and winter day time maximum air temperatures range from 12ºC to 17ºC.

P. noxius is found in New South Wales, parts of which have similar conditions to conditions in the far north of New Zealand.

Given that:

- nursery stock will be planted;
- the fungus spreads from infected roots to healthy roots or by airborne basidiospores;
- *P. noxius* is a high temperature organism;
- *P. noxius* is largely restricted to tropical and subtropical areas;
- New Zealand is mostly colder than sub tropical, but has some warmer regions with climates similar to areas where *P. noxius* occurs overseas;

The likelihood of exposure is considered to be moderate in limited areas of New Zealand and therefore non negligible.

1.5.3 Assessment of establishment and spread

If *P. noxius* entered New Zealand on rooted nursery stock, it is likely that it would spread from the roots of infected nursery stock to the roots of other plants when infected plants are planted in the ground in warmer areas. *P. noxius* can also spread following colonization of wounds or a freshly cut stump by basidiospores and then (in the case of stump colonisation) by mycelial movement from the stump to surrounding healthy roots (Ann et al. 2002), although this seems to be a rare occurrence.

P. noxius hosts are found in New Zealand, for example avocado, pear, grape and eucalyptus, and it could establish in plantations of any of these in the far north.

Given that:

- Susceptible hosts are common in the New Zealand natural and cultivated environment
- the fungus spreads from infected roots to healthy roots or by airborne basidiospores;

The likelihood of establishment is considered to be moderate in limited areas of New Zealand and therefore non negligible.

P. noxius spreads by root to root contact and rarely by airborne basidiospores coming into contact with wounds or cut stumps, spreading to roots and then to other plants by root to root contact (Ridley 2001, Ann et al. 2002). It would occur at a slow rate of spread. If it became established in New Zealand it could spread by people transplanting plants from an infected area to another area. Plants moved within New Zealand are more likely to have soil attached to their roots than plants moved internationally. Ann et al. (2002) state that it is not known how *P. noxius* spreads to new areas, but that it is likely to be from the movement of infected nursery stock. It is not known how far the airborne basidiospores travel, so how likely this is to spread the disease is uncertain. Spores do not seem to be a common method of spread (Ann et al. 2002, Nandris et al. 1987).

Movement of soil and plant material within New Zealand is not usually controlled, but if *Phellinus noxius* did arrive here, there could be an incursion response which could include restrictions on movement of soil and plant material from infected areas. This risk analysis does not consider this possibility directly.

Given that:

- There are no controls restricting the movement of host plants within New Zealand, so people are likely to move plants from infected areas to uninfected areas, although it is possible some controls could be put on movement of soil and plant material if *P. noxius* was found in New Zealand;
- *P. noxius* can also spread by airborne basidiospores and it is not known how far these travel;
- The rate of spread would probably be slow;

The likelihood of spread is considered to be high and therefore non- negligible.

1.5.4 Consequence assessment

Economic consequences

Although *Phellinus noxius* features as a significant root rot disease of *Hevea brasiliensis*, *Acacia mangium* and *Araucaria cunninghamii*, there is no data given on production losses (Bolland 1984; Hodges and Tenorio 1984; Nandris *et al.* 1987). Nandris *et al.* (1987) note that root decay pathogens (which include *P. noxius*) cause more than 50% mortality in old plantations established on cutover forest; they assumed a productive life of 25 years for *H. brasiliensis* and concluded that losses came to several thousand dollars (US) per hectare (Ridley 2001). In the Mariana Islands overlapping centres of infection of flame trees (*Delonix regia*) of 0.1 hectare together formed an area of 1 hectare with several hundred dead and infected trees (Hodges and Tenorio 1984).

In the far north of New Zealand plantations of avocado, pear, eucalyptus and vineyards may be affected. The impact of *P. noxius* is of increasing concern to the avocado industry in Australia, reported from the Atherton Tablelands and the Bundaberg area in Queensland, and northern New South Wales (Anon 2008). Infection ranged from minor (a few trees affected) to severe (80% of trees in a block) in affected Australian avocado orchards. Replanting typically failed (Dann et al. 2009). New Zealand avocados are worth $17.9 million domestically and $38.4 million in export earnings annually, and avocado oil another $0.2 million domestically and $2 million in export earnings (Plant and Food Research 2009). Pears are worth $9.1 million in export earnings annually (Plant and Food Research 2009). Wine exports were worth $985 million in the year to June 2009, and domestic spending on wine was $670 million for the same period (Plant and

Food Research 2009). As at 1 April 2007, 29,000 hectares were planted in *Eucalyptus* in New Zealand (MAF 2009). It is likely that only limited areas in the far north of New Zealand would be affected, however, damage in those limited areas may be significant with mortality of established trees, few options for control, and failure of replanting.

Often damage by *P. noxius* occurs when infected tropical native forests are cut down and plantations planted in the same area, and new plants are infected by contact with infected forest tree roots remaining in the soil. There is relatively little new native forest clearance in New Zealand to establish new plantations or agriculture. If *P. noxius* became established in New Zealand native forests in the far north could become infected in the future. It is hard to know if *P. noxius* could compete with indigenous wood colonising fungi under temperatures prevailing in this region. So while infection of plantation forests by growing over infected native forest is common overseas, in New Zealand this would be very unlikely.

The potential economic impact within New Zealand is considered to be low and therefore non negligible.

Environmental consequences

P. noxius is a natural component of many tropical forests (Hodges and Tenorio 1984, Brooks 2002, Nandris et al. 1987) but usually damage is recorded in plantations (Ridley 2001). It is in equilibrium in rainforests, and percentage infection of trees is low (Nandris et al. 1987). It is not known if it would spread to native trees in the far north of New Zealand. *P. noxius* does not have a big impact on trees in its natural environment but has an impact on exotic (naïve) trees (not previously exposed to *P. noxius*). This suggests that it would be likely to have an impact on New Zealand trees in the far north, as these are also naïve to the fungus.

P. noxius is very polyphagous, so it may attack many native New Zealand plants. Some of the genera from which *P. noxius* has already been recorded (see appendix 2) are *Agathis* and *Araucaria*, which include the New Zealand native kauri species. Species within the genera *Dysoxylum*, *Elaeocarpus*, and *Podocarpus* are hosts of *P. noxius* in its current range. There are native New Zealand species within these genera which could be hosts of *P. noxius* if it became established in New Zealand. Should these species be suitable hosts of *P. noxius*, the environmental consequences are likely to be high as *P. noxius* can kill host plants. Native species such as kauri are very important to New Zealanders, our culture and to native ecosystems.

P. noxius is known to attack amenity trees (Ann et al. 2002).

The potential environmental impact within New Zealand is considered to be moderate in some areas of New Zealand and therefore non negligible. This risk estimate is made with moderate uncertainty as it is not clear whether New Zealand native species such as kauri will prove to be hosts, and if so how strongly they will be attacked by the fungus.

Human health consequences

There are no known human health consequences.

1.5.5 Risk estimation

The likelihood of entry on rooted plants is low, exposure and establishment are moderate in some areas of New Zealand and the likelihood of spread is high. The potential economic consequences are low and environmental consequences are moderate (but highly uncertain) in some limited areas of New Zealand.

Since the risk estimate for *P. noxius* associated with nursery stock is non-negligible, options for phytosanitary measures are provided for consideration.

1.6 Risk management

The following risk management options have been analysed for their suitability to manage the risk posed by *P. noxius* associated with nursery stock (budwood and rooted plants):

- Current "basic" conditions stated in the generic nursery stock standard 155.02.06 (18 January 2010).
- Pest free place of production
- Pest free area
- Fungicidal treatment

Status quo (basic conditions under the nursery stock standard)

Under the current import health standard for nursery stock (budwood and rooted plants), a number of 'basic' conditions have to be met for all commodities within this commodity class imported into New Zealand. These 'basic' conditions can be separated into border actions and post border quarantine.

Current border actions

Host plants of *P. noxius* can be imported as cuttings, whole plants, dormant bulbs and tubers, or tissue culture. It is only likely that *P. noxius* would enter New Zealand on whole plants.

For each consignment a sample of 600 units is inspected for visible pests and diseases, or all of the units if the consignment has less than 600 units. An import permit is needed to accompany the consignment. Only inert/synthetic materials can be used for packing, not soil. A phytosanitary certificate must also accompany the consignment, saying that the consignment has been inspected in the exporting country and found to be free of pests and diseases.

Whole plants must either be grown in a soil-free medium or have or soil removed and pesticide dip applied to their roots (for control of insects). Whole plants must have additional insecticide and mite treatments, and there are additional measures to control some specific organisms.

If plants were grown in a soil-free medium, the likelihood of them being infected with *P. noxius* would be negligible. However if they were grown in unsieved soil or soil in the ground there is a very low likelihood that they could be infected with *P. noxius* (see entry assessment for details), and the treatments applied to them would not have any effect on controlling *P. noxius* as they are insect and mite treatments, and *P. noxius* could therefore enter New Zealand on these plants.

P. noxius may be detected on symptomatic plants by clearing away potting medium and examining the plant collar and roots, but this is not standard practice for nursery stock on entry into New Zealand. Currently whole plants can come in bare rooted or in soil-free growing media. If they come in bare rooted all of the roots are checked for nematodes but not fungi. If they come in growing media 5% of the roots are checked for nematodes but not fungi.

Current quarantine requirements

Imported nursery stock is grown in quarantine for three months. It is not known whether this is long enough or if conditions would be suitable for the disease to be detected through wilting of the leaves, or for mycelia to be detected on the roots or stem of plants. Hodges and Tenorio (1984) stated that with small trees (4-10cm dbh flame trees) the disease progresses rapidly compared to large trees, but they did not say how long this takes. There is a low to moderate likelihood that the disease would progress sufficiently for the disease to produce foliar symptoms within the 3 month quarantine period. The mycelial crust may be visible before foliar symptoms appear, and if roots were checked the disease may be observed earlier. Ann and others (2002) described two ways the disease can progress: quick decline, where foliage on a diseased tree may change from normal colour to pale green to brown within 1-2 months, or a slower decline where decline symptoms may occur over periods of a year or more. Plants can be diseased without showing any foliar symptoms until just before they wilt (Nandris et al. 1987) so detection of the disease may be difficult. Plant roots are not routinely examined in quarantine.

In summary, basic conditions for the importation of nursery stock would reduce the risk of entry of *P. noxius* into New Zealand on whole plants to very low but not to a negligible level.

Managed production system

It is possible to manage nursery production of plants in a way that prevents infection with *P. noxius*. *P. noxius* is mostly transmitted by contact of healthy roots with infected roots or root pieces in the soil. Within an infected area, transmission can be prevented largely by preventing plant roots coming into contact with roots in the soil. As an example, a glasshouse where plants were propagated only in soil-free media (never in the ground) and grown on raised benches would be sufficient to prevent root transmission of *P. noxius*.

There is some transmission by basidiospores also but this is not common. Having a wider area free from *P. noxius* around the production site provide greater confidence that basidiospores would not affect nursery-grown plants, although it is uncertain what distances would be required and what level of protection this would give.

A production system that prevents infection with *P. noxius* can be managed in a number of different ways, including pest-free place of production (described below).

1.6.1.1 Pest-free place of production

The International Standards for Phytosanitary Measures number 10: *Requirements for the establishment of pest free places of production and pest free production sites* (ISPM No 10) describes the requirements for the establishment and use of pest free places of production as a risk management option for meeting phytosanitary requirements for the import of plants. A pest free place of production is defined in the standard as a "place of production in which a specific pest does not occur as demonstrated by scientific evidence and in which, where appropriate, this condition is being officially maintained for a defined period". Pest freedom is established by surveys and/or growing season inspections and maintained as necessary by other systems to prevent the entry of the pest into the place of production.

When sufficient information is available to support a PFPP declaration, this phytosanitary measure is usually considered to provide a high level of protection depending on the epidemiological characteristics of the organism or disease in question. Precisely measuring the effectiveness of a PFPP is difficult, but the biology of *P. noxius* means that PFPP can reduce the likelihood of entry of *P. noxius* to a negligible level, as it is most commonly spread through root contact which would not happen if an area is free of *P. noxius*. If spread through spores was more common and these spores travelled long distances plants could be infected from spore movement from areas outside the PFPP.

Pest-free area

The International Standards for Phytosanitary Measures number 4: *Requirements for the establishment of pest free areas* (ISPM No 4) describes the requirements for the establishment and use of PFAs as a risk management option for meeting phytosanitary requirements for the import of plants. The standard identifies three main components or stages that must be considered in the establishment and subsequent maintenance of a PFA:

- systems to establish freedom
- phytosanitary measures to maintain freedom
- checks to verify freedom has been maintained.

Normally PFA status is based on verification from specific surveys such as an official delimiting or detection survey. It is accepted internationally that organisms or diseases that have never been detected in, or that have been detected and eradicated from, an area should not be considered present in an area if there has been sufficient opportunity for them to have been detected.

When sufficient information is available to support a PFA declaration, this phytosanitary measure can reduce the likelihood of entry of *P. noxius* to a negligible level.

Fungicide treatment

There are no known fungicides or fumigants suitably effective against *P. noxius* on plants.

1.7 References

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Appendix 1 – Wood products and wood packaging

It is not considered likely that *P. noxius* would establish in New Zealand if it entered on wood products or wood packaging. This is because the usual way that the infection spreads is by healthy plant roots of possible hosts coming into contact with infected plant roots or wood in the soil, and it is unlikely that infected wood products or packaging would come into contact with healthy plant roots in this way.

P. noxius can also spread by airborne basidiospores coming into contact with wounds or freshly cut stumps and then (in the case of colonisation of stumps) spreading through mycelial movement to the roots of trees. This is rare, and considered unlikely to arise from infected wood products or wood packaging. Some wood packaging is heat treated, to 56°C for 30 minutes. This should be enough to kill *P. noxius*, as 50°C for 20 minutes was enough to kill an organism in the same genus, *Phellinus weirii* (Ridley and Crabtree 2001). Wood packaging which is not heat treated is fumigated, heat treatment and fumigation are considered effective against most fungi.

Appendix 2 – Host list

Table 1: Hosts of *Phellinus noxius*

Host	Common name	Reference
Acacia aulacocarpa		Bolland 1984; Farr and Rossman 2010
Acacia confusa	Taiwan acacia	Chang and Yang 1998; Ann et al. 2002; Farr and Rossman 2010
Acacia mangium		Lee and Zakaria 1993; Farr and Rossman 2010
Actinodaphne pedicellata	litsea	Ann et al. 2002; Farr and Rossman 2010
Adenanthera pavonina		Brooks 2002
Agathis palmerstonii		Bolland 1984, Farr and Rossman 2010
Albizia lebbek		Hodges and Tenorio 1984, Farr and Rossman 2010
Albizia sp.		Farr and Rossman 2010
Aleurites fordii	tungoil tree	Chang and Yang 1998; Ann et al. 2002; Farr and Rossman 2010
Aleurites moluccana		Bolland 1984, Farr and Rossman 2010
Alstonia scholaris	blackboard tree	Chang and Yang 1998; Ann et al. 2002; Farr and Rossman 2010
Anacardium occidentale	Cashew	Supriadi Adhi et al. 2004
Annona montana	mountain soursop	Ann et al. 2002; Farr and Rossman 2010
Annona squamosa	custard apple	Ann et al. 2002; Farr and Rossman 2010
Annona squamosa x A. cherimola	atimoya	Ann et al. 2002; Farr and Rossman 2010
Aralia elata		Sahashi et al. 2007; Farr and Rossman 2010
Araucaria bidwillii		Bolland 1984
Araucaria cunninghamii	hook pine	Bolland 1984; Chang and Yang 1998; Ann et al. 2002; Farr and Rossman 2010
Araucaria heterophylla	Norfolk Island pine	Chang and Yang 1998; Ann et al. 2002; Farr and Rossman 2010
Araucaria spp.		Ridley 2001, Gibson 1979
Ardisia quinquegona		Farr and Rossman 2010
Ardisia sieboldii		Sahashi et al. 2007
Areca catechu		Farr and Rossman 2010
Areca triandra		Farr and Rossman 2010
Artemisia capillaris	wormwood	Chang and Yang 1998; Ann et al. 2002; Farr and Rossman 2010
Artemisia princeps	mugwort	Ann et al. 2002; Farr and Rossman 2010
Artocarpus altilis	breadfruit	Hodges and Tenorio 1984; Farr and Rossman 2010
Artocarpus heterophyllus	jack fruit	Ann et al. 2002; Farr and Rossman 2010
Averrhoa	carambola	Ann et al. 2002; Farr and Rossman 2010

carambola		
Azadirachta indica	sentang	Mohd Farid et al. 2001
Barleria cristata		Farr and Rossman 2010
Barringtonia asiatica		Brooks 2002
Barringtonia samoensis		Brooks 2002
Bauhinia acuminata		Farr and Rossman 2010
Bauhinia purpurea	purple bauhinia	Chang and Yang 1998; Ann et al. 2002; Farr and Rossman 2010
Bauhinia racemosa		Farr and Rossman 2010
Bauhinia sp.		Hodges and Tenorio 1984; Farr and Rossman 2010
Bauhinia variegata	orchid-tree	Chang and Yang 1998; Ann et al. 2002; Farr and Rossman 2010
Bauhinia x hybrid	butterfly-tree	Ann et al. 2002
Bischofia javanica	autumn maple tree	Chang and Yang 1998; Ann et al. 2002; Farr and Rossman 2010
Blepharocarya involucrigera		Bolland 1984; Farr and Rossman 2010
Boehmeria nivea		Farr and Rossman 2010
Bombax ceiba	silk cotton	Chang and Yang 1998; Ann et al. 2002; Farr and Rossman 2010
Bouganvillea sp.		Farr and Rossman 2010
Breynia nivosa		Farr and Rossman 2010
Broussonetia kazinoki	small paper mulberry	Ann et al. 2002; Farr and Rossman 2010
Broussonetia papyrifera	paper mulberry	Ann et al. 2002; Farr and Rossman 2010
Cajanus cajan		Farr and Rossman 2010
Calocedrus formosana	Taiwan incense cedar	Ann et al. 2002; Farr and Rossman 2010
Calophyllum inophyllum	Indian poon beauty leaf	Chang and Yang 1998; Ann et al. 2002; Farr and Rossman 2010
Calophyllum neo-ebudicum		Brooks 2002
Camellia japonica	camellia	Ann et al. 2002; Farr and Rossman 2010
Camellia japonica var. *japonica*		Chang and Yang 1998; Farr and Rossman 2010
Camellia sinensis	tea	Cooray et al. 2003; Ann et al. 2002; Farr and Rossman 2010
Cananga odorata		Brooks 2002; Farr and Rossman 2010
Canarium harveyi		Brooks 2002
Cassia fistula	yellow golden shower tree	Chang and Yang 1998; Ann et al. 2002; Farr and Rossman 2010
Cassia grandis		Farr and Rossman 2010
Cassia sp.		Farr and Rossman 2010
Castanospora alphandii		Bolland 1984
Castenospermum		Bolland 1984

australe		
Casuarina equisetifolia	ironwood tree	Chang and Yang 1998; Ann et al. 2002; Sahashi et al. 2007; Farr and Rossman 2010
Casuarina sp.		Hodges and Tenorio 1984
Casuarina torulosa		Bolland 1984; Farr and Rossman 2010
Cedrela mexicana		Farr and Rossman 2010
Ceiba pentandra		Ann et al. 2002; Farr and Rossman 2010
Celtis sinensis		Bolland 1984
Cerbera manghas	odollam cerberus tree	Ann et al. 2002; Brooks 2002; Farr and Rossman 2010
Chamaecyparis formosensis	Taiwan red cypruss	Ann et al. 2002; Farr and Rossman 2010
Chlorophora excelsa		Farr and Rossman 2010
Chorisia speciosa	floss silk tree	Ann et al. 2002; Farr and Rossman 2010
Chrysalidocarpus lutescens	yellow areca palm	Ann et al. 2002; Farr and Rossman 2010
Cinnamomum camphora	camphor	Chang and Yang 1998; Ann et al. 2002; Farr and Rossman 2010
Cinnamomum japonicum		Sahashi et al. 2007; Farr and Rossman 2010
Cinnamomum kanehirai	stout camphor	Chang and Yang 1998; Ann et al. 2002; Farr and Rossman 2010
Cinnamomum zeylanicum	Ceylon cinnamon	Chang and Yang 1998; Ann et al. 2002; Farr and Rossman 2010
Citrus aurantifolia		Farr and Rossman 2010
Citrus reticulata		Farr and Rossman 2010
Citrus sp.		Hodges and Tenorio 1984
Clutia sp.		Bolland 1984
Cocos nucifera		Farr and Rossman 2010
Codiaeum variegatum	croton	Ann et al. 2002; Farr and Rossman 2010
Coffea arabica	coffee	Ann et al. 2002; Farr and Rossman 2010
Coffea canephora		Farr and Rossman 2010
Coffea sp.		Farr and Rossman 2010
Cola nitida		Farr and Rossman 2010
Cordia aspera		Brooks 2002
Cordia dichotoma	cordia	Chang and Yang 1998; Ann et al. 2002; Farr and Rossman 2010
Crataegus sp.		Farr and Rossman 2010
Crescentia cujete		Farr and Rossman 2010
Crossostylis biflora		Brooks 2002
Crotalaria anagyroides		Farr and Rossman 2010
Crotalaria micans		Farr and Rossman 2010
Cryptocarya concinnai	Konishi cryptocarya	Ann et al. 2002
Cryptocarya mackinnoniana		Bolland 1984
Cupressus lusitanica		Bolland 1984; Farr and Rossman 2010

Cycas taiwaniana	Taiwan cycas	Chang and Yang 1998; Ann et al. 2002; Farr and Rossman 2010
Dalbergia sissoo	sissoo tree	Ann et al. 2002; Farr and Rossman 2010
Delonix regia		Bolland 1984; Chang and Yang 1998; Ann et al. 2002; Hodges and Tenorio 1984; Farr and Rossman 2010
Dimocarpus longan	longan	Ann et al. 2002; Farr and Rossman 2010
Diospyros ferrea var. *buxifolia*	Philippine ebony persimmon	Ann et al. 2002; Farr and Rossman 2010
Diospyros kaki	persimmon	Ann et al. 2002; Farr and Rossman 2010
Diospyros oldhami	oldham persimmon	Ann et al. 2002; Farr and Rossman 2010
Diospyros samoensis		Brooks 2002
Duranta repens	creeping sky flower	Ann et al. 2002; Farr and Rossman 2010
Dysoxylum samoense		Brooks 2002
Elaeis guineensis	oil palm	Bolland 1984; Farr and Rossman 2010
Elaeocarpus serratus	Ceylon olive	Chang and Yang 1998, Ann et al. 2002; Farr and Rossman 2010
Elaeocarpus sylvestris var. *ellipticus*		Sahashi et al. 2007; Farr and Rossman 2010
Elattostachys falcata		Brooks 2002
Eriobotrya japonica	loquat	Ann et al. 2002; Farr and Rossman 2010
Erythrina sp.		Hodges and Tenorio 1984
Erythrina variegata var. orientalis		Farr and Rossman 2010
Eucalyptus camaldulensis	murray red gum eucalyptus	Chang and Yang 1998; Ann et al. 2002; Farr and Rossman 2010
Eucalyptus citriodora	lemon gum eucalyptus	Bolland 1984; Chang and Yang 1998; Ann et al. 2002; Farr and Rossman 2010
Eucalyptus drepanophylla		Bolland 1984; Farr and Rossman 2010
Eucalyptus grandis	maiden eucalyptus	Chang and Yang 1998; Ann et al. 2002; Farr and Rossman 2010
Eucalyptus tessellaris		Bolland 1984
Eucalyptus sp.		Farr and Rossman 2010
Euonymus japonicus		Farr and Rossman 2010
Ficus copiosa		Bolland 1984
Ficus elastica	rubber plant	Ann et al. 2002; Farr and Rossman 2010
Ficus elastica var. *elastica*		Chang and Yang 1998; Farr and Rossman 2010
Ficus hanceana		Chang and Yang 1998; Farr and Rossman 2010
Ficus microcarpa	small -leafed banyan	Ann et al. 2002; Sahashi et al. 2007; Farr and Rossman 2010

Ficus obliqua		Brooks 2002
Ficus pumila var. *awkeotsang*	jellyfig	Ann et al. 2002; Farr and Rossman 2010
Ficus religiosa	botree fig	Chang and Yang 1998; Ann et al. 2002; Farr and Rossman 2010
Ficus septica		Bolland 1984
Ficus tinctoria		Brooks 2002
Ficus virgata		Sahashi et al. 2007; Farr and Rossman 2010
Firmiana simplex	Chinese parasol	Chang and Yang 1998; Ann et al. 2002; Farr and Rossman 2010
Flemingia macrophylla		Farr and Rossman 2010
Flindersia brayleyana		Bolland 1984; Farr and Rossman 2010
Flindersia pimentaliana		Bolland 1984
Flindersia schottiana		Bolland 1984
Flueggea flexuosa		Brooks 2002
Fraxinus formosana	island ash	Chang and Yang 1998; Ann et al. 2002; Farr and Rossman 2010
Garcinia subelliptica		Farr and Rossman 2010
Gardenia jasminoides	cape jasmin	Ann et al. 2002; Farr and Rossman 2010
Glochidion obovatum		Sahashi et al. 2007; Farr and Rossman 2010
Glochidion ramiflorum		Brooks 2002
Grevillea robusta	silver oak	Bolland 1984; Ann et al. 2002; Farr and Rossman 2010
Hedera australiana		Bolland 1984; Farr and Rossman 2010
Heritiera spp.		Bolland 1984
Hernadia nymphaefolia		Sahashi et al. 2007; Brooks 2002
Hevea brasiliensis	rubber	Nandris et al. 1987; Bolland 1984; Farr and Rossman 2010
Hevea sp.		Farr and Rossman 2010
Hibiscus rosa-sinensis	hibiscus	Chang and Yang 1998; Ann et al. 2002; Sahashi et al. 2007; Farr and Rossman 2010
Hibiscus schizopetalus	fringed hibiscus	Ann et al. 2002; Farr and Rossman 2010
Hibiscus tiliaceus	linden hibiscus	Chang and Yang 1998, Brooks 2002; Ann et al. 2002; Farr and Rossman 2010
Hydrangea chinensis	Chinese hydrangea	Ann et al. 2002; Farr and Rossman 2010
Inocarpus fagifer		Brooks 2002
Intsia bijuga		Brooks 2002
Ipomoea pescaprae		Chang and Yang 1998; Ann et al. 2002; Farr and Rossman 2010
Ilex rotunda		Sahashi et al. 2007; Farr and Rossman 2010

Jatropha integerrima		Farr and Rossman 2010
Keteleeria davidiana var. *formosuna*	Taiwan keteleeria	Chang and Yang 1998; Ann et al. 2002; Farr and Rossman 2010
Khaya nyassica		Bolland 1984
Kigelia pinnata	sausage tree	Ann et al. 2002; Farr and Rossman 2010
Kissodendron australianum		Farr and Rossman 2010
Koelreuteria henryi	flame gold rain tree	Chang and Yang 1998; Ann et al. 2002; Farr and Rossman 2010
Lactuca indica	wild lettuce	Chang and Yang 1998; Ann et al. 2002; Farr and Rossman 2010
Lagerstroemia turbinata	crape myrtle	Chang and Yang 1998; Ann et al. 2002; Farr and Rossman 2010
Lagerstroemia speciosa	queen's crape myrtle	Ann et al. 2002; Farr and Rossman 2010
Lagerstroemia subcostata		Sahashi et al. 2007
Lantana camara	lantana	Bolland 1984; Chang and Yang 1998; Ann et al. 2002; Farr and Rossman 2010
Lannea coromandelica		Supriadi Adhi et al. 2004
Leucaena leucocephala	white popinac	Chang and Yang 1998; Ann et al. 2002; Hodges and Tenorio 1984; Farr and Rossman 2010
Leucaena glabrata-leucocephala		Farr and Rossman 2010
Ligustrum japonicum		Sahashi et al. 2007
Liquidambar formosana	maple	Chang and Yang 1998; Ann et al. 2002; Farr and Rossman 2010
Litchi chinensis	litchi	Ann et al. 2002; Farr and Rossman 2010
Litsea glutinosa		Chang and Yang 1998; Ann et al. 2002; Farr and Rossman 2010
Litsea hypophaea		Ann et al. 2002; Farr and Rossman 2010
Litsea japonica		Sahashi et al. 2007; Farr and Rossman 2010
Macaranga harveyana		Brooks 2002
Macaranga tanarius	macaranga	Chang and Yang 1998; Ann et al. 2002; Farr and Rossman 2010
Macaranga stipulosa		Brooks 2002
Machilus thunbergii		Sahashi et al. 2007; Farr and Rossman 2010
Machilus zuihoensis	incense machilus	Ann et al. 2002; Farr and Rossman 2010
Maesa tenera	Taiwan maesa	Ann et al. 2002; Farr and Rossman 2010
Malaisia scandens		Bolland 1984
Mallotus paniculatus	turn in the wind	Ann et al. 2002; Farr and Rossman 2010
Mangifera indica		Farr and Rossman 2010

Manihot utilissima		Farr and Rossman 2010
Melaleuca leucadendron	cajuput tree	Chang and Yang 1998; Ann et al. 2002; Farr and Rossman 2010
Melia azedarach	China berry	Ann et al. 2002; Farr and Rossman 2010
Melicope merrilli	melicope	Chang and Yang 1998; Ann et al. 2002; Farr and Rossman 2010
Melodinus angustifolius	narrow leafed melodinus	Ann et al. 2002; Farr and Rossman 2010
Michelia compressa	Formosan michelia	Ann et al. 2002; Farr and Rossman 2010
Michelia compressa var. *formosana*		Chang and Yang 1998; Farr and Rossman 2010
Michelia figo	banana magnolia	Ann et al. 2002; Farr and Rossman 2010
Mitrephora froggattii		Bolland 1984
Morinda citrifolia		Brooks 2002
Morus australis		Sahashi et al. 2007
Muntingia calabura	Indian cherry	Ann et al. 2002; Farr and Rossman 2010
Murraya paniculata	orange jasmine	Ann et al. 2002; Sahashi et al. 2007; Farr and Rossman 2010
Murraya paniculata var. *paniculata*		Chang and Yang 1998; Farr and Rossman 2010
Myristica fatua		Brooks 2002
Nandina domestica		Sahashi et al. 2007; Farr and Rossman 2010
Neolitsea parvigemma	small bud neolitsea	Ann et al. 2002; Farr and Rossman 2010
Neonauclea forsteri		Brooks 2002
Nephelium lappaceum		Farr and Rossman 2010
Nerium oleander	oleander	Chang and Yang 1998; Ann et al. 2002; Farr and Rossman 2010
Ochroma lagopus		Farr and Rossman 2010
Osmanthus fragrans	sweet osmanthus	Ann et al. 2002; Farr and Rossman 2010
Pachira macrocarpa	malabar chestnut	Chang and Yang 1998; Ann et al. 2002; Farr and Rossman 2010
Palaquium formosanum	Formosan nato tree	Chang and Yang 1998; Ann et al. 2002; Farr and Rossman 2010
Persea americana	avocado	Ann et al. 2002; Farr and Rossman 2010
Persea gratissima		Farr and Rossman 2010
Pinus caribaea var. *hondurensis*		Gibson 1979, Bolland 1984
Pinus elliottii		Gibson 1979; Farr and Rossman 2010
Pinus elliottii var. elliottii		Farr and Rossman 2010
Pinus merkusii		Gibson 1979; Bolland 1984
Pinus spp.		Ridley 2001
Pinus thunbergii	black pine	Chang and Yang 1998; Ann et al. 2002; Farr and Rossman 2010
Piper nigrum		Farr and Rossman 2010

Pipturus argenteus		Brooks 2002
Pistacia chinensis	Chinese pistache	Chang and Yang 1998; Ann et al. 2002; Farr and Rossman 2010
Planchonella grayana		Brooks 2002
Planchonella samoensis		Brooks 2002
Podocarpus macrophyllus		Ann et al. 2002; Sahashi et al. 2007; Farr and Rossman 2010
Podocarpus macrophyllus var. *macrophyllus*		Chang and Yang 1998; Farr and Rossman 2010
Pometia pinnata		Brooks 2002
Pongamia pinnata	pongamia	Chang and Yang 1998; Ann et al. 2002; Farr and Rossman 2010
Populus sp.		Farr and Rossman 2010
Prunus campanulata	Taiwan cherry	Ann et al. 2002; Farr and Rossman 2010
Prunus mume	Japanese apricot, plum	Chang and Yang 1998; Ann et al. 2002; Farr and Rossman 2010
Prunus persica	peach	Ann et al. 2002; Sahashi et al. 2007; Farr and Rossman 2010
Prunus persica var. vulgaris		Farr and Rossman 2010
Pterocarpus indicus	rose wood	Chang and Yang 1998; Ann et al. 2002; Farr and Rossman 2010
Pygeum turneranum		Bolland 1984
Pyrus pyrifolia	pear	Ann et al. 2002; Farr and Rossman 2010
Rhaphiolepis umbellata		Sahashi et al. 2007; Farr and Rossman 2010
Rhododendron obtusum	rhododendron	Ann et al. 2002; Farr and Rossman 2010
Rhus succedanea		Sahashi et al. 2007
Rhus taitensis		Brooks 2002
Rosa sp.		Bolland 1984; Farr and Rossman 2010
Roystonea regia	royal palm	Ann et al. 2002; Farr and Rossman 2010
Salix babylonica	willow	Chang and Yang 1998; Ann et al. 2002; Farr and Rossman 2010
Samanea saman		Brooks 2002
Sauranja oldhami		Ann et al. 2002
Saurauia oldhamii		Farr and Rossman 2010
Schefflera actinophylla		Bolland 1984
Schefflera octophylla	schefflera	Ann et al. 2002; Farr and Rossman 2010
Spondias dulcis		Brooks 2002
Stenocarpus sinuatus		Bolland 1984; Farr and Rossman 2010
Sterculia foetida	hazel sterculia	Ann et al. 2002; Farr and Rossman 2010
Sterculia nobilis	ping-pong	Ann et al. 2002; Farr and Rossman 2010

Swietenia macrophylla	mahogany	Browne 1968; Bolland 1984; Farr and Rossman 2010
Swietenia mahagonia	mahogany	Chang and Yang 1998; Ann et al. 2002; Farr and Rossman 2010
Swietenia spp.		Ridley 2001
Syzygium inophylloides		Brooks 2002
Syzygium samarangense	wax apple	Ann et al. 2002; Farr and Rossman 2010
Tabebuia chrysantha	yellow golden bell tree	Ann et al. 2002; Farr and Rossman 2010
Taiwania cryptomerioides	Taiwania	Chang and Yang 1998; Ann et al. 2002; Farr and Rossman 2010
Tectona grandis		Farr and Rossman 2010; Farr and Rossman 2010
Tephrosia sp.		Farr and Rossman 2010
Tephrosia vogelii		Farr and Rossman 2010
Terminalia boivinii		Ann et al. 2002; Farr and Rossman 2010
Terminalia catappa	Indian almond	Ann et al. 2002; Farr and Rossman 2010
Terminalia richii		Brooks 2002
Theobroma cacao	cocoa	Farr and Rossman 2010
Thespesia populnea		Hodges and Tenorio 1984
Thevetia peruviana		Farr and Rossman 2010
Trema orientalis		Bolland 1984
Ulmus parvifolia	Chinese elm	Chang and Yang 1998; Ann et al. 2002; Farr and Rossman 2010
Urena lobata	cadillo	Ann et al. 2002; Farr and Rossman 2010
Vitis vinifera	grape	Ann et al. 2002; Farr and Rossman 2010
Zelkova serrata var. *serrata*	zelkova	Chang and Yang 1998; Ann et al. 2002; Farr and Rossman 2010

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Appendix 3 – Distribution list

Table 2. Geographic distribution of *Phellinus noxius*

Country	**Reference**
Asia	
Taiwan	Ann *et al*. 2002
Islands of China	Ann *et al*. 2002
China	Kai-Ming and Chee 1989
Islands of Japan	Ann *et al*. 2002
India	Farr and Rossman 2010
Indonesia	Farr and Rossman 2010
Malay Peninsula	Farr and Rossman 2010
Malaysia	Farr and Rossman 2010
Myanmar	Farr and Rossman 2010
East Indies	Farr and Rossman 2010
Andaman Islands	Farr and Rossman 2010
Nicobar Islands	Farr and Rossman 2010
Pakistan	CPC 2007
Phillipines	CPC 2007
Singapore	CPC 2007
Sri Lanka	CPC 2007
Vietnam	CPC 2007
Central America and Caribbean	
Cuba	Farr and Rossman 2010
Brazil	Farr and Rossman 2010
Costa Rica	CPC 2007
Puerto Rico*	Farr and Rossman 2010
Africa	
Nigeria	Farr and Rossman 2010
Ghana	Farr and Rossman 2010
Sierra Leone	Farr and Rossman 2010
Tanzania	Farr and Rossman 2010
Cote d'Ivoire	Farr and Rossman 2010
Angola	CPC 2007
Benin	CPC 2007
Burkina	CPC 2007
Faso	CPC 2007
Cameroon	CPC 2007
Central African Republic	CPC 2007
Democratic Republic of Congo	CPC 2007
Gabon	CPC 2007
Kenya	CPC 2007
Togo	CPC 2007
Uganda	CPC 2007
Liberia	Nandris *et al.* 1987
Oceania	
Australia (NSW, Queensland)	CPC 2007
Samoa	Farr and Rossman 2010

Fiji	Farr and Rossman 2010
New Guinea	Farr and Rossman 2010
Papua New Guinea	Farr and Rossman 2010
American Samoa	Brooks 2002
Mariana Islands	Hodges and Tenorio 1984
Samoa	Gibson 1979
Vanuatu	Gibson 1979

* the record from Puerto Rico is suspect. A review of the fungal data bases on that island did not contain any records of *P. noxius* (Ridley 2001).

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