Risk Management Proposal:

*Malus* spp. nursery stock from all countries

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Plant Imports
Import & Export Standards
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Purpose
The purpose of this document is to:
- summarise the biosecurity risks associated with *Malus* spp. nursery stock from all countries;
- recommend measures for the effective management of these risks; and,
- seek stakeholder feedback on the proposed management options and import requirements as outlined in the draft import health standard schedule.

This import health standard (IHS) schedule has been developed in accordance with Section 22 of the Biosecurity Act (1993).

Background
The IHS schedule for *Malus sylvestris* var. *domestica* budwood/cuttings (stems only) was previously issued in hard copy format on 12 June 1998, and has not been reviewed or converted to an electronic version since that time.

Recent reviews of the import requirements have identified a number of gaps in the current *Malus* nursery stock IHS schedule. The scope of the import health standard has been extended to include all species of *Malus* approved for import into New Zealand, and to allow the import of tissue cultures.

Objective
The objective is to effectively manage biosecurity risks posed by the importation of *Malus* spp. nursery stock, in a way that is consistent with New Zealand’s domestic legislation and international obligations.

Analysis
This analysis draws on the significant body of information that already exists for *Malus* spp. propagative material, which includes:
- the nursery stock IHS schedule for *Malus sylvestris* var. *domestica* budwood/cuttings (stems only), under the IHS 155.02.06: *Importation of Nursery Stock* (available on request);
- subsequent reviews of the import requirements for *Malus* spp. nursery stock, for the accreditation of MAF-approved offshore facilities in Canada, France, Italy, and the United States of America;
- the MAF Post-Entry Quarantine Testing Manual for *Malus* (Apple);
- the MAF Import Risk Analysis: Viruses, Viroids, Phytoplasmas, Bacteria, and Diseases of Unknown Aetiology on *Malus* Nursery Stock from all Countries (draft version available on request).

1. **COMMODITY DESCRIPTION**
Approved species of *Malus* nursery stock (dormant cuttings and plants *in-vitro* only) as listed on the MAF Plants Biosecurity Index, imported into New Zealand for the purpose of propagation.
2. REGULATED ORGANISMS REQUIRING MANAGEMENT

2.1 Insects and mites
The pest list has been updated to remove species of insects and mites that are now known to be present in New Zealand. MAF have not attempted to produce a full list of insects and mites known to be associated with Malus spp nursery stock.

The proposed management steps for insects and mites are discussed in section 4.

2.2 Fungi
The pest list has been updated to remove species of fungi that are now known to be present in New Zealand.

A MAF Plant Health & Environment Laboratory (PHEL) mycologist conducted a partial review of the regulated fungi associated with Malus spp. and has advised that Sphaeropsis pyriputrescens (Sphaeropsis rot) should be added as a regulated pest. S. pyriputrescens has been described as causing a canker and twig dieback disease in commercial apple orchards in the USA (Xiao and Boal 2005). In addition, this fungus has also been found to cause postharvest fruit rot in apples (Xiao et al., 2004) and pears (Xiao and Rogers 2004) in the USA and Canada (Sholberg et al., 2009).

The proposed management steps for fungi are discussed in section 4.

2.3 Bacteria
The pest list has been updated to remove species of bacteria that are now known to be present in New Zealand. MAF have classified the following regulated bacterium as a risk associated with imported Malus spp. nursery stock:

- Pseudomonas syringae pv. papulans

The proposed management steps for this bacterium are discussed in section 4. The MAF PHEL testing manual for Malus (Appendix 1 of manual) provides photos of symptoms caused by Pseudomonas syringae pv. papulans.

2.4 Viruses, viroids, phytoplasmas, and diseases of unknown aetiology
The 1998 Malus import health standard included these organisms under the generic headings ‘Virus or Virus-like Organisms’ and ‘Phytoplasma or Phytoplasma-like Organisms’. This review has removed a number of organisms from the regulated pest list, as some organisms were no longer classified as risks, due to reviewed host association, limited or obscure distribution, and changes in nomenclature. Additions to the pest list are highlighted in Bold.

The following regulated organisms and diseases are classified as risks associated with imported Malus spp. nursery stock:

**Viruses**
- Cherry rasp leaf virus
- Clover yellow mosaic virus
- Tomato bushy stunt virus
- Tomato ringspot virus

**Viroids**
- Apple dimple fruit viroid
- Apple fruit crinkle viroid
- Apple scar skin viroid
Phytoplasmas

- ‘Candidatus Phytoplasma asteris’
- ‘Candidatus Phytoplasma mali’

Diseases of unknown aetiology

- Apple blister bark agent
- Apple brown ringspot agent
- Apple bumpy fruit agent
- Apple dead spur agent
- Apple decline agent
- Apple freckle scurf agent
- Apple green dimple and ring blotch agent
- Apple junction necrotic pitting agent
- Apple McIntosh depression agent
- Apple narrow leaf agent
- Apple Newton wrinkle agent
- Apple pustule canker agent
- Apple red ring agent
- Apple rosette agent
- Apple rough skin agent
- Apple russet wart agent
- Apple star crack agent
- Apple transmissible internal bark necrosis agent

The proposed management steps for these regulated organisms and diseases are discussed in section 4. The MAF PHEL testing manual for Malus (Appendix 1 of manual) provides photos of symptoms caused by some of the organisms listed above.

3. MANAGEMENT OF RISK

All nursery stock imported into New Zealand must undergo a number of steps to ensure that the risk of regulated organisms is reduced to an acceptable level. Table 1 provides a summary of the mitigation and verification steps that Malus spp. nursery stock must go through to ensure freedom from regulated pests and disease.

All Malus nursery stock imported into New Zealand must be imported under a permit to import, issued by MAF under the import health standard 155.02.06: Importation of Nursery Stock. The permit to import is used to facilitate the import of the material, and details the specific import requirements for each consignment.

Table 1. Summary of mitigation and verification steps for Malus nursery stock

<table>
<thead>
<tr>
<th>Step</th>
<th>Target organisms</th>
<th>Description of measures</th>
<th>Related documents</th>
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| Pre-export growing season inspection, testing, and containment at a MAF-approved offshore facility | All; may include specific measures for bacteria, viruses, viroids, phytoplasmas, and diseases of unknown aetiology | Specific to material sourced from a MAF-approved offshore facility:  
- Offshore facilities are accredited by MAF to undertake specified tests, in accordance with the import health standard, prior to export of nursery stock to New Zealand. Specific testing may include herbaceous index, woody indexing, ELISA, and/or PCR.  
- Nursery stock undergoes growing season inspections and testing by experts familiar with pests and diseases associated with Malus.  
- Nursery stock is held in a facility suitable to exclude the introduction of regulated quarantine pests. | MAF import health standard 155.02.06: Importation of Nursery Stock  
MAF operational standard PIT.OS.TRA.ACPQF: Accreditation of Offshore Plant Quarantine Facilities and Operators  
Agreement between MAF and approved offshore facility |
| Pre-export phytosanitary inspection | All | Prior to issuing a phytosanitary certificate, the exporting National Plant Protection Organisation (NPPO) must inspect the nursery stock in accordance with appropriate official procedures for freedom from visually detectable regulated pests, and to ensure the consignment conforms to New | 155.02.06: Importation of Nursery Stock  
International Standards for Phytosanitary Measures ISPM 12, Guidelines for |
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| Zealand’s import requirements. | [Specific to material sourced from a MAF-approved offshore facility:](#)  
- The NPPO must also verify that the nursery stock has been:  
  - held and tested for/classified free from specified regulated pests as required in the agreement between MAF and the MAF-approved offshore facility  
  AND  
  - held in a manner to ensure that infestation/reinfestation does not occur following inspection and testing at the accredited facility, and certification. | phytosanitary certificates (2001)  
- 155.02.06: Importation of Nursery Stock  
- Agreement between MAF and approved offshore facility |
| **Pesticide treatments for cuttings** | Insects and mites | All cuttings shall be treated for regulated insects and mites. Where treatments are completed prior to export, the NPPO verifies this by recording the treatment details on the “Disinfestation and/or Disinfection Treatment” section of the phytosanitary certificate. | 155.02.06: Importation of Nursery Stock |
| **Packaging requirements for cuttings** | All | Following certification, cuttings shall be held and packaged in a manner to prevent infestation/reinfestation by regulated pests. Cuttings shall be packaged in inert/synthetic materials. | 155.02.06: Importation of Nursery Stock |
| **Packaging requirements for tissue culture** | All | Containers shall be pest proof. Growing media shall not contain fungicides or antibiotics. | 155.02.06: Importation of Nursery Stock |
| **On arrival verification/inspection** | All | A 600 unit sample is inspected to verify compliance with the import requirements, and to achieve a 95% confidence level for freedom from visually detectable regulated pests.  
- Documentation is inspected to ensure that appropriate pre-export activities have been verified by the exporting NPPO. | 155.02.06: Importation of Nursery Stock  
- MAF Border Clearance Procedures (internal MAF document) |
| **Post entry quarantine (PEQ)** | All | Nursery stock is held in a level 3 PEQ facility for a minimum growing period of 36 months, with tissue cultures exflasked into a PEQ greenhouse at the beginning of the PEQ period.  
- The minimum 36 month PEQ period is required for the completion of all serological, molecular and herbaceous indicator testing prior to samples being transferred to Level 1 PEQ for woody indicator tests.  
- Nursery stock undergoes growing season inspection for visual symptoms of disease expression, and testing for pests and diseases of significant biosecurity concern. | MAF operational standard PBC.NZ.TRA.PQCON: Specification for the Registration of a Plant Quarantine or Containment Facility, and Operator  
- 155.02.06: Importation of Nursery Stock  
- MAF Operational Standard 155.04.03: Diagnostic Facilities which undertake the identification or new organisms, excluding animal pathogens  
- MAF Post Entry Quarantine Testing Manual for Malus (Apple)  
- Border Clearance |

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3.1 MAF-approved offshore facility

*Malus* nursery stock may be sourced from a facility that has been approved by MAF as a supplier of high health *Malus* budwood. A list of approved offshore facilities for *Malus* spp. nursery stock can be viewed on the website: [http://www.biosecurity.govt.nz/regs/imports/plants/off-shore](http://www.biosecurity.govt.nz/regs/imports/plants/off-shore).

Material sourced from approved facilities will have some of the required testing completed prior to export. Which tests are completed at the offshore facility is determined as part of the facility accreditation process. Tests completed at the offshore facility must be in accordance with the testing requirements of the *Malus* spp. schedule; however, equivalence may be given for other internationally recognised testing methods.

It is the responsibility of the importer to ensure that only material that has been produced in accordance with the agreement with MAF is selected for importation into New Zealand.

3.2 Freedom from regulated organisms

3.2.1 Specific measures for budwood

Treatment of budwood for insects and mites is required to ensure that imported material is clean before importation into New Zealand, and entry into post entry quarantine. Budwood should be treated prior to export in accordance with section 2.2.1.6 (part B) of the import health standard.

3.2.2 Specific measures for tissue culture

Tissue cultures must be produced in a facility under conditions that prevents contamination with regulated pests. The tissue culture media must not contain fungicides or antibiotics, or other compounds which will make the media non-transparent, e.g. charcoal.

3.3 Pre-export phytosanitary inspection and certification

The exporting National Plant Protection Organisation (NPPO) inspects the consignment to confirm that it meets New Zealand’s import requirements. The exporting NPPO must verify the following pre-export activities have been completed:

- Budwood has been treated for insects and mites
- Budwood and tissue cultures are free from visually detectable regulated pests and diseases
- Material sourced from an approved offshore facility has been produced in accordance with the agreement with MAF

Where the exporting NPPO has verified that the consignment is compliant with the import requirements, a phytosanitary certificate is issued. Following certification the nursery stock must be held in a manner to prevent infestation/reinfestation with regulated pests and diseases.
3.4 **On arrival verification of pre-export measures**

On arrival in New Zealand, the MAF inspector will inspect the consignment to verify the required pre-export measures have been met. This verification includes the following steps:

- Inspection of the phytosanitary certificate to ensure compliance with the import requirements
- Inspection of 600 units to achieve a 95% confidence level for freedom from visually detectable regulated pests.

Where the MAF inspector has verified that the consignment is compliant, the inspector will authorise movement of the nursery stock to post entry quarantine.

3.5 **Post entry quarantine**

All *Malus* nursery stock imported into New Zealand must undergo a period of post entry quarantine to ensure freedom from regulated pests and diseases.

3.5.1 **Material from MAF-approved offshore facilities**

Due to the pre-export activities undertaken at approved offshore facilities, and a history of compliance with consignments imported from these facilities, it is proposed that Level 2 post entry quarantine facility for a minimum growing period of six months is appropriate.

3.5.2 **Material from non-approved offshore facilities**

As the history of material from non-approved facilities cannot be accurately assessed, and the unknown phytosanitary status (in particular, fungi), it is proposed that the material shall enter a Level 3 post entry quarantine facility. A minimum growing period of 36 months is proposed as the time required allowing the imported material to undergo serological, molecular, and herbaceous indicator testing, prior to woody indexing occurring in a Level 1 post entry quarantine facility.

3.5.3 **Growing season inspection**

Material must undergo regular growing season inspections by a MAF Biosecurity Inspector, to ensure freedom from visually detectable regulated pests. Where visible signs of pests and disease are detected, samples may be collected and sent for diagnostic testing.

The operator of the post entry quarantine facility is also expected to undertake regular inspections of the plants during the growing season, and to notify the MAF Biosecurity Inspector if pest or disease symptoms are observed.

3.5.4 **Testing for regulated organisms of significant biosecurity concern**

Pests and diseases of significant concern require specific mitigation measures to ensure they do not enter and establish in New Zealand.

For nursery stock, the following specific testing may be appropriate to detect regulated bacteria, viruses, viroids, phytoplasmas, and diseases of unknown aetiology:

- Biological tests: herbaceous indexing and woody indexing
- Molecular tests: polymerase chain reaction (PCR)
- Serological tests: enzyme linked immunosorbent assay (ELISA)

For viruses, viroids, and phytoplasmas the proposed testing requirements are based on the level of biosecurity risk associated with the organism. Due to the potential biosecurity risk posed by some organisms, a combination of testing methods is proposed.
For diseases of unknown aetiology, the causal organism is unknown, so there are no specific laboratory testing methods available for their detection. Woody indexing onto suitable woody indicators (susceptible *Malus* cultivars) provides the best chance of detection.

With prior approval from MAF, internationally accepted testing methods will be accepted as equivalent to the requirements of the import health standard.

The MAF Post Entry Quarantine Testing Manual for *Malus* (Apple) describes appropriate testing protocols for each of the proposed tests.

### 3.6 Non-compliance

Nursery stock that is not compliant with the import requirements will not be eligible for biosecurity clearance. Where the inspector identifies that the nursery stock is not compliant, the importer will be given the option to make the consignment compliant (where appropriate) or to reship or destroy the material.

### 3.7 Equivalence

If the nursery stock will not meet the conditions of the import health standard, the importer may submit to MAF an application for assessment of equivalent phytosanitary status. Where MAF determines that alternative measures will provide an equivalent phytosanitary status, the details of the equivalence will be recorded on the permit to import.

### 3.8 Biosecurity clearance

Biosecurity clearance shall only be given for imported material where the inspector is satisfied that the following has occurred:

- The nursery stock complies with the requirements of the import health standard
- There are no discrepancies in accompanying documentation
- The goods display no signs of harbouring organisms that may be unwanted organisms
- There has been no recent change in circumstances or knowledge that makes it unwise to give biosecurity clearance.

### 4. MAF PROPOSAL

This section outlines the proposed requirements for each regulated organism associated with *Malus* spp. nursery stock. A summary of the proposed inspection, treatment, and testing requirements are included in Appendix 1.

#### 4.1 Insects and mites

MAF considers that the pesticide treatments required as part of the Basic Conditions for nursery stock (section 2.2.1.6 of the import health standard), and the period of growing season inspection in post entry quarantine, will be sufficient to mitigate the presence of insects and mites on imported material.

#### 4.2 Fungi

MAF-approved offshore facilities in the USA and Canada are due to be audited by MAF in 2011. As part of the audit process, MAF will ensure that these offshore facilities have suitable procedures in place for the inspection of symptoms caused by *Sphaeropsis pyriputrescens*. For nursery stock from non-approved facilities, growing season inspection during the minimum 36 months post entry quarantine period will be sufficient to observe symptoms of *S. pyriputrescens*. 


The June 1998 *Malus* nursery stock import health standard required generic measures (i.e. growing season inspection) for all regulated fungi. It is proposed that growing season inspection still provides an appropriate level of protection for regulated fungi. It is proposed that material from non-approved facilities is held in a Level 3 post entry quarantine facility, as a Level 2 facility is not suitable to contain fungi.

4.3 **Bacteria**

4.3.1 *Pseudomonas syringae pv. papulans*

*Pseudomonas syringae* pv. *papulans* can be spread to leaves, blossoms, and fruit surfaces by the rain in spring and summer, where bacteria can multiply. Insects are also implicated in the spread of inoculum. The host range for *Pseudomonas syringae* pv. *papulans* is wider than *Malus*, and includes other economically important crops such as *Pyrus* and *Prunus*. As such, this bacterium is included on the list of regulated pests, for which MAF will take action if identified in post entry quarantine.

Trees of cultivar ‘Mutsu’ infected with *Pseudomonas syringae* pv. *papulans* display symptoms on both leaves and fruit; blemishes on fruit make it unsuitable for sale. The *Malus* cultivars ‘Braeburn’, ‘Fuji’, ‘Golden Delicious’, ‘Gala’, and ‘Delbarestivale’ are also known to display symptoms when infected with *Pseudomonas syringae* pv. *papulans*.

MAF considers that specific testing for this bacterium is required. PCR, using specific primers, is appropriate to detect *Pseudomonas syringae* pv. *papulans*.

**Proposal**

That *Pseudomonas syringae* pv. *papulans* is included as a regulated pest, and that one of the following measures is met prior to biosecurity clearance:

- Pest free area declaration (assessed by MAF)
- Pest free place of production (assessed by MAF)
- PCR

4.4 **Viruses**

4.4.1 *Cherry rasp leaf virus*

*Cherry rasp leaf virus* can be vectored by the nematode *Xiphinema americanum* (present in NZ), as well as natural spread from root grafting. The host range for CRLV is wider than *Malus*, and includes other economically important crops, such as *Rubus* and *Prunus*. CRLV is included in the nursery stock schedule for *Prunus* (requiring woody indexing and herbaceous indexing and TEM) and *Rubus* (requiring herbaceous indexing and ELISA or PCR). As CRLV is not known to be present in New Zealand, this virus is included on the list of regulated pests, for which MAF will take action if identified in post entry quarantine.

Trees of cultivars ‘Delicious’, ‘Golden Delicious’, ‘Jonagold’ and ‘Gala’ infected with CRLV will display symptoms on both leaves and fruit; fruit take on a flat appearance.

MAF considers that specific testing for this virus is required. A biological indexing test, in conjunction with a molecular test, is considered as appropriate to detect CRLV.

**Proposal**
That Cherry rasp leaf virus is included as a regulated pest, and that one of the following measures is met prior to biosecurity clearance:

- Pest free area declaration (assessed by MAF)
- Pest free place of production declaration (assessed by MAF)
- Woody indexing or herbaceous indexing (Chenopodium quinoa and Chenopodium amaranticolor) AND PCR

4.4.2 Clover yellow mosaic virus

Clover yellow mosaic virus is an addition to the pest list, and replaces Apple leaf pucker which was included in the 1998 Malus IHS. Clover yellow mosaic virus is recorded as causing a leaf pucker disease of Malus sylvestris cultivar ‘McIntosh’ (Welsh et al., 1973). Clover yellow mosaic virus can be spread by mechanical inoculation (contaminated tools), and by animals walking through fields. The host range for ClYMV is wider than Malus, and includes other economically important crops, such as Trifolium. As ClYMV is not known to be present in New Zealand, this virus is included on the list of regulated pests, for which MAF will take action if identified in post entry quarantine.

Welsh et al., 1973 found that ClYMV was associated with 10 trees of Malus sylvestris cultivar ‘McIntosh’, which were displaying leaf pucker symptoms. The same trees were also found to be infected with Apple chlorotic leafspot virus (non-regulated), as indicated by woody hosts. ClYMV could not be isolated from a further 44 trees displaying the same leaf pucker symptoms, or 200 trees that were not displaying symptoms.

At the time of publishing the 1973 paper, further trials were underway to return ClYMV to its apple host to produce leaf pucker symptoms. No further literature could be found on this topic. At this time it is not known if ClYMV is the causal agent of the leaf pucker symptoms in Malus sylvestris cultivar ‘McIntosh’. As ClYMV is not known to cause the leaf pucker symptoms MAF considers that specific testing for this organism is not justified, and that growing season inspection provides an appropriate level of mitigation.

It should be noted that ClYMV can be mechanically transmitted to Chenopodium quinoa, and diagnostic symptoms will develop. If ClYMV was detected in a consignment of imported Malus budwood, MAF would take action for this organism.

Proposal

That Clover yellow mosaic virus is included as a regulated pest, and that one of the following measures is met prior to biosecurity clearance:

- Pest free area declaration (assessed by MAF)
- Pest free place of production declaration (assessed by MAF)
- Growing season inspection

4.4.3 Tomato bushy stunt virus

Tomato bushy stunt virus can be released from the roots of infected plants into the soil where it can remain infective for up to 12 weeks, or spread by other natural methods of dispersal (e.g. seed, and pollen to seed). The host range for TBSV is wider than Malus, and includes other economically important crops, e.g. Pyrus, Lycopersicon esculentum, and Capsicum. As TBSV is not known to be present in New Zealand, this virus is included on the list of regulated pests, for which MAF will take action if identified in post entry quarantine.

As TBSV latently infects Malus (i.e. does not cause symptoms), MAF considers that specific testing for this virus is required. As TBSV is unlikely to have a direct impact on the apple...
industry, MAF considers that specific serological/molecular testing is not justified. Herbaceous indexing on to the indicator species Chenopodium quinoa and Chenopodium amaranticolor provides an appropriate level of mitigation for this virus on Malus spp. nursery stock.

Proposal
That Tomato bushy stunt virus is included as a regulated pest, and that one of the following measures must be met prior to biosecurity clearance:
- Pest free area declaration (assessed by MAF)
- Pest free place of production declaration (assessed by MAF)
- Herbaceous indexing (Chenopodium quinoa and Chenopodium amaranticolor)

4.4.4 Tomato ringspot virus
Tomato ringspot virus can be vectored by nematodes in the genus Xiphinema (six species are present in New Zealand), as well as spread through infected seed. The host range for ToRSV is wider than Malus, and includes other economically important crops, e.g. Fragaria, Prunus, Rubus, Vaccinium, and Lycopersicum esculentum.

Some strains of ToRSV are present in New Zealand. However, the strain infecting Malus has not been detected in New Zealand. ToRSV has a host range wider than Malus, and is included in the nursery stock schedule for Fragaria (herbaceous indexing and ELISA/PCR), Lilium (‘Pest free area’/’Pest free place of production’), Prunus (Woody indicators, herbaceous indicators, ELISA/PCR and TEM), Rubus (herbaceous indexing and ELISA/PCR), Tulipa (‘Pest free area’/’Pest free place of production’), and Vaccinium (herbaceous indexing, ELISA/PCR, and TEM).

As ToRSV can be dispersed naturally, and the introduction of this virus would have impacts outside the apple industry, MAF considers that specific testing for this virus is required. Recognising that ToRSV has been associated with Apple union necrosis and decline, MAF considers that herbaceous indexing on to the indicator species Chenopodium quinoa and Chenopodium amaranticolor, in conjunction with a serological or molecular test, is appropriate to detect ToRSV.

Proposal
That Tomato ringspot virus is included as a regulated pest, and that one of the following measures must be met prior to biosecurity clearance being given:
- Pest free area declaration (assessed by MAF)
- Pest free place of production declaration (assessed by MAF)
- Herbaceous indexing (Chenopodium quinoa and Chenopodium amaranticolor)
  AND ELISA or PCR

4.5 Viroids
4.5.1 Apple dimple fruit viroid
Apple dimple fruit viroid is an addition to the pest list (Saerio et al., 2003). This viroid is not known to be spread by a biological vector; however, ADFVd can be transmitted through flowers, leaves, roots and stems. As ADFVd is not known to be present in New Zealand, this viroid is included on the list of regulated pests, for which MAF will take action if identified in post entry quarantine.
Plant material infected with ADFVd may remain asymptomatic (latent infection), with some symptomatic cultivars not displaying symptoms for 2-3 years. ADFVd is known to infect cultivars that are economically important to New Zealand industry, with symptoms developing on fruit.

As the establishment of ADFVd would have an effect on fruit production/quality for some economically important cultivars, MAF considers that specific testing for this viroid is required. A molecular test followed by woody indexing in the field on to the indicator cultivar ‘Red Delicious’ is appropriate to detect ADFVd.

Proposal
That *Apple dimple fruit viroid* is included as a regulated pest, and that one of the following measures must be met prior to biosecurity clearance:
- Pest free area declaration (assessed by MAF)
- Pest free place of production declaration (assessed by MAF)
- Woody indexing (‘Red Delicious’) AND PCR

4.5.2 *Apple fruit crinkle viroid*

*Apple fruit crinkle viroid* is not known to be spread by a biological vector; however, AFCVd can be transmitted through propagative plant material (i.e. grafting). The host range for AFCVd is wider than *Malus*, and includes other economically important crops, e.g. *Pyrus*, *Humulus*, and possibly persimmons. As AFCVd is not known to be present in New Zealand, this viroid is included on the list of regulated pests, for which MAF will take action if identified in post entry quarantine.

AFCVd is known to infect cultivars that are economically important to New Zealand industry, with symptoms developing on fruit. The establishment of AFCVd would have an effect on fruit production and quality in some cultivars. The establishment on this viroid could also have an impact on other industries. MAF considers that specific testing for this viroid is required. A molecular test followed by woody indexing in the field on to the indicator cultivar ‘Golden Delicious’ is appropriate to detect AFCVd.

Proposal
*Apple fruit crinkle viroid* is included as a regulated pest, and that one of the following measures must be met prior to biosecurity clearance:
- Pest free area declaration (assessed by MAF)
- Pest free place of production declaration (assessed by MAF)
- Woody indexing (‘Golden Delicious’) AND PCR

4.5.3 *Apple scar skin viroid*

Natural spread of *Apple scar skin viroid* has been observed, which is thought to be by root grafting; ASSVd is also reported to be seed transmitted. The host range for ASSVd is wider than *Malus*, and includes other economically important crops, e.g. *Pyrus*. As ASSVd is not known to be present in New Zealand, this viroid is included on the list of regulated pests, for which MAF will take action if identified in post entry quarantine.


The establishment of ASSVd would have an effect on fruit production and quality in some cultivars. The establishment of this viroid could also have an impact on other industries. MAF
considers that specific testing for this viroid is required. A molecular test followed by woody indexing in the field on to the indicator cultivar ‘Golden Delicious’ or ‘Red Delicious’ is appropriate to detect ASSVd.

Proposal

That *Apple scar skin viroid* is included as a regulated pest, and that one of the following measures must be met prior to biosecurity clearance:

- Pest free area declaration (assessed by MAF)
- Pest free place of production declaration (assessed by MAF)
- Woody indexing (‘Golden Delicious’ or ‘Red Delicious’) AND PCR

4.6 Phytoplasmas

4.6.1 *Candidatus Phytoplasma asteris* (Apple sessile leaf phytoplasma)

*Candidatus Phytoplasma asteris* is an addition to the pest list (Jomantiene & Davis, 2005). This phytoplasma causes disease in a wide range of hosts. In *Malus* it causes a disease called *Apple sessile leaf phytoplasma* which was first identified infecting apple trees in 2005, and is considered as an emerging pest. Phytoplasmas are generally transmitted by phloem-feeding insects (i.e. leaf-hoppers, plant-hoppers, or psyllids); however, at this time the method of transmission has not been identified. As a pSL is not known to be present in New Zealand, this phytoplasma should be included on the list of regulated pests, for which MAF will take action if identified in post entry quarantine.

Symptoms are known to express on the leaves and shoots of infected trees, and have not yet been shown to exhibit on the fruit. However, the initial report comments that *Candidatus Phytoplasma asteris* has considerable significance for fruit production.

A s the method of transmission of A pSL is unknown, it is possible that a vector present in New Zealand could be able to transmit this phytoplasma. The establishment of this phytoplasma could also have an impact on other industries. A molecular test is appropriate to detect A pSL. It should be noted that nested PCR with universal phytoplasma primers is suitable to detect all regulated phytoplasmas.

Proposal

That *Candidatus Phytoplasma asteris* (Apple sessile leaf phytoplasma) is included as a regulated pest and that one of the following measures must be met prior to biosecurity clearance:

- Pest free area declaration (assessed by MAF)
- Pest free place of production declaration (assessed by MAF)
- Nested PCR using universal phytoplasma primers

4.6.2 *Candidatus Phytoplasma mali* (Apple proliferation phytoplasma)

*Candidatus phytoplasma mali* causes a disease in a wide range of hosts such as *Corylus, Pyrus, Prunus, Rosa*, and *Vitis*. In *Malus* it causes a disease called *Apple proliferation phytoplasma*, and can be vectored by psyllids and leafhoppers (a leafhopper which has been found to experimentally vector AP is present in New Zealand), as well as spread naturally by root fusion. A s such, this phytoplasma is included in the list of regulated pests, for which MAF will take action if identified in post entry quarantine.
A number of cultivars develop symptoms when infected with AP, including ‘Golden Delicious’, ‘Granny Smith’, and ‘McIntosh’. Symptoms develop on leaves, shoots, flowers, and fruit; the size, weight, and quality (i.e. sugar and acid content) of fruit significantly effected. Symptoms exhibited in infected trees are unevenly distributed, and are most pronounced under favourable temperatures of 21-24°C, so would be expected to be significant in most parts of New Zealand. Infected trees may also be more susceptible to other diseases (i.e. powdery mildew). Apple proliferation is one of the most economically important plant diseases caused by phytoplasmas (Seemuller and Schneider 2004).

AP could be spread by a vector present in New Zealand, and the introduction of this phytoplasma could have a significant impact on fruit production. The establishment of this phytoplasma could also have an impact on other industries. MAF considers that specific testing for this phytoplasma should be required. A molecular test followed by woody indexing in the field on to the indicator cultivar ‘Golden Delicious’ is appropriate to detect AP.

Proposal
That ‘Candidatus Phytoplasma mali’ (Apple proliferation phytoplasma) is included as a regulated pest and that one of the following measures must be met prior to biosecurity clearance:
- Pest free area declaration (assessed by MAF)
- Pest free place of production (assessed by MAF)
- Woody indexing (‘Golden Delicious’) AND nested PCR using universal phytoplasma primers

4.7 Diseases of unknown aetiology
For diseases of unknown aetiology, the causal organism is unknown, so there are no laboratory testing methods available for their detection. Where a disease is likely to exhibit symptoms on the fruit of susceptible cultivars, or reduce productivity MAF considers that specific testing measures are required. Woody indexing on to susceptible Malus cultivars is appropriate to detect the following diseases of unknown aetiology:
- Apple dead spur agent
- Apple rough skin agent
- Apple russet wart agent
- Apple star crack agent

Proposal
Diseases of unknown aetiology of significant biosecurity concern are included as regulated diseases, and that one of the following measures must be met prior to biosecurity clearance:
- Pest free area declaration (assessed by MAF)
- Pest free place of production (assessed by MAF)
- Woody indexing (‘Golden Delicious’ and ‘Red Delicious’)

MAF have identified that the generic measure of growing season inspection provides an appropriate level of protection for the following diseases:
- Apple blister bark agent
- Apple brown ringspot agent
- Apple bumpy fruit agent
- Apple decline agent
- Apple freckle scurf agent
- Apple green dimple and ring blotch agent
- Apple junction necrotic pitting agent
Ministry of Agriculture & Forestry  
Risk Management Proposal:  
Malus spp. Nursery Stock

- Apple McIntosh depression agent
- Apple narrow leaf agent
- Apple Newton wrinkle agent
- Apple pustule canker agent
- Apple red ring agent
- Apple rosette agent
- Apple transmissible internal bark necrosis agent

Proposal

Diseases of unknown aetiology of biosecurity concern, but that do not pose a significant risk to the New Zealand environment or economy, are to be included as regulated diseases and that one of the following measures must be met prior to biosecurity clearance:

- Pest free area declaration (assessed by MAF)
- Pest free place of production (assessed by MAF)
- Growing season inspection

REFERENCES


Seemuller, E and Schneider, B. 2004. “Candidatus Phytoplasma mali”, “Candidatus phytoplasma pyri” and “Candidatus Phytoplasma prunorum” the causal agents of apple proliferation, pear decline and European stone fruit yellows, respectively. International Journal of Systematic and Evolutionary Microbiology: 54 (4), pp 1217-1226


APPENDIX 1

The table below identifies the current testing requirements for *Malus* spp. nursery stock sourced from MAF-approved offshore facilities. Tests highlighted in **blue bold** are undertaken at the offshore facility prior to export to New Zealand.

<table>
<thead>
<tr>
<th>Regulated organism</th>
<th>Proposed MAF requirement</th>
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Endorsed on Phytosanitary certificate.