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Biosecurity Australia

DRAFT

Review of policy: importation of hazelnut (*Corylus* species) propagative material from Chile

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Cover image: Hazelnuts (mother plantation in Chile).

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Acronyms and abbreviations

Term or abbreviation	Definition
ALOP	Appropriate level of protection
APPD	Australian Plant Pest Database (Plant Health Australia)
AQIS	Australian Quarantine and Inspection Service
CABI	CAB International
CMI	Commonwealth Mycological Institute
DAFF	Australian Government Department of Agriculture, Fisheries and Forestry
ELISA	Enzyme-linked immunosorbent assay
FAO	Food and Agriculture Organization of the United Nations
IPC	International Phytosanitary Certificate
IPM	Integrated Pest Management
IPPC	International Plant Protection Convention
IRA	Import Risk Analysis
ISPM	International Standard for Phytosanitary Measures
NPPO	National Plant Protection Organization
PCR	Polymerase chain reaction
PEQ	Post-entry quarantine
PRA	Pest risk analysis
SAG	Servicio Agricola y Ganadero (Government of Chile)
SPS	Sanitary and phytosanitary
WTO	World Trade Organisation

Summary

Australia initiated a qualitative pathway-initiated pest risk analysis (PRA) following a request to import hazelnut propagative material from Chile in commercial quantities through a defined pathway. The applicant also asked Plant Biosecurity to consider open post-entry quarantine in Australia, rather than closed quarantine in quarantine glasshouses.

Currently, hazelnut propagative material is permitted entry into Australia from all countries and requires mandatory methyl-bromide fumigation on arrival and a minimum of 16 months of post-entry quarantine (PEQ) at a government facility. The existing policy is designed to manage the risk of arthropod pests and disease, particularly the diseases caused by *Anisogramma anomala* and *Phytophthora ramorum.*

Based on technical discussions, production site visits to Chile (March 2011), pest risk assessments and other available information, Plant Biosecurity considers that Chile is not only free of *Anisogramma anomala* and *Phytophthora ramorum* but also free from several other pests of quarantine concern to Australia in hazelnuts identified in this review. *Armillaria mellea* and *Neonectria ditissima* are two pests of concern which are present in Chile, but they have not been recorded on hazelnut during surveys conducted by Servicio Agricola y Ganadero (SAG).

This PRA proposes the following systems approach, which is designed to manage quarantine risk off-shore and takes into account Chile's low pest status for hazelnuts.

- The systems approach commences with sourcing hazelnut rooted dormant cuttings from a country with low pest status (i.e. out of 28 pathway-specific pests of quarantine concern, only two pathogens are present in Chile). Dormant cuttings sourced from mother plants that have been inspected and found to be free of pathogens are disinfected and transferred to SAG registered nurseries.
- Resultant plants are monitored by SAG for freedom from disease symptoms. Plants are grown in pasteurized soil-less media in SAG registered nurseries for one season (dormant cuttings are planted and harvested when they are again dormant). Appropriate pest control programs are to be in place throughout the growth cycle and monitored by SAG.
- An insecticidal treatment is applied no longer than seven days prior to export. Rooted dormant cuttings for export to Australia are inspected and certified by SAG officers immediately prior to export.
- Pre-export verification inspection by AQIS officers and a plant pathologist familiar with the diseases of hazelnuts is to be carried out immediately prior to export within approved production facilities for evidence of arthropod pests and diseases.
- Growth and disease screening by AQIS and a plant pathologist who is familiar with the diseases of hazelnuts in open quarantine for a minimum of 12 months.

The accredited system is subject to audit by AQIS to ensure ongoing compliance with the proposed systems approach.

Production of hazelnut rooted dormant cuttings in accordance with the proposed systems approach, phytosanitary inspection by SAG and an insecticidal treatment no longer than seven days prior to export to Australia, is considered equivalent to mandatory on-arrival fumigation.

Furthermore, AQIS will undertake a documentation compliance examination for consignment verification purposes, at the port of entry in Australia, prior to transfer of the imported hazelnut rooted dormant cuttings to open quarantine premises.

Plant Biosecurity invites comments on the technical aspects of the proposed risk management measures for hazelnut rooted dormant cuttings produced in Chile. In particular, comments are sought on their appropriateness and any other measures stakeholders consider would provide equivalent risk management outcomes.

During the course of undertaking this review, Plant Biosecurity identified additional pests of quarantine concern in hazelnut worldwide. Plant Biosecurity has reviewed the current import conditions for hazelnut propagation material from all other countries. The current import conditions for hazelnut propagative material are supported with additional risk management measures being recommended where required.

1 Introduction

1.1 Australia's biosecurity policy framework

Australia's biosecurity policies aim to protect Australia against the risks that may arise from exotic pests[1] entering, establishing and spreading in Australia, thereby threatening Australia's unique flora and fauna, as well as those agricultural industries that are relatively free from serious pests.

The pest risk analysis (PRA) process is an important part of Australia's biosecurity policies. It enables the Australian Government to formally consider the risks that could be associated with proposals to import products into Australia. If the risks are found to exceed Australia's appropriate level of protection (ALOP), risk management measures are proposed to reduce the risk to an acceptable level. If it is not possible to reduce the risks to an acceptable level, then no trade will be allowed.

Successive Australian governments have maintained a conservative, but not a zero risk, approach to the management of biosecurity risks. This approach is expressed in terms of Australia's ALOP, which reflects community expectations through government policy and is currently described as providing a high level of protection aimed at reducing risk to a very low level, but not to zero.

Australia's PRAs are undertaken by Biosecurity Australia using teams of technical and scientific experts in relevant fields, and involves consultation with stakeholders at various stages during the process. Biosecurity Australia provides recommendations for animal and plant quarantine policy to Australia's Director of Animal and Plant Quarantine (the Secretary of the Australian Department of Agriculture, Fisheries and Forestry). The Director or delegate is responsible for determining whether or not an importation can be permitted under the *Quarantine Act 1908*, and if so, under what conditions. The Australian Quarantine and Inspection Service (AQIS) is responsible for implementing appropriate risk management measures.

More information about Australia's biosecurity framework is provided in the *Import Risk Analysis Handbook 2007* (update 2009) located on the Biosecurity Australia website www.daff.gov.au/ba.

1.2 This review of existing policy

Australia has an existing policy to import hazelnut propagative material from all countries; however, this policy has not been reviewed for some time. Propagative material represents one of the highest plant quarantine risks, as it can harbour various forms of pathogens and arthropod pests. Many pests have been introduced to new locations on propagative material. The introduction of plant pathogens, especially pathogens with latent infection, is of particular concern in propagative material. A range of exotic arthropod pests and pathogens can be introduced and established via propagative material when imported in a viable state for ongoing propagation or horticultural purposes.

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[1] A pest is any species, strain or biotype of plant, animal, or pathogenic agent injurious to plants or plant products (FAO 2009).

1.2.1 Background

Many pests are associated with the production of hazelnut worldwide. As hazelnuts are propagated mainly by vegetative means, there is considerable risk of introducing and spreading pests through international trade of hazelnut rooted cuttings.

Hazelnut is currently categorised as high risk nursery stock because of its potential to introduce *Anisogramma anomala* and *Phytophthora ramorum* into Australia. Australia's existing policy to import hazelnut nursery stock (soil-free rooted dormant cuttings, tissue culture and seed) from all sources includes on-arrival inspection, mandatory methyl-bromide fumigation and growth in post-entry quarantine (PEQ) at a government facility with appropriate disease screening.

Plant Biosecurity initiated this review of existing policy in response to an application to import commercial quantities of hazelnut propagative material from Chile through a defined pathway. The importer has requested that Plant Biosecurity develop alternative risk management measures for hazelnut rooted dormant cuttings produced in Chile taking into account the specific export pathway and the plant health status of Chile. The importer has also requested that Plant Biosecurity examine the option of field post-entry quarantine, rather than closed quarantine in a government facility.

In order to better evaluate this proposal, officers from the Department of Agriculture, Fisheries and Forestry and experts from the NSW and Tasmanian governments conducted a verification visit to Chile in March 2011. This visit examined the proposed export pathway, production and pest management methods, and the Chilean government's pest management and surveillance processes.

1.2.2 Scope

The scope of this review is limited to:

- the identification of biosecurity risks associated with hazelnut propagative material produced through a defined pathway from Chile; and
- the identification of phytosanitary measures for the identified risks.

This review does not consider interstate quarantine regulations, as states and territories in Australia may have restrictions or specific conditions for the entry of hazelnut propagative material from other states and territories.

1.2.3 Existing import policy for hazelnut propagative material from all sources

Propagative material (soil-free rooted cuttings, seed and tissue culture) of hazelnut (*Corylus* species) is permitted entry into Australia, subject to specific import conditions. These conditions are available on the AQIS Import CONditions database (ICON) at http://www.aqis.gov.au/icon. As *Corylus* species are hosts of *Phytophthora ramorum* and /or other *Phytophthora* complex species, specific import conditions have been developed for imports from host countries of these pathogens.

Seed for sowing

Seeds of *Corylus* species listed in Condition C 15284 (list of permitted species) may be imported subject to quarantine/biosecurity measures set out in the import conditions C 8733 and C 7100 'Nuts/woody shelled tree seeds for sowing'. The requirements include:

- freedom from regulated articles including soil, disease symptoms and other extraneous contamination of quarantine concern;
- on-arrival inspection; and
- mandatory fumigation with either methyl-bromide (T 9072) or phosphine (T 9086).

Tissue culture

Tissue cultures of *Corylus* species listed in Condition C 15278 (list of permitted species) may be imported subjected to quarantine/biosecurity measures set out in the import conditions C 9597, and C 7330. The requirements include:

- an AQIS import permit;
- freedom from any bacterial or fungal infection, live insects, disease symptoms or other extraneous contamination of quarantine concern;
- on-arrival inspection; and
- growth under closed quarantine with general disease screening, at an AQIS approved post-entry quarantine facility for a minimum of nine months (and until the required disease screening/testing is completed).

Corylus species tissue cultures are allowed from all countries (C 9597), free from *Phytophthora ramorum*, accompanied by a Phytosanitary Certificate with the following additional declaration:

> 'Sudden Oak Death (*Phytophthora ramorum*) is not known to occur in [insert country of origin]'.

Nursery stock (soil-free dormant rooted cuttings)

Soil-free dormant rooted cuttings of *Corylus* species listed in Condition C 15278 (list of permitted species) may be imported subjected to quarantine/biosecurity measures set out in the import conditions C 9377, and C 7330. The requirements include:

- an AQIS import permit;
- freedom from regulated articles including soil, disease symptoms and other extraneous contamination of quarantine concern;
- on-arrival inspection;
- mandatory methyl-bromide fumigation (T 9072); and
- growth under closed quarantine, at a government post-entry quarantine facility for a minimum period of 16 months for fungal disease and virus screening.

Propagative material from *Phytophthora ramorum* host countries

Plants and plant parts (other than tissue cultures) of *Corylus* species are prohibited entry into Australia (C 15269) from countries where *Phytophthora ramorum* is known to occur.

Tissue culture

Tissue cultures of listed *Corylus* species may be imported subject to quarantine/biosecurity measures set out in the import condition C 10553. The requirements include:

- an AQIS import permit;
- freedom from bacterial and fungal infection, disease symptoms, live insects and any other extraneous contamination of quarantine concern;
- on-arrival inspection; and
- growth under closed quarantine, at a Government post-entry quarantine facility for a minimum period of nine months for disease screening.

- Visual inspection of plants at least once every month and immediately prior to release to check for symptoms of *Phytophthora ramorum* and/or other *Phytophthora* complex species.
- Any plants found to be infected with *Phytophthora ramorum* and/or other *Phytophthora* complex species must be destroyed.
- Two months prior to release, all plants must be treated with an approved systemic fungicide as a soil drench.
- Following fungicide treatment and final inspection, plants found free of *Phytophthora ramorum* and/or other *Phytophthora* complex species may be released from quarantine.

1.3 Chile's quarantine regulations to import propagative material

The Servicio Agricola y Ganadero (SAG) regulates imports of all propagative material in accordance with their quarantine legislation. Commercial nurseries require registration and regular monitoring and disease screening by SAG. SAG also conducts inspections of production and forestry areas, looking for disease symptoms. The sampling covers 20% of planted fields per year, and is scheduled so that all planted fields are sampled over a five year period (i.e. 20% per year x 5 years = 100%).

This surveillance activity applies to all commercial crops produced in Chile and provides SAG with detailed information on the pest status of its agricultural crops and nurseries throughout the country. During the verification visit to Chile, the delegation was able to collect detailed information on the pest status of hazelnuts in Chile, including pest interceptions in the field in the years following the clearance of imported varieties from quarantine. This information was extremely valuable in determining the potential pests of quarantine concern to Australia in Chile and the pest status of the plants proposed for export to Australia.

1.3.1 Importation of hazelnut propagative material into Chile

Hazelnut propagative material has been imported into Chile from Argentina, Italy and the USA (Table 1.1), subject to specific import conditions. These include an import permit with additional declarations for freedom from specific pests, and growth in post-entry quarantine (PEQ) facilities for two years for disease screening.

Table 1.1 Introduction of hazelnut propagative material in Chile

Year of introduction	Region	Country of origin	Type of material
1998	Curico	USA	Cuttings
1998	Curico	Italy	Cuttings
2003	Curico	Argentina	Cuttings
2003	Curico	Argentina	Cuttings
2004	Curico	Argentina	Plants
2004	Curico	Argentina	Cuttings
2005	Curico	Argentina	Cuttings
2005	Chillan	USA	Plants
2006	Temuco	Argentina	Plants
2006	Temuco	Argentina	Plants
2006	Temuco	Argentina	Plants

SAG has identified pests associated with hazelnut propagative material and requires phytosanitary certification endorsed by the NPPO of the exporting country (Argentina, Italy and the USA) for freedom from pathogens and arthropod pests. These pests include: **pathogens** (*Anisogramma anomala, Paralongidorus maximus, Pratylenchus penetrans*) and **insects** (*Archips rosanus*, *Agrilus viridis*, *Bemisia carpini, Curculio* species, *Cnephasia longana*, *Eotetranychus carpini*, *Eotetranychus pruni*, *Metcalfa pruinosa*, *Phenacoccus aceris, Phytoptus avellanae, Pseudalacaspis pentagona, Spilonota ocellana, Tetranychus turkestani*, *Zeuzera pyrina*).

Additionally, according to provisions of Decree-law No. 18755 of 1989 (modified by No. 19283 of 1994) and No. 3557 of 1980 related to plant protection, and Resolution No. 3080 of 2003 related to pests of quarantine concern, the following pests are absent from Chile mainland:

- **Arthropods:** *Cediophyopsis vermiformis*, *Argilus* species, *Oberea linearis*, *Archips* species and *Operophtera brumata*; and
- **Pathogens:** *Anisogramma anomala*, *Monilinia fructigena*, *Phytophthora ramorum* and *Pseudomonas syringae* pv. *avellanae*.

Following release from quarantine, the plants were monitored for pests through SAG's ongoing mandatory surveillance programs covering nurseries and plantations.

1.3.2 Monitoring and surveillance of hazelnut plantations

SAG consistently monitors registered nurseries and hazelnut plantations for exotic (identified by the resolutions to import hazelnut propagative material) and indigenous pests. SAG officials conduct 3–4 inspections of hazelnut plantations per year for any diseases symptoms. Any plants with suspect disease symptoms are sent to the SAG laboratories in Santiago for analysis. In addition, SAG also takes samples of symptomless plants for analysis, using a sampling rate giving 95% confidence levels. Pests detected by SAG on hazelnut plantations in Chile and their status in Australia is summarised in Table 1.2.

Table 1.2 Pests recorded in hazelnut plantations in Chile

Pest type	Status in Australia (see Appendix 1)
ARTHROPODS	
Aegorhinus nodipennis (Hope, 1834)	Not recorded; however, these species are not considered to be on the import pathway for rooted dormant cuttings.
Aegorhinus superciliosus (Guérin, 1830)	
Myzocallis coryli (Goeze, 1778)	Present (CSIRO 2005)
Phytoptus avellanae Nalepa, 1889	Present (CSIRO 2005)
PATHOGENS	
BACTERIA	
Pseudomonas syringae pv. *syringae* van Hall	Present (APPD 2011)
Rhizobium radiobacter (Beijerinck & van Delden) Young *et al.*	Present (APPD 2011)
Xanthomonas arboricola pv. *corylina* (Miller *et al*) Vauterin *et al.*	Present (Wimalajeewa and Washington 1980)
FUNGI	
Botrytis cinerea Pers.	Present (Nair *et al.* 1995)
Cylindrocarpon spp.[2]	Present (APPD 2011)
Fusarium oxysporum Schltdl.	Present (APPD 2011)
Pestalotiopsis spp. [3]	Present (APPD 2011)
Phomopsis spp. [4]	Not recorded; however, this species is not considered to be on the import pathway for rooted dormant cuttings.
Phyllactinia guttata (Wallr.) Lév.	Present (Farr and Rossman 2011)
Phytophthora cinnamomi Rands	Present (Podger 1972)
Sclerotinia minor Jagger	Present (Ekins *et al.* 2002)
NEMATODES	
Pratylenchus neglectus (Rensch 1924)	Present (Taylor *et al.* 2000)
Helicotylenchus spp.	
Xiphinema americanum Cobb, 1913	Present (Quader *et al.* 2003)
VIRUSES	
Apple mosaic *ilarvirus* (ApMV) [Bromoviridae]	Present (Snare 2006)
Prune dwarf *ilarvirus* (PDV) [Bromoviridae]	Present (Parbery and Greber 1996)

None of the above pests are of quarantine concern to Australia, as they are either already present in Australia, not on the export pathway, or not of economic significance.

[2] *Cylindrocarpon* species have been recorded on *Corylus* in Chile (SAG 2011); however, they have not been identified up to the species level. Similalrly, *Cylindrocarpon* species are recorded on hazelnut in Australia (Snare 2006).

[3] *Pestalotiopsis* species have been recorded on *Corylus* in Chile (SAG 2011); however, they have not been identified up to the species level. *Pestalotiopsis guepinii* has been recorded on hazelnut in other countries (Farr and Rossman 2011); therefore, it is likely that the species recorded in Chile is *Pestalotiopsis guepinii*.

[4] *Phomopsis* species have been recorded on *Corylus* in Chile (SAG 2011); however, they have not been identified up to the species level. *Phomopsis avellana* has been recorded on hazelnut in other countries (Farr and Rossman 2011); therefore, it is likely that the species recorded in Chile is *Phomopsis avellana*.

In addition to surveillance work, SAG regulates the transfer of plants between regions to ensure that pests in one region are not transferred to other regions where that pest is not present.

SAG conduct regular surveys for potato cyst nematode (PCN) and this nematode has not been detected in the mother tree blocks or nurseries proposed for export to Australia.

1.3 Pests of quarantine concern to Australia and their status in Chile

Plant Biosecurity has taken the opportunity to review the existing policy from all sources to ensure that the current import policy adequately addresses all quarantine risk posed by hazelnut propagative material and that the measures are appropriate to the risk. During this review, Plant Biosecurity has identified arthropod pests and pathogens of quarantine concern and has developed a pathway-specific pest list for dormant rooted hazelnut cuttings. The status of these pests in Chile is provided in Table 1.3.

Based on technical discussions, production site visits to Chile (March 2011), pest risk assessments and other available information, Plant Biosecurity considers that only two pests of quarantine concern to Australia are present in Chile. The conditions proposed in this PRA for the importation of hazelnut propagative material produced in Chile have been designed to manage the risk of these pests entering, establishing and spreading in Australia.

Table 1.3 Quarantine pests of hazelnut propagative material from all sources and their status in Chile

Pest Type	Sources	
	All sources	Chile
ARTHROPODS		
ACARI (mites)		
Cecidophyopsis vermiformis (Nalepa, 1889)	✓	
COLEOPTERA (beetles, weevils)		
Oberea linearis (Linné 1758)	✓	
HEMIPTERA (mealybugs, scales)		
Eulecanium excrescens (Ferris, 1920)	✓	
Phenococcus aceris (Signoret, 1875)	✓	
LEPIDOPTERA (moths, butterflies)		
Gypsonoma dealbana (Frolich, 1828)	✓	
Zeuzera pyrina Linnaeus,1761	✓	
PATHOGENS		
BACTERIA		
Pseudomonas avellanae Janse *et al.*	✓	
Pseudomonas syringae pv. *coryli* Scortichini *et al.*	✓	
FUNGI		
Anisogramma anomala (Peck) E. Müller	✓	
Armillaria mellea (Vahl: Fr) P. Kummar	✓	✓
Armillaria gallica Marxm. & Romagn.	✓	
Armillaria ostoyae (Romagn.) Herink	✓	
Cryptosporiopsis tarraconensis Gené & Guarro	✓	
Fomitiporia mediterranea M. Fischer	✓	
Monilia coryli Schellenb.	✓	
Monilinia fructigena Honey	✓	
Monostichella coryli (Roberge ex Desm.) Höhn.	✓	
Neonectria ditissima (Tul. & C. Tul.) Samuels & Rossman	✓	✓
Phymatotrichopsis omnivora (Duggar) Hennebert	✓	
Pucciniastrum coryli Kom.	✓	
Phytophthora nemorosa E.M. Hansen and Reeser	✓	
Phytophthora ramorum Werres *et al.*	✓	
PHYTOPLASMAS		
‘*Candidatus* Phytoplasma mali’ Seemüller & Schneider	✓	
‘*Candidatus* Phytoplasma prunorum’ Seemüller & Schneider	✓	
‘*Candidatus* Phytoplasma pyri’ Seemüller & Schneider	✓	
Clover Yellow Edge Phytoplasma	✓	
UNKNOWN EITIOLOGY		
Oregon hazelnut stunt syndrome (HSS)	✓	
VIRUSES		
Tulare apple mosaic *ilarvirus* (TAMV) [Bromoviridae]	✓	

2 Chile's commercial production practices for hazelnut

2.1 Production of rooted cuttings

The production of rooted cuttings for domestic or international markets consists of the following two stages.

2.1.1 Production of rooted cuttings from mother plants

Rooted cuttings are produced through mound or stool layering. In this method, mother plants are established in rows and allowed to grow for 2–3 years. Mother plants are treated with fungicides (Benomyl, Captan), insecticides (Imidacloprid, Abamectina [Avermectin], Thiacloprid), antibiotics (streptomycin) and bactericides (copper oxide) to control insect pests and fungal and bacterial pathogens on a regular basis. During this period plants undergo regular surveillance and monitoring by SAG. During the dormant season, 2–3 year old plants are cut back to the ground and shoots develop from the stump during spring. These newly emerging shoots are covered with sawdust or other media to encourage roots. Each stump produces many shoots which grow with vigour and healthy roots are produced throughout the season (Figure 2.1).

Figure 2.1 Suckers with healthy roots

In the next dormant season, healthy shoots are selected and are cut at ground level for removal. These cuttings have only few roots and are washed to remove soil and other particles. SAG regulates the transfer of plants between regions to ensure that pests in one region are not transferred to other regions where that pest is not present. Consequently, if the plant material is derived from other areas within Chile, SAG inspects the material before shipment.

An alternative method of production uses mature mother plant blocks to produce multiple suckers. The mother plants are covered with sawdust to encourage root formation and rooted suckers are removed from the mother tree. After treatment and washing, rooted suckers are propagated directly in the nursery. The verification team observed both methods of production in Chile.

Post-harvest treatment of rooted cuttings

The harvested dormant cuttings are cut to a length of 30 centimetres and are submerged in a solution (Figure 2.2) consisting of disinfectants and hormones (Propamocarb [Propamocarb hydrochloride] and Abamectina [Avermectin]) for a minimum of 20 minutes.

Figure 2.2 Dormant cuttings treatment with disinfectant and growth hormone

2.1.2 Production of rooted cuttings in the nurseries

Dormant cuttings which have undergone post-harvest treatment are dried and planted either in the propagation tunnel or open space growing areas. The nurseries use sprinkler irrigation to maximize quantity and quality of dormant rooted hazelnut cuttings for domestic and international markets. The irrigation water originates from springs or natural water courses. A filtration system is installed at the nurseries. Strict control of pests and pathogens, in addition to stringent monitoring and inspection by SAG and best practice in-crop agronomic husbandry, results in the production of very high quality dormant rooted hazelnut cuttings.

Production in poly propagation tunnels

The tunnels are greenhouse/hot house facilities with polyethylene enclosures, a micro irrigation system, and heat beds. Dormant cuttings are grown in pasteurized growing media in the heated beds. The pasteurized growing media (a mixture of coco fibre and peat) is sourced from a third country and is inspected and certified by SAG as pasteurised before use (SAG analyse the growing media for freedom from nematodes and pathogens). Newly established cuttings in the pasteurized growing medium are grown in the heated beds for one growing season (Figure 2.3).

Figure 2.3 Growth of cuttings in the propagation tunnel

Production in open space

The open space nursery area visited by the verification team covers an area of 3.825 hectares and is irrigated via a sprinkler system. The propagation process for plants grown in pots in open space is identical to that of plants in the poly propagation tunnel. The plant material type, sterilization, fertilization and growing medium are the same. The difference in the process is that the dormant cuttings are planted directly into a 2.5 litre plastic pot containing pasteurised growing media, and grown in the nursery yard instead of the heat beds in the propagation tunnels. The potted dormant cuttings are placed on a poly weed mat; this prevents root penetration from the pots and creates a barrier between the soil and the plant (Figure 2.4).

Figure 2.4 Growth of cuttings in open space

2.1.3 Pest monitoring of plants in nurseries (propagation tunnel and open space)

Pest monitoring is conducted daily by experienced nursery employees by means of observation and microscope examination, if required. Disease analysis and testing is conducted in specialized laboratories, as necessary. SAG maintains constant health control within the nursery. It is a requirement for the nursery to be managed and maintained as an environment that is free of pests and diseases. SAG can, at any time, request laboratory testing of plant material and enforce pest and disease control methods as required. The nursery is managed in accordance with SAG registration rules and standards.

2.1.4 Pest control measures in nurseries (propagation tunnel and open space)

As a precautionary measure, a pest control program is implemented throughout the growing season (September to May) within the nurseries. SAG reserves the right to extend or alter the program where necessary. Plants in the nursery are treated regularly with fungicides (Benomyl, Captan), insecticides (Imidacloprid, Abamectina [Avermectin], Thiacloprid), antibiotics (streptomycin) and bactericide (copper oxide) to control insect pests and fungal and bacterial pathogens. Additional chemical applications may be required and enforced by SAG if required. SAG is in constant supervision of the activities within the nursery. In addition to the chemical program, plants in the nurseries are also treated with three applications of copper based products at 30%, 50%, 80% leaf fall stage.

Pasteurized growing media and appropriate phytosanitary measures in production reduces the risk of pests from entering the pathway. Rooted hazelnut cutting production procedures include:

- **Sourcing cuttings** from designated mother plants (mother plants are monitored by SAG);
- **Disinfection and treatment of cuttings:** the cuttings are washed and treated with disinfectant and growth hormone (this process removes organic and soil particles, and eliminates any insects from cuttings);
- Production of rooted cuttings in a **pasteurised soil-less media** (this process reduces the likelihood of soil-borne insects, nematodes); and
- **Regular monitoring and application of insecticides, fungicides and bactericides** as a standard procedure in the nursery.

2.2 Harvest and preparation for export of rooted cuttings

The cuttings produced in the nurseries are removed when they are dormant. Dormant cuttings are then washed, treated with fungicides, bactericides and insecticides and packaged for export (Figure 2.5). These dormant rooted cuttings are approximately two years old, 30–40 centimetres tall and with a stem diameter of 12–15 millimetres. The cuttings consist of 1–2 secondary branches; and have healthy buds, a strong root system and are without leaves.

Figure 2.5 Rooted dormant cuttings are washed, treated and packed prior to export

2.3 Hazelnut plantations

During the verification team's visit, a number of hazelnut plantations were inspected in the Curico and Temuco regions. Some blocks were identified as mother trees for nursery production; however, the bulk of the plantations were dedicated to hazelnut production.

Figure 2.6 Hazelnut plantations in Chile

Whilst some symptoms of *Xanthomonas* infection were observed on some trees, the occurrence was rare. Overall, the production trees and mother trees appeared to be in very good condition, with little evidence of pest damage. As it was late in the growing season, the verification team expected to see some signs of pest damage; however, there was little in evidence. The team was advised that pest spraying occurred early in the growing season, and that there had not been any pest spraying since Christmas.

3 Pest risk analysis

Plant Biosecurity has conducted this pest risk analysis (PRA) in accordance with the International Standards for Phytosanitary Measures (ISPMs), including ISPM 2: *Framework for pest risk analysis* (FAO 2007) and ISPM 11: *Pest risk analysis for quarantine pests, including analysis of environmental risks and living modified organisms* (FAO 2004). The standards provide a broad rationale for the analysis of the scientific evidence to be taken into consideration when identifying and assessing the risk posed by quarantine pests.

Following ISPM 11, this pest risk analysis process comprises of three discrete stages:

- Stage 1: Initiation of the PRA
- Stage 2: Pest Risk Assessment
- Stage 3: Pest Risk Management

Phytosanitary terms used in this PRA are defined in ISPM 5 (FAO 2009).

3.1 Stage 1: Initiation

The *initiation* of a risk analysis involves identifying the reason for the PRA and the identification of the pest(s) and pathway(s) that should be considered for risk analysis in relation to the identified PRA area.

Plant Biosecurity initiated this review in response to an application to import commercial quantities of hazelnut propagative material from Chile through a defined pathway.

The pests associated with hazelnut in Chile were tabulated from information provided by the NPPO of the exporting country (SAG) and published scientific literature, such as reference books, journals and database searches. This information is set out in Appendix A and forms the basis of the pest categorisation.

In the context of this assessment, hazelnut propagative material (soil-free dormant rooted cuttings) is a potential import 'pathway' by which a pest can enter Australia.

For this PRA, the 'PRA area' is defined as Australia for pests that are absent from Australia or of limited distribution and under official control in Australia.

3.2 Stage 2: Pest Risk Assessment

A Pest Risk Assessment (for quarantine pests) is the 'evaluation of the probability of the introduction and spread of a pest and of the magnitude of the associated potential economic consequences' (FAO 2009, p. 13). The pest risk assessment provides technical justification for identifying quarantine pests and for establishing phytosanitary import requirements.

This is a commodity-initiated pest risk analysis and risk is estimated through a standard set of factors that contribute to introduction, establishment, spread or economic impact potential. Risk assessment evaluates the unrestricted pest risk to determine if the risk is sufficient to justify management. In this PRA, pest risk assessment was conducted using three consecutive steps: pest categorisation; assessment of the probability of entry, establishment and spread; and assessment of potential consequences.

3.2.1 Pest categorisation

Pest categorisation is a process to examine, for each pest identified in Stage 1 (*Initiation of the PRA process*), whether the criteria for a quarantine pest is satisfied. Pest categorisation includes all the main elements of a full pest risk assessment but is done in less detail and is essentially a quick assessment of whether a PRA on a particular pest is required in the context of a pathway PRA. The process of pest categorisation is summarised by ISPM 11 (FAO 2004) as a screening procedure based on the following criteria:

- identity of the pest;
- presence or absence in the endangered area;
- regulatory status;
- potential for establishment and spread in the PRA area; and
- potential for economic consequences (including environmental consequences) in the PRA area.

Pests are categorised according to their association with the pathway, their presence or absence or regulatory status, their potential to establish or spread, and their potential for economic consequences. Pests associated with hazelnut in Chile listed in Appendix A were used to develop a pathway-specific pest list for rooted dormant cuttings. This list identifies the pathway association of pests recorded on hazelnuts and their status in Australia, their potential to establish or spread, and their potential for economic consequences. Pests likely to be associated with propagative material, and absent or under official control in Australia, may be capable of establishment or spread within Australia if suitable ecological and climatic conditions exist.

The quarantine pests of hazelnut rooted dormant cuttings from Chile identified in the pest categorisation are listed in Table 3.1. These pathogens fulfil the IPPC criteria for a quarantine pest, specifically:

- these pests are economically important (as they cause a variety of direct and indirect economic impacts, such as reduced yield, reduced commodity value, loss of foreign or domestic markets); and
- these pests are not present in Australia or have a limited distribution and are under official control.

Table 3.1 Quarantine pests for hazelnut rooted dormant cuttings from Chile

Pathogen	Common name
FUNGI	
Armillaria mellea (Vahl: Fr) P. Kummar	Armillaria root rot
Neonectria ditissima (Tul. & C. Tul.) Samuels & Rossman	Neonectria canker

These pathogens are recorded in Chile (Minter and Peredo Lopez 2006, Gutierrez *et al*. 2005); however, these pathogens have not been detected in hazelnut orchards and production nurseries during regular surveys conducted by SAG.

3.2.2 Assessment of the probability of entry, establishment and spread

Details of how to assess the ‘probability of entry’, ‘probability of establishment’ and ‘probability of spread’ of a pest are given in ISPM 11 (FAO 2004).

In the case of propagative material imports, the concepts of entry, establishment and spread have to be considered differently. Propagative material intended for ongoing propagation purposes is deliberately introduced, distributed and aided to establish and spread. This material will enter and then be maintained in a suitable habitat, potentially in substantial numbers and for an indeterminate period. Significant resources are utilised to ensure the continued welfare of imported propagative material. Therefore, the introduction and establishment of plants from imported propagative material in essence establishes the pests and pathogens associated with the propagative material. Pathogens, in particular, may not need to leave the host to complete their life cycles, further enabling them to establish in the PRA area. Furthermore, propagative material is expected to be shipped at moderate temperatures and humidity which is unlikely to adversely affect any pest that is present during shipment.

Several key factors contribute to the increased ability of pests and pathogens associated with nursery stock to enter, establish and spread in Australia.

Probability of entry

- Association with host commodities provides the opportunity for the pest to enter Australia. Their ability to survive on, or in, nursery stock acts to ensure their viability on route to, and during distribution across, Australia.
- Propagative material is assumed to come from areas where these pests occur and no phytosanitary measures have been applied. The primary conditions for survival of pests are fulfilled by the presence of the live propagative material and the associated environmental conditions. Therefore, association with propagative material can provide long term survival for the pests.
- Infected propagative material is the main pathway for the introduction of the pests into new areas. This mode of introduction is greatly enhanced because of latency periods before conspicuous symptoms develop. Long latency periods can lead to the propagation and distribution of infected propagative material prior to obvious symptoms appearing.
- The pests associated with propagative material may be systemic or are associated with the vascular system (or occur internally in the nursery stock) and they are unlikely to be dislodged during standard harvesting, handling and shipping operations. Therefore, pests associated with propagative material are likely to survive during transport.

Probability of establishment

- Association with the host will facilitate the establishment of pests associated with it, as they are already established with, or within, a suitable host. As host plant material is likely to be maintained in places with similar climates to the area of production, climatic conditions are expected to favour the pest’s establishment.
  - Some pest specific factors are likely to impact upon a pest’s ability to establish in Australia. For example, the likelihood of establishment will vary if an alternative host is required for the pest to complete its life cycle or if multiple individuals are required to form a founder population. Where appropriate these considerations are addressed in the potential for establishment and spread field of the pest categorisation.
- Propagative material intended for ongoing propagation or horticultural purposes is deliberately introduced, distributed and aided to establish. This material will enter and then be maintained in a suitable habitat, potentially in substantial numbers and for an indeterminate period. Therefore, the introduction and establishment of plants from

imported propagative material in essence establishes the pests and pathogens associated with the propagative material.

- The latent period of infection before visible symptoms appear may result in non-detection of these pathogens; therefore, the pathogens will have ample time to establish into new areas.

Probability of spread

- The ability of the pest to be introduced and distributed throughout Australia on nursery stock commodities through human mediated spread is a high risk for continued spread post-border in Australia. Pest related factors which would aid the spread of the pest once it has established in Australia (such as wind, water or mechanical transmission) will increase the pest's ability to spread from an already high baseline.
- In the absence of statutory control there are high probabilities for the pests to spread quickly in Australia by trade of propagative material. Planting of infected propagative material will bring the pests into the environment. Climatic conditions such as those found in propagation houses may be sufficient for pest survival and spread.
- The systemic nature of some of the pests associated with propagative material is a major pathway for dispersal. Accordingly, local and long-distance spread of these pathogens has been associated with the movement of infected propagative material.

As a result of these pathway specific factors, it would be inappropriate to assess the probability of entry, establishment and spread using the processes described in ISPM 11 (FAO 2004). For the purposes of this PRA, the overall likelihood for the probability of entry, establishment and spread is considered to be high for pests entering on hazelnut nursery stock.

3.2.3 Assessment of potential consequences

The purpose of assessment of potential consequences in the pest risk assessment process is to identify and quantify, as much as possible, the potential impacts that could be expected to result from a pest's introduction and spread.

The basic requirements for the assessment of consequences are described in the SPS Agreement, in particular Article 5.3 and Annex A. Further detail on assessing consequences is given in the "potential economic consequences" section of ISPM 11. This ISPM separates the consequences into "direct" and "indirect" and provides examples of factors to consider within each.

The introduction of pests which meet the criteria of a quarantine pest will have unacceptable economic consequences in Australia as these pests will cause a variety of direct and indirect economic impacts. The identified pests (*Armillaria mellea* and *Neonectria ditissima*) are of economic concern and do not occur in Australia. A summary and justification is provided below:

- Direct impacts of the introduction and spread of multi-host pests in Australia will not only affect the imported host but also other hosts. Introduction and establishment of quarantine pests in Australia would not only result in phytosanitary regulations imposed by foreign or domestic trading partners, but also in increased costs of production including pathogen control costs.

- Quarantine pest introduction and establishment would also be likely to result in industry adjustment. The potential economic impact for the nursery trade is high. Without controls these pests have the potential to spread further in the trade network and could potentially expand their host range.

- Economic losses caused by *N. ditissima* are the most severe on apples and pears, although losses to forest trees such as *Acer*, *Fagus* and *Betula* have also been recorded (CABI 2010). The pathogen causes yield losses as a direct consequence of the open cankers and other damage to productive shoots and branches. In areas with suitable conditions *Neonectria ditissima* may cause losses of 10-60% (Swinburne 1964; Swineburn 1975). *Neonectria ditissima* is responsible for fruit rot of apple and can have a very negative effect on Australia's pome fruit industry. This can result from direct losses, as well as market access issues resulting from biosecurity risks posed by the presence of specific pests and diseases.
- Economic losses attributed to *Armillaria mellea* are common on deciduous and coniferous trees and shrubs in natural forest stands, plantations, orchards, and gardens as this fungus is one of the most prominent killers and decayers (Grand 2001). Weakening of infected trees in urban and high-use areas creates safety hazards from windthrow (uprooting), contributing to the economic importance of this pathogen. Additional losses occur from reduced vigour in both conifer and hardwood species (Griffin 2010).

Armillaria mellea and *Neonectria ditissima* are of economic significance and are not present in Australia. Therefore, they meet the IPPC criteria for a quarantine pest and phytosanitary measures are justified to manage these pathogens.

3.3 Stage 3: Pest Risk Management

ISPM 11 (FAO 2004) provides details on the identification and selection of appropriate risk management options. Pest risk management describes the process of identifying and implementing phytosanitary measures to manage risks posed by identified quarantine pests, while ensuring that any negative effects on trade are minimised.

Examples given of measures commonly applied to traded commodities include:

- options for consignments – e.g., inspection or testing for freedom from pests, prohibition of parts of the host, a pre-entry or post-entry quarantine system, specified conditions on preparation of the consignment, specified treatment of the consignment, restrictions on end-use, distribution and periods of entry of the commodity
- options preventing or reducing infestation in the crop – e.g., treatment of the crop, restriction on the composition of a consignment so it is composed of plants belonging to resistant or less susceptible species, harvesting of plants at a certain age or specified time of the year, production in a certification scheme
- options ensuring that the area, place or site of production or crop is free from the pest – e.g., pest-free area, pest-free place of production or pest-free production site
- options for other types of pathways – e.g., consider natural spread, measures for human travellers and their baggage, cleaning or disinfestation of contaminated machinery
- options within the importing country – e.g., surveillance and eradication programs
- prohibition of commodities – if no satisfactory measure can be found.

Pest risk management evaluates and selects risk management options to reduce the risk of entry, establishment or spread of identified pests for the identified import pathways. To effectively prevent the introduction of pests associated with an identified pathway a series of important safeguards, conditions or phytosanitary measures must be in place. Propagative material represents a direct pathway for pests identified by the pest categorisation. This pathway is direct since the end-use is the planting of a known host plant.

3.3.1 Identification and selection of appropriate risk management options

Phytosanitary measures to prevent the establishment and spread of quarantine pests may include any combination of measures including pre- or post-harvest treatments, inspection at various points between production and final distribution, surveillance, official control, documentation, or certification. A measure or combination of measures may be applied at any one or more points along the continuum between the point of origin and the final destination. Pest risk management explores options that can be implemented (i) in the exporting country, (ii) at the point of entry or (iii) within the importing country. The ultimate goal is to protect plants and prevent the introduction of identified quarantine pests.

Examples of phytosanitary measures which may be applied to propagative material consignments include:

- Import from pest free areas only (ISPM 4)—the establishment and use of a pest free area by an NPPO provides for the export of plants from exporting country to importing country without the need for application of additional phytosanitary measures when certain requirements are met.
- Inspections or testing for freedom from regulated pests—this is a practical measure for visible pests or for pests which produce visible symptoms on plants.
- Inspection and certification—the exporting country may be asked to inspect the shipment and certify that the shipment is free from regulated pests before export.
- Specified conditions for preparation of the consignment—the importing country may specify steps which must be followed in order to prepare the consignment for shipment. These conditions can include plants required to have been produced from appropriately tested parent material.
- Pre-entry or post-entry quarantine—the importing country may define certain control conditions, inspection and possible treatment of shipments upon their entry into the country. Often this involves isolating the shipments from other material capable of harbouring regulated pests until such time that it can be determined that the imported material is free from such pests.
- Removal of the pest from the consignment by treatment or other methods—the importing country may specify chemical or physical treatments which must be applied to the consignment before it may be imported.

Measures can range from total prohibition to permitting import subject to visual inspection. In some cases more than one phytosanitary measure may be required in order to reduce the pest risk to an acceptable level.

Phytosanitary measures implemented in the exporting country

Sourcing propagative material from pest free areas (country freedom)

Area freedom is a measure that might be applied to manage the risk posed by the identified pests in propagative material. The requirements for establishing pest free areas are set out in ISPM 4: *Establishment of pest free areas* (FAO 1995). ISPM 4 (FAO 1995, p. 37) identifies a pest free area as being 'an area in which a specific pest does not occur as demonstrated by scientific evidence and in which, where appropriate, this condition is being officially maintained'.

The establishment and use of a pest free area (PFA) by an NPPO provides for the export of plants and other regulated articles from the exporting country to the importing country without the need for application of additional phytosanitary measures when certain requirements are met. Thus, the pest free status of an area may be used as the basis for the phytosanitary certification of plants and other regulated articles with respect to the stated pest(s). The exporting country may also inspect the crop to confirm freedom from the pest and provide that certification. The requirements for the establishment, and subsequent maintenance, of a PFA include:

- systems to establish freedom (general surveillance, specific survey);
- phytosanitary measures to maintain freedom (regulatory actions, routine monitoring, extension advice to producers); and
- checks to verify freedom has been maintained.

Sourcing propagative material under systems approach

ISPM 14: *The use of integrated measures in a systems approach for pest risk management* provides guidelines on the use of systems approaches to manage pest risk. According to ISPM 14 (FAO 2002, p. 165), 'a systems approach requires the integration of different measures, at least two of which act independently, with a cumulative effect.'

Systems approaches, which integrate measures for pest risk management in a defined manner, could provide an alternative to single measures to meet the appropriate level of phytosanitary protection of an importing country. They can also be developed to provide phytosanitary protection in situations where no single measure is available. A systems approach requires the integration of different measures, at least two of which act independently, with a cumulative effect. Systems approaches range in complexity. Exporting and importing countries may consult and cooperate in the development and implementation of a systems approach. The decision regarding the acceptability of a systems approach lies with the importing country, subject to consideration of technical justification, minimal impact, transparency, non-discrimination, equivalence, and operational feasibility.

Sourcing propagative material from pest free place of production

Pest free place of production is a measure that might be applied to manage the risk posed by the identified pests in propagative material. The requirements for establishing pest free places of production are set out in ISPM 10: *Requirements for the establishment of pest free places of production and pest free production sites* (FAO 1999).

This standard uses the concept of "pest freedom" to allow exporting countries to provide assurance to importing countries that plants, plant products and other regulated articles are free from a specific pest or pests and meet the phytosanitary requirements of the importing country when imported from a pest free place of production. In circumstances where a defined portion of a place of production is managed as a separate unit and can be maintained pest free, it may be regarded as a pest free production site.

Requirements for the establishment and maintenance of a pest free place of production or a pest free production site as a phytosanitary measure by the NPPO include:

- systems to establish pest freedom

- systems to maintain pest freedom
- verification that pest freedom has been attained or maintained
- product identity, consignment integrity and phytosanitary security.

Where necessary, a pest free place of production or a pest free production site also includes the establishment and maintenance of an appropriate buffer zone.

Administrative activities required to support a pest free place of production or pest free production site involve documentation of the system and the maintenance of adequate records concerning the measures taken. Review and audit procedures undertaken by the NPPO are essential to support assurance of pest freedom and for system appraisal. Bilateral agreements or arrangements may also be needed.

Testing: Freedom based on field inspection and testing—the importing country may request testing to verify freedom from pests of quarantine concern. For example, visual inspections during growing season and PCR or an ELISA-based test for latent or low level of infection of propagative material can be used to verify pest freedom.

Treatment: Removal of the pest from the consignment by treatment or other methods—the importing country may specify chemical or physical treatments which must be applied to the consignment before it may be imported. For example, chemical treatments such as insecticides, fungicides and herbicides may be effective in eliminating specified quarantine pests from the consignment.

Certification: The importing country may specify that production of the commodity be undertaken under an officially monitored certification scheme to ensure stock is free from pests.

Phytosanitary measures implemented in the importing country

On-arrival inspection

On-arrival inspection is conducted by the NPPO for freedom from regulated articles and compliance with the import and certification requirements. The purpose of the inspection is to ensure that import requirements for freedom from the pest in question have been met and to detect new pests which may not have been categorised for their pest risk.

Post entry quarantine

In cases where plant material is imported without any certification, the NPPO may allow imports of the propagative material through growth in post entry quarantine facilities for visual and active disease screening.

Phytosanitary certification

Pest risk management includes the consideration of appropriate compliance procedures. The most important of these is export certification (refer to ISPM 7: *Export certification system*). The issuance of Phytosanitary Certificates (refer to ISPM 12: *Guidelines for phytosanitary certificates*) provides official assurance that a consignment meets specified import requirements and confirms that pest risk management options have been followed.

ISPM 12 states that importing countries should only require Phytosanitary Certificates for regulated articles including plants, bulbs and tubers, or seeds for propagation.

4 Risk management measures for hazelnut rooted dormant cuttings from Chile

To effectively prevent the introduction of pests associated with nursery stock, a series of important safeguards, conditions, or phytosanitary measures must be in place. Hazelnut is currently categorised as high risk nursery stock because of its potential to introduce *Anisogramma anomala* and *Phytophthora ramorum* and other pathogens into Australia. Based on technical discussions, production site visits to Chile (March 2011), pest risk assessments and other available information, Plant Biosecurity considers that Chile is free of these two pathogens.

The risk analysis has concluded that the following diseases, *Armillaria mellea* and *Neonectria ditissima,* are present in Chile but have not been recorded on hazelnut during SAG surveys of hazelnut orchards and propagation nurseries. Therefore, the importation of hazelnut nursery stock from Chile represents a relatively low risk of introduction of these pathogens. Nevertheless, it is recommended that suitable risk management measures be applied to manage the risk of introduction of these pathogens.

4.1 Existing risk management measures for rooted dormant cuttings from all sources

Australia has well established policy to import hazelnut rooted dormant cuttings grown in soil-less media from all countries (excluding *Phytophthora ramorum* host countries) which is based on on-shore risk management (phytosanitary measures implemented in the importing country). That is, on-arrival inspection, mandatory treatment and growth in closed government PEQ facilities with pathogen screening. Imported *Corylus* species rooted dormant cuttings grown in soil-less media are subject to specific quarantine/biosecurity measures. These conditions are available on the AQIS Import CONditions database (ICON) at http://www.aqis.gov.au/icon.

Australia's existing policy for rooted dormant cuttings grown in soil-less media from all sources (excluding *Phytophthora ramorum* and *Phytophthora* species complex host countries: Canada, European community, New Zealand, the USA) includes:

- soil-free dormant rooted cuttings only to be imported;
- mandatory on-arrival inspection;
- mandatory methyl-bromide fumigation; and
- mandatory growth in closed government PEQ facilities with pathogen screening.

4.2 Proposed risk management measures for rooted dormant cuttings from Chile

Plant Biosecurity proposes a systems approach for managing the risk of imported hazelnut nursery stock, taking into account:

- Chile's low pest status;
- high health production systems for the rooted dormant cuttings to be exported;
- regular pest monitoring of nurseries and plantations by SAG;
- pre-export treatment of rooted dormant cuttings with an appropriate insecticide/fungicide preparation;

- phytosanitary inspection and certification by SAG;
- off-shore verification inspection by AQIS; and
- mandatory growth in an open post-entry quarantine facility in Australia.

4.2.1 Low pest status

Out of 28 pathway-specific pests identified during the review of hazelnut propagative material, only two pathogens (*Armillaria mellea* and *Neonectria ditissima*) are present in Chile. Therefore, hazelnut propagative material from Chile is produced in an environment with low pest status (i.e. only a low number of quarantine pests are potentially present during production) and hence, has an inherently low risk.

4.2.2 Sourcing dormant cuttings from pest free mother stock

Hazelnut rooted cuttings will be sourced from mother stock which are free of disease symptoms, as identified by SAG inspectors. The prior inspection of mother stock ensures that relatively pest-free sources of plant material enter production nurseries. Hazelnut mother plants are routinely checked by SAG inspectors for freedom from disease symptoms and only disease free plants are grown further.

Plant Biosecurity has identified *Armillaria mellea* and *Neonectria ditissima* as pests of quarantine concern potentially associated with hazelnut in Chile. These pathogens are recorded in Chile (Minter and Peredo Lopez 2006, Gutierrez *et al*. 2005); however, these pathogens have not been detected in hazelnut orchards and production nurseries during regular surveys conducted by SAG. These pathogens cause root rot and canker respectively, that would be easily detected during inspection of mother plants; however, recently infected plants are unlikely to be detected immediately (Agrios 1997) with symptoms becoming visible during active growth.

As mother plants are inspected by SAG inspectors for pest freedom it is highly unlikely that these pests will be associated with dormant cuttings.

4.2.3 Disinfestation and growth of dormant cuttings in pasteurized media

The dormant cuttings will be washed and treated with disinfectant. This process will remove organic and soil particles, and will eliminate any external pests from the cuttings. The disinfected dormant rooted cuttings for export to Australia will be grown in pasteurized soil-less media (a mixture of coco fibre and peat). The use of soil-free growing media eliminates an initial source for pests.

4.2.4 Growth in nurseries (propagation tunnels and open space) registered with SAG

Ensuring production of pest free dormant cuttings requires the implementation of best practice hygiene and plant production systems.

The dormant rooted cuttings for export to Australia will be grown solely in nurseries registered with SAG in which sanitary procedures are adequate to maintain the high health of the cuttings. Sanitary procedures include cleaning and disinfection of tools and the application of measures to protect propagative material against any injurious diseases, insects or other plant pests.

Fungal pathogens are generally introduced into the propagation houses via infected plant material or soil. The use of high health propagation material, as established by the required inspection of mother plants by SAG, is a primary measure to prevent the introduction of fungal pathogens into the production houses.

Dormant rooted cuttings for export to Australia have been grown for at least one season (one year) in SAG registered nurseries. This will allow time for plant pests and diseases to develop and become visible and detectable. The growth for one year is necessary to allow ample time for the expression of disease symptoms, and other signs of pests.

4.2.5 Regular monitoring by SAG

Plants established from dormant cuttings sourced from disease free mother plants and grown in SAG registered nurseries are monitored by SAG inspectors. This monitoring includes inspection of nurseries and the plants growing within the nurseries.

4.2.6 Pest control in the production nurseries

Plants established from dormant cuttings sourced from disease free mother plants and grown in SAG registered nurseries are subject to the routine control of pests throughout the growing season within the nurseries. This pest control program allows the control of insects or pathogens during growth in the nurseries and the production of high health rooted hazelnut cuttings.

4.2.7 Treatment

In addition to the routine control of pests in the production nurseries, the dormant cuttings will be treated with a solution of insecticide and fungicide to ensure any pests that escape detection during SAG inspections or accidental contaminants, are controlled. The dormant cuttings for export to Australia will have an insecticidal and fungicidal treatment no longer than seven days prior to export under SAG supervision. The dormant cuttings will be immersed or drenched in a solution of broad spectrum insecticide and fungicide prior to export to Australia.

4.2.8 Inspection

Inspections are an integral phytosanitary measure to verify appropriate risk management measures have been successful in managing pest risks. The dormant cuttings for export to Australia will be inspected by SAG officers immediately prior to export and certified as meeting Australia's import requirements. The dormant cuttings will be inspected in SAG approved quarantine houses for evidence of arthropod pests and diseases.

The overall systems approach operates with tiered safeguards so that, if one mitigating measure fails, other safeguards exist to ensure that the risk is progressively reduced and managed.

4.2.9 Off-shore verification inspection (commercial consignments)

AQIS officers will observe the application of the treatment and the phytosanitary inspection by SAG officers in Chile for commercial consignments. Following the application of the treatment and SAG inspection, the consignment will be inspected by AQIS officers and a plant pathologist familiar with the diseases of hazelnuts. This inspection will replace the inspection conducted by AQIS on–arrival in Australia. Only rooted cuttings which have been inspected in Chile and found free of quarantine pest symptoms will be eligible for export to Australia. Non-commercial consignments are exempted from off-shore verification inspection.

For non-commercial consignments, the pre-export treatment will still apply and be certified by SAG. The consignment will be inspected on-arrival in Australia by AQIS. Should any live quarantine pests or disease symptoms be found during on-arrival inspection, AQIS will take remedial action, including

- methyl-bromide fumigation where arthropod pests are detected,
- transfer of the consignment to a government quarantine facility (rather than open quarantine) with disease screening, where suspected quarantine diseases are detected.

4.2.10 AQIS audit and verification

The phytosanitary system for hazelnut dormant rooted cuttings export production, certification of export facilities and mother orchards, pre-export inspection and certification is subject to audit by AQIS. Audits may be conducted at the discretion of AQIS, and with the agreement of SAG, during the entire production cycle.

AQIS production facility and mother orchard audits will measure compliance with production house registration and identification, pest/disease management including maintenance of a spray diary/monitoring and record management.

4.2.11 Growth in open quarantine facilities

Following arrival in Australia, the rooted cuttings will be required to undergo a period of 12 months post–entry quarantine with pest and disease screening in an AQIS approved open quarantine facility, with suitable security arrangements in place.

Open quarantine has been recommended, based on the assessment of the potential for identified diseases of quarantine concern to Australia to be present on this defined pathway, and in consideration of the systems approach implemented in Chile prior to export.

During the quarantine period, it is recommended that regular monitoring of the imported plants be undertaken by a plant pathologist familiar with the diseases of hazelnut and an AQIS officer. Inspections must occur throughout the growing season. Any suspect disease symptoms must be investigated prior to the release of the consignment. Any plants found to be infected with a quarantinable disease must not be released from quarantine and remedial action must be taken.

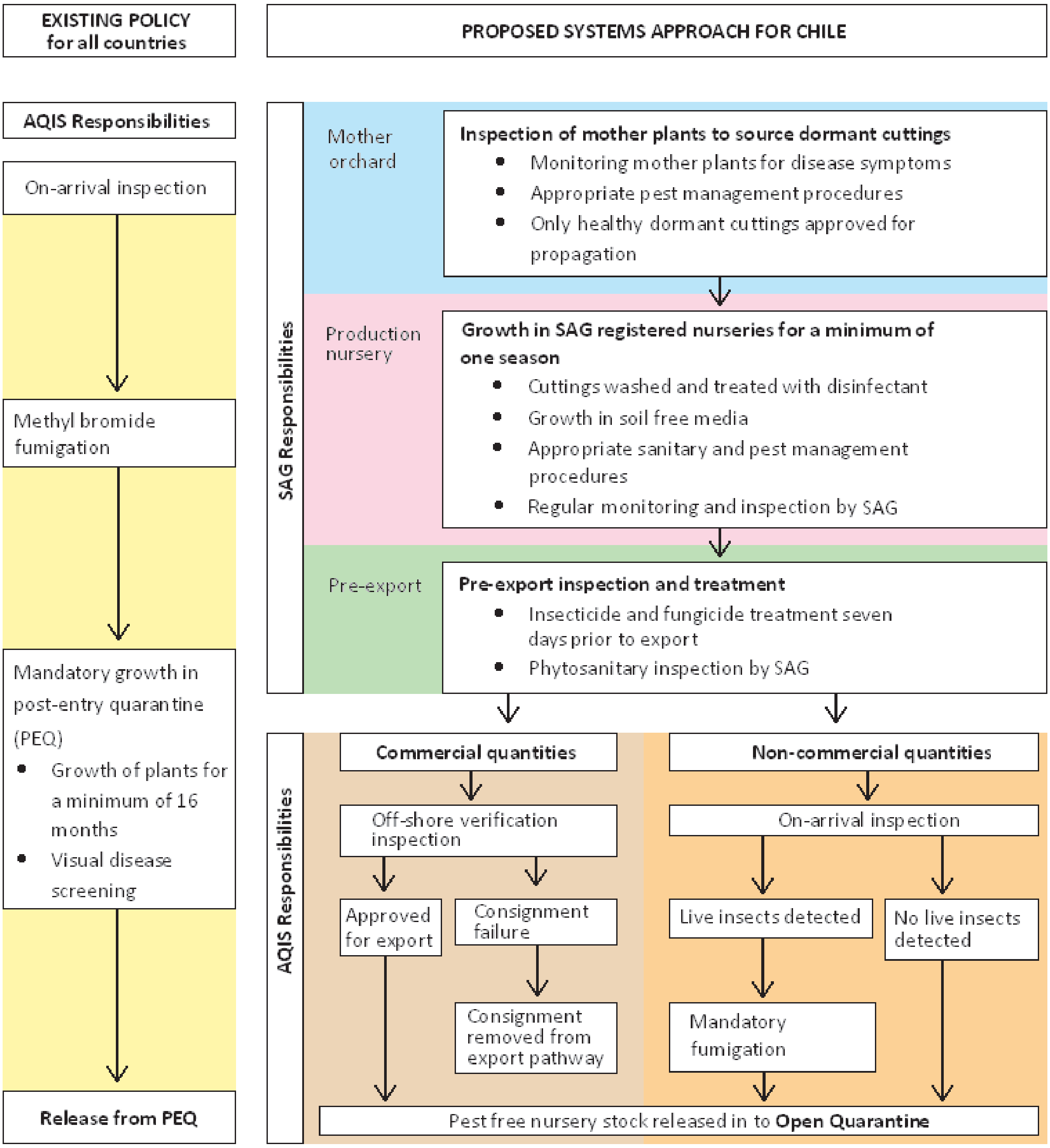
4.3 Evaluation of proposed systems approach for hazelnut rooted dormant cuttings from Chile

The evaluation of proposed alternative measures is based on the principles and terminology of the ISPM 14: *The use of integrated measures in a systems approach for pest risk management* (FAO 2002) and ISPM 24: *Guidelines for the determination and recognition of equivalence of phytosanitary measures* (FAO 2005) by the IPPC.

The PRA conducted on hazelnut rooted dormant cuttings produced in Chile identified *Armillaria mellea* and *Neonectria ditissima* as pests of quarantine concern. The proposed risk management program is a systems approach. Systems approaches are employed as an alternative to the use of a single measure that achieves an appropriate level of phytosanitary protection. The combinations of specific mitigation measures that provide overlapping or sequential safeguards are distinctly different from single mitigation methodologies such as fumigation or inspection. Systems approaches vary in complexity. However, they all require the integration of different pest risk management measures, at least two of which act independently, and their cumulative effect achieves the appropriate level of protection. Systems approaches are often tailored to specific commodity-pest-origin combinations.

To compare the current import conditions (from all sources) and those measures proposed for importation of dormant rooted cuttings from Chile, a comparison diagram is presented in Figure 4.1.

Figure 4.1 Comparison of current risk management measures for hazelnut propagative material (from all sources) with the proposed systems approach for Chile



The existing Australian policy to import hazelnut nursery stock from all sources requires multiple phytosanitary measures designed principally to manage the risk of introducing arthropod pests and the diseases *Anisogramma anomala* and *Phytophthora ramorum* into Australia. Chile is free of *Anisogramma anomala* and *Phytophthora ramorum* for which Australia currently requires mandatory growth in a government PEQ facility. Freedom from these pathogens is maintained through regulation and on-going surveillance.

In addition, the risk analysis has not identified any significant arthropod pests of quarantine concern to Australia on the import pathway. Hence the application of a mandatory methyl-bromide fumigation does not appear to be justified. The systems approach including regular chemical applications to the rooted cuttings whilst in the nurseries and the insecticidal dip immediately prior to export will manage the risk of any hitchhiker pests.

Hazelnut propagative material produced under the proposed systems approach in Chile would reduce the risk of entry, establishment or spread of quarantine pests to an acceptable level, and have the added advantage of managing the quarantine risk off-shore, rather than in Australia.

4.3 Operational system for the maintenance and verification of phytosanitary status

It is necessary to have a system of operational procedures in place to ensure that the phytosanitary status of hazelnut rooted dormant cuttings from Chile is maintained and verified during the export process to Australia.

4.3.1 Registration of export nurseries and mother orchards

Hazelnut rooted dormant cuttings for export to Australia must be sourced from nurseries and mother orchards registered with SAG. Copies of the registration records must be made available to DAFF, if requested.

All registered nurseries are expected to produce hazelnut rooted dormant cuttings under standard commercial cultivation, harvesting and packing activities; for example, in-field hygiene and management of pests (e.g. orchard control program) and cleaning and hygiene during packing.

4.3.2 Pest control program

Mother plant orchards and registered nurseries will have a pest control program approved by SAG. SAG will be responsible for ensuring registered mother plants and propagation nurseries are subject to sanitation and control measures against pests of quarantine concern to Australia. Registered mother plant orchards and nurseries must keep records of control measures for auditing purposes. If required, the details of the pest control program will need to be submitted to DAFF, through SAG.

The mother orchards and registered nurseries pest control program will include:

- Maintenance of the existing orchard disease survey program by SAG prior to harvest of dormant cuttings (for further propagation) to verify the effectiveness of orchard pest control measures and freedom from pests of quarantine concern.
- SAG to regularly inspect plants in nurseries for export to identify any pests of quarantine concern to Australia and ensure remedial action is undertaken should any of these pests be detected.

- SAG mother plant orchard and propagative nursery inspection records are to be available for review by DAFF, if requested.

4.3.3 Registration of packing houses, treatment facilities and auditing of procedures

DAFF requires that all packing houses and treatment facilities must:

- be registered by SAG;
- have systems in place to ensure traceability of dormant rooted hazelnut cuttings to the SAG registered production nurseries (where packing houses are separate from treatment facilities, traceability to the production nursery must be continuous via the respective treatment facility);
- be designed to prevent the entry of pests into areas where unpacked treated dormant rooted hazelnut cuttings are held;
- ensure all areas of the facility are hygienically maintained;
- maintain complete isolation of treated propagative material from untreated propagative material; and
- maintain records of treatments for all lots of rooted dormant cuttings for SAG auditing and DAFF monitoring purposes.

The objectives of these recommended procedures are to ensure that:

- hazelnut rooted dormant cuttings are processed and packaged at SAG registered packing houses, processing export quality hazelnut propagative material; and
- reference to the registered packinghouse and the source production house, by name or a number code, are clearly stated on packaging destined for export of hazelnut rooted dormant cuttings to Australia for trace back and auditing purposes.

4.3.4 Packaging and labelling

The objectives of this recommended procedure are to ensure that:

- hazelnut rooted dormant cuttings proposed for export to Australia are not contaminated by quarantine pests or regulated articles (e.g. trash, soil and weed seeds);
- unprocessed packing material (which may vector pests not identified as being on the pathway) is not imported with hazelnut rooted dormant cuttings;
- all wood material used in packaging of the commodity complies with AQIS conditions (see AQIS publication ‘Cargo Containers: Quarantine aspects and procedures);
- secure packaging is used if consignments are not transported in sealed containers directly to Australia; and
- the packaged hazelnut rooted dormant cuttings are labelled with the production facility identification number for the purposes of trace back to registered production facilities.

4.3.5 Pre-export insecticidal dipping requirements

It is mandatory that pre-export insecticidal dipping of hazelnut rooted dormant cuttings takes place no more than seven days prior to export under SAG supervision. This process can only be undertaken in facilities that have been registered with SAG for this purpose.

The purpose of this recommended procedure is to ensure that hazelnut rooted dormant cuttings exported to Australia are free of quarantine pests or accidental contaminants. The dormant rooted cuttings will be immersed or drenched in a solution of broad spectrum insecticide and fungicide prior to export to Australia.

4.3.6 Pre-export phytosanitary inspection and certification by SAG

SAG will issue an International Phytosanitary Certificate (IPC) for each consignment after completion of the pre-export treatments and pre-export phytosanitary inspection. The objective of this proposed procedure is:

- to provide formal documentation to DAFF verifying that the relevant measures have been undertaken offshore.

Each IPC is to contain the following information that is consistent with ISPM 7: *Export certification systems* (FAO 1997).

Description of consignment

The pack house registration number/treatment facility registration number, propagative nursery registration number, number of boxes per consignment weight, and container and seal numbers (as appropriate, for sea freight only).

Additional declarations

"*The hazelnut rooted dormant cuttings in this consignment have been produced in Chile in accordance with the conditions governing entry of hazelnut rooted dormant cuttings to Australia and inspected and found free of quarantine pests*"

Treatments

Details of disinfestation treatments, including date of treatment, dose rate and treatment facility number.

4.3.7 Monitoring by DAFF in Chile

DAFF officers will observe the application of the treatments and the phytosanitary inspection by SAG officers in Chile prior to export and at other times, as necessary.

4.3.8 On-arrival clearance for consignments subjected to off-shore verification inspection by AQIS

The objectives of this proposed procedure are to ensure that:

- the required off-shore verification inspection arrangement has been undertaken.

Hazelnut rooted dormant cuttings cleared under off-shore verification inspection in Chile would only undergo on-arrival verification in Australia. AQIS would examine documents for compliance and verification that the consignments received were those subjected to off-shore verification inspection, and that the integrity of the consignments had been maintained, prior to their movement to the post-entry quarantine premises. AQIS may open the consignments to verify the contents but will not carry out on-arrival quarantine inspection of the consignment. However, Australia maintains the right to select consignments for random quarantine inspection.

Any consignment with incomplete documentation or certification that does not conform to specifications, can be held pending clarification by SAG and determination by AQIS.

4.3.9 On-arrival quarantine inspection for consignments not subjected to off-shore verification inspection by AQIS

AQIS will undertake a documentation compliance examination for consignment verification purposes, followed by on-arrival inspection. The following conditions will apply:

- The shipment must have a Phytosanitary Certificate that identifies registered treatment facilities, registered packing houses and bears the required additional declaration.
- Any shipment with incomplete documentation or certification that does not conform to the import conditions may be refused entry, or be subject to additional quarantine measures, consistent with the quarantine risk. AQIS would notify SAG immediately of any such proposed action, and request them to investigate the incident.

4.3.10 Remedial action(s) for non-compliance detected on-arrival in Australia

Where inspection lots are found to be non-compliant with requirements on-arrival in Australia, remedial action must be taken. The remedial actions for consignments (subject to on-arrival inspection) where quarantine pests are detected will depend on the type of pest and the mitigation measure that the risk assessment has determined for that specific pest. Remedial actions could include:

- re-export of the consignment; or
- destruction of the consignment; or
- treatment of the consignment and re-inspection to ensure that the pest risk has been addressed.

Separate to the corrective measures mentioned above, other remedial actions may be necessary depending on the specific pest intercepted and the risk management strategy put in place against that pest in the protocol. In the event that an uncategorised pest is detected, SAG will be asked to investigate the association of that pest with the commodity.

DAFF reserves the right to suspend the export program and conduct an audit of the risk management systems in Chile. The program will recommence only after DAFF (in consultation with the relevant state departments, if required) is satisfied that appropriate corrective action has been taken.

4.4 Review of policy

Australia reserves the right to review and amend the import policy if circumstances change. SAG must inform DAFF immediately on detection of any new pests of hazelnuts that are of potential quarantine concern to Australia. For example, *Cecidophyopsis vermiformis*, *Eulecanium excrescens*, *Gypsonoma dealbana*, *Oberea linearis*, *Phenococcus aceris, Zeuzera pyrina*, *Armillaria gallica*, *Armillaria ostoyae*, '*Candidatus* Phytoplasma mali', '*Candidatus* Phytoplasma prunorum', '*Candidatus* Phytoplasma pyri', Clover Yellow Edge Phytoplasma, *Cryptosporiopsis tarraconensis*, *Fomitiporia mediterranea*, *Monilia coryli*, *Monilinia fructigena*, *Monostichella coryli*, Oregon hazelnut stunt syndrome, *Phymatotrichopsis omnivora*, *Phytophthora nemorosa*, *Pseudomonas avellanae*, *Pseudomonas syringae* pv. *coryli*, *Pucciniastrum coryli* and Tulare apple mosaic virus are currently absent from Chile. Should any of these pests be detected in Chile, SAG must immediately advise DAFF of the changed pest status.

4.5 Uncategorised pests

If an organism is detected on hazelnut propagative material prior to export or on-arrival in Australia that has not been categorised, it will require assessment by DAFF to determine its quarantine status and if phytosanitary action is required. The detection of any pests of quarantine concern not already identified in the analysis may result in remedial action and/or temporary suspension of trade while a review is conducted to ensure that existing measures continue to provide the appropriate level of protection for Australia.

5 Proposed risk management measures for hazelnut propagative material from all sources (excluding Chile)

Although this PRA deals primarily with the proposed importation of hazelnut rooted cuttings from Chile, Plant Biosecurity has taken the opportunity to review the general import conditions for hazelnut propagative material from all other sources. As specific pathway analyses have not been undertaken from countries other than Chile, the policy is general in nature and designed to provide a suitable level of protection to Australia for a range of pests of quarantine concern.

Australia's existing policy to import hazelnut propagative material (seed, rooted dormant cuttings and tissue culture) is based on on-shore risk management (phytosanitary measures implemented in the importing country). That is, on-arrival inspection, mandatory treatment and growth in closed government PEQ facilities with pathogen screening. Hazelnut propagative material can currently be imported into Australia as seed, tissue culture or dormant rooted cuttings grown in soil-less media. All imported hazelnut nursery stock consignments are subject to the quarantine/biosecurity measures set out in Condition C 15284, Condition C 8733 and C 7100 (for seed for sowing); C 15278, C 9597, and C 7330 (for tissue culture) and C 9377 and C 7330 (for soil-free rooted dormant cuttings). Plant Biosecurity has evaluated the existing policy for hazelnut propagative material (seed, rooted dormant cuttings and tissue culture) from all sources other than Chile and proposed additional measures, where required.

5.1 Proposed risk management measures for hazelnut propagative material from all sources

5.1.1 Hazelnut seed for sowing

Australia's existing policy on hazelnut seed includes:

- on-arrival inspection to verify freedom from regulated articles including soil, disease symptoms and other extraneous contamination of quarantine concern; and
- mandatory fumigation with either methyl-bromide (T 9072) or phosphine (T 9086).

Mandatory on arrival inspection

Imported hazelnut seed is subjected to on-arrival AQIS inspection to verify freedom from disease symptoms, live insects, soil and other extraneous contaminants of quarantine concern. Pest species may be hidden in soil (soil-borne fungal pathogens like Texas root rot, *Phymatotrichopsis omnivora*) and would be difficult to detect. Texas root rot is a soil-borne pathogen; importing seed without soil will reduce the risk of Texas root rot entering Australia. Therefore, the existing requirement of freedom from soil is supported. The mandatory requirement of seed that is free from soil will be effective against Texas root rot.

Sole reliance on on-arrival visual inspection to detect pests is inefficient for internal feeders. Seeds infected with pests, such as *Curculio neocorylus, C. nucum, C. occidentalis*, *C. uniformis* and *Cydia latiferreana,* may not display obvious signs of infestation. For this reason, visual inspection is not considered an appropriate measure to mitigate the risk posed by internal feeders. Therefore, additional measures are required to mitigate the risk posed by internal feeders of hazelnut seed.

Mandatory on-arrival fumigation

Imported hazelnut seed are subjected to mandatory fumigation with either methyl-bromide (T 9072) or phosphine (T 9086) to mitigate the risk posed by internal feeders such as *Curculio neocorylus, C. nucum, C. occidentalis*, *C. uniformis* and *Cydia latiferreana*. Therefore, existing on-arrival mandatory fumigation is supported.

5.1.2 Hazelnut rooted dormant cuttings

Australia's existing policy to import hazelnut rooted dormant cuttings includes: soil-free dormant rooted cuttings, growth in soil-less media, mandatory on-arrival inspection, mandatory methyl-bromide fumigation and mandatory growth in closed government PEQ facilities with pathogen screening. Plant Biosecurity has evaluated this existing policy and proposed additional measures where required.

During the review of biosecurity risks associated with hazelnut propagative material from all sources, additional **pests** were identified (Appendix D).

Mandatory on-arrival AQIS inspection and fumigation

All imported soil-free dormant cuttings require mandatory on-arrival visual inspection to verify freedom from live insects. Overwintering nymphs of some species, such as *Eulecanium excrescens* and *Phenococcus aceris* (AliNiazee 1980; Olsen and Bell 2009; Gantner *et al*. 2004; Tuncer *et al*. 2001), may be detected during on-arrival inspection. However, species such as *Cecidophyopsis vermiformis* overwinter in buds and complete their life cycles in buds (Özman and Toros 1997); *Oberea linearis* lay eggs under the bark of one to three year old shoots (Bahar and Demirbag 2007); *Gypsonoma dealbana* larvae overwinter in buds (Tuncer and Ecevit 1997) and the larvae of *Zeuzera pyrina* overwinter in twigs and branches (Tonini *et al.* 1986). These life history traits make these insect pests particularly difficult to detect using visual inspection. Similarly, latent infection caused by pathogens may not show clear visual symptoms of infection (particularly propagative material sourced from recently infected plants) and therefore, would not be detected during on-arrival visual inspection.

Sole reliance on on-arrival visual inspection to detect pests is ineffective for managing quarantine risk. For this reason, visual inspection is not considered an appropriate measure to mitigate the risk posed by these pests on hazelnut rooted dormant cuttings. Therefore, additional risk management measures are required for these pests.

Mandatory on-arrival fumigation of rooted dormant cuttings from all sources is supported. Treatments for hazelnut rooted dormant cuttings other than methyl-bromide fumigation will be considered on a case by case basis by Plant Biosecurity if proposed by an exporting country. Prior to the acceptance of an alternative fumigant for cuttings Plant Biosecurity would need to assess the efficacy of that fumigant to ensure it gives an equal level of protection to methyl-bromide for all pests likely to be associated with the commodity.

Mandatory growth in closed government PEQ facilities with pathogen screening

Mandatory growth of imported hazelnut rooted dormant cuttings in closed government PEQ facilities is applied to screen for pathogen freedom. Growing imported rooted dormant cuttings in closed government PEQ facilities for a minimum 16 month period of observation, and until the required pathogen screening/testing is completed can increase the likelihood that pathogens will be detected. Therefore, the existing requirement of mandatory on-arrival growth in PEQ and pathogen screening is supported.

Pathogen screening

Although visual assessment is an important method for screening pathogens, hazelnut rooted dormant cuttings may be infected and not produce any obvious disease symptoms due to cultivar susceptibility, environmental conditions or other plant related factors. Therefore, in addition to the observation for symptoms, Plant Biosecurity proposes isolation on media, active testing using PCR for identified pathogens and a generic nested primer PCR for identified phytoplasmas.

Bacterial pathogens

The pathway-specific bacterial pathogens for hazelnut rooted dormant cuttings of quarantine concern to Australia include *Pseudomonas avellanae* and *Pseudomonas syringae* pv *coryli*.

- **Bacterial isolation on media:** Isolation of bacterial pathogens on agar medium containing medium B of King *et al*. (1954), if *Pseudomonas* species are detected during growth in the PEQ.
- **PCR:** It is recommended that repetitive sequence-based PCR be used to identify the bacterial pathogen (Scortichini *et al.* 2005; Scortichini and Loreti 2007).

Fungal pathogens

The pathway-specific fungal pathogens for hazelnut propagative material of quarantine concern to Australia include: *Anisogramma anomala*, *Armillaria mellea*, *Armillaria gallica*, *Armillaria ostoyae*, *Cryptosporiopsis tarraconensis*; *Fomitiporia mediterranea*, *Monilia coryli*, *Monilinia fructigena*, *Monostichella coryli*, *Neonectria ditissima*, *Phytophthora nemorosa, Phytophthora ramorum* and *Pucciniastrum coryli*.

- **Fungal isolation on media:** Isolation of identified fungi (except for *Pucciniastrum coryli*) from suspected plants will be conducted on an optimum culture media. Aseptic techniques are proposed to be used throughout the test procedure. Suspected infected material will be surface sterilized (1% sodium hypochlorite) and rinsed in sterile water three times. Small sections of tissue should be cut out from the margin between the healthy and infected area, using a sterile scalpel, and placed onto the culture medium.
- **Biochemical tests** should be used to confirm the species of the pathogens in question.
    - PCR for *Anisogramma anomala* (De Silva *et al*. 2009).
    - PCR for *Fomitiporia mediterranea* (Pilotti *et al*. 2010).
    - PCR for *Monilinia* species (Hughes *et al*. 2000).
    - PCR for *Neonectria ditissima* (Langrell 2002).
- Conditions for the importation of plant material from *Phytophthora ramorum* and *Phytophthora* species complex host countries will remain as they are currently outlined in ICON. These conditions include PCR testing for *Phytophthora* species (Hughes *et al.* 2006) in certain circumstances.

Phytoplasma

Phytoplasma associated with hazelnut propagative material that are of quarantine concern to Australia include: *'Candidatus* Phytoplasma mali', '*Candidatus* Phytoplasma prunorum', '*Candidatus* Phytoplasma pyri', Clover Yellow Edge Phytoplasma and Oregon hazelnut stunt syndrome.

- A generic nested primer PCR test is recommended to detect phytoplasmas (Deng and Hiruki 1991; Lee *et al*. 1995; Schneider *et al*. 1995).

The nested primer PCR test is highly sensitive and is accepted by US regulatory officials as a suitable replacement for their three-year woody indexing procedure (Waterworth and Mock 1999). Testing in Oregon has suggested that the causal agent of Oregon hazelnut stunt syndrome is one or more phytoplasma species. These species are readily detectable using a generic nested primer PCR test (Postman *et al.* 2001). General tests for phytoplasmas are routinely used by some of the diagnostic laboratories in Australia. AQIS Plant Pathologists can make arrangements for the phytoplasma PCR test to be carried out at an AQIS approved diagnostic laboratory where the test is available.

Viruses

The pathway-specific fungal pathogens for hazelnut propagative material of quarantine concern to Australia include Tulare apple mosaic virus.

- Herbaceous indexing using *Nicotiana tabacum* for the detection of Tulare apple mosaic virus.

5.1.3 Propagative material from *Phytophthora ramorum* host countries

The existing policy for propagative material from *Phytophthora ramorum* host countries is supported. Plant Biosecurity also proposes that plants and plant parts (other than tissue cultures) of *Corylus* species are prohibited entry into Australia from countries where *Phymatotrichopsis omnivora* and *Phytophthora nemorosa* are known to occur, in accordance with conditions C 15269.

6 Conclusion

The findings of this draft review of policy are based on a comprehensive analysis of the scientific literature. Plant Biosecurity considers that the risk management measures proposed in this draft review of policy are adequate to mitigate the risks posed by the identified pathogens.

Measures to import hazelnut propagative material from Chile

Plant Biosecurity has proposed a systems approach to import hazelnut dormant cuttings produced in Chile. The overall systems approach operates like a fail-safe system in that tiered safeguards are built into the process. That is, if one mitigating measure fails, other safeguards exist to ensure that the risk is progressively reduced and managed. The systems approach is designed to apply multiple measures to minimise the risk to an acceptable level and to apply additional safeguards, as required. The steps or measures may be overlapping to ensure an adequate reduction in pest risk and to maintain the risk reduction during the entire process.

All phases associated with hazelnut rooted dormant cuttings established in soil-less pasteurized growing media—before planting, during the growing period, post harvest and during exportation to Australia—have been considered.

- The systems approach commences with sourcing hazelnut rooted dormant cuttings from a country with low pest status (i.e. out of 28 pathway-specific pests of quarantine concern, only two pathogens are present in Chile). Dormant cuttings sourced from mother plants that have been inspected and found to be free of disease symptoms are disinfected and transferred to SAG registered nurseries. There is limited opportunity for infection or infestation by pests of quarantine concern to Australia.
- Resultant plants are monitored by SAG for freedom from disease symptoms. Plants are grown in pasteurized soil-less media in SAG registered nurseries for one season (dormant cuttings are planted and harvested when they are again dormant). Appropriate pest control programs are to be in place throughout the growth cycle and monitored by SAG.
- An insecticidal treatment is applied no longer than seven days prior to export. Rooted dormant cuttings for export to Australia are inspected and certified by SAG officers immediately prior to export.
- Pre-export verification inspection by AQIS officers and a plant pathologist immediately prior to export within approved production facilities for evidence of arthropod pests and diseases will be applied for commercial volumes of rooted cuttings.

The accredited system will be audited by AQIS officers regularly to ensure on-going compliance with the accreditation scheme for hazelnut rooted dormant cuttings exports to Australia.

Production of hazelnut rooted dormant cuttings in accordance with the proposed systems approach, phytosanitary inspection by SAG and an insecticidal treatment no longer than seven days prior to export to Australia, is considered equivalent to mandatory on-arrival fumigation.

Furthermore, AQIS will undertake a documentation compliance examination for consignment verification purposes, at the port of entry in Australia, prior to discharge of the imported hazelnut rooted dormant cuttings shipment.

Measures to import hazelnut propagative material from all other countries

Plant Biosecurity reviewed the import conditions for hazelnut propagative material from all countries after identifying additional pests of quarantine concern on hazelnuts. The review supported the continuation of several risk management measures already in place for hazelnut nursery stock and proposed additional risk management measures where appropriate.

Appendices

Appendix A: Initiation and categorisation of pests associated with *Corylus* species in Chile

Initiation identifies the pests which occur on *Corylus* species and their status in Chile and Australia and their pathway association. In this assessment **pathway** is defined as soil-free rooted dormant cuttings. Due to the size and age of the propagative material, bark and wood are not considered to be part of the import pathway.

Pest categorisation identifies the potential of introduction and spread and economic consequences to determine if these pests qualify as quarantine pests.

Pest	Present in Chile	Present within Australia	Potential to be on pathway	Potential for establishment and spread	Potential for economic consequences[5]	Quarantine pest (yes/no)
ARTHROPODS						
ACARI (mites)						
Acalitus essigi (Hassan, 1928) [Acari: Eriophyidae]	Yes (Klein Koch and Waterhouse 2000)	Yes (Scott *et al.* 2008)	Assessment not required			
Bryobia rubrioculus (Scheuten 1857) [Acari: Tetranychidae]	Yes (Klein Koch and Waterhouse 2000)	Yes (Naumann 1993)	Assessment not required			
Panonychus ulmi (Koch, 1836) [Acari: Tetranychidae]	Yes (Klein Koch and Waterhouse 2000)	Yes (Thwaite 1991)	Assessment not required			
Phytoptus avellanae Nalepa, 1889 [Acari: Eriophyidae]	Yes (SAG 2011)	Yes (CSIRO 2005)	Assessment not required			
Tetranychus urticae Koch, 1836 [Acari: Tetranychidae]	Yes (Klein Koch and Waterhouse 2000)	Yes (Naumann 1993)	Assessment not required			
Tetranycopsis horridus (Canestrini & Fanzago, 1876) [Acari: Tetranychidae]		Not known to occur	No: This tetranychid mite typically feeds on upper and lower surfaces of hazelnut leaves (Ozman and Cobanoglu 2001) and lays eggs on the foliage of hazelnut trees (Helle and Bolland 1967). Foliage free	Assessment not required		

5 In this pest categorisation the potential for economic consequences is assessed in relation to the pest's likelihood to meet the ISPM 5 definition of a quarantine pest. Namely, that the pest is potentially economically important. Consequently, any pest which is considered a minor pest or is not known to be economically important and which is not considered to be an emerging pest problem does not meet the definition of a quarantine pest.

Pest	Present in Chile	Present within Australia	Potential to be on pathway	Potential for establishment and spread	Potential for economic consequences[5]	Quarantine pest (yes/no)
			dormant cuttings therefore do not provide a pathway for this mite.			
Tyrophagus longior (Gervais 1844) [Acari: Acaridae]	Yes (Klein Koch and Waterhouse 2000)	Yes (CSIRO 2005)	Assessment not required			
Tyrophagus putrescentiae (Schrank 1781) [Acari: Acaridae]	Yes (Klein Koch and Waterhouse 2000)	Yes (CSIRO 2005)	Assessment not required			
COLEOPTERA (beetles, weevils)						
Aegorhinus nodipennis (Hope, 1834) [Coleoptera: Curculionidae]	Yes (Klein Koch and Waterhouse 2000)	Not known to occur	No: These curculionid beetles have been recorded on *Corylus* species (Klein Koch and Waterhouse 2000; Lemus 2004). Adults feed on young leaves, shoots and fruits, then move to stems at night (Parra *et al.* 2009; Mutis *et al.* 2010). Therefore, dormant cuttings do not provide a pathway for these species.	Assessment not required		
Aegorhinus phaleratus Erichson, 1834 [Coleoptera: Curculionidae]	Yes (Klein Koch and Waterhouse 2000)	Not known to occur		Assessment not required		
Aegorhinus superciliosus (Guérin, 1830) [Coleoptera: Curculionidae]	Yes (Klein Koch and Waterhouse 2000; Lemus 2004; SAG 2011)	Not known to occur		Assessment not required		
Ahasverus advena (Walt, 1834) [Coleoptera: Silvanidae]	Yes (Klein Koch and Waterhouse 2000)	Yes (CSIRO 2005)	Assessment not required.			
Hylamorpha elegans (Burmeister) [Coleoptera: Scarabaidae]	Yes (Klein Koch and Waterhouse 2000)	Not known to occur	No: This scarabaid beetle has been recorded on *Corylus* (Klein Koch and Waterhouse 2000). This beetle generally feed on foliage causing defoliation of host plants (Ratcliffe and Ocampo 2002). Therefore foliage free dormant cuttings do not provide a pathway for this beetle.			

Pest	Present in Chile	Present within Australia	Potential to be on pathway	Potential for establishment and spread	Potential for economic consequences[5]	Quarantine pest (yes/no)
Otiorhynchus rugosostriatus (Goeze, 1777) [Coleoptera: Curculionidae]	Yes (Klein Koch and Waterhouse 2000)	Yes (CSIRO 2005)	Assessment not required.			
Otiorhynchus sulcatus (Fabricius, 1775) [Coleoptera: Curculionidae]	Yes (Prado 1988)	Yes (Akhurst 1983)	Assessment not required.			
HEMIPTERA (aphids, leafhoppers, mealybugs, psyllids, scales, true bugs, whiteflies)						
Diaspidiotus perniciosa (Comstock) Cockerell, 1899 [Hemiptera: Diaspididae]	Yes (Klein Koch and Waterhouse 2000)	Yes (APPD 2011)	Assessment not required			
Lepidosaphes ulmi (Linnaeus, 1758) [Hemiptera: Diaspididae]	Yes (Klein Koch and Waterhouse 2000)	Yes (Snare 2006)	Assessment not required			
Myzocallis coryli (Goeze, 1778) [Hemiptera: Aphididae]	Yes (Klein Koch and Waterhouse 2000; SAG 2011)	Yes (CSIRO 2005)	Assessment not required			
Myzus persicae (Sulzer, 1776) [Hemiptera: Aphididae]	Yes (Klein Koch and Waterhouse 2000)	Yes (Snare 2006)	Assessment not required			
Nezara viridula (Linnaeus, 1758) [Hemiptera: Pentatomidae]	Yes (Klein Koch and Waterhouse 2000)	Yes (APPD 2011)	Assessment not required			
Parthenolecanium corni (Bouché, 1844) [Hemiptera: Coccidae]	Yes (Klein Koch and Waterhouse 2000)	Yes (CSIRO 2005)	Assessment not required			
LEPIDOPTERA (moths, butterflies)						
Cadra cautella (Walker, 1863) [Lepidoptera: Pyralidae]	Yes (Klein Koch and Waterhouse 2000)	Yes (CSIRO 2005)	Assessment not required			
Orgyia antiqua (Linnaeus, 1758) [Lepidoptera: Lymantriidae]	Yes (Klein Koch and Waterhouse 2000)	Not known to occur	No: The larvae of this species feed on leaves. Once mature, larvae form cocoons on tree trunks or between leaves. (Pinder and Hayes 1986). Adult females are sedentary and lay eggs upon their cocoon (Tammaru	Assessment not required		

Pest	Present in Chile	Present within Australia	Potential to be on pathway	Potential for establishment and spread	Potential for economic consequences[5]	Quarantine pest (yes/no)
			et al. 2002). Foliage free dormant cuttings therefore do not provide a pathway for this moth.			
Plodia interpunctella (Hübner, 1813) [Lepidoptera: Pyralidae]	Yes (Klein Koch and Waterhouse 2000)	Yes (CSIRO 2005)	Assessment not required			
THYSANOPTERA (thrips)						
Thrips australis (Bagnall, 1915) [Thysanoptera: Thripidae]	Yes (Klein Koch and Waterhouse 2000)	Yes (CSIRO 2005)	Assessment not required			
PATHOGENS						
BACTERIA						
Pseudomonas syringae pv. *syringae* van Hall, 1902 [Pseudomonadales: Pseudomonadaceae]	Yes (France 2007; Acuna 2010; SAG 2011)	Yes (APPD 2011)	Assessment not required			
Rhizobium radiobacter (Beijerinck & van Delden, 1902) Young *et al.* 2001 [Rhizobiales: Rhizobiaceae] (synonym: *Agrobacterium tumefaciens* (Smith and Townsend 1907) Conn, 1942)	Yes (Latorre *et al.* 2002; Acuna 2010; SAG 2011)	Yes (APPD 2011)	Assessment not required			
Xanthomonas arboricola pv. *corylina* (Miller *et al.* 1940) Vauterin *et al.* 1995 [Xanthomonadales: Xanthomonadaceae]	Yes (France 2007; Acuna 2010; Ferrada 2010; SAG 2011)	Yes (Wimalajeewa and Washington 1980)	Assessment not required			
FUNGI						
Alternaria alternata (Fr.) Keissl. [Pleosporales: Pleosporaceae]	Yes (Minter and Peredo Lopez 2006)	Yes (Webley *et al.* 1997)	Assessment not required			
Alternaria tenuissima (Kunze) Wiltshire [Pleosporales:	Yes (Minter and Peredo Lopez 2006)	Yes (Webley *et al.* 1997)	Assessment not required			

Pest	Present in Chile	Present within Australia	Potential to be on pathway	Potential for establishment and spread	Potential for economic consequences[5]	Quarantine pest (yes/no)
Pleosporaceae]						
Armillaria mellea (Vahl: Fr) P. Kummar [Agaricales: Physalacriaceae]	Yes (Minter and Peredo Lopez 2006)	Not known to occur[6]	**Yes:** *Armillaria mellea* has been recorded on *Corylus* species (Adaskaveg 2002; Farr and Rossman 2011). This fungus is soil inhabitant and causes root-rot (Adaskaveg 2002; Deacon 2011). The fungus invades the bark of major roots, progressively destroying living root tissues and leading to serious decline and eventual death of their hosts (Deacon 2011). Therefore, dormant cuttings may provide a pathway for this fungus.	**Yes:** *Armillaria mellea* is established in areas with a wide range of climatic conditions (Deacon 2011) and can spread naturally in infected propagative material. A few *Armillaria* species are already established and have spread in Australia. Therefore, this fungus also has the potential for establishment and spread in Australia.	**Yes:** *Armillaria mellea* is destructive root-rot pathogen of trees (Deacon 2011). It is mainly a pathogen of broadleaved trees, but it can also kill young coniferous trees (Decon 2011). *Armillaria* species are considered to be of quarantine significance by several countries. Presence of these fungi in Australia would impact upon Australia's ability to access overseas markets. Therefore, *Armillaria* species have the potential for economic consequences in Australia.	**Yes**
Armillaria novae-zelandiae (G. Stev.) Boesew. [Agaricales: Physalacriaceae]	Yes (Minter and Peredo Lopez 2006)	Yes (Pildain *et al.* 2009)	Assessment not required			
Aspergillus niger Tiegh. [Eurotiales: Trichocomaceae]	Yes (Minter and Peredo Lopez 2006)	Yes (Shivas 1989)	Assessment not required			
Bertia moriformis (Tode) De Not. [Coronophorales: Bertiaceae]	Yes (Minter and Peredo Lopez 2006)	Not known to occur	No: This saprophytic fungus (Norden and Paltto 2001; Chlebicki and Chmiel 2006) has been reported from *Corylus* species (Farr and Rossman 2011). Foliage free dormant cuttings therefore	Assessment not required		

6 Reports of *Armillaria mellea* in Australia have been shown to be mis-identifications of *A. luteobubalina* (Keane *et al.* 2000).

Pest	Present in Chile	Present within Australia	Potential to be on pathway	Potential for establishment and spread	Potential for economic consequences[5]	Quarantine pest (yes/no)
			may not provide a pathway for fungus.			
Botryosphaeria obtusa (Schwein.) Shoemaker [Botryosphaeriales: Botryosphaeriaceae]	Yes (Minter and Peredo Lopez 2006)	Yes (Punithalingam and Waller 1973)	Assessment not required			
Botrytis cinerea Pers. [Helotiales: Screotiniaceae]	Yes (Acuna 2010; SAG 2011)	Yes (Nair *et al.* 1995)	Assessment not required			
Cerrena unicolor (Bull.) Murrill [Polyporales: Polyporaceae]	Yes (Palma *et al.* 2005)	Not known to occur	No: This fungus has been recorded on *Corylus* species (Farr and Rossman 2011).This fungus is a saprophyte and is typically found on dead and decaying trunks (Enebak and Blanchette 1989; or branches (Legon *et al.* 2005). Therefore, semi-hardwood dormant cuttings may not provide a pathway for this wood-decaying fungus.	Assessment not required		
Chondrostereum purpureum (Pers.) Pouzar [Agaricales: Cyphellaceae]	Yes (Minter and Peredo Lopez 2006)	Yes (Cook and Dube 1989)	Assessment not required			
Clonostachys rosea (Link) Schroers *et al.* [Hypocreomycetidae: Bionectriaceae]	Yes (HerbIMI 2011a)	Yes (Backhouse *et al.* 2004)	Assessment not required			
Corticium roseum Pers. [Corticiales: Corticiaceae]	Yes (Minter and Peredo Lopez 2006)	Not known to occur	No: This fungus has been reported from *Corylus* species (Farr and Rossman 2011) and is a saprophyte (Roberts 2005; Lawrey *et al.* 2008). Foliage free dormant cuttings therefore do not	Assessment not required		

Pest	Present in Chile	Present within Australia	Potential to be on pathway	Potential for establishment and spread	Potential for economic consequences[5]	Quarantine pest (yes/no)
			provide a pathway for this fungus.			
Cylindrosporium coryli Ibrah. & T.M. Achundov [Helotiales: Incertae sedis]	Yes (SAG 2011)[7]	Not known to occur	No: This species has been recorded on *Corylus* species and is associated with leaves (Constantinescu 1984). Foliage free dormant cuttings therefore do not provide a pathway for this fungus.	Assessment not required		
Discosia artocreas (Tode) Fr. [Xylariales: Amphisphaeriaceae]	Yes (Minter and Peredo Lopez 2006)	Not known to occur	No: This fungus has been recorded on *Corylus* species (Farr and Rossman 2011). Generally this species is associated with the foliage of host plants (Wu and Sutton 1996; Hogg and Hudson 1966) and is involved in litter decomposition (Osono and Takeda 2006). Foliage free dormant cuttings therefore do not provide a pathway for this fungus.	Assessment not required		
Epicoccum nigrum Link [Pleosporaceae: Pleosporaceae]	Yes (Minter and Peredo Lopez 2006)	Yes (Langrell *et al.* 2008)	Assessment not required			
Eurotium herbariorum (F.H. Wigg.) Link (synonym: *Aspergillus glaucus* (L.) Link) [Eurotiales: Trichocomaceae]	Yes (Minter and Peredo Lopez 2006)	Yes (Sivasithamparam *et al.* 1987)	Assessment not required			
Eutypa flavovirens (Pers.) Tul. & C.	Yes (Minter and	Not known to occur	No: This species has been	Assessment not required		

[7] *Cylindrosporium* species has been recorded on *Corylus* in Chile (SAG 2011); however, it has not been identified upto species level. *Cylindrosporium coryli* has been noted on hazelnut in other countries (Farr and Rossman 2011), therefore it is likely that the species recorded in Chile is *Cylindrosporium coryli*.

Pest	**Present in Chile**	**Present within Australia**	**Potential to be on pathway**	**Potential for establishment and spread**	**Potential for economic consequences[5]**	**Quarantine pest (yes/no)**
Tul. (synonym: *Diatrype flavovirens* (Pers.) Fr.) [Xylariales: Diatrypaceae]	Peredo Lopez 2006)		recorded on *Corylus* species (Farr and Rossman 2011) as saprobic on dead wood (EOL 2011). Dormant cuttings may not provide a pathway for this fungus.			
Eutypella leprosa (Pers.) Berlesy [Xylariales: Diatrypaceae]	Yes (Diaz *et al.* 2011)	Not known to occur	No: These fungi have been recorded on *Corylus* species (Farr and Rossman 2011). *Diatrypaceae* species are predominantly saprobic on angiosperm bark (Pildain *et al.* 2005) and are associated with dead branches of host trees (Chlebicki 2005). Foliage free dormant cuttings therefore, do not provide a pathway for these fungi.	Assessment not required		
Eutypella sorbi (Alb. & Schwein.) Sacc. [Xylariales: Diatrypaceae]	Yes (Minter and Peredo Lopez 2006)	Not known to occur		Assessment not required		
Fomes fomentarius (L.) J. Kickx [Polyporales: Polyporaceae]	Yes (Minter and Peredo Lopez 2006)	Not known to occur	No: This fungus has been recorded on *Corylus* species (Farr and Rossman 2011). This wood decomposing fungus is found on standing and fallen hardwood, causing a white rot (Kuo 2010). Semi-hardwood dormant cuttings may not provide a pathway for this fungus.	Assessment not required		
Fusarium oxysporum Schltdl. [Hypocreales: Nectriaceae]	Yes (SAG 2011)	Yes (APPD 2011)	Assessment not required			
Gibberella baccata (Wallr. Sacc.)	Yes (HerbIMI 2011b)	Yes (Hyun and	Assessment not required			

Pest	Present in Chile	Present within Australia	Potential to be on pathway	Potential for establishment and spread	Potential for economic consequences[5]	Quarantine pest (yes/no)
[Hypocreales: Nectriaceae] (synonym: *Fusarium lateritium*)		Clark 1998)				
Hypocrea gelatinosa (Tode) Fr. [Hypocreales: Hypocreaceae] (synonym: *Creopus gelatinosus* (Tode) Link)	Yes (Minter and Peredo Lopez 2006)	Yes (APPD 2011)	Assessment not required			
Hypoxylon fragiforme (Pers.) J. Kickx [Xylariales: Xylariaceae]	Yes (Minter and Peredo Lopez 2006)	Yes (APPD 2011)	Assessment not required			
Hypoxylon fuscum (Pers.) Fr. [Xylariales: Xylariaceae]	Yes (Minter and Peredo Lopez 2006)	Not known to occur	No: This fungus has been recorded on *Corylus* species (Farr and Rossman 2011) and is saprotrophic (Boddy 2001). Dormant cuttings therefore may not provide a pathway for this fungus.	Assessment not required		
Hypoxylon howeanum Peck [Xylariales: Xylariaceae]	Yes (Minter and Peredo Lopez 2006)	Yes (Gates and Ratkowsky 2005)	Assessment not required			
Laetiporus sulphureus (Bull.: Fr.) Murrill [Polyporales: Fomitopsidaceae]	Yes (Minter and Peredo Lopez 2006; Donoso *et al.* 2008)	Yes (APPD 2011)	Assessment not required			
Leotia lubrica (Scop.) Pers. [Leotiales: Leotiaceae]	Yes (Minter and Peredo Lopez 2006)	Yes (APPD 2011)	Assessment not required			
Microsphaera penicillata (Wallr.) Lév. [Erysiphales: Erysiphaceae] (synonym: *Microsphaera alni* (DC.) G. Winter)	Yes (Minter and Peredo Lopez 2006)	Yes (Cunnington and Brett 2009)	Assessment not required			
Monilia laxa (Ehrenb.) Sacc. & Voglino 1886 [Helotiales: Sclerotiniaceae]	Yes (Minter and Peredo Lopez 2006)	Yes (Mordue 1998)	Assessment not required			
Mycena haematopoda (Pers.: Fr.) P. Kumm. [Agaricales: Mycenaceae] (synonym: *Mycena haematopus*	Yes (Minter and Peredo Lopez 2006)	Not known to occur	No: This fungus has been recorded on *Corylus* species (Farr and Rossman 2011)	Assessment not required		

Pest	Present in Chile	Present within Australia	Potential to be on pathway	Potential for establishment and spread	Potential for economic consequences[5]	Quarantine pest (yes/no)
Pers. P. Kumm.)			and is a saprobe (McKnight and McKnight 1987; Shohet *et al.* 2008; Heilmann-Clausen 2005). Dormant cuttings therefore may not provide a pathway for entry of these fungi.			
Nectria cinnabarina (Tode) Fr. (synonym: *Tubercularia vulgaris* Corda) [Hypocreales: Nectriaceae]	Yes (Minter and Peredo Lopez 2006)	Yes (APPD 2011)	Assessment not required			
Neonectria ditissima (Tul. & C. Tul.) Samuels & Rossman [Hypocreales: Nectriaceae] (synonym: *Nectria galligena* Bres.; *Neonectria galligena* (Bes.) Rossman & Samuels)	Yes (Gutierrez *et al.* 2005)	Not known to occur	**Yes:** This fungus has been recorded on *Corylus* species (Farr and Rossman 2011). It is associated with side shoots, major and minor branches, rootstock and trunks (McCracken *et al.* 2003). Hyphae occurs in the xylem of infected hosts (McCracken *et al.* 2003). Therefore, dormant cuttings may provide a pathway for this fungus.	**Yes:** This pathogen is established in areas with a wide range of climatic conditions, and it affects more than 60 plant species (Langrell 2002). This pathogen can spread with the movement of infected propagative material (McCracken *et al.* 2003). This fungus was established but eradicated from Tasmania (Ransom 1997) indicating suitable environments does exists for its establish in Australia.	**Yes:** Although no information is available on losses caused by this fungus on hazelnut, but it is an important pathogen of apple and pear plantations in Europe and North America (Langrell 2002). This fungus also damages hardwood species important to forestry. It can cause significant reduction in log quality and therefore reduction in market value (Plante and Bernier 1997). This fungus has the potential for economic consequences in Australia.	**Yes**
Penicillium aurantiogriseum Dierckx [Eurotiales: Trichocomaceae]	Yes (Minter and Peredo Lopez 2006)	Yes (APPD 2011)	Assessment not required			
Penicillium digitatum (Pers.) Sacc.[Eurotiales: Trichocomaceae]	Yes (Minter and Peredo Lopez 2006)	Yes (APPD 2011)	Assessment not required			
Pestalotiopsis guepinii (Desm.) Steyaert [Xylariales:	Yes (Espinoza *et al* 2008)	Yes (APPD 2011)	Assessment not required			

Pest	Present in Chile	Present within Australia	Potential to be on pathway	Potential for establishment and spread	Potential for economic consequences[5]	Quarantine pest (yes/no)
Amphisphaeriaceae]						
Phellinus ferruginosus (Schrad.) Pat. [Hymenochaetales: Hymenochaetaceae] (synonym: *Polyporus ferruginosus* (Schrad.) Fr.)	Yes (Minter and Peredo Lopez 2006)	Not known to occur	No: *Phellinus* species are associated with trunk and scaffold leaves causing wood decay in hazelnut (Adaskaveg 2002). Wood decay fungi enter trees primarily through wounds exposing sapwood or heartwood. Semi-hardwood dormant cuttings may not provide a pathway for this fungus.	Assessment not required		
Phellinus igniarius (L.) Quél. [Hymenochaetales: Hymenochaetaceae] (synonym: *Phellinus alni* (Bondartsev) Parmasto)	Yes (Minter and Peredo Lopez 2006)	Not known to occur		Assessment not required		
Phomopsis avellana Petr. [Diaporthales: Valsaceae]	Yes (SAG 2011)[8]	Not known to occur	No: This species is known to be a cause of kernel mould in hazelnut (Pscheidt and Stone 2001). Semi-hardwood dormant cuttings do not provide a pathway for this fungus.	Assessment not required		
Phyllactinia guttata (Wallr.) Lév. [Erysiphales: Erysiphaceae] (synonym: Phyllactinia corylea (Pers.) P. Karst)	Yes (France 2007; Acuna 2010; SAG 2011)	Yes (Farr and Rossman 2010)	Assessment not required			
Physarum cinereum (Batsch) Pers. [Incertae sedis: Physaraceae]	Yes (Minter and Peredo Lopez 2006)	Yes (Davison *et al.* 2008)	Assessment not required			
Polyporus melanopus (Pers.) Fr. [Polyporales: Polyporaceae]	Yes (de Silveira 2006)	Yes (APPD 2011)	Assessment not required			
Rosellinia corticium (Schwein.)	Yes (Minter and	Not known to occur	No: This fungus has been recorded on *Corylus* species	Assessment not required		

[8] *Phomopsis* pecies has been recorded on *Corylus* in Chile (SAG 2011); however, it has not been identified upto species level. *Phomopsis avellana* has been noted on hazelnut in other countries (Farr and Rossman 2011), therefore it is likely that thespecies recorded in Chile is *Phomopsis avellana*.

Pest	Present in Chile	Present within Australia	Potential to be on pathway	Potential for establishment and spread	Potential for economic consequences[5]	Quarantine pest (yes/no)
Sacc. [Xylariales: Xylariaceae]	Peredo Lopez 2006)		(Farr and Rossman 2011). *Rosellinia* species are associated with dead branches of deciduous trees (Rogers *et al*. 2008). Members of the xylariaceae are considered in general as saprotrophs or weak parasites (Peláez *et al*. 2008). Dormant cuttings therefore may not provide a pathway for these fungi.			
Rosellinia necatrix Berl. ex Prill. [Xylariales: Xylariaceae]	Yes (Minter and Peredo Lopez 2006)	Yes (APPD 2011)	Assessment not required			
Sarcoscypha coccinea (Jacq.) Sacc. [Pezizales: Sarcoscyphaceae]	Yes (Minter and Peredo Lopez 2006; Tortella *et al*. 2008)	Yes (APPD 2011)	Assessment not required			
Schizophyllum commune Fr. [Agricales: Schizophyllaceae]	Yes (Minter and Peredo Lopez 2006; Donoso *et al*. 2008)	Yes (APPD 2011)	Assessment not required			
Schizopora paradoxa (Schrad.) Donk [Hymenochaetales: Schizoporaceae]	Yes (Minter and Peredo Lopez 2006)	Yes (APPD 2011)	Assessment not required			
Sclerotinia minor Jagger, 1920 [Helotiales: Sclerotiniaceae]	Yes (Acuna 2010; SAG 2011)	Yes (Ekins *et al*. 2002)	Assessment not required			
Steccherinum ochraceum (Pers.) Gray [Polyporales: Meruliaceae]	Yes (Minter and Peredo Lopez 2006)	Yes (APPD 2011)	Assessment not required			
Stereum hirsutum (Willd.) Pers. [Russulales: Stereaceae]	Yes (Donoso *et al*. 2008; Tortella *et al*. 2008)	Yes (APPD 2011)	Assessment not required			
Stereum rugosum Pers. [Russulales: Stereaceae]	Yes (Minter and Peredo Lopez 2006)	Yes (APPD 2011)	Assessment not required			

Pest	Present in Chile	Present within Australia	Potential to be on pathway	Potential for establishment and spread	Potential for economic consequences[5]	Quarantine pest (yes/no)
Trametes hirsuta (Wulfen) Lloyd [Polyporales: Polyporaceae]	Yes (Minter and Peredo Lopez 2006; Tortella *et al*. 2008)	Yes (APPD 2011)	Assessment not required			
Trametes ochracea (Pers.) Gilb. & Ryvarden [Polyporales: Polyporaceae] (synonym: *Trametes multicolor* (Schaeff) Julich)	Yes (Minter and Peredo Lopez 2006)	Yes (Hopkins 2007)	Assessment not required			
Trametes versicolor (L.) Lloyd [Polyporales: Polyporaceae]	Yes (Donoso *et al.* 2008; Tortella *et al.* 2008)	Yes (APPD 2011)	Assessment not required			
Tremella mesenterica Retz.: Fr. [Tremellales: Tremellaceae]	Yes (Minter and Peredo Lopez 2006; Tortella *et al*. 2008)	Yes (APPD 2011)	Assessment not required			
Trichoderma viride Pers. [Hypocreales: Hypocreaceae] (synonyms: *Hypocrea rufa* (Pers.) Fr., *Trichoderma lignorum* Pers.)	Yes (Minter and Peredo Lopez 2006)	Yes (APPD 2011)	Assessment not required			
Trichothecium roseum (Pers.) Link [Hypocreales: Incertae sedis]	Yes (Minter and Peredo Lopez 2006)	Yes (APPD 2011)	Assessment not required			
Xylaria hypoxylon (L.) Grev. [Xylariales: Xylariaceae]	Yes (Minter and Peredo Lopez 2006)	Yes (APPD 2011)	Assessment not required			
STRAMINOPILA						
Phytophthora cactorum (Lebert & Cohn) J. Schröt. [Peronosporales: Peronosporaceae]	Yes (Minter and Peredo Lopez 2006)	Yes (Shivas 1989)	Assessment not required			
Phytophthora cinnamomi Rands [Peronosporales: Peronosporaceae]	Yes (France 2007)	Yes (Podger 1972)	Assessment not required			
Phytophthora citricola Sawada [Peronosporales: Peronosporaceae]	Yes (Minter and Peredo Lopez 2006)	Yes (Burgess *et al.* 2009)	Assessment not required			
VIRUSES						
Apple mosaic *ilarvirus* (ApMV)	Yes (SAG 2011)	Yes (Snare 2006)	Assessment not required			

Pest	Present in Chile	Present within Australia	Potential to be on pathway	Potential for establishment and spread	Potential for economic consequences[5]	Quarantine pest (yes/no)
[Bromoviridae]						
Prune dwarf *ilarvirus* (PDV) [Bromoviridae]	Yes (Herrera and Madariaga 2002; SAG 2011)	Yes (Parbery and Greber 1996)	Assessment not required			
Prunus necrotic ringspot *ilarvirus* (PNRSV) [Bromoviridae]	Yes (Herrera and Madariaga 2002)	Yes (Bertozzi *et al.* 2002; Curtis and Moran 1986)	Assessment not required			
NEMATODES						
Pratylenchus neglectus (Rensch 1924) [Tylenchida: Pratylenchidae]	Yes (SAG 2011)	Yes (Taylor *et al.* 2000)	Assessment not required			
Xiphinema americanum Cobb, 1913 [Dorylaimida: Longidoridae]	Yes (SAG 2011)	Yes (Quader *et al.* 2003)	Assessment not required			

Appendix B: Additional quarantine pest data (for Chile)

Quarantine pest	*Armillaria mellea* (Vahl: Fr.) P. Kumm.
Synonyms	*Agaricus melleus* Vahl : Fr.; *Armillariella mellea* (Vahl : Fr.) P. Karst.; *Rhizomorpha subcorticalis* Pers. ex Gray
Common name(s)	Armillaria root rot
Main hosts	The fungus has been recorded as a pathogen on an extremely wide range of dicotyledonous and coniferous trees and shrubs. It has also been found on potato, narcissus, strawberry, bamboo, geranium, sugarcane and banana (Pegler and Gibson 1972). *Abies, Acacia, Acer, Actinidia, Alnus, Betula, Carya, Chamaecyparis, Citrus, Cryptomeria, Cupressocyparis, Eucalyptus, Ficus, Fraxinus, Juglans, Ligustrum, Malus, Morus, Opuntia, Pinus, Prunus, Pyracantha, Pyrus, Quercus, Ribes, Rosa, Syringa* and *Vitis* species are main hosts (CABI 2011). *Armillaria mellea* is also known to occur in *Corylus avellana (*Janick and Paull 2008; Keča *et al.* 2009; Lushaj *et al.* 2010).
Distribution	Known as a cosmopolitan fungus (Pegler and Gibson 1972; Farr and Rossman 2011). Widespread in Europe (France, Greece, Italy, Luxembourg, Portugal, Switzerland, UK), USA (California) and Japan (Kyushu). Also reported from many other European and few African countries (Kenya, Tanzania, Zaire and Reunion) (CABI/EPPO 1997).
Quarantine pest	*Neonectria ditissima* (Tul. & C. Tul.) Samuels & Rossman
Synonyms	*Cylindrocarpon heteronemum* (Berk. & Broome) Wollenw.; *Cylindrocarpon heteronema* (Berk. & Broome) Wollenw.; *Cylindrocarpon mali* (Allesch.) Wollenw.; *Cylindrocarpon willkommii* (Lindau) Wollenw.; *Nectria ditissima* Tul. & C. Tul.; *Nectria galligena* Bres.; *Nectria magnoliae* M.L. Lohman & Hepting; *Neonectria galligena* (Bres.) Rossman & Samuels.
Common name(s)	Neonectria canker
Main hosts	Known to infect more than 60 tree and shrub species from over 20 genera (Langrell 2002). *Acer saccharum*, *Betula alleghaniensis*, *Pyrus communis* are main hosts. Also infects *Corylus avellana* and many *Carya, Fagus, Juglans, Populus, Prunus, Quercus, Salix* and *Ulmus* species (CABI 2011).
Distribution	Europe, North America (Canada, USA), Asia (Japan, China), Africa (South Africa, Madagascar). Also reported in South America (Argentina, Chile, Uruguay) and New Zealand (CABI 2011; Farr and Rossman 2011).

Appendix C: Additional quarantine pest data

Quarantine pest	*Cecidophyopsis vermiformis* (Nalepa, 1889)
Synonyms	None
Common name(s)	Big bud mite; Filbert bud mite
Main hosts	*Corylus avellana* (Webber 2007).
Distribution	England (Webber and Chapman 2008), New Zealand (Webber 2007), Republic of Georgia (Webber and Chapman 2008), Turkey (Ozman and Toros 1997) and USA (AliNiazee 1998).
Quarantine pest	*Phytoptus avellanae* Nalepa, 1889
Synonyms	*Eriophyes avellanae* Nalepa, 1889; *Phytocoptella avellanae* (Nalepa)
Common name(s)	Filbert bud mite; Hazelnut gall mite
Main hosts	*Corylus avellana* (Webber 2007).
Distribution	New Zealand (Webber 2007), Poland (Gantner 2000), Romania (Ioachim and Bobarnac 1997), Serbia (Stamenkovic *et al.* 1997), Turkey (Ozman and Toros 1997), USA (AliNiazee 1998) and Yugoslavia (Stamenkovic *et al.* 1997). In Australia, *P. avellanae* is restricted to the state of Tasmania (CSIRO 2005).
Quarantine pest	*Oberea linearis* (Linné 1758)
Synonyms	None
Common name(s)	Hazel longhorned beetle; Hazelnut and walnut twig borer
Main hosts	*Alnus spp., Carpinus betulus* (Fraval 1998), *Corylus avellana* (Bahar and Demirbag 2007), *Juglans regia* and *Salix spp.* (Fraval 1998).
Distribution	Austria, Belgium, France, Germany (GBIF 2010), Greece (Capinera 2008), Italy, Netherlands, Norway, Poland, Sweden (GBIF 2010) and Turkey (Bahar and Demirbag 2007).
Quarantine pest	*Eulecanium excrescens* (Ferris, 1920)
Synonyms	*Lecanium excrescens* Ferris, 1920
Common name(s)	Excrescent scale; Wisteria scale
Main hosts	*Acer pseudoplatanus* (Malumphy 2005), *Corylus avellana* (AliNiazee 1980), *Juglans regia, Malus* spp.*, Podranea ricasoliana, Prunus* spp.*, Pyrus communis, Ulmus spp.* and *Wisteria* spp. (Malumphy 2005).
Distribution	Britain, China (Malumphy 2005) and USA (AliNiazee 1980; Alford 2007).
Quarantine pest	*Phenacoccus aceris* (Signoret, 1875)
Synonyms	None
Common name(s)	Apple mealybug
Main hosts	*Corylus avellana, Malus* spp.*, Prunus* spp. (AliNiazee 1980; Rau 1942), *Pyrus communis, Ribes* spp. and *Vitis* spp. (Rau 1942).
Distribution	Canada (BCMA 2007), England, Holland, Japan (Rau 1942), Turkey (Ulubas Serce *et al.* 2007) and USA (AliNiazee 1980).
Quarantine pest	*Gypsonoma dealbana* (Frolich, 1828)
Synonyms	None
Common name(s)	Tortricid larva
Main hosts	*Corylus avellana* (Tuncer and Ecevit 1997; AliNiazee 1998).
Distribution	Common throughout central and northern Europe (Alford 2007).

Quarantine pest	*Zeuzera pyrina* Linnaeus, 1761
Synonyms	None
Common name(s)	Leopard moth; Stem borer
Main hosts	This species affects more than 150 plant species (Kutinkova *et al.* 2006). These include *Acer* spp., *Citrus* spp. (Fraval 1998), *Corylus avellana* (Tuncer and Ecevit 1997), *Cydonia oblonga, Fagus* spp., *Malus* spp., *Olea europaea, Platanus* spp., *Populus* spp., *Prunus* spp., *Punica granatum, Pyrus communis, Quercus* spp., *Ribes* spp., *Salix* spp., *Tamarix* spp., *Tilia* spp. and *Vitis* spp. (Fraval 1998).
Distribution	Algeria, Austria, Belgium (CABI 2011), Bulgaria (Kutinkova *et al.* 2006), Cyprus, Czechoslovakia (former), Denmark, Egypt, France (CABI 2011), Greece (Haniotakis *et al.* 1999), Iran, Iraq, Israel (CABI 2011), Italy (Haniotakis et al. 1999), Japan, Korea DPR, Lebanon, Libya, Malta, Morocco, Netherlands, Norway, Poland, Portugal, Romania, Russian Federation, Spain, Sweden, Switzerland, Syria, Taiwan, Turkey, UK, USA, USSR (former) and Yugoslavia (former) (CABI 2011).
Quarantine pest	*Pseudomonas avellanae* Janse *et al.*
Synonyms	*Pseudomonas syringae* pv. *avellanae* Psallidas
Common name(s)	Moria; Dieback; Bacterial canker of hazelnut
Main hosts	*Corylus avellana* (Psallidas 1993; Scortichini *et al.* 2000).
Distribution	Greece (Psallidas and Panagopoulos 1979), Italy (Scortichini and Tropiano 1994).
Quarantine pest	*Pseudomonas syringae* pv. *coryli* Scortichini *et al.*
Synonyms	None
Common name(s)	Bacterial Twig Dieback
Main hosts	*Corylus avellana* (Scortichini *et al.* 2005; Psallidas 1993).
Distribution	Italy and Germany (Cirvilleri *et al.* 2007; Loreti *et al.* 2008; Scortichini *et al.* 2005).
Quarantine pest	*Anisogramma anomala* (Peck) E. Müll.
Synonyms	*Apioporthe anomala* (Peck) Höhn.; *Cryptosporella anomala* (Peck) Sacc.
Common name(s)	Eastern Filbert blight
Main hosts	*Corylus americana*, *Corylus avellana* and other *Corylus* species (CABI 2011; EPPO 2011; Farr and Rossman 2011).
Distribution	Canada (British Columbia, Nova Scotia, Manitoba, Ontario, Quebec) and USA (Connecticut, Delaware, Illinois, Iowa, Maine, Maryland, Massachusetts, New Jersey, New York, North Carolina, Oregon, Washington, Wisconsin) (CABI 2011; EPPO 2011).
Quarantine pest	*Armillaria mellea* (Vahl: Fr.) P. Kumm.
Synonyms	*Agaricus melleus* Vahl : Fr.; *Armillariella mellea* (Vahl : Fr.) P. Karst.; *Rhizomorpha subcorticalis* Pers. ex Gray
Common name(s)	Armillaria root rot
Main hosts	The fungus has been recorded as a pathogen on an extremely wide range of dicotyledonous and coniferous trees and shrubs. It has also been found on potato, narcissus, strawberry, bamboo, geranium, sugarcane and banana (Pegler and Gibson 1972). *Abies, Acacia, Acer, Actinidia, Alnus, Betula, Carya, Chamaecyparis, Citrus, Cryptomeria, Cupressocyparis, Eucalyptus, Ficus, Fraxinus, Juglans, Ligustrum, Malus, Morus, Opuntia, Pinus, Prunus, Pyracantha, Pyrus, Quercus, Ribes, Rosa, Syringa* and *Vitis* species are main hosts (CABI 2011). *Armillaria mellea* is also known to occur in *Corylus avellana* (Janick and Paull 2008; Keča *et al.* 2009; Lushaj *et al.* 2010).
Distribution	Known as a cosmopolitan fungus (Pegler and Gibson 1972; Farr and Rossman 2011). Widespread in Europe (France, Greece, Italy, Luxembourg, Portugal, Switzerland, UK), USA (California) and Japan (Kyushu). Also reported from many other European and few African countries (Kenya, Tanzania, Zaire and Reunion) (CABI/EPPO 1997).

Quarantine pest	*Armillaria gallica* Marxm. & Romagn
Synonyms	*Armillariella bulbosa* (Barla) Romagn.*; Armillaria bulbosa* (Barla) Kile & Watling*; Armillaria inflata* Velen.
Common name(s)	Armillaria root rot, Honey mushroom
Main hosts	*Acer macrophyllum, Arbutus menziesii, Lithocarpus densiflorus, Pseudotsuga menziesii, Quercus agrifolia, Quercus kelloggii, Umbellularia californica* (Baumgartner and Rizzo 2001), *Corylus avellana* (Keča *et al.* 2009; Lushaj *et al.* 2010; Ota *et al.* 1998) and many other *Abies, Betula, Fagus, Fraxinus, Leucadendron, Picea, Pinus, Protea, Prununs, Rubus, Salix* and *Ulmus* species (Farr and Rossman 2011).
Distribution	Wide spread in Europe (France, Germany, Poland, Italy), USA (California, New Hampshire, South Carolina, Washington), Japan, South Africa (Cape) (Farr and Rossman 2011; Ota *et al.* 1998)
Quarantine pest	*Armillaria ostoyae* (Romagn.) Herink
Synonyms	*Armillariella ostoyae* Romagn.*; Armillaria solidipes* Peck; *Armillariella solidipes* (Peck) T.J. Baroni
Common name(s)	Armillaria root rot, Honey mushroom
Main hosts	*Abies alba, Abies balsamea, Abies concolor, Abies grandis, Abies lasiocarpa, Larix deciduas, L. kaempferi, Picea abies, P. glauca, P. mariana, P. omorika, P. pungens, P. Rubens, P. Sitchensis, Pinus banksiana, P. cembra, P. contorta, P. resinosa, P. strobes, P. sylvestris, P. taeda, P. nigra, P. pinaster, P. ponderosa, Pseudotsuga menziesii, Thuja plicata, Tsuga canadensis, T. heterophylla* (CABI 2011; Farr and Rossman 2011). *Armillaria ostoyae* is also known to occur in *Corylus avellana* (Keča *et al.* 2009).
Distribution	Wide spread in Europe (Austria, Denmark, Finland, France, Germany, Italy, Norway, Poland, Slovenia, Sweden, Switzerland, UK), Asia (China, India, Japan, Korea, Turkey), Canada (Alberta, British Columbia, Manitoba, Newfoundland, Ontario, Quebec), USA (Idaho, Maine, Michigan, New Hampshire, New Mexico, New York, Oregon, Vermont, Washington) (CABI/EPPO 2009).
Quarantine pest	*Cryptosporiopsis tarraconensis* Gené & Guarro
Synonyms	None. This species was originally mis-identified as *Cryptosporiopsis coryli*
Common name(s)	Budrot
Main hosts	*Corylus avellana* (Gene *et al.* 1990)
Distribution	Spain (Gene *et al.* 1990)
Quarantine pest	*Fomitiporia mediterranea* M. Fisher
Synonyms	None
Common name(s)	Esca disease
Main hosts	*Acer negundo, Actinidia chinensis, Corylus avellana, Citrus, Lagerstroemia indica, Laurus nobilis, Ligustrum vulgare, Olea europaea, Quercus ilex, Robinia pseudoacacia* and *Vitis vinifera* (Fischer 2002; Fischer *et al.* 2005; Fischer 2006; Pilotti *et al.* 2010)
Distribution	Austria, France, Germany, Greece, Hungary, Italy, Portugal, Slovenia, Spain, Switzerland (Fischer *et al.* 2005; Fischer 2006; Ciccarone *et al.* 2004)
Quarantine pest	*Monilia coryli* Schellenb.
Synonyms	None
Common name(s)	Brown rot
Main hosts	*Corylus avellana* (Farr and Rossman 2011)
Distribution	Poland (Gantner 2009; Machowicz-Stefaniak and Zalewska 2002).

Quarantine pest	*Monilinia fructigena* Honey
Synonyms	*Acrosporium fructigenum* (Pers.) Pers.; *Monilia fructigena* (Pers.) Pers.; *Oidium fructigenum* (Pers.) Fr.; *Sclerotinia fructigena* (Pers.) J. Schröt); *Torula fructigena* Pers.
Common name(s)	Brown rot disease; Nut drop
Main hosts	*Actininidia arguta*, *Amelanchier canadensis*, *Berberis* species, *Capsicum* species, *Cornus mas*, *Corylus avellana*, *Crataegus laevigata*, *Cydonia oblonga*, *Diospyros kaki*, *Eriobotrya japonica*, *Ficus carica*, *Fragaria* species, *Malus* species, *Mespilus germanica*, *Prunus* species, *Psidium guajava*, *Pyrus* species, *Rhododendron* species, *Rosa* species, *Rubus* species, *Solanum lycopersicum, Sorbus* species, *Vaccinium* species and *Vitis vinifera* (CABI 2011; Mackie *et al.* 2005; Wormald 1954).
Distribution	Western and Southern Europe and extending into the Scandinavian countries, Eastern Europe, the former Soviet Union, the Middle and Far East, India and North Africa (Mackie *et al.* 2005).
Quarantine pest	*Monostichella coryli* (Roberge ex Desm.) Höhn
Synonyms	*Gloeosporium coryli* (Roberge ex Desm.) Sacc.; *Labrella coryli* (Roberge ex Desm.) Sacc.; *Piggotia coryli* (Roberge ex Desm.) B. Sutton
Common name(s)	Anthracnose, Bud-rot
Main hosts	*Corylus avellana, Corylus cornuta, Corylus heterophylla* (Farr and Rossman 2011).
Distribution	England, France, Italy, Spain (Janick and Paull 2008; Tavella and Gianetti 2006), Poland, USA (Oregon, Washington), Japan and Korea (Farr and Rossman 2011).
Quarantine pest	*Neonectria ditissima* (Tul. & C. Tul.) Samuels & Rossman
Synonyms	*Cylindrocarpon heteronemum* (Berk. & Broome) Wollenw.; *Cylindrocarpon heteronema* (Berk. & Broome) Wollenw.; *Cylindrocarpon mali* (Allesch.) Wollenw.; *Cylindrocarpon willkommii* (Lindau) Wollenw.; *Nectria ditissima* Tul. & C. Tul.; *Nectria galligena* Bres.; *Nectria magnoliae* M.L. Lohman & Hepting; *Neonectria galligena* (Bres.) Rossman & Samuels.
Common name(s)	Neonectria canker
Main hosts	Known to Infect more than 60 tree and shrub species from over 20 genera (Langrell 2002). *Acer saccharum*, *Betula alleghaniensis*, *Pyrus communis* are main hosts. Also infects *Corylus avellana* and many *Carya, Fagus, Juglans, Populus, Prunus, Quercus, Salix* and *Ulmus* species (CABI 2011).
Distribution	Europe, North America (Canada, USA), Asia (Japan, China), Africa (South Africa, Madagascar). Also reported in South America (Argentina, Chile, Uruguay) and New Zealand (CABI 2011; Farr and Rossman 2011).
Quarantine pest	*Phymatotrichopsis omnivora* (Duggar) Hennebert
Synonyms	*Ozonium omnivorum* Shear; *Phymatotrichum omnivorum* (Shear) Duggar
Common name(s)	Texas root rot
Main hosts	The fungus infects more than 200 species of dicotyledons including 31 economic field crops, 58 vegetable crops, 18 fruits and berries including citrus, 35 forest trees and shrubs, 7 herbaceous ornamentals and 20 weeds (CABI/EPPO 2011). *Abelmoschus esculentus, Arachis hypogaea, Beta vulgaris, Carya illinoinensis, Fabaceae, Ficus carica, Glycine max, Gossypium, Juglandaceae, Juglans regia, Malus domestica, Malvaceae, Medicago sativa, Petroselinum crispum, Phaseolus, Pistacia vera, Populus, Prunus dulcis, Prunus persica, Pyrus communis, Robinia pseudoacacia, Rosaceae, Salix, Ulmus, Umbelliferae, Vitis vinifera* are main hosts (CABI 2011).
Distribution	Mexico (northern) and USA (south-western states including Arizona, Arkansas, California, Louisiana, Nevada, New Mexico, Oklahoma, Texas, Utah) (CABI/EPPO 2011).

Quarantine pest	*Pucciniastrum coryli* Kom.
Synonyms	None
Common name(s)	Asian filbert rust
Main hosts	*Abies firma, A. homolepis, A. veitchii, Corylus avellana, C. colurna, C. heterophylla, C. heterophylla* var. *thunbergia, C. sieboldiana, C. sieboldiana* var. *mandshurica* (CABI 2011; Farr and Rossman 2011; Yun 2011).
Distribution	China (Jilin), Japan (Hokkaido, Honshu, Kyushu), Korea and USSR (Western Serbia) (CABI 2011; Farr and Rossman 2011; Yun 2011).
Quarantine pest	*Phytophthora nemorosa* E.M. Hansen and Reeser
Synonyms	None
Common name(s)	Canker, Leaf blight
Main hosts	*Corylus cornuta, Lithocarpus densiflorus, Lonicera hispidula, Pseudotsuga menzesii, Quercus agrifolia, Sequoia sempervirens, Umbellularia californica, Vaccinium ovatum,* (Farr and Rossman 2011; Hansen *et al.* 2003; Wickland *et al.* 2008).
Distribution	North America (California, Oregon) (Farr and Rossman 2011; Hansen *et al.* 2003; Wickland *et al.* 2008).
Quarantine pest	*Phytophthora ramorum* Werres *et al.*
Synonyms	None
Common name(s)	Sudden oak death syndrome, Ramorum blight, Ramorum dieback
Main hosts	*Arbutus menziesii, Heteromeles salicifolia, Lithocarpus densiflorus, Pseudotsuga menziesii, Quercus agrifolia, Quercus chrysolepis, Quercus falcata, Quercus kelloggii, Quercus parvula* var. *shrevei, Vaccinium ovatum, Viburnum* spp. (CABI 2011). Also reported from *Corylus avellana* (DiLeo *et al.* 2008).
Distribution	Europe (Belgium, Denmark, France, Germany, Ireland, Italy, Netherlands, Norway, Poland, Slovenia, Spain, Sweden, Switzerland, UK), USA (California, Florida, Georgia, Louisiana, Oregon, Soth Carolina, Tennessee, Virginia, Washington) and Canada (British Columbia) (CABI/EPPO 2006).
Quarantine pest	'*Candidatus* Phytoplasma mali' Seemüller & Schneider
Synonyms	Apple proliferation phytoplasma Seemüller *et al.;* Phytoplasma mali [Candidatus] Seemüller & Schneider
Common name(s)	Apple proliferation
Main hosts	*Malus domestica* and *Prunus salicina* are main hosts (CABI 2011). Also reported from *Corylus avellana* (Marcone *et al.* 1996), *Pyrus communis* and *Vitis vinifera* (CABI 2011).
Distribution	Widespread in Czech Republic, Hungary, Italy, Slovakia and Switzerland. Restricted distribution is reported from Austria, Bulgaria, Croatia, France, Germany, Greece, Norway, Serbia and Slovenia (CABI 2011). Also reported from Belgium (Olivier *et al.* 2010) and Poland (Kamińska and Śliwa 2007).
Quarantine pest	'*Candidatus* Phytoplasma prunorum' Seemüller & Schneider
Synonyms	None
Common name(s)	European stone fruit yellows
Main hosts	This phytoplasma preferentially infect plants of the genus *Prunus*. *Prunus armeniaca, P. domestica, P. dulcis, P. persica, P. salicina* and *P. serrulata* are main hosts. Also detected in naturally infected plants of Celtis australis, *Corylus avellana, Fraxinus excelsior, Rosa canina* and *Vitis vinifera* (Marcone *et al.* 2010).
Distribution	Restricted distribution in Europe (France, Greece, Slovenia, and Switzerland) and Asia

	(Turkey). Few occurrences are reported from Belgium, Germany and Spain. Also known to occur in Albania, Austria, Bulgaria, Czech Republic, Hungary, Italy, Romania and Serbia (CABI/EPPO 2010).
Quarantine pest	'*Candidatus* Phytoplasma pyri' *Seemüller & Schneider*
Synonyms	Pear decline phytoplasma Seemüller et al.; Phytoplasma pyri [Candidatus] Seemüller & Schneider
Common name(s)	Pear decline
Main hosts	*Pyrus communis* is the main host. Also reported from *Catharanthus roseus, Corylus avellana, Cydonia oblonga, Malus domestica, Prunus salicina* and *Pyrus pyrifolia* (CABI 2011).
Distribution	Widespread in Europe (Germany, Italy and Switzerland) and USA (Connecticut). Restricted distribution in Europe (Croatia, Czech Republic, France, Greece, Netherlands, Poland, Slovakia, Slovenia, UK and Yugoslovia) (CABI 2011). Also reported from Canada (Hunter *et al.* 2010), Lebanon (Choueiri *et al.* 2007), Turkey (Serce *et al.* 2006) and Tunisia (Khalifa *et al.* 2007).
Quarantine pest	Clover Yellow Edge Phytoplasma
Synonyms	None
Common name(s)	None
Main hosts	Clover (Staniulis *et al.* 2000), *Corylus avellana* (Jomantiene *et al.* 2000), Strawberry (Jomantiene *et al.* 1999)
Distribution	Canada (Ontario and Quebec) (Nyvall 1999; Staniulis *et al.* 2000) and USA (Oregon (Jomantiene *et al.* 2000) and Maryland (Jomantiene *et al.* 1999)).
Quarantine pest	Oregon hazelnut stunt syndrome
Synonyms	None
Common name(s)	Filbert stunt
Main hosts	*Corylus avellana* (Postman *et al.* 2001).
Distribution	Oregon (Postman *et al.* 2001).
Quarantine pest	Tulare apple mosaic *ilarvirus*
Synonyms	None
Common name(s)	Hazelnut mosaic
Main hosts	*Corylus avellana* and *Malus* spp. (Fulton 1971; Scott and Zimmerman 2009)
Distribution	France and USA (Fulton 1971; Scott and Zimmerman 2009). This virus occurred on a single host in California, USA. However, this tree no longer exists and there are no further records of the natural occurrence of this virus in the USA.

Appendix D: Additional quarantine pest from all sources

ARTHROPODS	PATHOGENS
Cecidophyopsis vermiformis	*Armillaria mellea*
Eulecanium excrescens	*Armillaria gallica*
Gypsonoma dealbana	*Armillaria ostoyae*
Oberea linearis,	*Candidatus Phytoplasma mali*
Phenococcus aceris	*Candidatus Phytoplasma prunorum*
Zeuzera pyrina	*Candidatus Phytoplasma pyri*
	Clover Yellow Edge Phytoplasma
	Cryptosporiopsis tarraconensis
	Fomitiporia mediterranea
	Monilia coryli
	Monilinia fructigena
	Monostichella coryli
	Neonectria ditissima
	Oregon hazelnut stunt syndrome
	Phymatotrichopsis omnivora
	Phytophthora nemorosa
	Pseudomonas avellanae
	Pseudomonas syringae pv. coryli
	Pucciniastrum coryli
	Tulare apple mosaic virus

Glossary

Term or abbreviation	Definition
Additional declaration	A statement that is required by an importing country to be entered on a phytosanitary certificate and which provides specific additional information on a consignment in relation to regulated pests (FAO 2009).
Appropriate level of protection	The level of protection deemed appropriate by the Member establishing a sanitary or phytosanitary measure to protect human, animal or plant life or health within its territory (WTO 1995).
Area	An officially defined country, part of a country or all or parts of several countries (FAO 2009).
Biosecurity Australia	A prescribed agency, within the Australian Government Department of Agriculture, Fisheries and Forestry, responsible for recommendations for the development of Australia's biosecurity policy.
Certificate	An official document which attests to the phytosanitary status of any consignment affected by phytosanitary regulations (FAO 2009).
Consignment	A quantity of plants, plant products and/or other articles being moved from one country to another and covered, when required, by a single phytosanitary certificate (a consignment may be composed of one or more commodities or lots) (FAO 2009).
Control (of a pest)	Suppression, containment or eradication of a pest population (FAO 2009).
Endangered area	An area where ecological factors favour the establishment of a pest whose presence in the area will result in economically important loss (FAO 2009).
Entry (of a pest)	Movement of a pest into an area where it is not yet present, or present but not widely distributed and being officially controlled (FAO 2009).
Establishment	Perpetuation, for the foreseeable future, of a pest within an area after entry (FAO 2009).
Fruits and vegetables	A commodity class for fresh parts of plants intended for consumption or processing and not for planting (FAO 2009).
Host range	Species capable, under natural conditions, of sustaining a specific pest or other organism (FAO 2009).
Import Permit	Official document authorising importation of a commodity in accordance with specified phytosanitary import requirements (FAO 2009).
Import Risk Analysis	An administrative process through which quarantine policy is developed or reviewed, incorporating risk assessment, risk management and risk communication.
Infestation (of a commodity)	Presence in a commodity of a living pest of the plant or plant product concerned. Infestation includes infection (FAO 2009).
Inspection	Official visual examination of plants, plant products or other regulated articles to determine if pests are present and/or to determine compliance with phytosanitary regulations (FAO 2009).
Intended use	Declared purpose for which plants, plant products, or other regulated articles are imported, produced, or used (FAO 2009).
Interception (of a pest)	The detection of a pest during inspection or testing of an imported consignment (FAO 2009).
International Standard for Phytosanitary Measures	An international standard adopted by the Conference of FAO [Food and Agriculture Organization], the Interim Commission on phytosanitary measures or the Commission on phytosanitary measures, established under the IPPC (FAO 2009).
Introduction	The entry of a pest resulting in its establishment (FAO 2009).
National Plant Protection Organisation	Official service established by a government to discharge the functions specified by the IPPC (FAO 2009).
Official control	The active enforcement of mandatory phytosanitary regulations and the application of mandatory phytosanitary procedures with the objective of eradication or containment of quarantine pests or for the management of regulated non-quarantine pests (FAO 2006).

Term or abbreviation	Definition
Pathway	Any means that allows the entry or spread of a pest (FAO 2009).
Pest	Any species, strain or biotype of plant, animal, or pathogenic agent injurious to plants or plant products (FAO 2009).
Pest categorisation	The process for determining whether a pest has or has not the characteristics of a quarantine pest or those of a regulated non-quarantine pest (FAO 2009).
Pest Free Area	An area in which a specific pest does not occur as demonstrated by scientific evidence and in which, where appropriate, this condition is being officially maintained (FAO 2009).
Pest free place of production	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 (FAO 2009).
Pest free production site	A defined portion of a place of production in which a specific pest does not occur as demonstrated by scientific evidence and in which, where appropriate, this conditions is begin officially maintained for a defined period and that is managed as a separate unit in the same way as a pest free place of production (FAO 2009).
Pest Risk Analysis (agreed interpretation)	The process of evaluating biological or other scientific and economic evidence to determine whether an organism is a pest, whether it should be regulated, and the strength of any phytosanitary measures to be taken against it (FAO 2009).
Pest risk assessment (for quarantine pests)	Evaluation of the probability of the introduction and spread of a pest and the magnitude of the associated potential economic consequences (FAO 2009).
Pest risk management (for quarantine pests)	Evaluation and selection of options to reduce the risk of introduction and spread of a pest (FAO 2009).
Phytosanitary Certificate	Certificate patterned after the model certificates of the IPPC (FAO 2009).
Phytosanitary measure (agreed interpretation)	Any legislation, regulation or official procedure having the purpose to prevent the introduction and/or spread of quarantine pests, or to limit the economic impact of regulated non-quarantine pests (FAO 2009).
Phytosanitary regulation	Official rule to prevent the introduction and/or spread of quarantine pests, or to limit the economic impact of regulated non-quarantine pests, including establishment of procedures for phytosanitary certification (FAO 2009).
Plant Biosecurity	A work area within the Biosecurity Australia and the Australian Government Department of Agriculture, Fisheries and Forestry, responsible for recommendations for the development of Australia's biosecurity policy for plants and plant products.
Polyphagous	Feeding on a relatively large number of host plants from different plant families.
PRA area	Area in relation to which a Pest Risk Analysis is conducted (FAO 2009).
Quarantine pest	A pest of potential economic importance to the area endangered thereby and not yet present there, or present but not widely distributed and being officially controlled (FAO 2009).
Regulated article	Any plant, plant product, storage place, packaging, conveyance, container, soil and any other organism, object or material capable of harbouring or spreading pests, deemed to require phytosanitary measures, particularly where international transportation is involved (FAO 2009).
Restricted risk	Risk estimate with phytosanitary measure(s) applied.
Rhizomes	A horizontal plant stem with shoots above and roots below serving as a reproductive structure. Rhizomes may also be referred to as creeping rootstalks, or rootstocks
Spread	Expansion of the geographical distribution of a pest within an area (FAO 2009).
Stakeholders	Government agencies, individuals, community or industry groups or organizations, whether in Australia or overseas, including the proponent/applicant for a specific proposal, who have an interest in the policy issues.
Unrestricted risk	Unrestricted risk estimates apply in the absence of risk management measures.

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