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Biosecurity Australia

FINAL

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
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 is also free from several other pests of quarantine concern to Australia in hazelnuts. *Aegorhinus nodipennis*, *A. phaleratus*, *A. superciliosus*, *Armillaria mellea* and *Neonectria ditissima* are pests of concern which are present in Chile. *Armillaria mellea* and *Neonectria ditissima* are present in Chile they have not been recorded on hazelnut during surveys conducted by Servicio Agricola y Ganadero (SAG). Consequently, SAG offered to certify the absence of these pathogens in the mother orchards.

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

- Sourcing hazelnut soil- and foliage-free dormant rooted cuttings from a country with low pest status (i.e. out of 33 pathway-specific pests of quarantine concern, only five pests are present in Chile). Dormant rooted cuttings, sourced from mother plants that have been inspected and found to be free of pests, 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 rooted 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 and fungicidal treatment is applied no longer than seven days prior to export. Dormant rooted cuttings for export to Australia are inspected and certified by SAG officers immediately prior to export.
- Pre-export verification inspection by Department of Agriculture, Fisheries and Forestry (DAFF) officers and a DAFF-approved plant pathologist 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 an AQIS –approved 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 recommended systems approach.

Production of hazelnut dormant rooted cuttings in accordance with the recommended systems approach, phytosanitary inspection by SAG and an insecticidal/fungicidal 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 dormant rooted cuttings to open quarantine premises.

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.

Plant Biosecurity has made several changes following consideration of stakeholder comments on the *Draft review of policy – importation of hazelnut propagative material from Chile.* These changes include:

- the re-assessment of pathway association of three native weevils (*Aegorhinus* species) for Chile and inclusion of these weevils as pests of quarantine concern to Australia;
- the re-assessment of pathway association of two mites (*Aculus comatus* and *Cenopalpus pulcher*) for global pests and inclusion of these mites as quarantine pests of quarantine concern to Australia;
- the provision of extra information for wood decaying fungi (*Fomes, Phellinus* and *Phomopsis*) in the pest categorisation appendix; and
- the clarification of the pathway: due to the size and age of propagative material, bark and wood are not considered to be part of the import pathway.

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 recommended 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 dormant 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 (dormant rooted 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 dormant rooted 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 (DAFF) and experts from the New South Wales and Tasmanian governments conducted a verification visit to Chile in March 2011. This visit examined the 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 considers *Corylus* species to include all cultivars of any *Corylus* species which is permitted on the Import Conditions database.

In this assessment the import pathway is defined as soil- and foliage-free dormant rooted cuttings. Due to the size and age of the propagative material, bark and wood are not considered to be part of the import pathway. Small dormant rooted cuttings with a diameter of 12–15 mm are unlikely to support wood or bark affecting pests. These cuttings would not provide a pathway equivalent to tree trunks or branches which contain wood or bark.

1.2.3 Existing import policy for hazelnut propagative material from all sources

Propagative material (dormant 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 (dormant rooted cuttings)

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, 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 which pests of quarantine concern to Australia are present in Chile and the pest status of the plants 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 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 National Plant Protection Organisation (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*).

Chile has declared certain pests to be absent from the country based on the results of ongoing surveys and pest monitoring practices. Specifically, 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, declare the following pests are absent from mainland Chile:

- **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 during their ongoing surveys on hazelnut plantations in Chile are summarised in Table 1.2; a complete listing of all pests known to occur on hazelnut which are present in Chile is provided in the pest categorisation (Appendix 1).

Table 1.2 Pests recorded by SAG in hazelnut plantations in Chile

Pest type[2]	
ARTHROPODS	
Aegorhinus nodipennis (Hope, 1834)	*Myzocallis coryli* (Goeze, 1778)
Aegorhinus superciliosus (Guérin, 1830)	*Phytoptus avellanae* Nalepa, 1889
PATHOGENS	
BACTERIA	
Pseudomonas syringae pv. *syringae* van Hall	*Xanthomonas arboricola* pv. *corylina* (Miller *et al.*) Vauterin *et al.*
Rhizobium radiobacter (Beijerinck & van Delden) Young *et al.*	
FUNGI	
Botrytis cinerea Pers.	*Phomopsis* spp.
Cylindrocarpon spp.	*Phyllactinia guttata* (Wallr.) Lév.
Fusarium oxysporum Schltdl.	*Phytophthora cinnamomi* Rands
Pestalotiopsis spp.	*Sclerotinia minor* Jagger
NEMATODES	
Pratylenchus neglectus (Rensch 1924)	*Xiphinema americanum* Cobb, 1913
Helicotylenchus spp.	
VIRUSES	
Apple mosaic *ilarvirus* (ApMV) [Bromoviridae]	Prune dwarf *ilarvirus* (PDV) [Bromoviridae]

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 conducts regular surveys for potato cyst nematode (PCN) and this nematode has not been detected in the mother tree blocks or nurseries which may export to Australia[3].

1.4 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 for the risk. Plant Biosecurity identified arthropod pests and pathogens of quarantine concern and developed a pathway-specific pest list for hazelnut dormant rooted 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 five pests of quarantine concern to Australia are present in Chile. The conditions recommended 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.

[2] Full details about a pests' status in Australia and potential to be on the import pathway is provided in the pest categorisation in Appendix 1. Additional details of individual species known to occur on hazelnut which are present in Chile are also presented for those genus level records presented here.

[3] Hazelnut is not considered to be a host for potato cyst nematode; therefore, this pest is not considered further in this pest risk analysis.

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)		
Aculus comatus (Nalepa, 1892)	✓	X
Cecidophyopsis vermiformis (Nalepa, 1889)	✓	X
Cenopalpus pulcher (Canestrini & Fanzago 1876)	✓	X
COLEOPTERA (beetles, weevils)		
Aegorhinus nodipennis (Hope, 1834)	✓	✓
Aegorhinus phaleratus Erichson, 1834	✓	✓
Aegorhinus superciliosus (Guerin, 1830)	✓	✓
Oberea linearis (Linné 1758)	✓	X
HEMIPTERA (mealybugs, scales)		
Eulecanium excrescens (Ferris, 1920)	✓	X
Phenococcus aceris (Signoret, 1875)	✓	X
LEPIDOPTERA (moths, butterflies)		
Gypsonoma dealbana (Frolich, 1828)	✓	X
Zeuzera pyrina Linnaeus,1761	✓	X
PATHOGENS		
BACTERIA		
Pseudomonas avellanae Janse *et al.*	✓	X
Pseudomonas syringae pv. *coryli* Scortichini *et al.*	✓	X
FUNGI		
Anisogramma anomala (Peck) E. Müller	✓	X
Armillaria mellea (Vahl: Fr) P. Kummar	✓	✓
Armillaria gallica Marxm. & Romagn.	✓	X
Armillaria ostoyae (Romagn.) Herink	✓	X
Cryptosporiopsis tarraconensis Gené & Guarro	✓	X
Fomitiporia mediterranea M. Fischer	✓	X
Monilia coryli Schellenb.	✓	X
Monilinia fructigena Honey	✓	X
Monostichella coryli (Roberge ex Desm.) Höhn.	✓	X
Neonectria ditissima (Tul. & C. Tul.) Samuels & Rossman	✓	✓
Phymatotrichopsis omnivora (Duggar) Hennebert	✓	X
Pucciniastrum coryli Kom.	✓	X
Phytophthora nemorosa E.M. Hansen and Reeser	✓	X
Phytophthora ramorum Werres *et al.*	✓	X
PHYTOPLASMAS		
'*Candidatus* Phytoplasma mali' Seemüller & Schneider	✓	X
'*Candidatus* Phytoplasma prunorum' Seemüller & Schneider	✓	X
'*Candidatus* Phytoplasma pyri' Seemüller & Schneider	✓	X
Clover Yellow Edge Phytoplasma	✓	X
UNKNOWN EITIOLOGY		
Oregon hazelnut stunt syndrome (HSS)	✓	X
VIRUSES		
Tulare apple mosaic *ilarvirus* (TAMV)	✓	X

2 Chile's commercial production practices for hazelnut

2.1 Production of dormant rooted cuttings

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

2.1.1 Production of dormant rooted cuttings from mother plants

Dormant 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 a 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 dormant rooted cuttings

The harvested dormant rooted 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 rooted cuttings treatment with disinfectant and growth hormone

2.1.2 Production of dormant rooted cuttings in the nurseries

Dormant rooted cuttings which have undergone post-harvest treatment are dried and planted in soil-free media 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 rooted 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 pasteurized 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 rooted 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 rooted 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 **pasteurized soil-less media** (this process reduces the likelihood of soil-borne insects and 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 dormant rooted cuttings

The cuttings produced in the nurseries are removed when they are dormant. Dormant rooted 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 Dormant rooted 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 late December.

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 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: *Glossary of phytosanitary terms* (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- and foliage-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 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 PRA and risk is estimated through a standard set of factors that contribute to introduction, establishment, spread or economic impact potential. A pest risk assessment evaluates the unrestricted pest risk to determine if the risk is sufficient to justify management. In this PRA, the pest risk assessment was conducted using three consecutive steps: 1) pest categorisation; 2) assessment of the probability of entry, establishment and spread; and 3) 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 dormant rooted 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 dormant rooted cuttings, 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 dormant rooted cuttings from Chile identified in the pest categorisation are listed in Table 3.1. These pests fulfil the International Plant Protection Convention (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 of hazelnut dormant rooted cuttings from Chile

Pests	Common name
ARTHROPODS	
Aegorhinus nodipennis (Hope, 1834)	Plum capachitos
Aegorhinus phaleratus Erichson, 1834	Peach root borer
Aegorhinus superciliosus (Guerin, 1830)	Raspberry weevil
FUNGI	
Armillaria mellea (Vahl: Fr) P. Kummar	Armillaria root rot
Neonectria ditissima (Tul. & C. Tul.) Samuels & Rossman	Neonectria canker

These pests are recorded in Chile (SAG 2011a; Minter and Peredo Lopez 2006; Gutierrez *et al*. 2005; Lemus 2004; Klein Koch and Waterhouse 2000); however, *Armillaria mellea* and *Neonectria ditissima* 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).

ISPM 11 states that 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 establishes the arthropod 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 arthropod 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 en 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/infested propagative material is the main pathway for the introduction of the pests into new areas. This mode of introduction is greatly enhanced by latency periods for pathogens or cryptic behaviour of arthropods, as conspicuous symptoms may not develop immediately. Long latency/cryptic periods can lead to the propagation and distribution of infected/infested propagative material prior to obvious symptoms appearing/damage occurring.
- The pests associated with propagative material may be systemic or associated with the vascular system (or occur internally in the nursery stock) and may not be dislodged during standard harvesting, handling and shipping operations. Therefore, pests associated with propagative material are likely to survive during transport.
- The ability to overwinter could allow pathogens or arthropod pests to survive potentially suboptimal conditions during harvesting, handling or shipping. Careful handling of plant propagative material to maintain plant health would assist the pests in surviving within the host plant. Propagative material hosting pests could then be distributed and propagated throughout Australia.

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. For arthropods, this may also include the ability to actively seek out suitable alternative hosts. 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 establishes the arthropod pests and pathogens associated with the propagative material.
- A latent or cryptic period of infection/infestation before visible symptoms appear may result in non-detection of pests; therefore, the pests will have ample time to establish in new areas.
- Pests that overwinter may remain undetected in the host plant until environmental conditions are suitable to complete their life cycle.

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, as nursery stock is commonly traded across large areas of Australia.
  - Some pest specific factors are likely to impact upon a pest's ability to spread once it has established in Australia. For example, the likelihood of spread may increase if a pest can be spread by vectors, wind, water, mechanical transmission or independent means (e.g. flight, crawling). For arthropod pests, this may include the ability to attract mates or actively seek suitable alternative hosts on which to spread. Where appropriate, these considerations are addressed in the potential for establishment and spread field of the pest categorisation.
- 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/infested propagative material will bring the pests into the environment. The systemic or cryptic nature of 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/infested 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 Sanitary and Phytosanitary Agreement, in particular Article 5.3 and Annex A. Further details 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 (*Aegorhinus nodipennis*, *A. phaleratus*, *A. superciliosus*, *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 increased pest 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.
- *Aegorhinus* weevils are considered serious pests of hazelnuts and other fruit crops in Chile (Mutis *et al*. 2010; Grau *et al*. 2001). Larval activity is the primary cause of damage to crops, and can result in plant death (Mutis *et al*. 2010; Parra *et al.* 2009b). In addition, the adult weevils cause damage to shoots, leaves and fruits (Parra *et al*. 2009b). In severe cases, host plants are defoliated, sometimes causing plant death (Parra *et al*. 2009b). Additionally, the European Community considers *Aegorhinus* weevils as of quarantine concern. This can result market access issues resulting from biosecurity risks posed by the presence of these weevils.
- 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).
- Economic losses caused by *Neonectria ditissima* are the most severe on apples and pears, although losses to forest trees such as *Acer*, *Betula* and *Fagus* have also been recorded (CABI 2011). 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; Swinburne 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 this pathogen.

Aegorhinus nodipennis, *A. phaleratus*, *A. superciliosus, 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.

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:

- Importation from pest free areas only—the establishment and use of a pest free area by a NPPO provides for the export of plants from an exporting country to an 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 importation 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 (PFA) are set out in ISPM 4: *Establishment of pest free areas* (FAO 1995). ISPM 4 (FAO 1995, p. 37) identifies a PFA 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 PFA by a 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 ALOP 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.

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 (FAO 2001; p. 144) states that importing countries should only require Phytosanitary Certificates for regulated articles including 'plants, bulbs and tubers, or seeds for propagation, fruits and vegetables, cut flowers and branches, grain, and growing medium'.

4 Risk management measures for hazelnut dormant rooted 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, Phytophthora ramorum* and other pathogens into Australia. Based on technical discussions, production site visits to Chile (March 2011), published literature and other available information, Plant Biosecurity considers that Chile is free of these two pathogens.

Three weevils, *Aegorhinus nodipennis*, *A. phaleratus* and *A. superciliosus*, are known to occur on hazelnuts in Chile. However, 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. It is recommended that suitable risk management measures be applied to manage the risk of introduction of these pests.

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

Australia has well established policy to import hazelnut dormant rooted 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 dormant rooted cuttings are subject to specific quarantine/biosecurity measures. These conditions include certification that the plant has been grown in a soil-free media and are available on the AQIS Import CONditions database (ICON) at http://www.aqis.gov.au/icon.

Australia's existing policy for dormant rooted 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:

- 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; 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.

4.2 Recommended risk management measures for dormant rooted cuttings from Chile

An 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.

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

- Chile's low pest status;
- high health production systems for the dormant rooted cuttings to be exported;
- regular pest monitoring of nurseries and plantations by SAG;
- pre-export treatment of dormant rooted 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.

Low pest status

Out of 33 pathway-specific pests identified during the review of hazelnut propagative material, only two pathogens (*Armillaria mellea* and *Neonectria ditissima*) and three weevils (*Aegorhinus nodipennis*, *A. phaleratus* and *A. superciliosus*) 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.

4.2.1 Sourcing dormant rooted cuttings from pest free mother stock

Hazelnut dormant rooted cuttings will be sourced from mother stock which is 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 pathogens 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 rooted cuttings.

4.2.2 Disinfestation and growth of dormant rooted cuttings in pasteurized media

The dormant rooted 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.

4.2.3 Growth in nurseries (propagation tunnel and open space) registered with SAG

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.

4.2.4 Regular monitoring by SAG

Plants established from dormant rooted 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.

4.2.5 Pest control in the production nurseries

Plants established from dormant rooted 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 dormant rooted hazelnut cuttings.

4.2.6 Treatment

In addition to the routine control of pests in the production nurseries, the dormant rooted 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 rooted cuttings for export to Australia will have the insecticidal and fungicidal treatment no longer than seven days prior to export under SAG supervision. The dormant rooted cuttings will be immersed or drenched in a solution of broad spectrum insecticide and fungicide prior to export to Australia. The treatment of cuttings with an insecticide immediately prior to export is considered to be adequate to address the risk of weevil species of quarantine concern entering Australia.

4.2.7 Inspection

Inspections are an integral phytosanitary measure to verify appropriate risk management measures have been successful in managing pest risks. The dormant rooted 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 rooted cuttings will be inspected in SAG approved quarantine houses for evidence of arthropod pests and diseases.

4.2.8 Off-shore verification inspection

Off-shore verification inspection is an option which will be employed for large consignments of hazelnut propagative material. DAFF officers will observe the application of the treatment and the phytosanitary inspection by SAG officers in Chile prior to export. Following the application of the treatment and SAG inspection, the consignment will be inspected by DAFF officers and a DAFF-approved plant pathologist familiar with the diseases of hazelnuts. When utilised, this inspection will replace the inspection conducted by AQIS on–arrival in Australia. Only dormant rooted cuttings which have been inspected in Chile and found free of quarantine pest symptoms will be eligible for export to Australia. Smaller consignments may be exempted from off-shore verification inspection; this will be determined on a case by case basis.

For consignments where off-shore verification inspection is not used, the pre-export treatment will still apply and be certified by SAG. The consignment will be inspected on-arrival in Australia by AQIS. If no live arthropod pests or disease symptoms are found during the on-shore inspection, then the consignment can be transferred to the open quarantine facility, as described below. Should any live quarantine pests or disease symptoms be found during on-arrival inspection, AQIS will take remedial action. 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; or
- transfer of the consignment to a government quarantine facility (rather than open quarantine) with disease screening, where suspected quarantine diseases are detected.

4.2.9 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 DAFF officers. Audits may be conducted at the discretion of DAFF, and with the agreement of SAG, during the entire production cycle. DAFF officers will audit the production system annually for the initial trade. This requirement will be reviewed after significant trade has occurred.

DAFF 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.

4.2.10 Growth in open quarantine facilities

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

During the quarantine period, it is recommended that regular monitoring of the imported plants be undertaken by an AQIS-approved 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 appropriate remedial action must be taken.

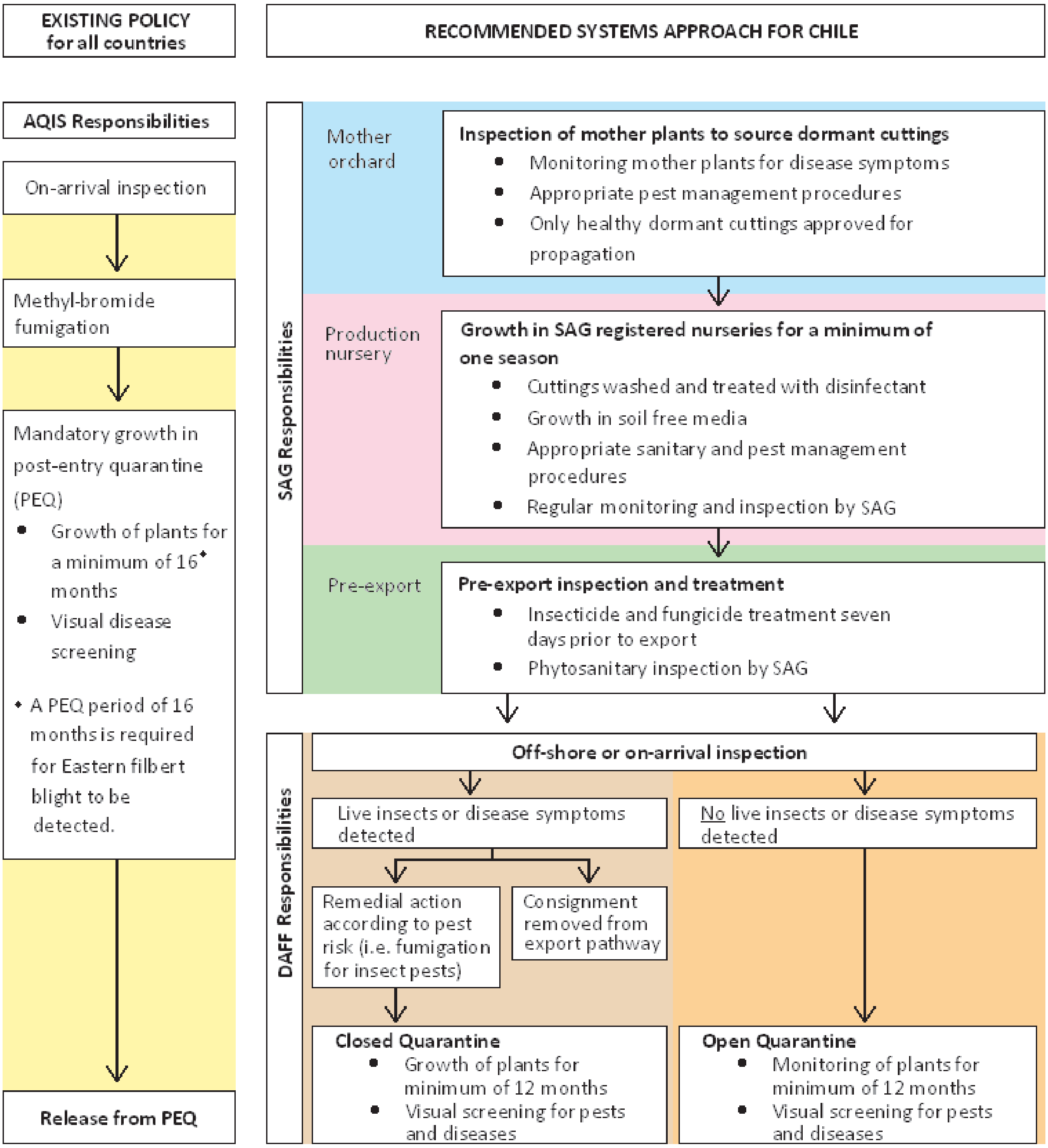
4.3 Evaluation of recommended systems approach for hazelnut dormant rooted cuttings from Chile

The evaluation of recommended 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 dormant rooted cuttings produced in Chile identified *Aegorhinus nodipennis*, *A. phaleratus*, *A. superciliosus*, *Armillaria mellea* and *Neonectria ditissima* as pests of quarantine concern. The recommended 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 recommended for importation of dormant rooted cuttings from Chile, a comparison diagram is presented in Figure 4.1.

Figure 4.1 Comparison of existing import policy (from all sources) with the recommended 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.

The systems approach recommended in this report is considered adequate to address the risk posed by arthropod pests. Hence the application of a mandatory methyl-bromide fumigation does not appear to be justified. The systems approach including regular chemical applications to the dormant 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 recommended 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 dormant rooted cuttings from Chile is maintained and verified during the export process to Australia.

4.3.1 Registration of export nurseries and mother orchards

Hazelnut dormant rooted 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 dormant rooted 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 rooted 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 will 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 packinghouses 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 dormant rooted cuttings for SAG auditing and DAFF monitoring purposes.

The objectives of these recommended procedures are to ensure that:

- hazelnut dormant rooted 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 dormant rooted 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 dormant rooted cuttings 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 dormant rooted 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 dormant rooted 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 dormant rooted 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 dormant rooted 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 recommended 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 dormant rooted cuttings in this consignment have been produced in Chile in accordance with the conditions governing entry of hazelnut dormant rooted 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 DAFF

The objective of this recommended procedure is to ensure that:

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

Hazelnut dormant rooted cuttings cleared under off-shore verification inspection in Chile would only undergo on-arrival verification in Australia. AQIS would examine documents for compliance and verify 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 PEQ 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 DAFF

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. 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, *Aculus comatus, Cecidophyopsis vermiformis*, *Cenopalpus pulcher*, *Eulecanium excrescens*, *Gypsonoma dealbana*, *Oberea linearis*, *Phenococcus aceris, Zeuzera pyrina*, *Anisogramma anomala*, *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*, *Phytophthora ramorum*, *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 Recommended risk management measures for hazelnut propagative material from all sources (excluding Chile)

Although this PRA deals primarily with the recommended importation of hazelnut dormant 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, dormant rooted 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 dormant rooted cuttings). Plant Biosecurity has evaluated the existing policy for hazelnut propagative material (seed, dormant rooted cuttings and tissue culture) from all sources other than Chile and recommended additional measures, where required.

5.1 Recommended 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 seeds 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 dormant rooted cuttings

Australia's existing policy to import hazelnut dormant rooted cuttings includes: soil-free dormant rooted cuttings, growth in soil-less media (and certification to this effect on the Phytosanitary Certificate), 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 recommended 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 *Aculus comatus* overwinters under the bud scales (Krantz 1973); *Cecidophyopsis vermiformis* overwinter in buds and complete their life cycles in buds (Özman and Toros 1997); *Cenopalpus pulcher* overwinters in the buds (Jeppson *et al*. 1975); *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 dormant rooted cuttings. Therefore, additional risk management measures are required for these pests.

Mandatory on-arrival fumigation of dormant rooted cuttings from all sources is supported. Treatments for hazelnut dormant rooted 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, and life stages, likely to be associated with the commodity.

Mandatory growth in closed government PEQ facilities with pathogen screening

Mandatory growth of imported hazelnut dormant rooted cuttings in closed government PEQ facilities is applied to screen for pathogen freedom. Growing imported dormant rooted 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 dormant rooted 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 recommends 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 dormant rooted 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 recommended 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 must be cut out from the margin between the healthy and infected area, using a sterile scalpel, and placed onto the culture medium.
- **Biochemical tests** must 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.

Phytoplasmas

Phytoplasmas 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 the United States 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 viral pathogen for hazelnut propagative material of quarantine concern to Australia is Tulare apple mosaic virus.

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

5.1.3 Propagative material from *Phytophthora ramorum* host countries

The existing policy for prohibiting propagative material (other than tissue cultures) from *Phytophthora ramorum* host countries is supported to prevent the entry of this fungal pathogen through this pathway into Australia. Plant Biosecurity also recommends 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 final review of policy are based on a comprehensive analysis of the scientific literature. Plant Biosecurity considers that the risk management measures recommended in this final 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 recommended a systems approach to import hazelnut dormant rooted 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 dormant rooted 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 recommended systems approach includes:

- Sourcing hazelnut dormant rooted cuttings from a country with a low pest status (i.e. out of 33 pathway-specific pests of quarantine concern, only five pests are present in Chile). Dormant rooted cuttings, sourced from mother plants that have been inspected and found to be free of pests, 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 rooted 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. Dormant rooted cuttings for export to Australia are inspected and certified by SAG officers immediately prior to export.
- Pre-export verification inspection by DAFF officers and a plant pathologist immediately prior to export within approved production facilities for evidence of arthropod pests and diseases will be applied for large volumes of dormant rooted cuttings.

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

Production of hazelnut dormant rooted cuttings in accordance with the recommended 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 dormant rooted 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 recommended 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- and foliage-free dormant rooted 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[4]	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 2011a)	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]	Yes (SAG 2011b)	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		

[4] 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[4]	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	**Yes:** The adults and larvae of these curculionid weevil are associated with *Corylus avellana* (Grau *et al*. 2001). Eggs are laid on or underneath the soil surface, but occasionally on the leaves or stems of host plants (Parra *et al*. 2009a, b; Carillo *et al*. 2002). The larvae feed on the phloem of the roots and rootlets (Grau *et al*. 2001; France *et al*. 2000) and later on larvae can bore galleries into the roots and remain inside the gallery for part of their development (France *et al*. 2000) and pupate within the main root.. Larger roots may harbour developing larvae or pupae and provide pathway for these weevils. However, the roots of the proposed dormant cuttings are too	**Yes:** *Aegorhinus* species are widely distributed in southern Chile (Grau *et al*. 2001). *Aegorhinus superciliosus* is also reported from Argentina (Parra *et al*. 2009b). There are similar climatic regions in parts of Australia that would be suitable for the establishment and spread of these species. *Aegorhinus superciliosus* has a wide host range that includes strawberry, currant, gooseberry, raspberry, blueberry, apple and plum (Parra *et al*. 2009b). These hosts are present in Australia. *Aegorhinus* species do not require an alternative host to complete their life cycle (Grau *et al*. 2001). Therefore, these species have the potential	**Yes:** While these weevils are considered serious pests of hazelnut in Chile (Grau *et al*. 2001), no quantification of their impact in hazelnuts has been conducted. In other hosts, the damage is primarily caused by the root - feeding larvae, however the adult weevils also cause damage to shoots, leaves and fruits (Mutis *et al*. 2010; Mutis *et al*. 2009; Parra *et al*. 2009a, b). In severe cases host plants can become completely defoliated and die (Parra *et al*. 2009a, b). These weevils are identified by the European Union as being of quarantine concern, therefore the establishment of these species in Australia will impact on trade. Therefore, *Aegorhinus* species have the potential for economic	**Yes**
Aegorhinus phaleratus Erichson, 1834 [Coleoptera: Curculionidae]	Yes (Klein Koch and Waterhouse 2000)	Not known to occur				**Yes**
Aegorhinus superciliosus (Guérin, 1830) [Coleoptera: Curculionidae]	Yes (Klein Koch and Waterhouse 2000; Lemus 2004; SAG 2011a)	Not known to occur				**Yes**

Pest	Present in Chile	Present within Australia	Potential to be on pathway	Potential for establishment and spread	Potential for economic consequences[4]	Quarantine pest (yes/no)
			small to support these life stages. Nevertheless young larvae may contaminate the roots. Therefore, *Corylus* rooted cuttings may provide a pathway for these species to enter Australia.	for establishment and spread in Australia.	consequences in Australia.	
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: *Hylamorpha elegans* has been recorded on *Corylus* species (Klein Koch and Waterhouse 2000). The larvae of this scarabaid beetle feed externally on plant roots and soil organic matter (Millas and Carrillo 2010). Adult beetles defoliate species of *Nothofagus, Pinus, Fraxinus* and *Betula* (FAO 2008). As this species occurs externally on the roots it is not considered to be on the export pathway.	Assessment not required.		
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:	Yes (Klein Koch and Waterhouse 2000)	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[4]	Quarantine pest (yes/no)
Diaspididae]						
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 2011a)	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 *et al.* 2002). Foliage free dormant cuttings therefore do not provide a pathway for this moth.	Assessment not required		
Plodia interpunctella (Hübner, 1813) [Lepidoptera: Pyralidae]	Yes (Klein Koch and Waterhouse 2000)	Yes (CSIRO 2005)	Assessment not required			
THYSANOPTERA (thrips)						
Thrips australis (Bagnall, 1915)	Yes (Klein Koch and	Yes (CSIRO 2005)	Assessment not required			

Pest	Present in Chile	Present within Australia	Potential to be on pathway	Potential for establishment and spread	Potential for economic consequences[4]	Quarantine pest (yes/no)
[Thysanoptera: Thripidae]	Waterhouse 2000)					
PATHOGENS						
BACTERIA						
Pseudomonas syringae pv. *syringae* van Hall, 1902 [Pseudomonadales: Pseudomonadaceae]	Yes (France 2007; Acuna 2010; SAG 2011a)	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 2011a)	Yes (APPD 2011)	Assessment not required			
Xanthomonas arboricola pv. *corylina*[5] (Miller *et al.* 1940) Vauterin *et al.* 1995 [Xanthomonadales: Xanthomonadaceae]	Yes (France 2007; Acuna 2010; Ferrada 2010; SAG 2011a)	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: Pleosporaceae]	Yes (Minter and Peredo Lopez 2006)	Yes (Webley *et al.* 1997)	Assessment not required			
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;	**Yes:** *Armillaria mellea* is established in areas with a wide range of climatic	**Yes:** *Armillaria mellea* is destructive root-rot pathogen of trees (Deacon 2011). It is	**Yes**

[5] Some strains of *X. arboricola* pv. *corylina* have been recorded globally; however, no geographic relationship between the strains has been demonstrated and there is no recorded significant difference between the pathogenicity of the strains (Scortichini *et al.* 2002). Consequently, there is no technical reason why individual strains should be considered separately in this pest categorisation. If further information becomes available about differences amongst strains of *X. aboricola* pv. *corylina*, or if new strains are detected, Plant Biosecurity will reconsider their inclusion in the pest categorisation.

[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**[4]	**Quarantine pest (yes/no)**
			Farr and Rossman 2011). This fungus is a 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.	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.	mainly a pathogen of broadleaved trees but it can also kill young coniferous trees (Deacon 2011). *Armillaria* species are considered to be of quarantine significance by several countries. The 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.	
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 on *Corylus* species (Farr and Rossman 2011). However, since this fungus prefers dead or decaying materials it is unlikely to be found on semi-hardwood dormant cuttings.	Assessment not required		
Botryosphaeria obtusa (Schwein.) Shoemaker [Botryosphaeriales:	Yes (Minter and Peredo Lopez 2006)	Yes (Punithalingam and Waller 1973)	Assessment not required			

Pest	Present in Chile	Present within Australia	Potential to be on pathway	Potential for establishment and spread	Potential for economic consequences[4]	Quarantine pest (yes/no)
Botryosphaeriaceae]						
Botrytis cinerea Pers. [Helotiales: Screotiniaceae]	Yes (Acuna 2010; SAG 2011a)	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 provide a pathway for this fungus.	Assessment not required		
Cylindrocarpon ianthothele Wollenw. var. *majus* Wollenw., Z. Parasitenk	Yes (Brayford *et al.* 2004)	Yes (Brayford *et al.* 2004)	Assessment not required			

Pest	Present in Chile	Present within Australia	Potential to be on pathway	Potential for establishment and spread	Potential for economic consequences[4]	Quarantine pest (yes/no)
(synonym: *Neonectria discophora* (Mont.) Mantiri & Samuels) [Hypocreales: Nectriaceae]						
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. Tul. (synonym: *Diatrype flavovirens* (Pers.) Fr.) [Xylariales: Diatrypaceae]	Yes (Minter and Peredo Lopez 2006)	Not known to occur	No: This species has been 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.	Assessment not required		
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	Assessment not required		
Eutypella sorbi (Alb. & Schwein.) Sacc. [Xylariales: Diatrypaceae]	Yes (Minter and Peredo Lopez 2006)	Not known to occur		Assessment not required		

Pest	Present in Chile	Present within Australia	Potential to be on pathway	Potential for establishment and spread	Potential for economic consequences[4]	Quarantine pest (yes/no)
			predominantly saprobic on angiosperm bark (Pildain *et al.* 2005) and are associated with dead branches of host trees (Chlebicki 2005). Dormant cuttings therefore, do not provide a pathway for these fungi.			
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 species generally acts as a wood decomposing fungus and is found on standing and fallen hardwood, causing a white rot (Kuo 2010). In other host species it has been recorded in healthy wood; however, this has not been recorded in hazelnuts. Semi-hardwood dormant cuttings may not provide a pathway for this fungus.	Assessment not required		
Fusarium oxysporum Schltdl. [Hypocreales: Nectriaceae]	Yes (SAG 2011a)	Yes (APPD 2011)	Assessment not required			
Gibberella baccata (Wallr. Sacc.) [Hypocreales: Nectriaceae] (synonym: *Fusarium lateritium*)	Yes (HerbIMI 2011b)	Yes (Hyun and Clark 1998)	Assessment not required			
Hypocrea gelatinosa (Tode) Fr. [Hypocreales: Hypocreaceae] (synonym: *Creopus gelatinosus* (Tode) Link)	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[4]	Quarantine pest (yes/no)
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* Pers. P. Kumm.)	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 a saprobe (McKnight and McKnight 1987; Shohet *et al.* 2008; Heilmann-Clausen 2005). Dormant cuttings therefore may not provide a pathway for entry of this fungus.	Assessment not required		

Pest	Present in Chile	Present within Australia	Potential to be on pathway	Potential for establishment and spread	Potential for economic consequences[4]	Quarantine pest (yes/no)
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 occur 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 do exist for it to establish in Australia.	**Yes:** Although no information is available on losses caused by this fungus on hazelnut, 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 a significant reduction in log quality and therefore reduction in market value (Plante and Bernier 1997). Therefore, 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: Amphisphaeriaceae]	Yes (Espinoza *et al.* 2008)	Yes (APPD 2011)	Assessment not required			
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	Assessment not required		
Phellinus igniarius (L.) Quél.	Yes (Minter and	Not known to occur		Assessment not required		

Pest	Present in Chile	Present within Australia	Potential to be on pathway	Potential for establishment and spread	Potential for economic consequences[4]	Quarantine pest (yes/no)
[Hymenochaetales: Hymenochaetaceae] (synonym: *Phellinus alni* (Bondartsev) Parmasto)	Peredo Lopez 2006)		primarily through wounds exposing sapwood or heartwood. Semi-hardwood dormant cuttings may not provide a pathway for this fungus.			
Phomopsis avellana Petr. [Diaporthales: Valsaceae]	Yes (SAG 2011a)[7]	Not known to occur	No: *Phomopsis avellana* is associated with the dead branchlets of *Corylus avellana* in the Czech Republic (Petrak 1931). Members of the genus are also known to cause kernel mold on hazelnuts (Pscheidt and Stone 2001). While some members of the genus are endophytic in woody plants (Rossman *et al.* 2007; Wadia *et al.* 2000), there are no records of *P. avellana* occurring as an endophyte in healthy *Corylus avellana*.	Assessment not required		
Phyllactinia guttata (Wallr.) Lév. [Erysiphales: Erysiphaceae] (synonym: Phyllactinia corylea (Pers.) P. Karst)	Yes (France 2007; Acuna 2010; SAG 2011a)	Yes (Farr and Rossman 2011)	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.	Yes (de Silveira	Yes (APPD 2011)	Assessment not required			

[7] *Phomopsis* species has been recorded on *Corylus* in Chile (SAG 2011a); however, it has not been identified up to species level. *Phomopsis avellana* has been noted on hazelnut in other countries (Farr and Rossman 2011); therefore, it is likely that the species recorded in Chile is *Phomopsis avellana*. Recently *P. revellens* has been recorded on hazelnut in North America (WSU 2011); there is no evidence that this species is present in Chile.

Pest	Present in Chile	Present within Australia	Potential to be on pathway	Potential for establishment and spread	Potential for economic consequences[4]	Quarantine pest (yes/no)
[Polyporales: Polyporaceae]	2006)					
Rosellinia corticium (Schwein.) Sacc. [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). *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.	Assessment not required		
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 2011a)	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			

Pest	Present in Chile	Present within Australia	Potential to be on pathway	Potential for establishment and spread	Potential for economic consequences[4]	Quarantine pest (yes/no)
Stereum rugosum Pers. [Russulales: Stereaceae]	Yes (Minter and Peredo Lopez 2006)	Yes (APPD 2011)	Assessment not required			
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			

Pest	Present in Chile	Present within Australia	Potential to be on pathway	Potential for establishment and spread	Potential for economic consequences[4]	Quarantine pest (yes/no)
VIRUSES						
Apple mosaic *ilarvirus* (ApMV) [Bromoviridae]	Yes (SAG 2011a)	Yes (Snare 2006)	Assessment not required			
Prune dwarf *ilarvirus* (PDV) [Bromoviridae]	Yes (Herrera and Madariaga 2002; SAG 2011a)	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						
Helicotylenchus dihystera (Cobb) Sher [Tylenchida: Hoplolaimidae]	Yes (CABI/EPPO 2010a)	Yes (McLeod 1994)	Assessment not required			
Pratylenchus neglectus (Rensch 1924) [Tylenchida: Pratylenchidae]	Yes (SAG 2011a)	Yes (Taylor *et al.* 2000)	Assessment not required			
Xiphinema americanum Cobb, 1913 [Dorylaimida: Longidoridae]	Yes (SAG 2011a)	Yes (Quader *et al.* 2003)	Assessment not required			

Appendix B: Additional quarantine pest data (Chile)

Quarantine pest	*Aegorhinus nodipennis* (Hope, 1834)
Synonyms	None
Common name(s)	Plum capachitos
Main hosts	*Corylus avellana, Drimys winteri* and *Nothofagus* spp. (Grau *et al*. 2001; Koch and Waterhouse 2000)
Distribution	Chile (Grau *et al*. 2001)
Quarantine pest	*Aegorhinus phaleratus* Erichson, 1834
Synonyms	None
Common name(s)	Peach root borer
Main hosts	*Castanea sativa*, *Corylus avellana, Cydonia oblonga*, *Fragaria ananassa*, *Prunus* spp., *Pyrus communis* and *Salix viminalis* (Grau *et al*. 2001; Klein Koch and Waterhouse 2000)
Distribution	Chile (Parra *et al*. 2009*a*; Grau *et al*. 2001)
Quarantine pest	*Aegorhinus superciliosus* (Guérin, 1830)
Synonyms	None
Common name(s)	Raspberry weevil
Main hosts	*Corylus avellana, Fragaria ananassa*, *Nothofagus* spp., *Ribes* spp., *Rubus* spp. and *Vaccinium corymbosum* (Parra *et al*. 2009*b*; Grau *et al*. 2001; Klein Koch and Waterhouse 2000)
Distribution	Argentina and Chile (Mutis *et al*. 2010; Carillo *et al*. 2002; Grau *et al*. 2001)
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). The main hosts include: *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 (CABI 2011). *Armillaria mellea* is also known to occur on *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) (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). The main hosts are *Acer saccharum*, *Betula alleghaniensis* and *Pyrus communis*; and 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 (China, Japan), Africa (Madagascar, South Africa). Also reported in South America (Argentina, Chile, Uruguay) and New Zealand (CABI 2011; Farr and Rossman 2011)

Appendix C: *Aegorhinus* species (cabrito)

The larvae of native *Aegorhinus* weevils are important pests of introduced fruit trees in Chile (Carillo *et al*. 2002). The following three native curculionid weevils have been recorded on hazelnut in Chile (SAG 2011a; Klein Koch and Waterhouse 2000):

- *Aegorhinus nodipennis* (Hope, 1834);
- *Aegorhinus phaleratus* Erichson, 1834; and
- *Aegorhinus superciliosus* (Guérin, 1830).

Aegorhinus superciliosus is a serious pest of fruit crops in southern Chile (Para *et* al. 2009a), such as berries (Aguilera and Rebolledo 2001), gooseberries (Parra *et al*. 2009a) and hazelnuts (Grau *et al*. 2001). *Aegorhinus phaleratus* is also considered a serious pest of hazelnuts (Grau *et al*. 2001). Larvae of these weevils feed on the bark and the main root (Grau *et al*. 2001). However, no information is provided on economic losses caused by these weevils in hazelnuts. Due to the economic importance of *Aegorhinus superciliosus* (raspberry weevil) on various fruit tree hosts, there is more published information on this weevil. Therefore, unless otherwise stated, the majority of information provided here refers to *A. superciliosus*; it is expected that the similarities in biology mean the the three species can be considered together.

Distribution: *Aegorhinus nodipennis*, *A. phaleratus* and *A. superciliosus* are native to southern Chile (Mutis *et al*. 2009). However, *Aegorhinus superciliosus* has also been found in the Neuquén district of Argentina (Kuschel 1951).

Host(s): *Aegorhinus nodipennis* is associated with *Corylus avellana*, *Drimys winteri* and *Nothofagus* species (Grau *et al*. 2001; Kein Kloch and Waterhouse 2000). *Aegorhinus phaleratus* occurs on *Castanea sativa, Corylus avellana*, *Cydonia oblonga*, *Fragaria ananassa*, *Prunus* species, *Pyrus communis* and *Salix viminalis* (Grau *et al*. 2001; Kein Kloch and Waterhouse 2000). *Aegorhinus superciliosus* is a pest of *Fragaria* spp.*Rubus* spp., *Vaccinium* spp. (Aguilera and Rebolledo 2001), *Ribes* spp. (Parra *et al*. 2009a), *Corylus* spp. (Grau *et al*. 2001) and *Nothofagus* species (Kein Kloch and Waterhouse 2000).

Damage: Damage is primarily caused by the root-feeding larvae; however, the adult weevils also cause damage to shoots, leaves and fruits of host plants (Mutis *et al*. 2010; Mutis *et al*. 2009; Parra *et al*. 2009a, b). In severe cases, host plants are killed from either the root-boring activity of the larvae or by complete defoliation by adult weevils (Mutis *et* al. 2009; Parra *et al*. 2009a, b).

Biology: *Aegorhinus* weevils have four life stages (Figure 1): eggs, larvae (several stages), pupae and adults (Aguilera and Rebolledo 2001; Parra *et al*. 2009a). The eggs are small (length 1.55±0.10 mm and width 1.23±0.98 mm) (Parra *et al*. 2009a) and are laid on or next to host plants (Carillo *et al*. 2002).

The newly emerged larvae are approximately 1.5 mm long (Parra *et al*. 2009a) when fully developed larvae are about 2 cm long (Parra *et al*. 2009a). Larvae feed on the roots and rootlets (Grau *et al.* 2001; France *et al*. 2000) and the collar of the stem (Parra *et al*. 2009a). The larvae may bore galleries into the main roots and remain inside this gallery for part of their development (France *et al*. 2000). These galleries may reach the collar of the plant (Parra *et al*. 2009a). The boring activity of the larvae can result in plant death (Parra *et al*. 2009a). Pupation occurs in the soil or inside galleries bored in the main root (Parra *et al*. 2009a). The pupae are on average 15.25 mm long and 7.73 mm wide (Parra *et al*. 2009a).

Figure A: Life stages of *Aegorhinus superciliosus* a) eggs and larvae, b) pupae and c) adults

a)

b)

c)

Source: Para *et al*. (2009a)

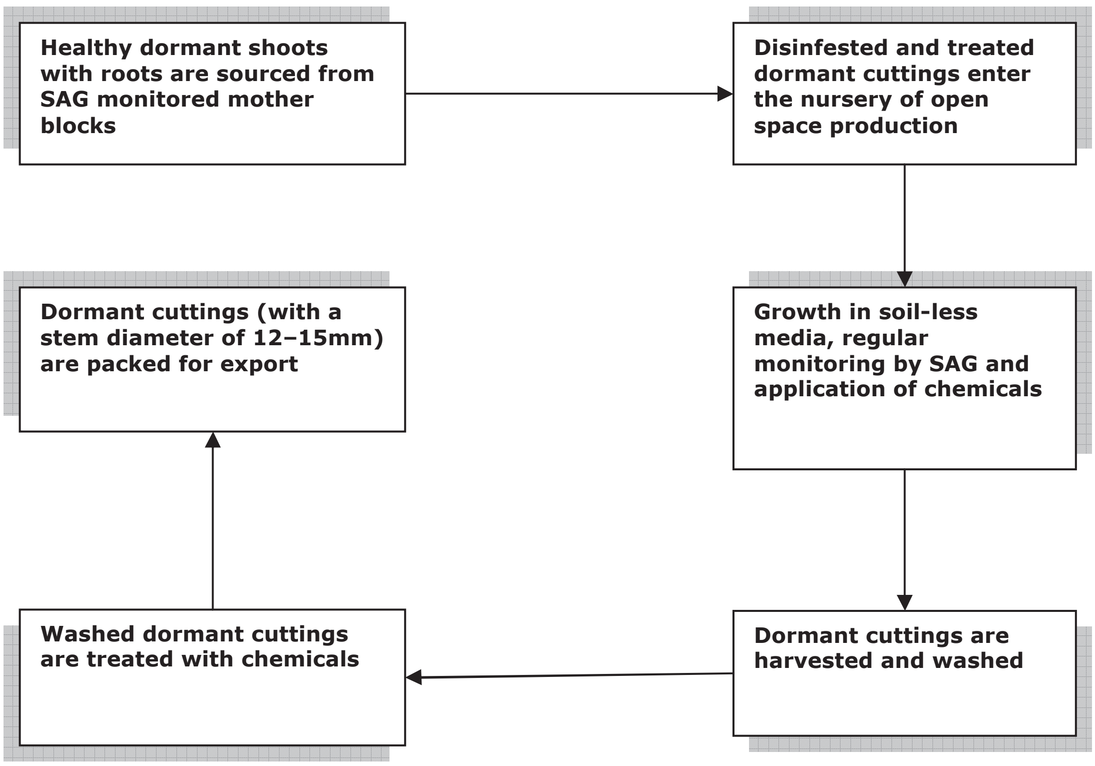
Herbivorous insects often use plant volatiles (kairomones) to locate hosts (Vet and Dicke 1992). However, the efficiency of attraction depends on the odour quality and/or the amount released (Tinzaara *et al.* 2002). *Aegorhinus superciliosus* is attracted to kairomones released by its major host *Vaccinium corymbosum* at fruit set stage (Parra *et al*. 2009b) for feeding and oviposition (Ruther *et al*. 2002). Aguilera (1988) described the life cycle of this weevil on blueberries in southern Chile. There is much overlap between different stages. *Aegorhinus superciliosus* lay eggs in December–mid March and the larval stages develop from March to mid-December. The pupal stage begins in September and continues through to early October. The adult emerges in September and mates in January and February. Studies conducted in the Araucania region in southern Chile for two seasons revealed a single generation per year (Aguilera 1988). This weevil overwinters as larvae (Aguilera 1988) in the soil or in or inside galleries bored in the main root. Adults have also been detected in soil lumps indicating that the weevil is capable of overwintering as adult (Aguilera 1988). However, laboratory studies indicate that larval development (14 stages) of *Aegorhinus superciliosus* requires on average 435 days (Aguilera and Rebolledo 2001).

Commercial production of hazelnut dormant rooted cuttings

The information provided above is based on observations under field conditions on mature trees. However, specific conditions for the preparation of the consignment will have an impact on the association of this weevil with the hazelnut dormant rooted cuttings (30–40 centimetres tall and with a stem diameter of 12–15 millimetres and a strong root system). The dormant rooted cutting production has two stages:

- **Stage one:** Growth in mother blocks in the fields, regular monitoring by SAG, application of pesticides, harvest at dormancy, disinfection and treatment of cuttings before entering nursery production stage; and
- **Stage two:** Growth in the soil-less media in poly propagation tunnels or in open space, regular monitoring by SAG, application of chemicals, harvest when dormant, washed and treated with fungicides, bactericides and insecticides and packaged for export.

Figure B: Production process of dormant rooted cuttings



Pathways

The following pathways were considered for the entry of *Aegorhinus* weevils into Australia:

Soil

Oviposition and larval development of *Aegorhinus* weevils can occur in the soil (Parra *et al.* 2009a, b). Pupation can occur in the soil or in galleries bored into large roots (Parra *et al.* 2009a; Aguilera 1988). Therefore soil containing these life stages of *Aegorhinus* species could provide a pathway for entry of these weevils into Australia.

- The hazelnut dormant rooted cuttings will be sourced from mother orchards and washed and treated with disinfectant and growth hormone (this process removes organic and soil particles, and eliminates any insects from cuttings). Dormant cuttings are further grown in soil-less media; and

- AQIS requires such import consignments to be free from soil; therefore, soil contamination should not be a risk on this material.

Commercially produced dormant rooted cuttings

Aegorhinus larvae can bore galleries into the main roots and remain inside the gallery for part of their development and pupation (Parra *et al*. 2009a; France *et al*. 2000). Plant roots would need to be of sufficient diameter to accommodate the developing larvae and/or pupae.

The commercially produced hazelnut dormant rooted cuttings have a strong root system. However, the hazelnut dormant rooted cuttings from Chile are only two years old, and their roots are fibrous and likely to be too small for larvae to bore galleries in which to complete their development.

- Eggs may easily be dislodged during washing and treatment with disinfectant and growth hormone.
- Externally feeding larvae may also be dislodged during washing, disinfestation and growth hormone treatment.

Aegorhinus weevils larvae preferably feed on phloem of roots and are capable of drilling galleries inside large roots and then sealing the hole (Grau *et al.* 2001) for further development (pupation). Therefore, large roots may harbour pupae and provide a pathway for the introduction of these weevils into Australia. However, taking into account the size of the proposed hazelnut propagative material (with a stem diameter of 12–15 mm) and the size of the larvae (fully developed 20 mm long), pupae (about 15mm long and 8 mm wide) and adults (about 15–20 mm long), it is considered that the roots of dormant cuttings are too small and are unlikely to conceal these life stages of *Aegorhinus* weevils. Furthermore, the plants proposed for export have been grown for approximately 12 months in soil-less media, which restricts the opportunity for root infestation. Nevertheless young larvae may contaminate the roots.

Appendix D: Quarantine pests from all sources

ARTHROPODS	PATHOGENS
Aculus comatus	*Anisogramma anomala* [8]
Aegorhinus nodipennis	*Armillaria mellea*
Aegorhinus phaleratus	*Armillaria gallica*
Aegorhinus superciliosus	*Armillaria ostoyae*
Cecidophyopsis vermiformis	'*Candidatus* Phytoplasma mali'
Cenopalpus pulcher	'*Candidatus* Phytoplasma prunorum'
Eulecanium excrescens	'*Candidatus* Phytoplasma pyri'
Gypsonoma dealbana	Clover Yellow Edge Phytoplasma
Oberea linearis	*Cryptosporiopsis tarraconensis*
Phenococcus aceris	*Fomitiporia mediterranea*
Zeuzera pyrina	*Monilia coryli*
	Monilinia fructigena
	Monostichella coryli
	Neonectria ditissima
	Oregon hazelnut stunt syndrome
	Phymatotrichopsis omnivora
	Phytophthora nemorosa
	Phytophthora ramorum [9]
	Pseudomonas avellanae
	Pseudomonas syringae pv. *coryli*
	Pucciniastrum coryli
	Tulare apple mosaic virus

[8] *Anisogramma anomala* was considered a quarantine pest in hazelnut propagative material prior to theis review of import conditions being undertaken.

[9] *Phytophthora ramorum* was considered a quarantine pest in hazelnut propagative material prior to theis review of import conditions being undertaken.

Appendix E: Additional quarantine pest data (all sources)

Quarantine pest	*Aculus comatus* (Nalepa, 1892)
Synonyms	*Vasates comatus* (Nalepa)
Common name(s)	Rust mite
Main hosts	*Corylus* spp. (Krantz 1973; Ripka 2007; Tuncer and Ecevit 1997).
Distribution	New Zealand (Webber 2007), North America (Krantz 1973), England (BRC 2011; Krantz 1973) and Continental Europe (Krantz 1973), including Hungary (Ripka 2007) and Turkey (Tuncer and Ecevit 1997; Ozman and Cobanoglu 2001)
Quarantine pest	*Aegorhinus nodipennis* (Hope, 1834)
Synonyms	None
Common name(s)	Plum capachitos
Main hosts	*Corylus avellana, Drimys winteri* and *Nothofagus* spp. (Grau *et al.* 2001; Koch and Waterhouse 2000).
Distribution	Chile (Grau *et al.* 2001)
Quarantine pest	*Aegorhinus phaleratus* Erichson, 1834
Synonyms	None
Common name(s)	Peach root borer
Main hosts	*Castanea sativa*, *Corylus avellana, Cydonia oblonga*, *Fragaria ananassa*, *Prunus* spp., *Pyrus communis* and *Salix viminalis* (Grau *et al.* 2001; Klein Koch and Waterhouse 2000).
Distribution	Chile (Parra *et* al. 2009*a*; Grau *et al.* 2001)
Quarantine pest	*Aegorhinus superciliosus* (Guérin, 1830)
Synonyms	None
Common name(s)	Raspberry weevil
Main hosts	*Corylus avellana, Fragaria ananassa*, *Nothofagus* spp., *Ribes* spp., *Rubus* spp., and *Vaccinium corymbosum* (Parra *et al.* 2009*b*; Grau *et al.* 2001; Klein Koch and Waterhouse 2000)
Distribution	Argentina and Chile (Mutis *et al.* 2010; Carillo *et al.* 2002; Grau *et al.* 2001)
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	*Cenopalpus pulcher* (Canestrini & Fanzago 1876)
Synonyms	*Brevipalpus ciferrii* Lombardini, 1951, *Brevipalpus pulcher* (Canestrini & Fanzago, 1876), *Brevipalpus pyri* Sayed, 1946, *Caligonus pulcher* Canestrini & Fanzago, 1876, *Tenuipalpus bodenheimeri* Bodenheimer, 1930, *Tenuipalpus oudemansi* Geijskes, 1939
Common name(s)	Flat scarlet mite
Main hosts	*Cydonia oblonga* (quince), *Eriobotrya* sp. (loquat), *Juglans* sp. (walnut), *Malus* sp. (apple), *Plantanus orientalis* (plane), *Prunus armeniaca* (apricot), *Prunus domestica* (plum), *Punica granatum* (pomegranate), *Pyrus communis* (European pear), *Salix* sp. (willow) (Jeppson *et al.* 1975; NAPPO 2011)

Distribution	Afghanistan, Algeria, Austria, Bulgaria, Cyprus, Denmark, Egypt, England, Germany, Holland, India, Iran, Iraq, Israel, Italy, Lebanon, Libya, Portugal, Central Asia, Syria, Turkey, former USSR (Crimea, Georgia, Transcaucasia), United States (Oregon) (NAPPO 2011)
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* spp. (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* spp. 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* spp. (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, A. balsamea, A. concolor, A. grandis, A. 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* spp., *Capsicum* spp., *Cornus mas*, *Corylus avellana*, *Crataegus laevigata*, *Cydonia oblonga*, *Diospyros kaki*, *Eriobotrya japonica*, *Ficus carica*, *Fragaria* spp., *Malus* spp., *Mespilus germanica*, *Prunus* spp., *Psidium guajava*, *Pyrus* spp., *Rhododendron* spp., *Rosa* spp., *Rubus* spp., *Solanum lycopersicum, Sorbus* spp., *Vaccinium* spp. 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* spp. (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). The main hosts include: *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* (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	Generalist pathogen with a broad host range that is continuously expanding (Kliejunas 2010). This fungus has also been 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, South 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 infects plants of the genus *Prunus*. The main hosts are *Prunus armeniaca, P. domestica, P. dulcis, P. persica, P. salicina* and *P. serrulata*. 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 2010b)
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 Yugoslavia) (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) and strawberry (Jomantiene *et al.* 1999)
Distribution	Canada (Ontario and Quebec) (Nyvall 1999; Staniulis *et al.* 2000) and USA (Maryland

	[Jomantiene *et al.* 1999] and Oregon [Jomantiene *et al.* 2000])
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

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).
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).
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

Term or abbreviation	Definition
	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 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.

References

Acuna R (2010) Compendio de bacterias y hongos de fruta; es y vides en Chile. Servicio Agricola y Ganadero, Division Proteccion Agricola y Forestal. 150 p.

Adaskaveg JE (2002) Wood decay In: *Compendium of nut crop diseases in temperate zones* (eds. Teviotdale BL, Michailides TJ, Pscheidt JW). p. 9–10. The American Phytopathological Society, Minnesota.

Agrios GN (1997) Plant Pathology, 4th Ed. Academic Press Inc., New York, USA.

Aguilera A (1988) Plagas del arándo en Chile. In Lobos W (ed) *Seminario: El cultivo del Arándano*. Instituto de Investigaciones Agropecuarias, Carillanca, Temuco, Chile, serie Carillanca, No 2: 109–130.

Aguilera A, Rebolledo R (2001) Estadios larvarios de *Aegorhinus superciliosus* (Guérin, 1830) (Coleoptera: Curculionidae). *Revista Chilena Entomologia* 28: 5–8.

Akhurst RJ (1983) Taxonomic study of *Xenorhabdus*, a genus of bacteria symbiotically associated with insect pathogenic nematodes. *International Journal of Systematic Bacteriology* 33: 38–45.

Alford DV (2007) *Pests of Fruit Crops – A color handbook*. Manson Publishing Ltd., London.

AliNiazee MT (1980) Filbert insect and mite pests. Agricultural Experiment Station, Oregon State University, Corvallis.

AliNiazee MT (1998) Ecology and management of hazelnut pests. *Annual Review of Entomology* 43: 395–419.

APPD (2011) Australian Plant Pest Database, Plant Health Australia, http://pha.vpac.org/broker/broker/queryForm.jsp (Accessed 8 December 2010).

Backhouse D, Abubakar AA, Burgess LW, Dennis JI, Hollaway GJ, Wildermuth GB, Wallwork H, Henry FJ (2004) Survey of *Fusarium* species associated with crown rot of wheat and barley in eastern Australia. *Australasian Plant Pathology* 33: 255–261.

Bahar AA, Demirbag Z (2007) Isolation of pathogenic bacteria from *Oberea linearis* (Coleoptera: Cerambycidae). *Biologica Bratislava* 62: 13–18.

Baumgartner K, Rizzo DM (2001) Ecology of *Armillaria* spp. in mixed-hardwood forests of California. *Plant Disease* 85: 947–951.

BCMA (2007) Little Cherry Disease in British Columbia. Ministry of Agriculture, British Columbia (BCMA). http://www.agf.gov.bc.ca/cropprot/tfipm/lcv.htm (Accessed 18 February 2011).

Bertozzi T, Alberts E, Sedgley M (2002) Detection of *Prunus* necrotic ringspot virus in almond: effect of sampling time on the efficiency of serological and biological indexing methodologies. *Australian Journal of Experimental Agriculture* 42: 207–210.

Boddy L (2001) Fungal community ecology and wood decomposition processes in angiosperms: from standing tree to complete decay of coarse woody debris. *Ecological Bulletin* 49: 43–56.

Brayford D, Honda BM, Mantiri FR, Samuels GJ (2004) *Neonectria* and *Cylindrocarpon*: the Nectria mammoidea group and species lacking micronidia. *Mycologia* 96(3): 572–597.

BRC (2011) Biological Records Centre: Database of Insects and their Food Plants. http://www.brc.ac.uk/. Accessed 27 July 2011.

Burgess TI, Webster JL, Ciampini JA, White D, Hardy GEStJ, Stukely MJC (2009) Re-evaluation of *Phytophthora* species isolated during 30 years of vegetation health surveys in Western Australia using molecular techniques. *Plant Disease* 93: 215–223.

CABI (2011) Crop Pest Compendium, CABI International, Wallingford, UK. http://www.cabicompendium.org/cpc/home.asp. (Accessed: May 2011).

CABI/EPPO (1997) *Armillaria mellea* (Vahl) P. Kumm. Distribution Maps of Plant Diseases No. 143:1–2. CAB International, Wallingford, UK.

CABI/EPPO (2006) *Phytophthora ramorum* Werres, de Cock & Man In't Veld. Distribution Maps of Plant Diseases No. 978:1–2. CAB International, Wallingford, UK.

CABI/EPPO (2009) *Armillaria ostoyae* (Romagn.) Herink. Distribution Maps of Plant Diseases No. 1047:14. CAB International, Wallingford, UK.

CABI/EPPO (2010a) *Helicotylenchus dihystera*. Distribution Maps of Plant Diseases No. 1077. CABI Head Office, Wallingford, UK.

CABI/EPPO (2010b) *Candidatus* Phytoplasma prunorum Seemüller & Schneider. Distribution Maps of Plant Diseases No. 752. CAB International, Wallingford, UK.

CABI/EPPO (2011) *Phymatotrichopsis omnivora*. Data Sheets on Quarantine Pests. EPPO A1 List No. 21. http://www.eppo.org/QUARANTINE/fungi/Phymatotrichopsis_omnivora/PHMPOM_ds.pdf (Accessed 25 February 2011).

Capinera JL (eds.) (2008) Encyclopaedia of entomology. Springer Science, Germany.

Carillo R, Perez H, Neira C (2002) Comportamiento de oviposicion de *Aegorhinys superciliosus* (Guerin) (Coleoptera: Curculionidae). *Agro Sur* 30(1): 47–50.

Chlebicki A (2005) Some ascomycete fungi from primeval forests of north-eastern Poland. *Acta Mycologica* 40: 71–94.

Chlebicki A, Chmiel MA (2006) Microfungi of *Carpinus betulus* from Poland I. Annotated list of microfungi. *Acta Mycologica* 41: 253–278.

Choueiri E, Salar P, Jreijiri F, El Zammar S, Danet JL, Foissax X (2007). First report and characterisation of pear decline phytoplasma on pear in Lebanon. *Journal of Plant Pathology* 89: S75.

Ciccarone C, Graniti A, Schiaffino A and Marras F (2004) Molecular analysis of *Fomitiporia mediterranea* isolates from esca-affected grapevines in southern Italy. *Phytopathol. Mediterr.* 43: 268–272.

Cirvilleri G, Scuderi G, Bonaccorsi A, Scortichini M (2007) Occurrence of *Pseudomonas syringae* pv. *coryli* on hazelnut orchards in Sicily, Italy and characterization by Fluorescent Amplified Fragment Length Polymorphism. *Journal of Phytopathology* 155: 397–402.

Cook RP, Dube AJ (1989) *Host-Pathogen Index of Plant Diseases in South Australia*. Field Crops Pathology Group, South Australian Department of Agriculture.

CSIRO (2005) Australian Insect Common Names, http://www.ento.csiro.au/aicn/index.htm (Accessed: 8 December 2010).

Cunnington JH, Brett RW (2009) S-type powdery mildew on lilac in Australia. *Australasian Plant Disease Notes* 4: 21–22.

Curtis CE, Moran JR (1986) The incidence of Prunus Necrotic Ringspot Virus in commercial cut flower roses grown under cover in Victoria. *Australasian Plant Pathology* 15: 42–43.

Davison EM, Davison PJN, Brims MH (2008) Moist chamber and field collections of Myxomycetes from the Northern Simpson Desert, Australia. *Australasian Mycologist* 27: 129–204.

De Silva H, Castlebury LA, Green S, Stone JK (2009) Characterisation and phylogenetic relationships of *Anisogramma virgultorum* and *A. anomala* in the Diaporthales (Ascomycota). *Mycological Research* 113: 73–81.

De Silveira RMB (2006) El genero *Polyporus* s. str. (Basidiomycota) en el cono sur de America. *Biociencias, Porto Alegre* 14: 3–14.

Deacon J (2011) The microbial world: *Armillaria mellea* and other wood decay fungi. http://www.biology.ed.ac.uk/research/groups/jdeacon/microbes/armill.htm (Accessed: 6 May 2011).

Deng S, Hiruki D (1991) Amplification of 16S rNNA genes from culturable and nonculturable molliccutes. *Journal of Microbiological Methods* 14: 53–61.

Díaz GA, Prehn D, Latorre BA (2011) Disease notes: First report of *Cryptovalsa ampelina* and *Eutypella leprosa* associated with grapevine trunk disease in Chile. *Plant Disease* 95: 490.

DiLeo MV, Bienapfl JC, Rizzo DM (2008) *Phytophthora ramorum* infects hazelnut, vine maple, blue blossom, and manzanita species in California. Online. Plant Health Progress doi:10.1094/PHP-2008-0118-02-BR.

Donoso C, Becerra J, Martinez M, Garrido N, Silva M (2008) Degradative ability of 2,4,6-tribromophenol by saprophytic fungi *Trametes versicolor* and *Agaricus augustus* isolated from chilean forestry. *World Journal of Microbiology and Biotechnology* 24: 961–968.

Ekins MG, Aitken EAB, Goulter KC (2002) Carpogenic germination of *Sclerotinia minor* and potential distribution in Australia. *Australasian Plant Pathology* 31: 259–265.

Enebak SA, Blanchette RA (1989) Canker formation and decay in sugar maple and paper birch infected by *Cerrena unicolour. Canadian Journal of Forest Research* 19: 225–231.

EOL (2011) *Eutypa flavovirens* (Pers.) Tul. & C. Tul. 1863. Encyclopedia of Life, http://www.eol.org/pages/133754 (Accessed: 27 Apr 2011).

EPPO (2011) *Anisogramma anomala*. Data Sheets on Quarantine Pests. EPPO A1 List No. 201. http://www.eppo.org/QUARANTINE/fungi/Anisogramma_anomala/CRSPAN_ds.pdf (Accessed: 2 February 2011).

Espinoza JG, Briceno EX, Keith LM, Latorre BA (2008) Canker and twig dieback of blueberry caused by *Pestalotiopsis* spp. and a *Truncatella* spp. in Chile. *Plant Disease* 92: 1407–1414.

FAO (Food and Agricultural Organization of the United Nations) (1995) International Standards for Phytosanitary Measures (ISPM) No. 4: *Requirements for the establishment of pest free areas.* Secretariat of the International Plant Protection Convention, Rome, Italy.

FAO (Food and Agricultural Organization of the United Nations) (1997) International Standards for Phytosanitary Measures (ISPM) No. 7: *Phytosanitary certification system.* Secretariat of the International Plant Protection Convention, Rome, Italy.

FAO (Food and Agricultural Organization of the United Nations) (1999) International Standards for Phytosanitary Measures (ISPM) No. 10: *Requirements for the establishment of pest free places of production and pest free production sites.* Secretariat of the International Plant Protection Convention, Rome, Italy.

FAO (Food and Agricultural Organization of the United Nations) (2001) International Standards for Phytosanitary Measures (ISPM) No.12: *Guidelines forphytosaniatry certificates.* Secretariat of the International Plant Protection Convention, Rome, Italy.

FAO (Food and Agricultural Organization of the United Nations) (2002) International Standards for Phytosanitary Measures (ISPM) No. 14: *The use of integrated measures in a systems approach for pest risk management.* Secretariat of the International Plant Protection Convention, Rome, Italy.

FAO (Food and Agricultural Organization of the United Nations) (2004) International Standards for Phytosanitary Measures (ISPM) No. 11: *Pest risk analysis for quarantine pests including analysis of environmental risks and living modified organisms.* Secretariat of the International Plant Protection Convention, Rome, Italy.

FAO (Food and Agricultural Organization of the United Nations) (2005) International Standards for Phytosanitary Measures (ISPM) No. 24: *Guidelines for the determination and recognition of equivalence of phytosanitary measures.* Secretariat of the International Plant Protection Convention, Rome, Italy.

FAO (Food and Agricultural Organization of the United Nations) (2006) International Standards for Phytosanitary Measures (ISPM) No. 1: *Phytosantiary principles for the protection of plants and the application of phytosanitary measures in international trade.* Secretariat of the International Plant Protection Convention, Rome, Italy.

FAO (Food and Agricultural Organization of the United Nations) (2007) International Standards for Phytosanitary Measures (ISPM) No. 2: *Framework for pest risk analysis.* Secretariat of the International Plant Protection Convention, Rome, Italy.

FAO (Food and Agricultural Organization of the United Nations) (2008) *Overview of forest pests: Chile*. Working paper FBS/12E. Forestry Department, FAO, Rome.

FAO (Food and Agricultural Organization of the United Nations) (2009) International Standards for Phytosanitary Measures (ISPM) No. 5: *Glossary of phytosanitary terms.* Secretariat of the International Plant Protection Convention, Rome, Italy.

Farr DF, Rossman AY (2011) Fungal databases, Systematic mycology and microbiology, laboratory, ARS, USDA. http://nt.ars-grin.gov/fungaldatabases/ (Accessed: May 2011).

Ferrada S (2010) Avellano Europeo en la Region de la Araucania. Primeros resultados productivos y economicos. Instituto de Investigaciones Agropecuarias (INIA), Centro Regional Carillanca. Boletin INIA N° 203. Temuco, Chile. 60 pp.

Fischer M (2002) A new wood decaying basidiomycete species associated with esca of grapevine: *Fomitiporia mediterranea* (Hymenochaetales). *Mycological Progress* 1: 315–324.

Fischer M (2006) Biodiversity and geographic distribution of basidiomycetes causing esca-associated white rot in grapevine: a worldwide perspective. *Phytopathologia Mediterranea* 45: S30–S42.

Fischer M, Edwards J, Cunnington JH, Pascoe IG (2005) Basidiomycetous pathogens on grapevine: a new species from Australia – *Fomitipora austrailensis. Mycotaxon* 92: 85–96.

France A (2007) Enfermedades del Avellano europeo. En seminario del Avellano europeo. FDF. Julio del 2007. http://www.fdf.cl/download/Andres%20France.pdf.

France A, Gerding M, Gerding M, Sandoval A (2000) Patogenicidad de una colección de cepas nativas de *Metarhizium* spp. y *Beauveria* spp. en *Aegorhinus superciliosus*, *Asynonychus cervinus* y *Otiorhynchus sulcatas*. *Agricultura Técnica* 60(3): 189–194.

Fraval A (1998) HYPP Zoology. Encyclopédie des ravageurs européens, Institut National de la Recherche Agronomique (INRA), Paris, France. http://www.inra.fr/hyppz/pa.htm (Accessed: 2 February 2011).

Fulton RW (1971) Tulare apple mosaic virus. No 42. Descriptions of plant viruses. http://www.dpvweb.net/index.php (Accessed: 3 March 2011).

Gantner M (2009) Koszty ochrony plantacji leszczyny przed szkodnikami I chorobami. *Progress in Plant Protection/Postępy w Ochronie Roślin* 49: 1610–1616.

Gantner M, Jaskiewicz B, Golan K (2004) Occurrence of *Parthenolecanium corni* (Bouche) on 18 cultivars of hazelnut. *Folia Horticulturae* 16: 95–100.

Gates GM, Ratkowsky DA (2005) A preliminary census of the macrofungi of Mt Wellington, Tasmania – the Ascomycota. *Papers and Proceedings of the Royal Society of Tasmania* 139: 49–52.

GBIF (2010) *Oberea linearis*. Global Biodiversity Information Facility, Denmark. http://data.gbif.org/occurrences/searchCountries.htm?c[0].s=20&c[0].p=0&c[0].o=14513262 (Accessed: 7 December 2011).

Gene J, Guarro J, Figueras MJ (1990) A new species of *Cryptosporiopsis* causing bud rot of *Corylus avellana*. *Mycological Research* 94: 309–312.

Grand LF (2001) *Armillaria mellea*(Vahl:Fr.) Kummer. NC State University Department of Plant Pathology PP 318. http://www.cals.ncsu.edu/course/pp728/Armillaria/Armillaria.htm (Accessed: 8 June 2011)

Grau P, France A, Gerding M, Lavini A, Torres A (2001) Preliminary evaluation of hazelnut performance in Chile. Proceedings of the V International Congress on Hazelnut. *Acta Horticulturae* 556: 49–57.

Griffin E (2010) Shoestring Root Rot caused by *Armillaria mellea*. http://wiki.bugwood.org/Archive:South/Armillaria_mellea (Accessed: 8 June 2011).

Gutierrez M, Theoduloz C, Rodriguez J, Lolas M, Schmeda-Hirschmann G (2005) Bioactive metabolites from the fungus *Nectria galligena*, the main apple canker agent in Chile. *Journal of Agricultural and Food Chemistry* 53: 7701–7708.

Haniotakis GE, Koutroubas A, Sachinoglou A, Lahlou A (1999) Studies on the response of the leopard moth, *Zeuzera pyrina* L. (Lepidoptera: Cossidae) to pheromones in apple orchards. *IOBC wprs Bulletin* 22. www.phero.net/iobc/dachau/bulletin99/haniotakis.html (Accessed: 3 March 2011).

Hansen EM, Reeser PW, Davidson JM, Garbelotto M, Ivors K, Douhan L, Rizzo DM (2003) *Phytophthora nemorosa*, a new species of causing cankers and leaf blight of forest trees in California and Oregon, USA. *Mycotaxon* 88: 129–138.

Heilmann-Clausen J (2005) Diversity of saproxylic fungi on decaying beech wood in protected forests in the county of Halland. Habitat Vision, Halland.

Helle W, Bolland HR (1967) Karotypes and sex-determination in spider mites (Tetranychidae). *Genetica* 38: 43–53.

HerbIMI (2011a) IMI 270275 *Clonostachys rosea* f. *rosea*. HerbIMI. Royal Botanic Gardens, Kew. http://www.herbimi.info/herbimi/specimen.htm?imi=270275 (Accessed: 11 May 2011).

HerbIMI (2011b) IMI 259072 *Gibberella baccata*. HerbIMI. Royal Botanic Gardens, Kew. http://www.herbimi.info/herbimi/specimen.htm?imi=259072 (Accessed: 11 May 2011).

Herrera GM, Madariaga MV (2002) Incidence of Prunus Necrotic Ringspot Virus (PNRSV), Prune Dwarf Virus (PDV), Tomato Ringspot Virus (ToRSV) and Plum Pox Virus (PPV) in stone fruit nurseries in the central zone of Chile (in Spanish). *Agricultura Tecnica* 62: 38–45.

Hogg BM, Hudson HJ (1966) Micro-fungi on leaves of *Fagus sylvatica*. *Transactions of the British Mycological Society* 49: 185–192.

Hopkins AJM (2007) The taxonomy and ecology of wood decay fungi in *Eucalyptus obliqua* trees and logs in the wet sclerophyll forests of southern Tasmania. PhD thesis, University of Tasmania, Australia.

Hughes KJD, Fulton CE, McReynolds D, Lane CR (2000) Development of new PCR primers for identification of *Monilinia* species. *Bulletin OEPP/EPPO Bulletin* 30: 507–511.

Hughes KJD, Griffin RL, Tomlinson JA, Boonham N, Inman AJ, Lane CR (2006) Development of a one-step real-time PCR assay for diagnosis of *Phytophthora ramorum. Phytopathology* 96: 975–981.

Hunter DM, Svircev AM, Kaviani M, Michelutti R, Wang L, Thompson D (2010) First report of pear decline caused by '*Candidatus* Phytoplasma pyri' in Ontario, Canada. *Plant Disease* 94: 634.

Hyun J-W, Clark CA (1998) Analysis of *Fusarium lateritium* using RAPD and rDNA RFLP techniques. *Mycological Research* 102: 1259–1264.

Janick J, Paull RE (2008) The encyclopaedia of fruit and nuts. CAB International, Wallingford, UK.

Jeppson LR, Keifer HH and Baker EW (1975) *Mites injurious to economic plants*. University of California Press: Berkeley, CA.

Jomantiene R, Maas JL, Dally EL, Davis RE (1999) First report of Clover yellow edge phytoplasma in Strawberry in Maryland. *Plant Disease* 83: 1072.

Jomantiene R, Postman JD,Montano HG, Maas JL, Davis RE, Johnson KB (2000) First report of Clover Yellow Edge Phytoplasma in *Corylus* (hazelnut). *Plant Disease* 84: 102.

Kamińska M, Śliwa H (2007) First report of *'Candidatus* Phytoplasma mali' in oriental lilies and its association with leaf scorch in Poland. *New Disease Reports* 15: 46.

Keane PJ, Kile GA, Podger FD, Brown BN (Eds.) (2000) *Diseases and Pathogens of Eucalypts*. CSIRO Publishing Collingwood, Victoria, Australia.

Keča N, Karadžić D, Woodward S (2009) Ecology of *Armillaria* species in managed forests and plantations in Serbia. *Forest Pathology* 39: 217–231.

Khalifa MB, Marrakchi M, Fakhfakh H (2007) *Candidatus* Phytoplasma pyri infections in pear orchards in Tunisia (Short Communication). *Journal of Plant Pathology* 89: 269–272.

King EO, Ward MK, Raney DE (1954) Two simple media for the demonstration of pyocyanin and fluorescin. *Journal of Clinical and Laboratory Medicine* 59: 945–952.

Klein Koch C, Waterhouse DF (2000) The distribution and importance of arthropods associated with agriculture and forestry in Chile. Collaborative project from Australian Centre for International Agricultural Research and Universidad de la Frontera.

Kliejunas JT (2010) *Sudden Oak Death and Phytophthora ramorum: A summary of the literature*. United States Department of Agriculture, Pacific Southwest Research Station, Albany, California.

Krantz KW (1973) Observations on the morphology and behavior of the Þlbert rust mite, Aculus comatus (Prostigmata: Eriophyoidea) in Oregon. *Annals of the Entomological Society of America* 66: 709–717.

Kuo M (2010) *Fomes fomentarius.* http://www.mushroomexpert.com/fomes_fomentarius.html (Accessed: 28 April 2011).

Kuschel G (1951) La subfamilia Aterpinae en América. The subfamily Aterpinae in America. *Revista Chilena de Entomología* 1: 205–244 [*Chilean Journal of Entomology* 1: 205–244].

Kutinkova H, Andreev R, Arnaoudov V (2006) The leopard moth borer, *Zeuzera pyrina* L. (Lepidoptera: Cossidae)—important pest in Bulgaria. *Journal of Plant Protection Research* 46: 111–115.

Langrell SRH (2002) Molecular detection of *Neonectria galligena* (syn. *Nectria galligena*). *Mycological Research* 106: 280–292.

Langrell SRH, Glen M, Alfenas AC (2008) Molecular diagnosis of *Puccinia psidii* (guava rust)—a quarantine threat to Australian eucalypt and Myrtaceae biodiversity. *Plant Pathology* 57: 687–701.

Latorre BA, Rioja ME, Lillo C (2002) The effect of temperature on infection and a warning system for pear blossom blast caused by *Pseudomonas syringae* pv. *syringae. Crop Protection* 21: 33–39.

Lawrey JD, Diederich P, Sikaroodi M, Gillevet PM (2008) Remarkable nutritional diversity of basidiomycetes in the corticiales, including a new foliicolous species of *Marchandiomyces*

(Anamorphic Basidiomycota, Corticiaceae) from Australia. *American Journal of Botany* 95: 816–823.

Lee IM, Bertaccini A, Vibio M, Gundersen DE (1995) Detection of multiple phytoplasmas in perennial fruit trees with decline symptoms in Italy. *Phytopathology* 85: 728–735.

Legon NW, Henrici A, Roberts PJ, Spooner BM, Watling R (2005) Checklist of the British and Irish Basidiomycota. http://www.basidiochecklist.info (Accessed: 28 April 2011).

Lemus G (2004) El cultivo del avellano. http://www.cvta.cl/pdf/El%20Cultivo%20del%20Avellano.pdf

Loreti S, Gervasi F, Gallelli A, Scortichini M (2008) Further molecular characterisation of *Pseudomonas syringae* pv. *coryli*. *Journal of Plant Pathology* 90: 57–64.

Lushaj BM, Woodward S, Keča N, Intini M (2010) Distribution, ecology and host range of *Armillaria* species in Albania. *Forest Pathology* 40: 485–499.

Machowicz-Stefaniak Z, Zalewska E (2002) Hazel diseases and their fight. Plant press. http://www.ho.haslo.pl/article.php?id=1119 (Accessed: 31 May 2011).

Mackie A, Eyres N, Kumar S (2005) Brown rot *Monilinia fructigena*. *Department of Agriculture and Food Factsheet* (Note: 181): 2 pp.

Malumphy CP (2005) *Eulecanium excrescens* (Ferris) (Hemiptera: Coccidae), an Asian pest of woody ornamentals and fruit trees, new to Britain. *British Journal of Entomology and Natural History* 18: 45–49.

Marcone C, Jarausch B, Jarausch W (2010) *Candidatus* Phytoplasma prunorum, the causal agent of European stone fruit yellows: An overview. *Journal of Plant Pathology* 92: 19–34.

Marcone C, Ragozzino A, Seemuller E (1996) Association of phytoplasmas with the decline of European hazel in southern Italy. *Plant Pathology* 45: 857–863.

McCracken AR, Berrie A, Barbara DJ, Locke T, Cooke LR, Phelps K, Swinburne TR, Brown AE, Ellerker B, Langrell SRH (2003) Relative significance of nursery infections and orchard inoculums in the development and spread of apple canker (*Nectria galligena*) in young orchards. *Plant Pathology* 52: 553–566.

McKnight KH, McKnight VB (1987) *Peterson Field Guides: Mushrooms*. Houghton Mifflin Company, New York.

McLeod R, Reay F, Smyth J (1994) *Plant nematodes of Australia listed by plant and by genus*. New South Wales Agriculture and Rural Industries Research and Development Corporation.

Millas P, Carrillo R (2010) Rate of soil egestion by larvae of *Hylamorpha elegans* (Burm.) and *Phytoloema hermanni* Germ. (Coleoptera: Scarabaeidae). *Neotropical Entomology* 39(5): 697–702.

Minter DW, Peredo Lopez H (2006) Fungi of Chile, www.cybertruffle.org.uk/chilfung (Accessed: 10 May 2011).

Mordue JEM (1998) CMI Descriptions of Pathogenic Fungi and Bacteria No. 619 – *Sclerotinia laxa*. CAB International, UK.

http://www.cabi.org/DFB/FullTextPDF/2005/20056400619.pdf (Accessed: 17 December 2010).

Mutis A, Parra L, Manosalva L, Palma R, Candia O, Lizama M, Pardo F, Perich F, Quiroz A (2010) Electroantennographic and behavioural responses of adults of Raspberry Weevil *Aegorhinus superciliosus* (Coleoptera: Curculionidae) to odours released from conspecific females. *Environmental Entomology* 39: 1276–1282.

Mutis A, Parra L, Palma R, Pardi F, Perich F, Quiroz A (2009) Evidence of contact pheromone use in mating behaviour of the raspberry weevil (Coleoptera: Curculionidae). *Environmental Entomology* 38(1): 192–197.

Nair NG, Guibaud-Oulton S, Barchia I, Emmett R (1995) Significance of carry over inoculum, flower infection and latency on the incidence of *Botrytis cinerea* in berries of grapevines at harvest in New South Wales. *Australian Journal of Experimental Agriculture* 35: 1177–1180.

NAPPO (2011) *Cenopalpus pulcher* (Canestrini and Fanzago) North American Plant Protection Organization's Pest Alert System (Accessed July 2011). http://www.pestalert.org/viewArchPestAlert.cfm?rid=54

Naumann I (1993) *CSIRO handbook of Australian insect names* 6th ed. CSIRO, Australia.

Norden B, Paltto H (2001) Wood-decay fungi in hazel wood: species richness correlated to stand age and dead wood features. *Biological Conservation* 101: 1–8.

Nyvall RF (1999) *Field Crop Diseases*, Thrid Edition. Iowa State University Press, Iowa.

Olivier T, Steyer S, Demonty E, Laurent P (2010) First report of molecular identification of '*Candidatus* Phytoplasma mali' in apple trees in Belgium. *Disease Reports* 21: 11.

Olsen J, Bell N (2009) Hazelnut Pests. Pacific Northwest Insect Management Handbook http://insects.ippc.orst.edu/pnw/insects?19NUTS02.dat (Accessed: 14 February 2011).

Osono T, Takeda H (2006) Fungal decomposition of *Abies* needle and *Betula* leaf litter. *Mycologia* 98: 172–179.

Ota Y, Matsushita N, Nagasawa E, Terashita T, Fukuda K, Suzuki K (1998) Biological species of *Armillaria* in Japan. *Plant Disease* 82: 537–543.

Ozman SK, Cobanoglu S (2001) Current status of hazelnut mites in Turkey. *Acta Horticulturae* 556: 479–487.

Ozman SK, Toros S (1997) Life cycle of *Phytoptus avellanae* and *Cecidophyopsis vermiformis* (Eriophyoidea: Acarina). *Acta Horticulturae* 445: 493–502.

Palma A, Valenzuela E, Parra P, Gutierrez M, Torelli Silva L (2005) *Cerrena unicolour* (Bull.) Murr. (Basidiomycota) isolated from mycangia of *Tremex fuscicornis* Fabr. (Hymenoptera Siricidae) associated to poplar decline (*Populus* sp.) in Chile. *Boletín Micológico* 20: 57–61.

Parbery DG, Greber RS (1996) Lionel Leslie Stubbs: Pioneer of Australian plant virology. *Australasian Plant Pathology* 25: 261–270.

Parra L, Mutis A, Aguilera A, Rebolledo R, Quiroz A (2009a) Estado del conocimiento sobre el cabrito del frambueso (cf), *Aegorhinus superciliosus* (Guérin) (Coleoptera: Curculionidae). *IDESIA* 27(1): 57–65.

Parra L, Mutis A, Ceballos R, Lizama M, Pardo F, Perich F, Quiroz A (2009b) Volatiles released from *Vaccinium corymbosum* were attractive to *Aegorhinus superciliosus* (Coleoptera: Curculionidae) in an olfactory bioassay. *Environmental Entomology* 38(3): 781–789.

Pegler DN, Gibson IAS (1972) *Armillariella mellea*. IMI Descriptions of Pathogenic Fungi and Bacteria No. 321: 1–2. CAB International, Wallingford, UK.

Peláez F, González V, Platas G, Sánchez-Ballesteros J, Rubio V (2008) Molecular phylogenetic studies within the family Xylariaceae based on ribosomal DNA sequences. *Fungal Diversity* 31: 111–134.

Petrak F (1931) *List of new species and varieties of fungi, new combinations and new names published 1921. Volume 2*. Commonwealth Mycological Institue, Kew, Surrey, UK.

Pildain MB, Coetzee MPA, Rajchenberg M, Petersen RH, Wingfield MJ, Wingfield BD (2009) Molecular phylogeny of *Armillaria* from the Patagonian Andes. *Mycological Progress* 8: 181–194.

Pildain MB, Novas MV, Carmaran CC (2005) Evaluation of anamorphic state, wood decay and production of lignin-modifying enzymes for diatrypaceous fungi from Argentina. *Journal of Agricultural Technology* 1: 81–96.

Pilotti M, Tizzani L, Brunetti A, Gervasi F, Lernia GDi, Lumia V (2010) Molecular identification of *Fomitiporia mediterranea* on declining and decayed hazelnut. *Journal of Plant Pathology* 92: 115–129.

Pinder PS, Hayes AJ (1986) An outbreak of vapourer moth (*Orgyia antiqua* L.: Lepidoptera Lymantridae) on Sitka spruce (*Picea sitchensis* (Bong.) Carr.) in central Scotland. *Forestry* 59: 97–105.

Plante F, Bernier L (1997) Variability of virulence of *Nectria galligena* towards northern hardwoods. *European Journal of Forest Pathology* 27: 261–272.

Podger FD (1972) *Phytophthora cinnamomi*, a cause of lethal disease in indigenous plant communities in Western Australia. *Phytopathology* 62: 972–981.

Postman JD, Maas JL, Johnson KB, Davis RE, Jomantiene R (2001) The 'Oregon hazelnut stunt syndrome' and phytoplasma associations. *Acta Horticulturae* 556: 407–409.

Prado E (1988) Notes on some insects of agricultural importance in Chile. *Agricultura Tecnica* 48: 51–54.

Psallidas PG (1993) *Pseudomonas syringae* pv. *avellanae* pathovar nov., the bacterium causing canker disease on *Corylus avellana*. *Plant Pathology* 42: 358–363.

Psallidas PG, Panagopoulos CG (1979) A bacterial canker of *Corylus avellana* in Greece. *Phytopathologische Zeitschrift* 94: 103–111.

Pscheidt JW, Stone J (2001) Diseases of European Hazelnet. American Phytopathological Society, http://www.apsnet.org/publications/commonnames/Pages/Hazelnut.aspx (Accessed: 17 February 2011).

Punithalingam E, Waller JM (1973) CMI Descriptions of Pathogenic Fungi and Bacteria No. 394 – *Botryosphaeria obtusa*. CAB International, UK. http://www.cabi.org/DFB/FullTextPDF/2005/20056400394.pdf (Accessed: 17 December 2010).

Quader M, Riley IT, Walker GE (2003) Spatial and temporal distribution patterns of dagger (*Xiphinema* spp.) and root lesion (*Pratylenchus* spp.) nematodes in a South Australian vineyard. *Australasian Plant Pathology* 32: 81–86.

Ransom LM (1997) The eradication of *Nectria galligena* from apple trees in Tasmania, 1954 to 1991. *Australasian Plant Pathology* 26: 121–125.

Ratcliffe BC, Ocampo FC (2002) A review of the genus *Hylamorpha* Arrow (Coleoptera: Scarabaeidae: Rutelinae: Anoplognathini: Brachysternina). *The Coleopterists Bulletin* 56: 367–378.

Rau GJ (1942) The Canadian apple mealybug, *Phenacoccus aceris* Signoret, and its allies in Northeastern America. *The Canadian Entomologist* 74: 118–125.

Ripka G (2007) Checklist of the Eriophyoid mite fauna of Hungary (Acari: Prostigmata: Eriophyoidea). *Acta Phytopathologica et Entomologica Hungarica* 42: 59–142.

Roberts P (2005) *Celatogloea simplicibasidium*: a heterobasidiomycetous parasite of *Corticium roseum*. *Mycologist* 19: 69–71.

Rogers JD, Miller AN, Vasilyeva LN (2008) Pyrenomycetes of the Great Smoky Mountains National Park. VI. *Kretzschmaria*, *Nemania*, *Rosellinia* and *Xylaria* (Xylariaceae). *Fungal Diversity* 29: 107–116.

Rossman AY, Farr DF, Castlebury LA (2007) A review of the phylogeny and biology of Diaporthales. *Mycoscience* 48: 135–144.

Ruther J, Meiner T, Steidle JLM (2002) Rich in pheromena-lacking in terms. A classification of kairomons. *Chemoecology* 12: 161–167.

SAG (2011a) Registro de Plagas. Subdepto. Vigilancia y Control Oficial Agricola. Division Proteccion Agricola y Forestal. Chile.

SAG (2011b) SAG Pest Presence in Chile. Servicio Agricola y Ganadero, Ministerio de Agricultura, Gobierno de Chile http://idase.sag.gob.cl/sistema/consu.asp (Accessed 21 July 2011).

Schneider B, Seemüller E, Smart CD, Kirkpatrick BC (1995) Phylogenetic classification of plant pathogenic mycoplasma-like organisms or phytoplasmas. In ‘Molecular and diagnostic procedures in mycoplasmology’ (Eds S Razin and JG Tully). Academic Press, San Diego, CA, USA pp: 369–380.

Scortichini M, Loreti S (2007) Occurrence of an endophytic, potentially pathogenic strain of *Pseudomonas syringae* in symptomless wild trees of *Corylus avellana* L. *Journal of Plant Pathology* 89: 431–434.

Scortichini M, Marchesi U, Angelucci L, Rossi MP, Dettori MT (2000) Occurrence of *Pseudomonas avellanae* (Psallidas) Janse et al. and related pseudomonads on wild *Corylus avellana* trees and genetic relationships with strains isolated from cultivated hazelnuts. *Journal of Phytopathology* 148: 523–532.

Scortichini M, Rossi MP, Loreti S, Bosco A, Fiori M, Jackson RW, Stead DE, Aspin A, Marchesi U, Zini M, Janse JD (2005) *Pseudomonas syringae* pv. *coryli*, the causal agent of bacterial twig dieback of *Corylus avellana*. *Phytopathology* 95: 1316–1324.

Scortichini M, Rossi MP, Marchesi U (2002) Genetic, phenotypic and pathogenic diversity of *Xanthomoas aboricola* pv. *corylina* strains questions the representative nature of the type strain. *Plant Pathology* 51: 374–381.

Scortichini M, Tropiano FG (1994) Severe outbreak of *Pseudomonas syringae* pv. *avellanae* on hazelnut in Italy. *Journal of Phytopathology* 140: 65–70.

Scott JK, Yeoh PB, Knihinicki DK (2008) Redberry mite, *Acalitus essigi* (Hassan) (Acari: Eriophyidae), an additional biological control agent for *Rubus* species (blackberry) (Rosaceae) in Australia. *Australian Journal of Entomology* 47: 261–264.

Scott SW, Zimmerman MT (2009) The nucleotide sequences of the RNA 1 and RNA 2 of asparagus virus 2 show a close relationship to citrus variegation virus. *Archives of Virology* 154: 719–722.

Serce CU, Gazel M, Caglayan K, Bas M, Son L (2006) Phtoplasma diseases of fruit trees in germplasm and commercial orchards in Turkey. *Journal of Plant Pathology* 88: 179–185.

Shivas RG (1989) Fungal and bacterial diseases of plants in Western Australia. *Journal of the Royal Society of Western Australia* 72: 1–62.

Shohet C, Bautista S, Perez D (2008) Appendix C: Brief life history narratives for botanical, wildlife, and fish species of local interest. Gifford Pinchot National Forest, Columbia River Gorge National Scenic Area, Washington side. Invasive Plant Treatment FEIS. USDA Forest Service, Washington.

Sivasithamparam K, MacNish GC, Fang CS, Parker CA (1987) Microflora of soil and wheat rhizosphere in a field following fumigation. *Australian Journal of Soil Research* 25: 491–498.

Snare L (2006) Pests and disease analysis in hazelnuts. NSW Department of Primary Industries, http://www.dpi.nsw.gov.au/__data/assets/pdf_file/0003/117984/pest-and-disease-analysis-in-hazelnuts.pdf (Accessed: 1 February 2011).

Staniulis JB, Davis RE, Jomantiene R, Kalvelyte A, Dally EL (2000) Single and mixed phytoplasma infections in phyllody- and dwarf-diseased clover plants in Lithuania. *Plant Disease* 84: 1061–1066.

Swinburne TR (1964) Rotting of apples of the variety Bramley's seedling by *Nectria galligena*, (Bres.). *Nature* 204: 493–494.

Swinburne TR (1975) European canker of apple (*Nectria galligena*). *Review of Plant Pathology* 54: 787–799.

Tammaru T, Esperk T, Castellanos I (2002) No evidence for costs of being large in females of *Orgyia* spp. (Lepidoptera, Lymantriidae): larger is always better. *Oecologia* 133: 430–438.

Tavella L, Gianetti G (2006) Le principali avversita del nocciolo in piemonte. *Petria* 16: 45–58.

Taylor SP, Hollaway GJ, Hunt CH (2000) Effect of field crops on population densities of *Pratylenchus neglectus* and *P. thornei* in southeastern Australia; Part 1: *P. neglectus*. *Journal of Nematology* 32: 591–599.

Thwaite WG (1991) Resistance to clofentezine and hexythiazox in *Panonychus ulmi* from apples in Australia. *Experimental and Applied Acarology* 11: 73–80.

Tinzaara M, Dicke M, van Huis A, Gold C (2002) use of infochemicals in pest management with special reference to the banana weevil, *Cospopolites sordisu* (Germar) (Coleoptera: Curculionidae. *Insect Science appl* 22: 241–261.

Tonini C, Cassani G, Massardo P, Guglielmetti G, Castellari PL (1986) Study of female sex pheromone of leopard moth, *Zeuzera pyrina* L. isolation and identification of three components. *Journal of Chemical Ecology* 13: 1545–1558.

Tortella GR, Rubilar O, Gianfreda L, Valenzuela E, Diez MC (2008) Enzymatic characterization of Chilean native wood-rotting fungi for potential use in the bioremediation of polluted environments with chlorophenols. *World Journal of Microbiology and Biotechnology* 24: 2805–2818.

Tuncer C, Akca IM, Saruhan I (2001) Integrated pest management in Turkish hazelnut orchards. *Acta Horticulturae* 556: 419–429.

Tuncer C, Ecevit O (1997) Current status of hazelnut pests in Turkey. *Acta Horticulutrae* 445: 545–552.

Ulubas Serce C, Kaydan MB, Kilincer AN, Ertunc F (2007) Investigation of mealybug (Hemiptera: Coccoidea: Pseudococcidae) species from Turkey by RAPD. *Phytoparasitica* 35: 232–238.

Vet LE, Dicke M (1992) Ecology of infochemical use by natural enemies in a tritophic context. *Annual Review of Entomology* 32: 141–172.

Wadia, KDR, Klinac D, McNeil DL, Osmonalieva A, Stewart A, Knowles RD (2000) Occurrence of *Phomopsis castanea* as an endophyte in chestnut trees. *New Zealand Plant Protection* 53: 133–137.

Waterworth HE, Mock R (1999) An assessment of nested PCR to detect phytoplasmas in imported dormant buds and internodal tissues of quarantined fruit tree germplasm. *Plant Disease* 83: 1047–1050.

Webber JD (2007) *Phenology of hazelnut big bud mites in Canterbury and implications for management*. M (A.Sc). thesis, Lincoln University, New Zealand. http://researcharchive.lincoln.ac.nz/dspace/bitstream/10182/342/5/webber_mapplsc.pdf.txt. Accessed 27 July 2011.

Webber J, Chapman RB (2008) Timing of sulphur spray application for control of hazelnut Big Bud Mites (*Phytoptus avellanae* and *Cecidophyopsis vermiformis*). *New Zealand Plant Protection* 61: 191–196.

Webber JD (2007) *Phenology of hazelnut big bud mites in Canterbury and implications for management* (Masters thesis). Lincoln University, New Zealand.

Webley DJ, Jackson KL, Mullins JD, Hocking AD, Pitt JI (1997) *Alternaria* toxins in weather-damaged wheat and sorghum in the 1995–1996 harvest. *Australian Journal of Agricultural Research* 48: 1249–1255.

Wickland AC, Jensen CE, Rizzo DM (2008) Geographic distribution, disease symptoms and pathogenicity of *Phytophthora nemorosa* and *Phytophthora pseudosyringae* in California, USA. Forest Pathology 38: 288–298.

Wimalajeewa DLS, Washington WS (1980) New Diseases – Bacterial Blight of Hazelnut. *Australasian Plant Pathology* 9: 113–114.

Wormald H (1954) *The Brown Rot Diseases of Fruit Trees*. Ministry of Agriculture and Fisheries Technical Bulletin No.3., HMSO, London.

WSU (2011) *Phomopsis revellens*. Pacific Northwest Fungi Database. Washington State University. http://pnwfungi.wsu.edu. Accessed 19 July 2011.

WTO (World Trade Organisation) (1995) 'Agreement on the application of sanitary and phytosanitary measures'. World Trade Organisation, Geneva. http://www.wto.org/english/tratop_e/sps_e/spsagr_e.htm, Accessed: 27 April 2010.

Wu WP, Sutton BC (1996) A reassessment of some *Discosia* species. *Mycological research* 100: 287–290.

Yun HY (2011) Systematic Mycology and Microbiology Laboratory, ARS, USDA. Invasive Fungi. Asian filbert rust – *Pucciniastrum coryli*. Retrieved, from /sbmlweb/fungi/index.cfm (Accessed: 9 May 2011).