INDUSTRY BIOSECURITY PLAN

FOR THE NURSERY & GARDEN INDUSTRY

Threat Specific Contingency Plan

Pierce's disease

(*Xylella fastidiosa*)

Plant Health Australia

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1 Purpose and background of this contingency plan

This contingency plan provides background information on the pest biology and available control measures to assist with preparedness for an incursion into Australia of Pierce's disease, the causal agent of which is *Xylella fastidiosa*. This contingency plan focuses specifically on the pathogen, but recognises that the introduction, spread and economic impact of the disease will depend strongly on the presence of one of its main vectors, the Glassy winged sharpshooter (*Homalodisca vitripennis*). A separate contingency plan has previously been prepared for Glassy winged sharpshooter (GWSS), and is referenced where appropriate in this contingency plan.

This contingency plan provides guidelines and options for steps to be undertaken and considered when developing a Response Plan for incursion of Pierce's disease. The control and management information provided in this document is specifically for the pathogen *Xylella fastidiosa*, as control of the main vector *Homalodisca vitripennis* is addressed in the Glassy winged sharpshooter contingency plan (Plant Health Australia 2009). Any Response Plan developed using information in whole or in part from either of these contingency plans must follow procedures as set out in PLANTPLAN and be endorsed by the National Management Group prior to implementation.

This contingency plan was developed for the Nursery and Industry Australia (NGIA), and therefore is focused on production nurseries covered by this association. In the event of an incursion, operations that are not covered by the NGIA or another Emergency Plant Pest Response Deed (EPPRD) signatory (e.g. retail nurseries), will not be represented or have a decision making say in any arrangements for emergency response.

The information for this plan has been primarily obtained from documents sourced electronically as cited in the reference section and the National Diagnostic Protocol for Pierce's Disease, *Xylella fastidiosa* (Luck *et al.* 2010). Information on background, life cycle, host range, distribution and symptoms is given, with the emphasis of this document on the management and control of the pathogen.

2 Australian nursery industry

The Australian nursery industry is a significant horticultural sector with a combined supply chain (production to retail/grower) valued at more than $6 billion dollars annually. The industry employs approximately 45,000 people spread over more than 20,000 small to medium sized businesses including production nurseries and retail outlets. The industry is located predominantly along the Australian coastline and in major inland regions servicing urban and production horticulture.

Nursery production is a highly diverse primary industry servicing the broader $14 billion horticultural sector within Australia (Table 1). A pest incursion is likely to impact market access (see Section 10.5 Appendix 5 for further information).

Table 1. *Nursery production supply sectors within Australian horticulture*

Production Nursery	Horticultural markets	Economic value
Container stock[1]	Ornamental/urban horticulture	$2 billion retail value
Foliage plants[1]	Interior-scapes	$87 million industry
Seedling stock[2]	Vegetable growers	$3.3 billion industry
Forestry stock[3]	Plantation timber	$1.7 billion industry
Fruit and nut tree stock[2]	Orchardists (citrus, mango, etc)	$5.2 billion industry
Landscape stock[1]	Domestic & commercial projects	$2 billion industry
Plug and tube stock[4]	Cut flower	$319 million industry
Revegetation stock[1]	Farmers, government, landcare	$109 million industry
Mine revegetation	Mine site rehabilitation	Value unknown
	Total horticultural market value	$14.5 billion

2.1 Notification process for the reporting of suspect pests

Early detection and reporting may prevent or minimise the long-term impact of an incursion into Australia of the Pierce's disease (*Xylella fastidiosa*) and/or its vector the Glassy winged sharpshooter (*Homalodisca vitripennis*).

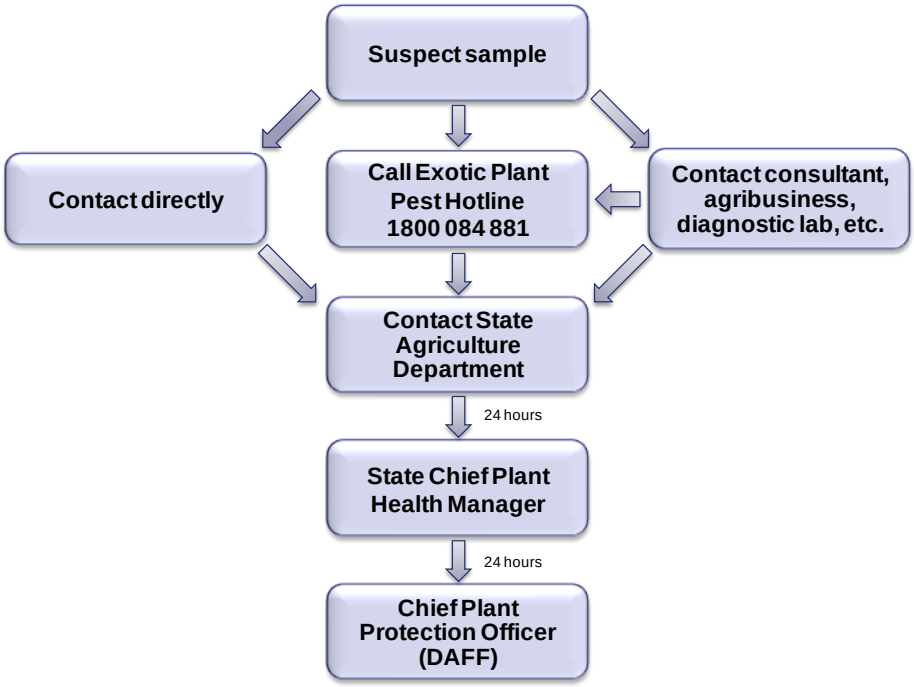

Figure 1. *Notification process for the reporting of suspect pests*

[1] Data sourced from Market Monitor

[2] Data sourced from Horticultural Handbook 2004

[3] Data sourced from ABARE 2005

[4] Data sourced from industry

3 Eradication or containment decision matrix

The decision to eradicate should be based on the potential economic impact of host damage resulting from Pierce's disease infection, the cost of eradication and on technical feasibility. Eradication costs must factor in long term surveys to prove the success of the eradication program. A minimum of three years with no detections of the pathogen may be necessary to confirm that Pierce's disease is absent and pest free status can be declared. The timeframe needs to be considered on a case by case basis, based both on the size of the infection, the degree and distribution of the pest, with the final decision determined by the National Management Group.

No specific eradication matrix has been determined for Pierce's disease; however, the general decision process as outlined in Figure 2 and Table 2 should be followed in determining if an incursion of this pest will be eradicated or managed/contained. The final decision between eradication and management will be made through the National Management Group.

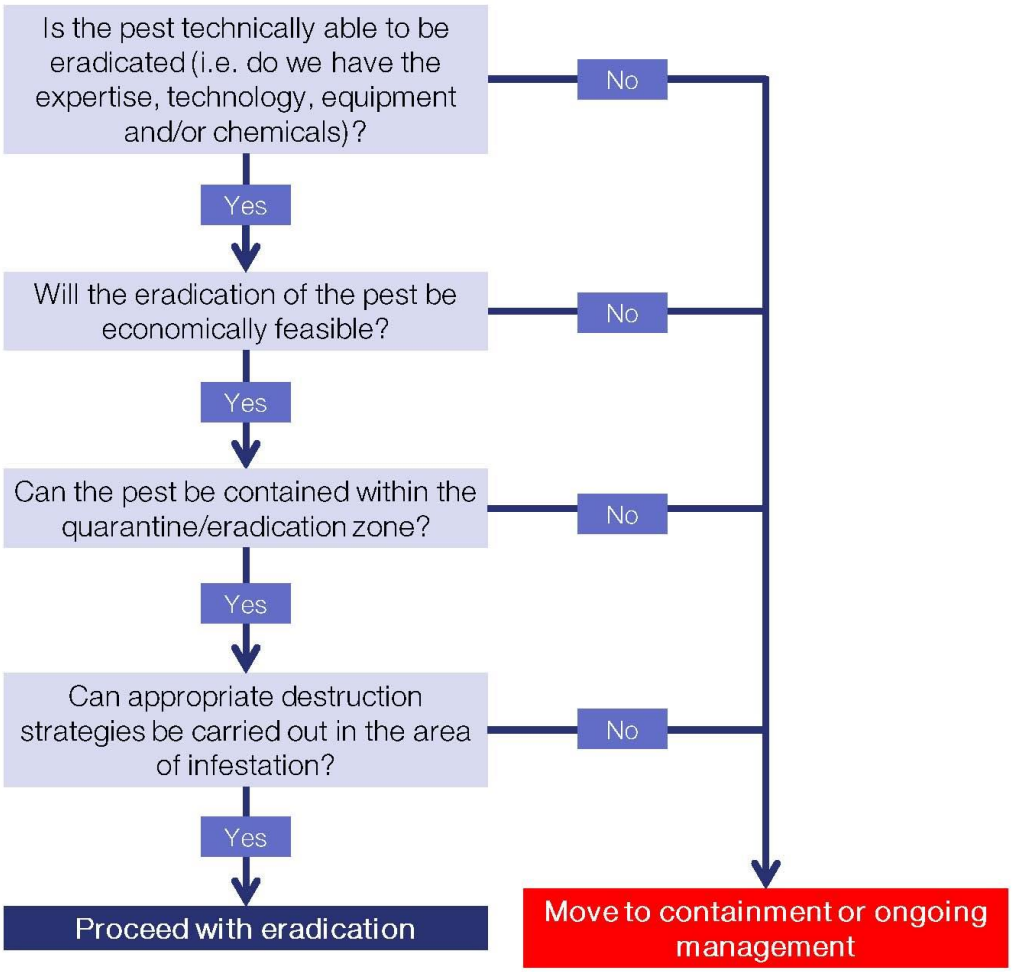

Figure 2. *Decision outline for the response to an exotic pest incursion*

Table 2. *Factors considered in determining whether eradication or alternative action will be taken for an EPP Incident (taken from Appendix 12 of PLANTPLAN)*

Factors favouring eradication	Factors favouring alternative action
• Cost/benefit analysis shows significant economic or amenity loss to industry or the community if the organism establishes. • Physical barriers and/or discontinuity of hosts between production districts. • Cost effective control difficult to achieve (e.g. limited availability of protectant or curative treatments). • The generation time, population dynamics and dispersal of the organism favour more restricted spread and distribution. • Pest biocontrol agents not known or recorded in Australia. • Vectors discontinuous and can be effectively controlled. • Outbreak(s) few and confined. • Trace information indicates few opportunities for secondary spread. • Weather records show unfavourable conditions for pest development. • There is reasonable ease of access to outbreak site and any alternate hosts.	• Cost/benefit analysis shows relatively low economic or environmental impact if the organism establishes. • Major areas of continuous production of host plants. • Cost effective control strategies available. • Short generation times, potential for rapid population growth and long distance dispersal lead to rapid establishment and spread. • Widespread populations of known pest biocontrol agents present in Australia. • Vectors unknown, continuous or difficult to control. • Outbreaks numerous and widely dispersed. • Trace information indicates extensive opportunities for secondary spread. • Weather records show optimum conditions for pest development. • Terrain difficult and/or problems accessing and locating host plants.

4 Pest information/status

4.1 Pest details

Common name:	Pierce's disease of grapes Plum leaf scald Phony disease of peach Pecan leaf scorch Pear leaf scorch Almond leaf scorch Citrus variegated chlorosis Coffee leaf scorch Dwarf lucerne Leaf scorch disease (elm, sycamore, oleander, maple, oak) Sweetgum dieback Leaf scorch of purple-leafed plum Mulberry leaf scorch
Scientific name:	*Xylella fastidiosa*
Taxonomic position:	Kingdom, Animalia; Phylum, Proteobacteria; Class, Gammaproteobacteria; Order, Xanthomonadales; Family, Xanthomonadaceae

4.1.1 Background

Pierce's disease of grapevines was first discovered in 1892 in California, and is now a damaging pest in southern parts of the United States, Mexico and Central America. The disease is caused by the xylem-limited bacterium *Xylella fastidiosa* (Wells *et al*. 1987), which is also the causal agent of a range of disorders in other species. These include leaf scorch of oak, oleander, elm, sycamore and maple (Hearon *et al*. 1980), Sweetgum dieback and Leaf scorch of purple-leafed plum (Hernandez-Martinez *et al*. 2009) and diseases of agriculturally important crops such as peach, plum, pear, coffee, lucerne, citrus, almond and pecan (Hopkins 1989; Leu and Su 1993; de Lima *et al*. 1998).

Pierce's disease is a lethal grapevine disease killing grapevines outright by blocking the xylem tissue. The plant can die within 1-2 years of the initial infection date. The disease and the vector can persist all year round (Luck *et al.* 2010).

Several molecular studies have shown that distinct groups or clusters of *X. fastidiosa* exist (e.g. Chen *et al.* 1995, Pooler *et al.* 1995, Hendson *et al*. 2001). Schaad *et al.* (2004) described three subspecies of *X. fastidiosa* based on genetic and phenotypic evidence, namely subsp. *piercei;* subsp. *multiplex* and subsp. *pauca*. *Xyella fastidiosa* subsp. *pauca* causes Citrus veinal chlorosis only, whilst subsp. *piercei* and subsp. *multiplex* can cause disease symptoms in multiple hosts. Schuenzel *et al.* (2005) further classified a group of Oleander leaf scorch isolates as a separate subspecies, *X. fastidiosa* subsp. *sandyi*. More recently, Janse and Obradovic (2010) described five subspecies:

(i) *Xylella fastidiosa* subsp. *fastidiosa* (erroneously named *X. f.* subsp. *piercei*), which causes Pierce's disease and Almond leaf scorch. Strains have been isolated from cultivated grape, lucerne, almond, and maple;

(ii) *X. fastidiosa* subsp. *multiplex* which causes Phony disease of peach and Plum leaf scald. Strains have been isolated from peach, elm, plum, pigeon grape, sycamore and almond;

(iii) *X. fastidiosa* subsp. *pauca*, which causes Citrus variegated chlorosis. Strains have been isolated from citrus and probably include those from coffee;

(iv) *X. fastidiosa* subsp. *sandyi* which causes Oleander leaf scorch. Strains have been isolated from *Nerium oleander*;

(v) *X. fastidiosa* subsp. *Tashke.* Strains of this subspecies have been isolated from the ornamental tree *Chitalpa tashkentensis.*

Despite these classifications, the relationship between strains and hosts appears complex and is still not fully understood and is further complicated by the existence of pathovars (within plant-host strains) (Schuenzel *et al*. 2005). For example, some pathovars causing Almond leaf scorch can also cause Pierce's disease in grapes, yet other pathovars are limited to causing disease symptoms only in almonds (Hendson *et al.* 2001). However, the sequencing of the *X. fastidiosa* genome (Simpson *et al.* 2000) and subsequent sequencing of various strains of *X. fastidiosa* should improve understanding of host-strain relationships in the years to come.

4.1.2 Life cycle

A generic life cycle of the pathogen in shade trees is depicted in Figure 3. The bacteria proliferate in the xylem vessels of susceptible hosts, and notably, are maintained or can multiply in wild hosts. Survival of the bacteria depends strongly on winter climate, as persistence in plants over winter is limited by cold conditions (Purcell 1980). The bacteria is sensitive to dry conditions, such as those found in many seeds, but despite this, seed transmission of the bacteria is known to occur in citrus (CABI 2011). The bacteria can also persist in the gut of vector insects indefinitely, with the ability to multiply in the foregut (Janse and Obradovic 2010). In particular, the presence of vectors that overwinter as adults (as opposed to eggs or nymphs) appears to be a major factor in disease prevalence, as these vectors have the capacity to establish early season infections (Purcell 1997).

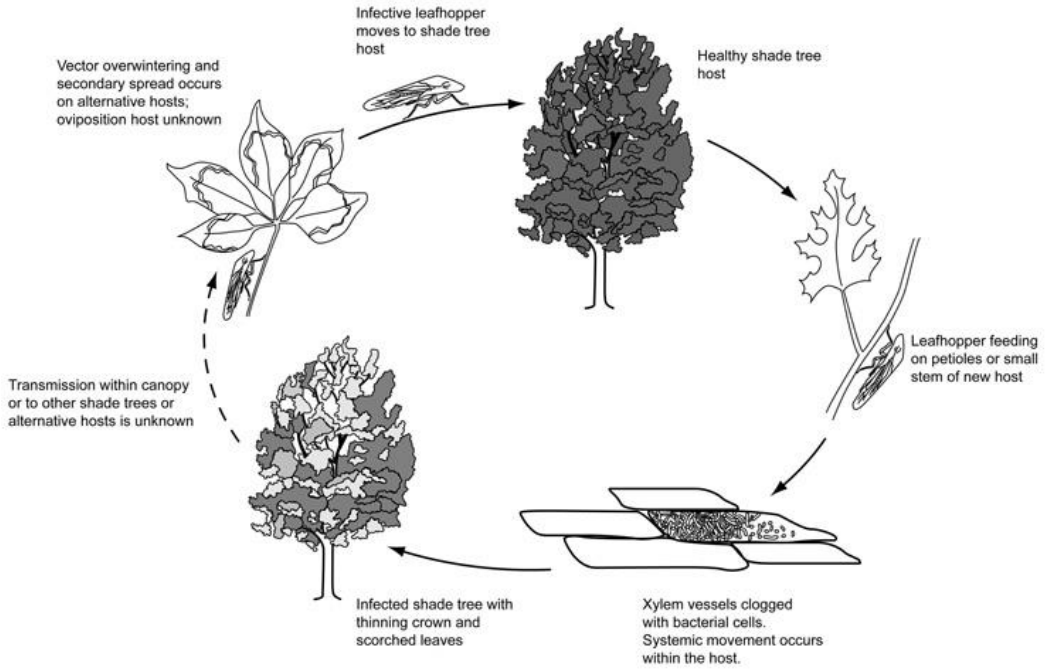

***Figure 3**: Disease cycle of X. fastidiosa in shade trees (Gould and Lashomb 2007)*

4.1.3 Dispersal

By

Plant parts liable to carry *X. fastidiosa* in trade/transport are:

- Bulbs, Tubers, Corms, Rhizomes: Borne internally, not visible to naked eye but usually visible under light microscope
- Flowers, Inflorescences, Cones, Calyx: Borne internally, not visible to naked eye but usually visible under light microscope
- Fruits (inc. pods): Borne internally, not visible to naked eye but usually visible under light microscope
- Leaves: Borne internally, not visible to naked eye but usually visible under light microscope
- Roots: Borne internally, not visible to naked eye but usually visible under light microscope
- Seedlings, Micropropagated plants: Borne internally, not visible to naked eye but usually visible under light microscope
- Stems (above ground), Shoots, Trunks, Branches: Borne internally, not visible to naked eye but usually visible under light microscope
- True seeds (inc. grain): Borne internally, not visible to naked eye but usually visible under light microscope

Plant parts not known to carry the pest in trade/transport are: bark, growing medium accompanying plants and wood.

Vectors can also be carried internationally on plants or plant products (usually as viable egg masses on plants), which is a major concern to Australia because no vectors are known to exist in Australia at present.

Australia has no record of Pierce's disease or Glassy winged sharpshooter.

4.2 Affected hosts

4.2.1 Host range

Xylella fastidiosa has an extremely wide host range as listed in Section 10.1 Appendix 1. The majority of hosts are wild hosts on which no leaf scorch symptoms are observed. It is worth noting that the host range of vectors, in particular the GWSS, will have a bearing on the spread of the disease. Hosts of the GWSS are listed in the GWSS contingency plan.

4.2.2 Current geographic distribution

Diseases caused by *X. fastidiosa* have so far been limited to the Americas and Taiwan (Pear leaf scorch only; Leu and Su 1993). Coffee leaf scorch and Citrus variegated chlorosis have been restricted to South America. There are also unconfirmed and unreliable reports of *X. fastidiosa* in Kosovo, Morocco, India and Turkey (CABI 2011).

The geographic distribution of Pierce's disease appears to be related to the ability of the bacteria to survive winter temperatures (Varela 2000). In general the disease is less prevalent where winter temperatures are colder. Wet winters also promote survival of vector populations and favour disease spread in regions with dry summers.

As winter weather conditions in Australia are not as severe as those in the USA, the effects of winter are likely to favour survival of the bacterium in Australia (Luck *et al*. 2010).

4.2.3 Symptoms

4.2.3.1 PIERCE'S DISEASE OF GRAPEVINES

Leaf scorch is the most characteristic symptom of primary infection, with early signs including sudden drying of parts of green leaves, which then turn necrotic with adjacent tissues turning yellow or red (Figure 4). Scorched leaves may shrivel and drop, leaving bare petioles attached to stems. Diseased stems often mature irregularly, with patches of brown and green tissue. In later years, infected plants develop late and produce stunted chlorotic shoots. Chronically infected plants may have small, distorted leaves with interveinal chlorosis (Figure 5) and shoots with shortened internodes (CABI 2011). Highly susceptible cultivars rarely survive more than 2-3 years while tolerant cultivars may survive chronic infection for more than 5 years (Goodwin and Purcell 1992).

It can take four to five months for the symptoms to appear, with only one or two canes showing symptoms in year 1. With young vines the symptoms appear more quickly covering the entire vine in a single season (Varela *et al*. 2001).

***Figure 4**: Leaf symptoms in the field include yellowing and reddening of leaf tissue. Image courtesy of ENSA-Montpellier Archive, Ecole nationale supérieure agronomique de Montpellier, Bugwood.org*

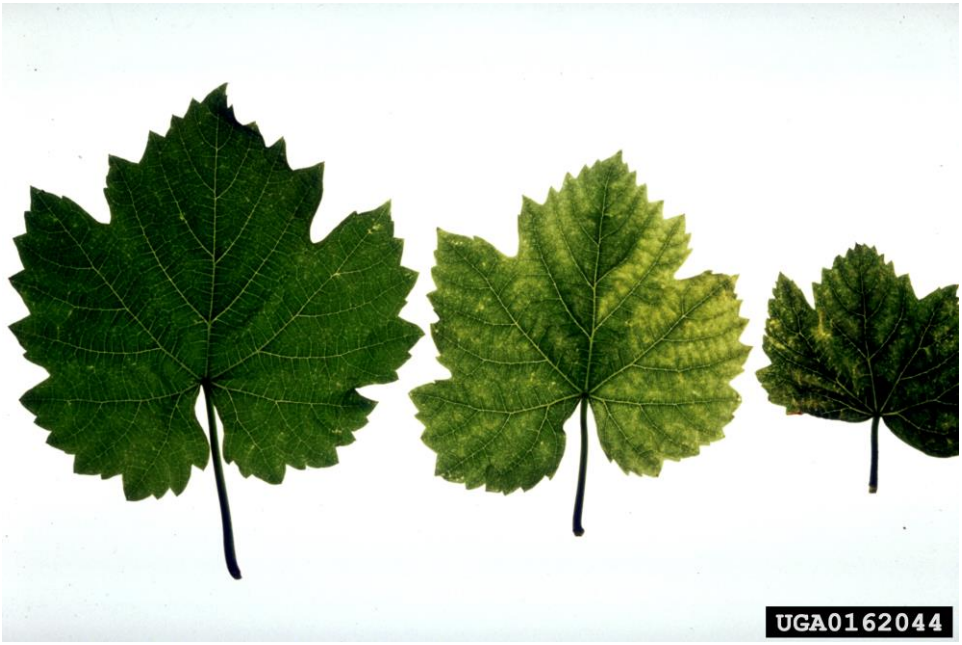

***Figure 5**: Leaf symptoms of pierce's disease (right) on Chardonnay grape compared to healthy leaf (left). Image courtesy of Alex. H. Purcell, University of California - Berkeley, Bugwood.org*

4.2.3.2 PHONY PEACH DISEASE

Young shoots are stunted with greener, denser foliage than healthy trees (CABI 2011). The shortening of internodes is accompanied by increased development of lateral branches that grow horizontally or droop (Janse and Obradovic 2010). Leaves and flowers appear early, and leaves

remain on the tree longer than on healthy trees. Trees are not generally killed, but suffer fruit yield losses and are susceptible to attack from insects and other diseases.

4.2.3.3 CITRUS VARIEGATED CHLOROSIS

Typical symptoms on trees up to 10 years of age include foliar chlorosis resembling zinc deficiency with interveinal chlorosis (Figure 6); symptoms in older trees appear as a few diseased branches. As the leaves mature, small, light-brown, slightly raised gummy lesions (becoming dark-brown or even necrotic) appear on the underside, directly opposite the yellow chlorotic areas on the upper side. Newly affected trees show sectoring of symptoms, whereas trees which have been affected for a period of time show variegated chlorosis throughout the canopy. Affected trees show stunting and slow growth rate; twigs and branches die back and the canopy thins, but affected trees do not die (CABI 2011). Trees may also wilt. Fruit are smaller (Figure 7) with a hard rind and higher sugar content (CABI 2011).

***Figure 6**: Leaf interveinal chlorosis caused by Citrus variegated chlorosis disease. Image courtesy of Alex. H. Purcell, University of California, Bugwood.org*

***Figure 7**: Fruit are smaller, and small raised lesions appear on the underside of leaves. Image courtesy of Alex. H. Purcell, University of California, Bugwood.org*

4.2.3.4 OTHER LEAF SCORCH DISEASES CAUSED BY X. FASTIDIOSA

'Scorching' or bronzing of the leaf margins is the classic early symptom of diseases caused by *X. fastidiosa* (Figure 8). The bronzing may intensify (Figure 9) and become water soaked before browning and drying (Janse and Obradovic 2010). Symptoms usually appear on just a few branches but later spread to cover the entire plant. Depending on the plant, dieback, stunting, fruit distortion or plant death may occur.

***Figure 8**: Bronzing of oak leaves caused by X. fastidiosa. Image courtesy of Randy Cyr, Greentree, Bugwood.org*

***Figure 9**: Bronzing intensifies over time (leaf from American Sycamore). Image courtesy of Theodor D. Leininger, USDA Forest Service, Bugwood.org*

4.3 Diagnostic information

An endorsed National Diagnostic Protocol (NDP6) for Pierce's Disease, *Xylella fastidiosa* has been prepared by Luck *et al*. (2010). This protocol describes three methods for the positive identification of *X. fastidiosa* including morphological methods, serological test, Enzyme Linked Immunosorbent Assay (ELISA) or Polymerase Chain Reaction (PCR) methodology (Varela 2000).

For a list of diagnostic facilities and advisory services that can be utilised in the event of an incursion see Section 10.2 Appendix 2 and Section 10.3 Appendix 3.

4.3.1 Morphological methods

Specialised media has been developed for isolating and growing the bacterium (Luck *et al*. 2002 & 2010).

X. fastidiosa is a Gram-negative, slow growing rod-shaped bacterium that lacks flagella for motility and is strictly aerobic (Janse and Obradovic 2010). Bacterial cells typically possess a rippled (undulating) cell wall and terminal fimbriae (surface structures, shorter than flagella, that help to anchor the cells together in the xylem stream) (Gould and Lashomb 2007). As the name suggests, *X. fastidiosa* has fastidious nutrient requirements and grows only on selective media to form small colonies that appear white to yellow (Gould and Lashomb 2007).

4.3.2 Molecular methods

Luck *et al*. (2010) provide detailed protocols for the detection/diagnosis of *X. fastidiosa* in Australia for all three diagnostic methods, but recommend using PCR followed by bacterial culturing to confirm a positive result. Further advances in PCR-based methods that allow detection of all strains of the pathogen in plant or vector insect tissues and a description of primers required are given in Janse and Obradovic (2010).

5 Risk assessments for pathways and potential impacts

X. fastidiosa and its vector GWSS are not present in Australia, but both pests have the potential for establishment of spread and economic consequences in Australia, and therefore meet the criteria for a quarantine pest.

The risk assessments in this section focus on the major pathways identified for the potential introduction of *X. fastidiosa*. Unlike most other pests, the risk of establishment and spread will depend both on the commodity on which it enters Australia and also whether or not the vector is present.

Much of the data on the risk of entry, probability of establishment, probability of spread has been sourced on *X. fastidiosa* from the 'Final IRA report: Stone fruit from California, Idaho, Oregon and Washington (2010) and the 'Report on Pierce's disease and the Glassy winged sharpshooter' more specifically with reference to importing grapes from the USA (Scott and De Barro 2000). For further information on the phytosanitary risk of *X. fastidiosa* with the vector GWSS refer to the Contingency plan developed for NGIA (Plant Health Australia 2009).

5.1 Entry of the pathogen with a vector

All sucking insects that feed on xylem sap are potential vectors of *X. fastidiosa,* with all known vectors limited to the Homoptera suborder (Purcell 1999). Insects currently known to be capable of transmitting *X. fastidiosa* all belong to the spittlebug/ froghopper family (Cercopidae) and the 'sharpshooter' subfamily.

Xylem feeding insects acquire the bacterium from infected hosts. The bacterium adheres to and is retained in the foregut of the vector where it replicates and from which it is transmitted to new hosts almost immediately (Purcell and Hopkins 1996) with virulence maintained throughout the life of adult vectors (Redak *et al*. 2004).

GWSS is a major vector for *X. fastidiosa* and there is potential to introduce infected GWSS with importation of fruit.

5.1.1 Entry potential

Rating: Medium

Entry pathways for GWSS to arrive in Australia are shown in Table 3. The most likely pathway of entry for GWSS is as a hitchhiker on plant material and transport machinery, including on imported nursery stock. Evidence suggests that the leafhopper entered California in nursery stock as eggs, which are difficult to detect. Since then the agriculture quarantine inspections have frequently intercepted leafhopper specimens.

Table grape exports into Australia could also be a potential entry pathway for sharpshooter. The risk of GWSS arriving in Australia would in some part be related to the number of insects present in the source areas from which the table grape exports originate. In the early part of the table grape season when the insect is extremely active and all forms of the insect can be found in vineyards and in other orchards the risk of the insect entering Australia would be higher.

The risk of entry of GWSS into Australia is **medium**. Given the reasonable likelihood that the vectors that enter may also be harbouring *X. fastidiosa*, the entry potential of the pathogen in the presence of the vector is also **medium**.

5.1.2 Establishment potential

Rating: Medium

The wide host range of GWSS together with suitable environmental conditions, would allow for the establishment of GWSS in many regions of Australia. The likelihood of GWSS establishment in Australia following entry, and therefore the likelihood of establishment of *X. fastidiosa*, is considered **medium**.

Table 3. *Potential entry pathways for GWSS into Australia*[5]

Parameter	Details
Plant parts that can carry GWSS in transport/trade	• Fruits (including pods) can carry eggs internally – visible to the naked eye • Leaves can carry eggs and nymphs both internally and externally – visible to the naked eye • Stems, shoots, trunks and branches can carry nymphs and adults externally – visible to the naked eye
Plant parts not known to carry GWSS in transport/trade	• Bark • Bulbs, tubers, corms and rhizomes • Growing medium accompanying plants • Flowers, inflorescences, cones and calyx • Seedlings and micropropagated plants • Roots • True seeds (include grain) • Wood
Transport pathways for long distance transport	• Adults can be carried within transport vehicles • Adults and nymphs can be moved in storage and transport bins
Main pathways for the likely entry of GWSS into Australia	• Nursery stock for planting (excluding seeds and fruit) of known susceptible hosts • Foliage of cut branches (for ornamental purposes) of susceptible foliar hosts • Fruit of susceptible hosts

5.1.3 Spread potential

Rating: High

GWSS adults are strong flyers allowing rapid movement of the insect. In addition, all life stages can move on machinery, equipment and plant material. These factors combined with the wide distribution of suitable host species results in a **high** spread potential for GWSS.

The wide host range *X. fastidiosa* and lack of latent period and retention of the pathogen in the gut of vectors result in a **high** spread potential for the pathogen in the presence of the vector.

5.1.4 Economic impact

Rating: High

The pathogen has a high economic impact on grapevines in southern USA (Hopkins 2005) and on a range of other agricultural and amenity plants in North and South America (Schaad *et al*. 2004). Australian climatic conditions that favour pathogen survival (e.g. milder winters), wide host range and lack of chemical/physical control methods or plant resistance to the pathogen suggest that economic impact of the pathogen in Australia would be **high.**

[5] Information taken from CABI (2011)

5.1.5 Environmental impact

Rating: Medium

The pathogen is damaging to a number or ornamental and amenity trees in the USA (Schaad *et al.* 2004), many of which are found in parks and gardens in Australia (oaks, sycamores, maples, elm, oleander). Other potential environmental effects would be the increased use of pesticides.

5.1.6 Overall risk

Rating: Medium

Based on the individual ratings above, the combined overall risk is considered **medium**.

5.2 Entry of the pathogen in the absence of a vector

5.2.1 Entry potential

Rating: Low

Given the strict import requirements for fruit from the USA and post entry quarantine requirements for nursery stock, the entry potential for the pathogen in the absence of a known vector is **low**.

5.2.2 Establishment potential

Rating: Medium

If *X. fastidiosa* were distributed in a viable state to a suitable host it could establish in Australia given the wide range of hosts spread throughout the country. Hopkins (1989) has shown that non-virulent strains are known to multiply in susceptible hosts. A vector would not be needed for initial multiplication of the bacterium as the initially infected host plant would be sufficient.

X. fastidiosa proliferates in the USA in environments with warm conditions and mild winters and with such similar climates, *X. fastidiosa* could establish in Australia. *X. fastidiosa* is sensitive to cold and with Australia's winters less severe than those in North America, the Australian environments may allow for growth of the bacterium throughout the year.

X. fastidiosa reproduces inside its hosts by cell division, doubling in population in less than 48 hours (Hopkins 1989). This short generation time suggests there would be potential for genetic variation leading to adaption to new environments.

Based on this information, the establishment potential for *X. fastidiosa* is considered **Medium**.

5.2.3 Spread potential

Rating: Low

With the warmer conditions and milder winters in Australia compared with the USA, *X. fastidiosa* would be expected to spread more easily all year round. The broad host range of *X. fastidiosa* includes many host weeds, crops and native plants present in Australia, and suggests the pathogen could have many potential hosts within close proximity to an infection allowing spread to occur readily.

Without either a vector, or movement of nursery stock and other propagative material, the spread of *X. fastidiosa* is limited to the host plant. Interstate quarantine controls may also limit the rate of spread.

The pathogen could be spread in planting material, but this pathway has not been considered a major risk for grapevine in North America (Goheen and Hopkins 1988). As the pathogen is already widely distributed in America, infected plant material is seen as a relatively minor pathway for new introduction and establishment. This is not the case in the European Plant Protection Organisation (EPPO) region where the pathogen is not present and large areas of susceptible grapevines are at risk. If the pathogen was introduced on grapevine planting material or on symptomless plant hosts it is considered that spread could occur easily especially in the presence of the vector (EPPO 1990).

Information on the presence of the pathogen in fruit and seeds and the capacity of vectors to penetrate xylem in infected fruits is limited. Long distance transmission of *X. fastidiosa* can occur through the transport of infected plant propagative material. However, it may be difficult to detect the disease in asymptomatic plants.

Information presented in previous sections shows that the main issue in the spread or establishment of *X. fastidiosa* is the availability of a vector. Without the vector the disease is unlikely to be a serious threat to Australian viticulture (Scott and De Barro 2000). The risk of spread in the absence of the vector is considered **low**.

5.2.4 Economic impact

Rating: Medium-Unknown

It is extremely difficult to predict the economic impact of *X. fastidiosa* in the absence of any known vectors. If Australian native insects were capable of vectoring the disease it is most likely that the epidemiology would be similar to that observed in Californian riparian environments prior to the introduction of the GWSS, where the disease can be managed and losses can be kept to manageable levels (Merriman et al. 2001). If native insects were able to vector the disease the economic impact may be more severe.

5.2.5 Environmental impact

Rating: Medium

The pathogen is damaging to a number or ornamental and amenity trees in the USA (Schaad *et al.* 2004), many of which are found in parks and gardens in Australia (oaks, sycamores, maples, elm, oleander). Other potential environmental effects would be the increased use of pesticides.

5.2.6 Overall risk

Rating: Low

Based on the individual ratings above, the combined overall risk is considered **low**.

6 Pest management

6.1 Response checklist

The following checklist (Table 4) provides a summary of generic requirements to be identified and implemented within a Response Plan.

Table 4. *Checklist of requirements to be identified in a Response Plan*

Checklist item	Further information
Destruction methods for plant material, soil and disposable items	Section 7.1.1, 7.1.2
Disposal procedures	Section 7.1.5
Quarantine restrictions and movement controls	Section 7.3
Decontamination and property cleanup procedures	Section 7.5
Diagnostic protocols and laboratories	Section 4.3
Trace back and trace forward procedures	Section 7.6
Protocols for delimiting, intensive and ongoing surveillance	Section 6.2
Zoning	Section 7.4
Reporting and communication strategy	Section 10.4

For a range of specifically designed procedures for the emergency response to a pest incursion and a general communication strategy refer to PLANTPLAN (Plant Health Australia 2010). Additional information is provided by Merriman and McKirdy (2005)[6] in the Technical Guidelines for Development of Pest Specific Response Plans.

6.2 Surveys and epidemiology studies

Information provided in Section 6.2.1 to 6.2.3 provides a framework for the development of early detection and delimiting surveys for diseases caused by *X. fastidiosa*.

Where *X. fastidiosa* is found in a production nursery that is in close proximity to potential plants (including weeds) periodically inspect nearby hosts for symptoms caused by *X. fastidiosa* (leaf scorching) by examining leaves closely and looking for symptoms. Infected sources within a production nursery may provide an opportunity for *X. fastidiosa* to spread outside the production nursery. With the vector GWSS, *X. fastidiosa* would be spread more rapidly.

Leaf scorching is the most typical symptom across the range of hosts that show symptoms. Agricultural inspectors and other production nursery visitors should avoid moving infested plant material between production nurseries. Shoes, tools and vehicle tyres should be thoroughly washed of soil and then sanitised with a registered disinfectant. Extra precaution should be taken when working in areas known to be infected, including disposable overboots that may be used and disposed of on-site.

[6] Available on the PHA website (**www.planthealthaustralia.com.au/go/phau/biosecurity/general-biosecurity-information**)

6.2.1 Technical information for planning surveys

When developing surveys for *X. fastidiosa* presence and/or distribution, the following characteristics of the pest provide the basic biological knowledge that impact on the survey strategy:

- *X. fastidiosa* (and the GWSS vector) have a wide host range and share many of the same hosts
- Leaf scorch symptoms may look similar to other abiotic or biotic stress symptoms
- Host species in Australia are likely to be numerous and widely dispersed
- Movement of *X. fastidiosa* can occur by human assistance through the transfer of nursery stock or with the GWSS vector by flight
- The risk of pest movement on machinery, equipment and personal effects is high
- Production nursery greenhouses and significant proportions of Australia have favourable climatic conditions for the spread and establishment of *X. fastidiosa* (and its vector)
- As the *X. fastidiosa* vector spreads readily in a greenhouse or production nursery environment the tracing of plant material from one nursery to another needs to be taken into consideration

6.2.2 Surveys for early detection of an incursion in a production nursery

The success of an eradication response to a *X. fastidiosa* incursion in a production nursery is more likely following early detection of the pest before it has had the opportunity to disperse to a wide area. This is especially so if the vector GWSS was present. It is therefore necessary to consider pathways and plan surveys accordingly: see the contingency plan for the Glassy winged sharpshooter (Plant Health Australia 2009) for information on surveys in an incursion of the vector). Important points to consider when developing early detection surveys for *X. fastidiosa* in production nurseries are:

- Systematic and careful inspection of crops and propagative plant material is essential to prevent introduction of the *X. fastidiosa* pathogen and limit its spread within and from contaminated outdoor and greenhouse production areas. Early detection of the pathogen (and if the vector is present), while at low levels, will provide the best chance of eradication
- An inspector must be trained to recognise *X. fastidiosa* pathogen symptoms and other similar disorders for comparison (see Section 4.2.3). A layout map of the outdoor and greenhouse production area that includes approximate locations of target species will be required to develop a strategy for surveys. A survey map should include species and cultivar names, locations, approximate quantity and sources of targeted plants within the area. During the survey walkthrough, record the date, observations, and sampling information directly onto the survey map. The recorded information should be reviewed and used to develop an efficient survey strategy each time the production area is inspected
- Awareness information should be targeted at people who are in regular close contact with potential hosts in high risk areas or movement vectors (e.g. production nursery operators)
- Should the presence of *X. fastidiosa* be detected in Australia and movement of potential host material is permitted, any new host material entering nurseries from suspected areas of infection should be quarantined prior to distribution throughout the property to allow for visual inspection or testing for the presence of the pest

If an incursion of GWSS (and the pathogen) is to be eradicated in a production nursery, it must be detected early, before the insect has had the opportunity to disperse over a large area.

6.2.3 Delimiting surveys in the event of an incursion

- In the event of an incursion, delimiting surveys are essential to inform the decision-making process
- The size of the survey area will depend on the size of the infected area and the severity of the infection, as well prevailing winds and movement of plant material during the period prior to detection (Figure 10). Other considerations are for example, movement of people or plant material equipment as a result of trace-forward and trace-backs
- If vectors are present, they can readily spread by flying long distances or by being transported on infested plants
- Initial surveys should be carried out in 2 km radius of the initial detection but if GWSS is present, and as GWSS is an active flier the survey radius should be expanded to a 30 km radius as the delimitation progresses. It should be noted this will only take into account natural dispersal and survey range will need to be extended if human assisted dispersal is considered a factor, especially after taking into account tracing information
- All potential host species (refer to Appendix 1) should be surveyed, with particular attention paid to the species in which the pest was initially detected
- In addition to inspection of possible host plants, material should be collected for diagnostic purposes (refer to Section 6.2.4). Complete destruction should not occur until sufficient material has been collected for diagnostic purposes
- If the incursion is in a populated area, publication and distribution of information sheets and appeals for public assistance may be helpful

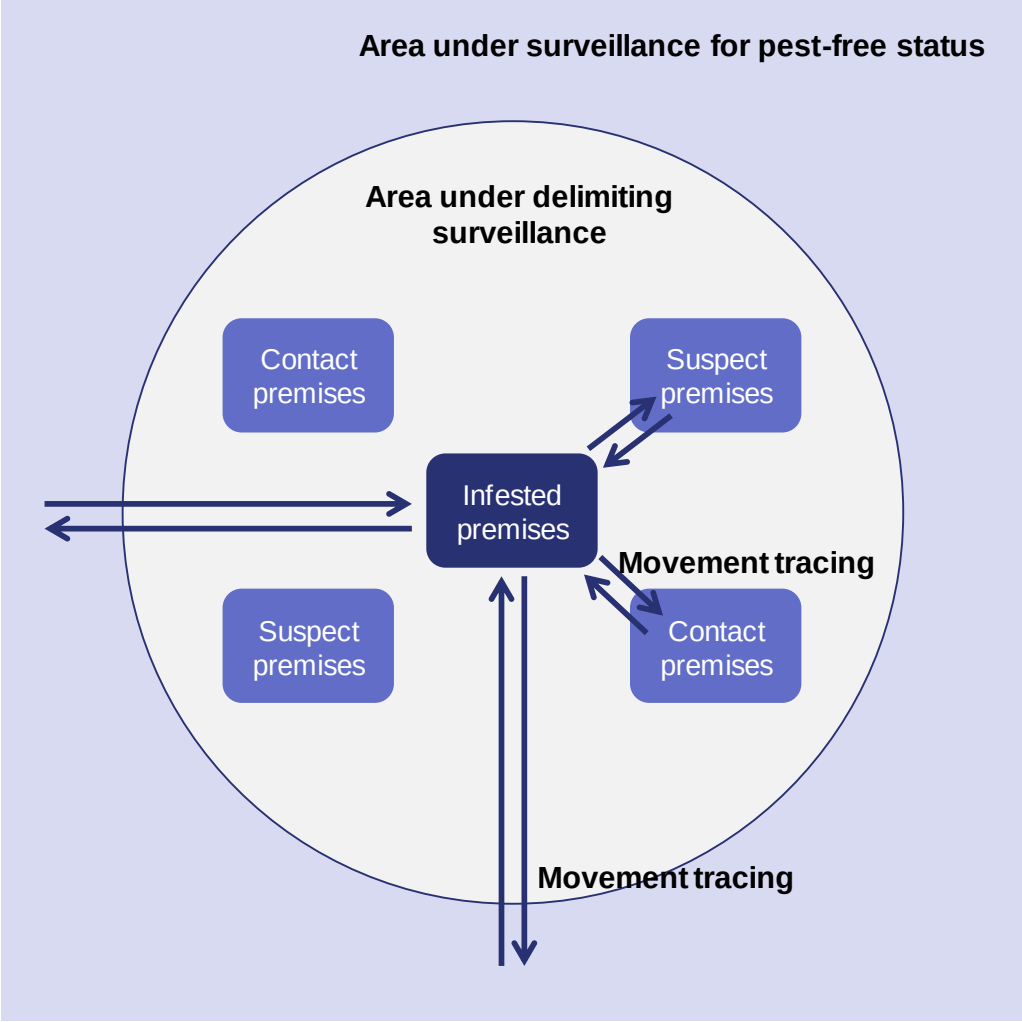

Figure 10. *Diagram of a delimiting survey showing surveillance activities from the infected premises*

6.2.4 Collection and treatment of samples

Protocols for the collection, transport and diagnosis of suspect Emergency Plant Pests (EPPs) must follow PLANTPLAN (Plant Health Australia 2010). Any personnel collecting samples for assessment should notify the diagnostic laboratory prior to submitting samples to ensure expertise is available to undertake the diagnosis.

All sample containers should be clearly labelled with the name, address and contact phone number of both the sending and receiving officers. In addition containers should be clearly labelled in accordance with the requirements of PLANTPLAN (Plant Health Australia 2010). Containers should be carefully sealed to prevent loss, contamination or tampering of samples. The Chief Plant Health Manager will select the preferred laboratory. Additional labelling includes the identification of plant species/parts affected, location of nursery and affected plant within the nursery (preferably with a GPS reading) as well as symptoms and an image if available.

Refer to PLANTPLAN for packing instructions under IATA 650. For protocols on collecting samples of the vector, see the GWSS contingency plan.

See the contingency plan for the GWSS (Plant Health Australia 2009) for information on the collection and treatment of samples for the GWSS vector. The following refers to the collection and treatment of

X. fastidiosa samples based on the National Diagnostic Protocol for Pierce's disease by Luck *et al.* (2010).

6.2.4.1 COLLECTION OF SPECIMENS

Sampling procedures

Grapevine samples should ideally be collected late summer to autumn. In chronically infected vines, bacteria do not move into the new season's growth until the middle of the summer. Leaves attached to the cane generally give the most reliable result.

Number of specimens to be collected

Collect leaf material showing symptoms of *X. fastidiosa* infection which is attached to the cane. From each suspect plant collect 4-5 canes. The most optimum tissue to sample for the detection of *X. fastidiosa* the mid-rib and petiole from symptomatic leaves. Select five leaves from affected canes and treat as one sample (Luck *et al.* 2010).

Record the identity of the host plant where the samples were collected. Record the location, preferably as GPS co-ordinates, or alternatively, a map reference or distance and direction from a suitable landmark. If the land is privately owned, record the owner's details including contact telephone numbers.

How to collect and send plant samples

Samples should be treated in a manner that allows them to arrive at the laboratory in a fresh, well preserved state.

Wrap the cane samples in damp newspaper and place inside a sealed plastic bag.

All sample containers should be clearly labelled with the name, address and contact phone number of both the sending and receiving officers. In addition containers should be clearly labelled in accordance with the requirements of PLANTPLAN (Plant Health Australia 2010; Appendix 3). Containers should then be carefully sealed to prevent loss, contamination or tampering of samples. The Chief Plant Health Manager will select the preferred laboratory. Additional labelling includes the identification of plant species/parts affected, location of affected plant (where available include GPS reading) as well as symptoms and an image if available.

Refer to PLANTPLAN for packing instructions under IATA 650.

Precaution

Overheating or desiccation of samples prior to despatch should be prevented.

Receipt

On receipt of the samples the diagnostic laboratory should follow strict quarantine and processing guidelines. In keeping with ISO 17025 refer to PLANTPLAN (Plant Health Australia 2010).

6.2.5 Epidemiological study

The extent of infection in a production nursery, on a property or within a region will depend on the initial population size and whether conditions have been favourable for the pest to spread from the

initial location. Sampling should be based upon the origins of the initial suspect sample(s). Factors to consider will be:

- The proximity of other susceptible plants to the initial infestation source, including both current and previous crops. This will include crops in the production nursery or on the property with the initial detection and those on neighbouring properties
- Machinery or vehicles that have been into the infested area or in close proximity to the infestation source
- The extent of human movements into and around the infested area including follow up of any recent trips overseas. A possible link to the recent importation of plant material from other regions should also be considered
- The source of any production nursery stock propagation material and whether any other crops have been propagated from the same source and/or distributed from the affected nurseries
- If the vector is present, the lifecycle and spread potential of the vector will also need to be considered

6.2.6 Models of spread potential

No models of spread potential have been developed for diseases caused by *X. fastidiosa*.

6.2.7 Pest Free Area guidelines

Determination of Pest Free Areas (PFAs) should be completed in accordance with the International Standards for Phytosanitary Measures (ISPMs) 8 and 10 (IPPC 1998a, 1999).

General points to consider are:

- Design of a statistical delimiting survey for symptoms on host plants (see Section 6.2 for points to consider in the design)
- Surveys should be completed as described in the BioSecure *HACCP* manual (Nursery and Garden Industry Australia 2008), including monitoring processes (summarised in Table 5 and Table 6), and assessment of indicator plants and weed monitoring
- Surveys should also consider alternative hosts (see Section 4.2.1) and not be limited to the primary infected host
- Information (including absence of the pest) should be recorded

Table 5. *Summary of monitoring processes for protected production areas as described in BioSecure HACCP Guidelines*

Wear protective clothing when handling suspect samples
Walk at random through the area in a zigzag pattern
Take at least 10 minutes to inspect 10-20 plants or plug trays per 100 m^2 of production area
Inspect the tops and bottoms or leaves, looking for any direct evidence of insects
Inspect the entire plant if it has less than six leaves, or from larger plants select six leaves from all parts of the plant (upper, lower, middle) and examine them individually
Inspect the length of all stems and branches for insects and symptoms
During individual plant inspection, examine the foliage for any damage
If any plants show suspect symptoms (refer to Section 4.2.3) take a sample (refer to Section 6.2.4) to be formally diagnosed (refer to Section 4.3)
Check for a problem that have occurred regularly in the past, until you are certain it is not present
Record on the 'Crop Monitoring Record' sheet the presence or absence of the pest
Routinely inspect growing areas and remove alternate hosts and reservoirs of the pest, including weeds, crop residues and old plants that will not be marketed

Additional information is provided by the IPPC (1995) in Requirements for the Establishment of Pest Free Areas. This standard describes the requirements for the establishment and use of pest free areas as a risk management option for phytosanitary certification of plants and plant products. Establishment and maintenance of a PFA can vary according to the biology of the pest, pest survival potential, means of dispersal, availability of host plants, restrictions on movement of produce, as well as PFA characteristics (e.g. size, degree of isolation and ecological conditions).

Table 6. *Summary of monitoring processes for field production areas as described in BioSecure HACCP Guidelines*

Wear protective clothing when handling suspect samples
Pay particular attention to areas on the windward side, the sides bordering ditches, canals or other uncultivated areas and growing block centres
Place a flag or other marker at the entrance to the block or sampling area at the beginning of each inspection
Vary the entrance point in the sampling area (1 m to 3 m) for each subsequent sampling so that the same plants are not inspected each time
Walk at random through the area in a zigzag pattern
The scout should follow the same general pattern at each sampling
Make an effort to select those plants that appear less healthy for visual inspection
Take at least 10 minutes to inspect 10-20 plants or plug trays per 100 m^2 of production area
Inspect the tops and bottoms or leaves, looking for any direct evidence of plant damage (or the vector)
Inspect the entire plant if it has less than six leaves, or from larger plants select six leaves from all parts of the plant (upper, lower, middle) and examine them individually
Inspect the length of all stems and branches for symptoms (or the insect vector)
If any plants show suspect symptoms (or evidence of eggs or larvae of the vector) (refer to Section 4.2.3) take a sample (refer to Section 6.2.4) to be formally diagnosed (refer to Section 4.3)
Check for a problem that may have occurred regularly in the past, until you are certain it is not present
Record on the 'Crop Monitoring Record' sheet the presence or absence of the pest
Routinely inspect growing areas and remove alternate hosts and reservoirs of the pest, including weeds, crop residues and old plants that will not be marketed

6.3 Availability of control methods

6.3.1 General procedures for control

- Keep traffic out of affected areas and minimise movement in adjacent areas
- Adopt best-practice property hygiene procedures to retard the spread of the pest between glasshouses, fields and adjacent properties
- After surveys are completed, and permission has been obtained from the Chief Plant Health Manager, destruction of the infested plant material is an effective control
- On-going surveillance of infected areas to ensure the pest is eradicated
- Do not use any material from infected plants for propagation

6.3.2 Phytosanitary measures

As Pierce's disease is an extremely difficult to control in grape vines it is recommended that importation of grapevine planting material is severely restricted from countries where the pathogen is present. As recommended by EPPO (OEPP/EPPO, 1990), if planting material is imported under licence, it should be maintained in post-entry quarantine for two years and shown to be free from the

pest. Imported plants and fruits should be free from vectors, possibly by use of an appropriate treatment. Heat treatments has been shown to eliminate the pathogen (45°C for at least 3 h) (Goheen *et al.* 1973), and could have potential as a phytosanitary measure.

6.3.3 Chemical control

Chemical control of *Xylella* diseases in the field has not been successful. Hopkins and Mortenson (1971) showed that a tetracycline drench could cause a temporary remission of symptoms in potted grapevines.

6.3.4 Cultural Control

Literature from the USA has shown the use of tolerant cultivars is an effective control for Pierce's disease in areas at high risk for development of Pierce's disease (see University of California IPM website for details).

7 Course of action

Additional information is provided by the IPPC (1998b) in Guidelines for Pest Eradication Programmes. This standard describes the components of a pest eradication programme which can lead to the establishment or re-establishment of pest absence in an area. A pest eradication programme may be developed as an emergency measure to prevent establishment and/or spread of a pest following its recent entry (re-establish a pest free area) or a measure to eliminate an established pest (establish a pest free area). The eradication process involves three main activities: surveillance, containment, and treatment and/or control measures.

7.1 Destruction strategy

7.1.1 Destruction protocols

- General protocols:
    - No plant material should be removed from the infested area unless part of the disposal procedure
    - Disposable equipment, infested plant material or growing media/soil should be disposed of by autoclaving, high temperature incineration or deep burial
    - Any equipment removed from the site for disposal should be double-bagged
    - Machinery used in destruction processes need to be thoroughly washed, preferably using a detergent or farm degreaser

7.1.2 Decontamination protocols

Machinery, equipment and vehicles in contact with infested plant material or growing media/soil, or present within the Quarantine Area, should be washed to remove plant material and growing

media/soil using high pressure water or scrubbing with products such as a degreaser or a bleach solution (1% available chlorine) in a designated wash down area. When using high pressure water, care should be taken not to spread plant material. High pressure water should be used in wash down areas which meet the following guidelines:

- Located away from crops or sensitive vegetation
- Readily accessible with clear signage
- Access to fresh water and power
- Mud free, including entry and exit points (e.g. gravel, concrete or rubber matting)
- Gently sloped to drain effluent away
- Effluent must not enter water courses or water bodies
- Allow adequate space to move larger vehicles
- Away from hazards such as power lines
- Waste water, growing media/soil or plant residues should be contained (see Appendix 18 of PLANTPLAN [Plant Health Australia 2010])
- Disposable overalls and rubber boots should be worn when handling infested plant material or growing media/soil in the field. Boots, clothes and shoes in contact with infested plant material or growing media/soil should be disinfected at the site or double-bagged to remove for cleaning
- Skin and hair in contact with infested plant material or growing media/soil should be washed

Procedures for the sterilisation of plant containers and growing media are provided within the BioSecure *HACCP* Guidelines, however, in the event of a *X. fastidiosa* incursion, additional or modified procedures may be required for the destruction of the pest. Any sterilisation procedure must be approved for use in the endorsed Response Plan.

7.1.3 Priorities

- Confirm the presence of the pest
- Limit movement or people and prevent movement of vehicles and equipment through affected areas
- Stop the movement of any plant material that may be infested with the pest
- Determine the strategy for the eradication/decontamination of the pest and infested host material
- Determine the extent of infestation through survey and plant material trace back and trace forward which would be assessed on a case by case basis and included within the response plan

7.1.4 Plants, by-products and waste processing

- Any growing media/soil or infected plant material removed from the infected site should be destroyed by (enclosed) high temperature incineration, autoclaving or deep burial

- As the pest can be spread with plant material, plant debris from the destruction zone must be carefully handled and transported
- Infested areas or production nursery yards should remain free of susceptible host plants until the area has been shown to be free from the pathogen (and/or vector)

7.1.5 Disposal issues

- Particular care must be taken to minimise the transfer of infected plant material from the area
- Host material including leaf litter should be collected and incinerated or double bagged and deep buried in an approved site

7.2 Containment strategies

For some exotic pest incursions where eradication is considered impractical, containment of the pest may be attempted to prevent or slow its spread and to limit its impact on other parts of the state or country. Containment is currently being considered for inclusion within the Emergency Plant Pest Response Deed (EPPRD). The decision on whether to eradicate or contain the pest will be made by the National Management Group, based on scientific and economic advice. Emergency interim containment measures are possible under EPPRD arrangements to gather information to determine if eradication is technically feasible.

7.3 Quarantine and movement controls

Consult PLANTPLAN (Plant Health Australia 2010) for administrative details and procedures.

7.3.1 Quarantine priorities

- Plant material and growing media/soil at the site of infestation to be subject to movement restrictions
- Machinery, equipment, vehicles and disposable equipment in contact with infested plant material or growing media/soil, or present in close proximity to the site of infestation to be subject to movement restrictions

7.3.2 Movement controls

Movement controls need to be put in place to minimise the potential for transport of the pest, and this will apply to all plant material, growing media and other items within the quarantined area.

Movement of people, vehicles, equipment and plant material, from and to affected properties or areas, must be controlled to ensure that the pest is not moved off-property. Movement controls can be achieved through the following, however specific measures must be endorsed in the Response Plan:

- Signage to indicate quarantine area and restricted movement into and within these zones
- Fenced, barricaded or locked entry to quarantine areas

- Movement of equipment, machinery, plant material or growing media/soil by permit only. Therefore, all non-essential operations in the area or on the property should cease
- Where no dwellings are located within these areas, strong movement controls should be enforced
- Where dwellings and places of business are included within the Restricted and Control Areas movement restrictions are more difficult to enforce, however limitation of contact with infested plants should be enforced
- If a production nursery is situated within the Restricted Area, all nursery trading in host and non-host material must cease and no material may be removed from the site without permission, due to the high likelihood of pest spread. Movement restrictions would be imposed on both host and non-host material
- Residents should be advised on measures to minimise the inadvertent transport of vectors, should the pathogen and vector both be present
- Clothing and footwear worn at the infested site should either be double-bagged prior to removal for decontamination or should not leave the site until thoroughly disinfected, washed and cleaned
- Plant material or plant products must not be removed from the site unless part of an approved disposal procedure
- All machinery and equipment should be thoroughly cleaned down with a high pressure cleaner (see Section 7.1.2) or scrubbing with products such as a farm degreaser or a 1% bleach (available chlorine) solution, prior to leaving the affected area. Machinery should be inspected for the presence of insects and if found, treatment with insecticide may be required. The clean down procedure should be carried out on a hard surface, preferably a designated wash-down area, to avoid mud being re-collected from the affected site onto the machine. When using high pressure water, care should be taken to contain all plant material and mud dislodged during the cleaning process

7.4 Zoning

The size of each quarantine area will be determined by a number of factors, including the location of the incursion, biology of the pest, climatic conditions and the proximity of the infested property to other infested properties. This will be determined by the National Management Group during the production of the Response Plan. Further information on quarantine zones in an Emergency Plant Pest (EPP) incursion can be found in Appendix 10 of PLANTPLAN (Plant Health Australia 2010). These zones are outlined below and in Figure 11.

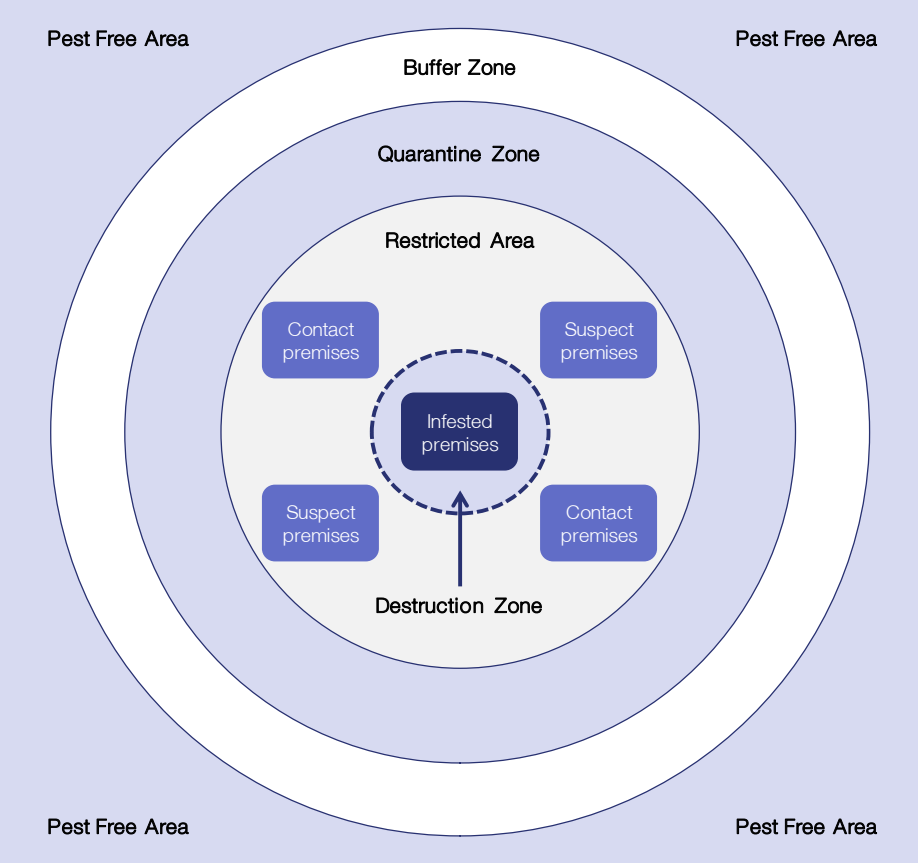

***Figure 11**. Schematic diagram of quarantine zones used during an EPP incursion (not drawn to scale)*

7.4.1 Destruction Zone

The size of the destruction zone (i.e. zone in which the pest and all host material is destroyed) will depend on the ability of the pest to spread, distribution of the pest (as determined by delimiting surveys), time of season (and part of the pest life cycle being targeted) and factors which may contribute to the pest spreading.

All host plants should be destroyed after the level of infestation has been established. The delimiting survey will determine whether or not neighbouring plants are infested and need to be destroyed. Non-host plant material within this zone may be destroyed, based on recommendations in the Response Plan. The Destruction Zone may be defined as contiguous areas associated with the same management practices as, or in contact with, the infested area (i.e. the entire production nursery, property or area if spread could have occurred prior to the infection being identified).

Particular care needs to be taken to ensure that plant material (including non-hosts) is not moved into surrounding areas.

7.4.2 Quarantine Zone

The Quarantine Zone is defined as the area where voluntary or compulsory restraints are in place for the affected property or properties. These restraints may include restrictions or movement control for removal of plants, people, growing media/soil or contaminated equipment from an infected property.

7.4.3 Buffer Zone

A Buffer Zone may or may not be required depending on the incident. It is defined as the area in which the pest does not occur but where movement controls or restrictions for removal of plants, people, soil or equipment from this area are still deemed necessary. The Buffer Zone may enclose an infested area (and is therefore part of the Control Area) or may be adjacent to an infested area.

7.4.4 Restricted Area

The Restricted Area is defined as the zone immediately around the infected premises and suspected infected premises. The Restricted Area is established following initial surveys that confirm the presence of the pest. The Restricted Area will be subject to intense surveillance and movement control with movement out of the Restricted Area to be prohibited and movement into the Restricted Area to occur by permit only. Multiple Restricted Areas may be required within a Control Area.

7.4.5 Control Area

The Control Area is defined as all areas affected within the incursion. The Control Area comprises the Restricted Area, all infected premises and all suspected infected premises and will be defined as the minimum area necessary to prevent spread of the pest from the Quarantine Zone. The Control Area will also be used to regulate movement of all susceptible plant species to allow trace back, trace forward and epidemiological studies to be completed.

7.5 Decontamination and farm clean up

Decontaminant practices are aimed at eliminating the pathogen thus preventing its spread to other areas.

7.5.1 Decontamination procedures

General guidelines for decontamination and clean up:

- Refer to PLANTPLAN (Plant Health Australia 2010) for further information
- Keep traffic out of affected area and minimise it in adjacent areas
- Adopt best-practice property hygiene procedures to retard the spread of the pest between growing areas/fields and adjacent properties
- Machinery, equipment, vehicles in contact with infested plant material or growing media/soil present within the Quarantine Zone, should be washed to remove growing media/soil and

plant material using high pressure water or scrubbing with products such as a degreaser or a bleach solution in a designated wash down area as described in Section 7.1.2

- Only recommended materials are to be used when conducting decontamination procedures, and should be applied according to the product label
- Infested plant material should be disposed of by autoclaving, high temperature (enclosed) incineration or deep burial

7.5.2 General safety precautions

For any chemicals used in the decontamination, follow all safety procedures listed within each MSDS.

7.6 Surveillance and tracing

7.6.1 Surveillance

Detection and delimiting surveys are required to delimit the extent of the incursion, ensuring areas free of the pest retain market access and appropriate quarantine zones are established.

Initial surveillance priorities include the following:

- Surveying all host growing properties and businesses in the pest quarantine area
- Surveying all properties and businesses identified in trace-forward or trace-back analysis as being at risk
- Surveying all host growing properties and businesses that are reliant on trade with interstate or international markets which may be sensitive to the pathogens (and/or vectors) presence
- Surveying production nurseries selling at risk host plants
- Surveying other host growing properties and backyards

7.6.2 Survey regions

Establish survey regions around the surveillance priorities identified above. These regions will be generated based on the zoning requirements (see Section 7.4), and prioritised based on their potential likelihood to currently have or receive an incursion of this pest. Surveillance activities within these regions will either allow for the area to be declared pest free and maintain market access requirements or establish the impact and spread of the incursion to allow for effective control and containment measures to be carried out. Detailed information that will assist develop surveys for Pierce's disease have been outlined elsewhere in this plan (refer to Section 6.2).

Steps outlined in Table 7 form a basis for a survey plan. Although categorised in stages, some stages may be undertaken concurrently based on available skill sets, resources and priorities.

Table 7. *Phases to be covered in a survey plan*

Phase 1	Identify properties that fall within the buffer zone around the infested premise Complete preliminary surveillance to determine ownership, property details, production dynamics and tracings information (this may be an ongoing action)
Phase 2	Preliminary survey of host crops in properties in buffer zone establishing points of pest detection
Phase 3	Surveillance of an intensive nature, to support control and containment activities around points of pest detection
Phase 4	Surveillance of contact premises. A contact premise is a property containing susceptible host plants, which are known to have been in direct or indirect contact with an infested premises or infected plants. Contact premises may be determined through tracking movement of materials from the property that may provide a viable pathway for spread of the disease. Pathways to be considered are: • Movement of plant material and growing media/soil from controlled and restricted areas • Items of equipment and machinery which have been shared between properties including bins, containers, irrigation lines, vehicles and equipment • The producer and retailer of infected material if this is suspected to be the source of the outbreak • Labour and other personnel that have moved from infected, contact and suspect premises to unaffected properties (other growers, tradesmen, visitors, salesmen, crop scouts, harvesters and possibly beekeepers) • Storm and rain events and the direction of prevailing winds that result in air-borne dispersal of the pathogen during these weather events
Phase 5	Surveillance of production and greenlife retailers, including garden centres, hardware outlets and supermarkets, as well as gardens and public land where plants known to be hosts of pathogen are being grown
Phase 6	Agreed area freedom maintenance, post control and containment

7.6.3 Post-eradication surveillance

The period of pest freedom sufficient to indicate that eradication of the pest has been achieved will be determined by a number of factors, including growth conditions, the previous level of infection, the control measures applied and the pest biology.

Specific methods to confirm eradication of Pierce's disease may include:

- Monitoring of sentinel plants that have been grown at the affected sites. Plants are to be grown *in situ* under quarantine conditions and monitored for symptoms of infection or other indications of Pierce's disease (and/or the vector)
- If symptoms are detected, samples are to be collected and stored and plants destroyed
- Targeted surveys for the pathogen (and/or the vector) should be undertaken within the Quarantine Zone to demonstrate pest absence
- Alternate non-host crops should be grown on the site and any self-sown plants sprayed out with a selective herbicide

8 Technical debrief and analysis for stand down

Refer to PLANTPLAN (Plant Health Australia 2010) for further details

The emergency response is considered to be ended when either:

- Eradication has been deemed successful by the lead agency, with agreement by the Consultative Committee on Emergency Plant Pests and the Domestic Quarantine and Market Access Working Group.
- Eradication has been deemed impractical and procedures for long-term management of the disease risk have been implemented.

A final report should be completed by the lead agency and the handling of the incident reviewed.

Eradication will be deemed impractical if, at any stage, the results of the delimiting surveys lead to a decision to move to containment/control.

9 References

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9.1 Related Websites

Center for Invasive Species and Ecosystem Health - Bugwood network 2010 **www.bugwood.org**

CABI 2011 **www.cabicompendium.org/cpc/home.asp**

PaDil 2011 **www.padil.gov.au/**

University of California IPM 2011 **www.ipm.ucdavis.edu/PMG/r302101211.html**

10 Appendices

10.1 Appendix 1 – Host range of *Xylella fastidiosa* (all strains) where host status has been confirmed[7]

Scientific name	Common name
Acacia longifolia	Golden wattle
Acer macrophyllum	Big leaf maple
Acer negundo	Box elder
Aesculus californica	California buckeye
Alnus rhombifolia	White alder
Ampelopsis arborea	Peppervine
Amsinckia douglasiana	Buckthorn weed

[7] Sourced from **www.cnr.berkeley.edu/xylella/control/hosts.htm**

Scientific name	Common name
Artemisia douglasiana	Mugwort
Avena fatua	Wild oat
Baccharis halimifolia	Eastern baccharis
Baccharis pilularis	Coyote brush
Baccharis salicifolia	Mule fat
Bidens pilosa var. *pilosa*	Beggar-ticks
Bromus catharticus	Rescue grass
Bromus rigidus	Ripgut grass
Bromus sp.	Russian brome grass
Callicarpa americana	American beautyberry
Callistephus chinensis	China aster
Canna sp.	Canna
Chenopodium ambrosioides	Mexican tea
Citrus limon	Lemon 'Meyer'
Citrus reticulata	Tangerine
Citrus sinensis	Sweet orange
Claytonia perfoliata	Miner's lettuce
Conium maculatum	Poison hemlock
Coprosma baueri	Coprosma
Cotoneaster francheti	Cotoneaster
Cotoneaster rotundifolia	Cotoneaster
Cynodon dactylon	Bermuda grass
Cyperus eragrostis	Purple nutsedge
Cyperus esculentus	Yellow nutsedge
Cytisus scoparius	Scotch broom
Daucus carota var. *sativa*	Short white carrot
Digitaria sanguinalis	Hairy crabgrass
Duranta repens	Pigeon-berry
Echinochloa crus-galli	Water grass
Epilobium californicum	Willow-herb
Epilobium paniculatum	Panicled willow-herb

Scientific name	Common name
Eragrostis diffusa	Diffuse love grass
Erodium cicutarium	Red stem filaree
Escallonia montevidensis	Escallonia
Eugenia myrtifolia	Aust. brush-cherry
Fragaria californica	Wild strawberry
Franseria acanthicarpa	Annual bur-sage
Fraxinus dipetala	California ash
Fraxinus latifolia	Oregon ash
Fuchsia magellanica	Fuchsia
Genista monspessulana	French broom
Hedera helix	English ivy
Helianthus sp.	Wild sunflower
Heteromeles arbutifolia	Toyon
Hordeum murinum	Common foxtail
Hordeum vulgare	Barley
Hydrangea paniculata	Hydrangea
Juglans californica	Calif. black walnut
Lactuca serriola	Prickly lettuce
Lathyrus cicera	Lathyrus
Lathyrus clymenium	Lathyrus
Lathyrus sativa	Grass pea
Lolium multiflorum	Italian ryegrass
Lolium temulentum	Darnel
Lonicera japonica	Japanese honeysuckle
Majorana hortensis	Sweet majoram
Malus sylvestris	Apple
Malva parvifolia	Cheeseweed
Matricaria suaveolens	Pineapple weed
Medicago hispida	Burr clover
Melilotus alba	White meliot
Melilotus indica	Hubam clover

Scientific name	Common name
Melilotus officinalis	Yellow sweet clover
Melilotus sp.	Sweet clover
Melissa offcinalis	Garden balm
Mentha sp.	Mint
Mimulus aurantiacus	Bush monkeyflower
Nerium oleander	Oleander
Nicotiana tabacum	Tobacco
Oeanthe sarmetosa	Water parsley
Oenothera hookeri	Evening primrose
Parthenocissus quinquefolia	Virginia creeper
Parthenocissus tricuspidata	Boston ivy
Paspalum dilatatum	Dallisgrass
Pelargonium hortorum	Fish geranium
Pennisetum clandestimun	Kikuyugrass
Phalaris minor	Mediter. canary grass
Phalaris paradoxa	Gnawed canary grass
Philadelphus lewisii	Syringa
Phleum pratense	Timothy grass
Pittosporum crassifolium	Karo
Platanus occidentalis	Sycamore
Poa annua	Annual bluegrass
Polygonum convolvulus	Black bindweed
Polygonum persicaria	Ladys thumb
Populus fremontii	Fremont cottonwood
Prunus demissa	Western chokecherry
Prunus mume	Japanese apricot
Prunus persica	Peach
Prunus salicana	Plum
Prunus sp.	Wild plum
Pyracantha augustifolia	Firethorn
Quercus agrifolia	Coast live oak

Scientific name	Common name
Quercus falcata	Southern red oak
Quercus imbricaria	Shingle oak
Quercus laurifolia	Laurel oak
Quercus lobata	Valley oak
Quercus nigra	Water oak
Quercus palustris	Pin oak
Quercus rubra	Northern red oak
Quercus sp.	Oak
Reseda odorata	Common migonette
Rheum rhaponticum	Rhubarb
Rhus sp.	Sumac
Rosa californica	California wild rose
Rosmarinus offcinalis	Rosemary
Rubus discolor	Himalayan blackberry
Rubus sp.	Blackberry
Rubus ursinus	California blackberry
Rumex crispus	Curly dock
Salix laevigata	Red willow
Salix lasiolepis	Arroyo willow
Sambucus canadensis	American elder
Sambucus mexicana	Blue elderberry
Setaria lutescens	Yellow bristle grass
Solidago fistulosa	Goldenrod
Sonchus asper	Prickly sowthistle
Sorghum halepense	Johnson grass
Sorghum vulgare	Sudangrass
Symphoricarpos albus	Snowberry
Syringa vulgaris	Lilac
Toxicodendron diversilobum	Poison oak
Trifolium fragarium	Strawberry clover
Trifolium hybridum	Aliske clover

Scientific name	Common name
Trifolium incarnatum	Crimson clover
Trifolium pratense	Red clover
Trifolium repens	White clover
Trifolium repens var. *latum*	Ladino clover
Ulmus americana	American elm
Umbellularia californica	California bay or laurel
Urtica dioica ssp.gracilis	Stinging nettle
Veronica sp.	Speedwell
Vicia monathus	Vetch
Vinca major	Greater periwinkle
Vinca minor	Periwinkle
Vitis californica	Calif. wild grape
Vitis rupestris	St. George
Vitis vinifera	grape 'Pinot Noir'
Vulpia myuros var. *hirsuta*	Foxtail fescue
Xanthium strumarium	Cocklebur

10.2 Appendix 2: Standard diagnostic protocols

For a range of specifically designed procedures for the emergency response to a pest incursion refer to Plant Health Australia's PLANTPLAN (**www.planthealthaustralia.com.au/plantplan**).

10.3 Appendix 3: Resources and facilities

Table 8 provides a list of diagnostic facilities for use in professional diagnosis and advisory services in the case of an incursion.

Table 8. Diagnostic service facilities in Australia

Facility	State	Details
DPI Victoria – Knoxfield Centre	Vic	621 Burwood Highway Knoxfield VIC 3684 Ph: (03) 9210 9222; Fax: (03) 9800 3521
DPI Victoria – Horsham Centre	Vic	Natimuk Rd Horsham VIC 3400 Ph: (03) 5362 2111; Fax: (03) 5362 2187

Facility	State	Details
DPI New South Wales – Elizabeth Macarthur Agricultural Institute	NSW	Woodbridge Road Menangle NSW 2568 PMB 8 Camden NSW 2570 Ph: (02) 4640 6327; Fax: (02) 4640 6428
DPI New South Wales – Tamworth Agricultural Institute	NSW	4 Marsden Park Road Calala NSW 2340 Ph: (02) 6763 1100; Fax: (02) 6763 1222
DPI New South Wales – Wagga Wagga Agricultural Institute	NSW	PMB Wagga Wagga NSW 2650 Ph: (02) 6938 1999; Fax: (02) 6938 1809
SARDI Plant Research Centre – Waite Main Building, Waite Research Precinct	SA	Hartley Grove Urrbrae SA 5064 Ph: (08) 8303 9400; Fax: (08) 8303 9403
Grow Help Australia	QLD	Entomology Building 80 Meiers Road Indooroopilly QLD 4068 Ph: (07) 3896 9668; Fax: (07) 3896 9446
Department of Agriculture and Food, Western Australia (AGWEST) Plant Laboratories	WA	3 Baron-Hay Court South Perth WA 6151 Ph: (08) 9368 3721; Fax: (08) 9474 2658

10.4 Appendix 4: Communications strategy

A general Communications Strategy is provided in Appendix 6 of PLANTPLAN (Plant Health Australia, 2010).

10.5 Appendix 5: Market access impacts

Within the AQIS PHYTO database (**www.aqis.gov.au/phyto**) there is currently no additional phytosanitary statement required that declares Pierce's disease is not known to occur in Australia (as at May 2011). Should Pierce's disease be detected or become established in Australia, countries may require specific declaration or supplementary measures upon export. Latest information can be found within PHYTO, using an Advanced search "Search all text" for Pierce's disease.