



Name and Description of Measure	
Name of Measure	Pest Free Areas and Allied Phytosanitary Procedures & Systems Approaches for Pathogens Associated with Apple
Measure Type	Pest Freedom / Integrated Methods
Active Ingredient	N/A
Schedule	<p>Pest free area (PFA)</p> <p>Or</p> <p>Pest-free places of production (PFPP) / Pest free production sites (PFPS)</p> <p>OR</p> <p>Washing</p> <p>OR</p> <p>Treatment of crop + Visual inspection in the crop + Visual inspection of consignment [combination].</p> <p>OR</p> <p>Consignments from infested areas should be kept in quarantine over the growing season and found free from <i>Gymnosporangium</i> spp.</p> <p>OR</p> <p>Systems approach (two or more independent measures)</p> <p>Handling and packaging methods to prevent the contamination of fruit consignments should also be considered in addition to all above options.</p>
Target Pest	<p>Fungal pathogens</p> <ol style="list-style-type: none"> 1. <i>Alternaria mali</i> 2. <i>Botryosphaeria kuwatsukai</i> 3. <i>Gymnosporangium clavipes</i> 4. <i>Gymnosporangium juniperi-virginianae</i> 5. <i>Phyllosticta solitaria</i> <p>Viruses / Viroids</p> <ol style="list-style-type: none"> 6. Apple dimple fruit viroid (ADFVd) 7. Apple fruit crinkle viroid (AFCVd) 8. Cherry rasp leaf virus (CRLV)

Name and Description of Measure	
Included in ISPM 28	NO
Reference	

Other information (Please complete as many fields as possible)	
Is there quantitative or qualitative evidence to indicate the measure is effective?	
<p>Fungal Pathogens</p> <p>Apple fruit is not considered a major pathway for the fungal pathogens listed above and, in all cases, infected plant material for planting is considered the more significant risk.¹⁻⁵ That notwithstanding, assessments of the risk associated with these pathogens have identified fresh fruit as a possible pathway in the cases of <i>A. mali</i>, <i>B. kuwatsukai</i> and <i>P. solitaria</i>.^{2,4,6} The potential for <i>Gymnosporangium</i> species to be introduced via fresh fruit is considered unlikely as either the fruit will be uninfected or, if infected, not of saleable quality and hence discarded before export.⁵ Fruit for export should be free of the symptoms of <i>A. mali</i> and sourced from pest free areas or pest-free places of production.² Basic research has demonstrated the use of fungicide treatments in mitigating the pest risk associated with <i>Alternaria</i>-infected apples destined for export to specific markets and in general.⁷⁻⁹ There is little direct research evidence in support of the above measures for <i>B. kuwatsukai</i> and the fungus is primarily of phytosanitary concern when infecting plants for planting. As such, the measures outlined here are likely effective in preventing transport of the pathogen with apple fruit consignments and are included in documents that have assessed the risk of this fungal pathogen.^{3 4}</p> <p>Data available for <i>G. clavipes</i> suggest phytosanitary measures should be as for <i>G. juniperus-virginianae</i>, procedures which are largely concerned with plants for planting.^{5,10} The above measures do, however, closely align with procedures set-out by other jurisdictions (e.g. Australia, New Zealand) for <i>Gymnosporangium</i> species.^{5,11,12} <i>Phyllosticta solitaria</i> is likely more readily transported by infected fruit than the other fungi species considered here, although its primary means of movement is via plants for planting.⁶ Infected fruits with viable inoculum are, however, considered a biosecurity concern by some jurisdictions (e.g. Australia, listed as <i>P. arbutifolia</i>).¹¹ Phytosanitary methods to prevent movement of the pathogen should be focussed on treatment of the disease at the place of production, inspection of fruit prior to export and sourcing from pest-free areas.¹³ Risk management procedures pertaining to <i>P. solitaria</i> are indicated to be a systems approach including several of measures outlined above.¹¹</p> <p>Viruses / Viroids</p> <p>The identified pathway for ADFVd entry is via infected plants for planting and, as such, fruit imports are considered very unlikely (with a medium level of confidence) to be a pathway for entry.^{14,15} Moreover, no invertebrate vector has been identified as being involved in transmission and natural spread between trees is, at best, low.^{14,16} The symptoms present in fruit, such as depressed yellow-green spots, shrivelling and discolouration, render apples of no commercial value and, as a result, this allows affected lots to be identified through phytosanitary inspection.^{14,15,17} Little specific data is available with respect to phytosanitary measures that should be employed to address the low pest risk</p>	

associated with importation of infected fruit. This notwithstanding, the described schedule aligns with the procedures of other jurisdictions where ADFVd poses a risk.¹⁷

There is no known vector of AFCVd and the identified pathway is through the international trade in plants for planting, with movement of the pathogen via fruit thought to be unlikely.¹⁷ The disease manifests itself in fruit as depressions and malformation (crinkling), a factor that allows inspection to identify consignments containing infected material.¹⁷ Measures to manage ASFCVd that have been described elsewhere typically involve the measures described above.¹⁷

CRLV is transmitted by the dagger nematodes *Xiphenema americanum*, *X. californicum* and *X. rivesi* and, as such, spread of the disease is contingent of the presence of one of these species.¹⁸ The major pathway for CRLV is the international movement of infected plants and published phytosanitary measure focus on this aspect.¹⁹ Movement of the vectors is most likely via soil associated with plants for planting. As such, fruit imports have not received attention with respect to introducing the disease and/or its vectors into new areas.¹⁷ Infected apples are smaller and deformed (flattened) and readily identified during phytosanitary inspection.¹⁸ An Import Risk Assessment (IRA) conducted by Australia with respect to apples imported from the Pacific Northwest of the USA found no reason to assess CRLV, despite the virus being present in several western states, a fact that is probably indicative of the low likelihood of this pathogen being spread via apple fruit.²¹

There are no known in-field control measures for the viroids and virus dealt with here and, as a result, alternative phytosanitary measures are required that manage these pathogens procedurally.²² The use of PFAs, PFPS etc and/or systems approaches constitute widely implemented approaches that are used by a number of jurisdictions for a range of pests, either as a result there being limited phytosanitary treatment options or, commonly, in addition (or an alternative) to available measures. The mandating, for example, of a given commodity to derive from a PFA provides a very robust measure for the prevention of spread of pests of phytosanitary concern. Examples where such approaches (PFAs, SAs etc.) are mandated by an importing nation include measures indicated by Australia for apples deriving from China and Japan,^{23,24} whilst New Zealand indicates PFAs, PFPP and SAs as measure to be applied to stone fruit deriving from the USA and all apple consignments bound for the country.^{25,26} In these cases, the measures apply to the range of insect pests and diseases of phytosanitary concern.

Unlike other phytosanitary measures, such as cold treatments or irradiation, the efficacy of the above measures, for the most part (e.g. PFAs, PFPPs etc.), cannot be evaluated directly via basic research. As such, the major validation of the approach derives from the widespread use of the various elements of the schedule for the prevention of spread of fungal pathogens from or to a number of fruit exporting/importing nations.

The determination of PFAs (as set out in ISPM 4)²⁷ may be used as the basis for the phytosanitary certification and can be:

- an entire country
- an uninfested part of a country in which a limited infested area is present
- an uninfested part of a country situated within a generally infested area

Pest Free Places of Production (PFPP) and Pest Free Production Sites (PFPS) (as set out in ISPM 10)²⁸ comprise smaller areas than PFAs, such as discrete production units (contiguous fields, orchards,

facilities) that can be demonstrated by scientific evidence to be free of a given pest for a defined period.

Systems approaches integrate measures in order to meet phytosanitary import requirements and may include field treatments, pre- and post-harvest treatments (e.g. fungicides), inspection and certification, and shipping/distribution methods. Combinations of these measures can contribute to the effective risk management of a given pest and can provide highly effective quarantine strategies for both domestic and international trade.²⁹ General guidelines for applying systems approaches are set out in ISPM 14,³⁰ whilst national governments, such as Australia, also produce guidelines for implementing systems approaches in specific crops.³¹ A further example of the implementation of a systems approach to pest management is provided by Nepal, a country that has developed the approach to manage the risk associated with fruit flies.³²

Does experience from use in international trade indicate that the measure is effective?

In the absence of measures that are effective in the field such as chemical treatments, or post-harvest pest control regimes such as cold treatment or irradiation, the use of PFAs and allied measures constitute the best available phytosanitary strategy to manage the named viroids (ADFVd and AFCVd) and virus (CRLV). Systems approaches are particularly appropriate for fungal pathogens as the use of, for example, fungicides at the pre-harvest coupled with other procedures, such as surveillance, can effectively exclude infected material from consignments. The risk associated with pathogens such as those dealt with here are often managed through importing countries stipulating phytosanitary measures such as those described in the above schedule.

Efficacy of the above measures can only be gauged indirectly through the lack of spread (or otherwise) of a quarantine pest. However, the fact that these measures are widely used for a wide range of pests and diseases by several countries would imply that such procedures are effective in preventing the spread of pathogens, such as the ones dealt with here, by international trade.

The Australian apple market was effectively closed to imports up to 2010. However, bilateral agreements based on Import Risk Analyses and the mandating of specific phytosanitary measures have opened up exports from the Pacific Northwest (in 2022),^{11,33} and China (in 2010).³⁴ In both these examples pest-free areas and systems approaches are indicated as measures appropriate for managing the risk associated with fungal pathogens, including *Gymnosporangium* and *Phyllosticta* species. Exports of apples from New Zealand to Australia had been banned for over 90 years.³⁵ However, after New Zealand challenged the ban (via the WTO) Australia conducted an IRA and, although heavily revised due to New Zealand challenging the validity of several aspects of the document (especially the measures requested), issues were resolved to allow exports to start in 2010/2011 although volumes remain low presently.

Apples imported from China into the USA (if grown in areas free of, for example, the fruit fly *Bactrocera dorsalis*) are required to be produced in accordance with a systems approach. This includes requirements for registration of places of production and packinghouses, inspection for quarantine pests at set intervals by the national plant protection organization of China, bagging of fruit, safeguarding, labelling, and importation in commercial consignment.³⁶ Currently, the USA

market takes in 2.3% of Chinese apple exports.³⁷

The import health standard for apples exported from the USA to New Zealand stipulates that fruit must either have been appropriately treated against *G. clavipes* (effective fungicide) or be sourced from a PFA.³⁸ Tasmania similarly indicates FPAs and systems approaches as appropriate measures for a number of fungal pathogens of fruit, in this case with respect to imports from mainland Australia.³⁹

The broad geographic distribution of the *A. mali* encompasses major apple exporting nations, such as China and Chile, as well as a range of other countries from Asia and North America. The remaining species are only of concern with respect to apples exported from North America (*Gymnosporangium* spp and *P. solitaria*) and parts of east Asia/Japan (*B. kuwatsukai*) and, as a consequence, affect much lower volumes of trade. The measures described here are applicable to over 2 million tonnes of exports.

With respect to viruses, measures described here have relevance to apples deriving from the Pacific Northwest of the USA and Canada (for CRLV),²² Japan (for AFCVd),¹⁸ and much of Asia and Near East (with some reports of the viroid from Italy, Moldova and Turkey) (for ADFVd).^{15,40,41} ADFVd occurs in countries (e.g. China) that export large volumes of apples (>2 million tonnes) whilst CRLV and AFCVd occur in counties outside of the top ten exporting nations. As such, significant volumes of apples are exported from regions where ADFVd occurs into areas of pest freedom.

Has the measure been successfully used to manage non-compliant consignments?

The above schedule is used in circumstances where alternative measures either cannot be employed or are unavailable.

The measures described here are designed to ensure compliance of a given commodity up to the point of export. As such, the above schedule cannot be used to manage non-compliance directly at, say, the point of entry. Components of the schedule, such as such as inspections of consignments can, however, remove infected fruit and, as a result, lead to compliance for a lot or consignment at, for example, the packing stage or, alternatively, lead to a consignment being destroyed prior to export. A systems approach allows for a number of independent measures to be employed to ensure compliance and, as such, in some circumstances non-compliant consignments could be brought to a state of compliance using integrated phytosanitary measures.

Has the measure been successfully used to effectively manage pest risk domestically?

The establishment of pest free areas, pest free places of production and pest free production sites are common mechanisms that are used by many countries to ensure the phytosanitary safety of a commodity and, as a result, facilitate consignment movement either within or outside national borders. The establishment of such areas/sites is clearly set-out in FAO guidelines (ISPMs 4 and 10) and importing nations typically demand that these guidelines are met before a commodity can be safely exported.^{27,28} As a consequence, these procedures provide mechanisms to ensure that exporting nations can maintain compliance, especially for pests that cannot be controlled by post-harvest phytosanitary measures (cold treatment, fumigation etc.).

Many countries maintain lists of pest free areas within their jurisdiction as well as those of other countries that export fresh commodities to them, such the USA.⁴² The UK, for example, maintains

several PFAs to prevent the spread of a number of pests and pathogens that occur within some parts of the country but not in others.⁴³ In Europe, a series of Protected Zones are clearly demarcated for certain areas that are free of a given pest that is present in other areas of the EU.⁴⁴ To promote the export of fresh fruit, South Africa and Mozambique have recently initiated a programme to establish PFAs for fruit flies.⁴⁵ South Africa also demands that a number of commodities sourced from EU and other countries, including apples, originate from PFAs to prevent the movement of a range of pests and pathogens.⁴⁶

An example of where the establishment of PFAs forms an important phytosanitary tool is Australia where, for instance, Tasmania maintains pest-free status for fruit flies that are present on the mainland.³⁹ Mainland Australia maintains several PFAs, encompassing a number of pests, that restricts interstate trade of a number of commodities. The procedures associated with the establishment and certification of PFAs are described in Interstate Certification Assurance protocol ICA-23.⁴⁷

Systems approaches, using a combination of independent measures, are becoming increasingly widespread for a number of pests associated with fruit.²⁹ These approaches have particular utility when other measures are either not available, are contraindicated or technically unfeasible, or are difficult to implement. Although systems approaches are more typically described in the context of internationally traded commodities, uses in a domestic context are available. For example, Tasmania accepts systems approaches as a means of managing the risk of fruit flies associated with commodities from mainland Australia. Two Interstate Certification Assurance protocols (ICA-28 and ICA-34) describe the procedures used.^{31,48}

Has the measure been used successfully by the private sector or authorized entities?

PFAs can apply to whole countries or areas within them, encompassing enterprises associated with the commodity in question. The smaller scale of PFPPs and PFPSs mean that they can encompass a number of contiguous growing areas that can belong to the private sector (orchards and associated facilities). Using the example of Tasmania, the island enjoys status as a PFA with respect to the fruit fly *Bactrocera tryoni*, a fact that facilitates the export of several fruit commodities to mainland Australia.

The phytosanitary demands of importing countries often stipulate that the approaches detailed here are overseen by a local competent body (NPPO, for example).

Has the measure been identified as an effective pest risk management option based on a PRA or comparable technical evaluation?

The comprehensive Pest Categorisation assessments produced by EFSA have assessed the risk for *Alternaria* spp., *B. kuwatsukai*, *G. clavipes*, *G. juniperi-virginianae* and *P. solitaria* and all include PFAs as an appropriate phytosanitary measure, in some instances allied with control procedures such as fungicide applications.^{2,4,6,10}

An Import Risk Analysis from New Zealand dealing with apple imports from the USA is available for a series of pests of phytosanitary concern. This document indicates that the only phytosanitary measures required with respect to *G. clavipes* are a pre-export visual inspection and, if required, remedial action (control measures).¹¹ A similar IRA from Australia (concerning apple imports from

Japan) indicates that this measure (PFA) is to be used in the case of *A. mali*.²⁴

Another Australian IRA, for apples from China, indicates that for pathogens such as *Gymnosporangium* and *Phyllosticta* species, a systems approach or a number of other measures (control, surveillance, fruit bagging, post harvest processing and visual inspection) should be employed.²³ Similarly, the phytosanitary import requirements for fresh apples from the Pacific Northwest of the USA into Australia also indicates systems approaches in the source country had been introduced for several fungal species to include pre- and post harvest fungicide use, and pre-export monitoring.²¹

There are no treatments available to manage ADFVd, AFCVd and CRLV in the field and, as a result, alternative approaches are required to address the pest risks posed. The risks management procedures associated with the virus / viroids described in the above schedule are all documented elsewhere and are primarily cited in the context of dealing with the international trade of plants for planting. The risks of AFDVd, ADFVd and CRLV has been subject to analysis by, for example, Australia, New Zealand and the UK.

The risk associated with CRLV has received some attention from EFSA (Pest categorisation of Non-EU viruses of *Rubus*) but phytosanitary measures described are confined to plants for planting and there is no specific mention of procedures applicable to apple fruit.¹⁹

Is the measure, relevant to the pest, adopted in an ISPM or regional standard?

- ISPM 4: Requirements for the establishment of pest free areas (2017).²⁷
- ISPM 7: Phytosanitary Certification system (1997).⁴⁹
- ISPM 10: Requirements for the establishment of pest free places of production and pest free production sites (2016).²⁸
- ISPM 12 Phytosanitary certificates (2001).⁵⁰
- ISPM 14: The use of integrated measures in a systems approach for pest risk management (2019).³⁰

Australia

- ICA-23: Certification of area or property freedom based on monitoring by the accrediting authority (2020).⁴⁷
- ICA-28: Pre-harvest bait spraying and inspection of citrus (2012).³¹
- ICA-34: Pre-harvest field control and inspection of strawberries (2021).⁴⁸
- Plant Biosecurity Manual Tasmania (2023).³⁹

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