Australian Government
Department of Agriculture

Final policy review: Alternative risk management measures to import *Lilium* spp. cut flowers from Taiwan

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Cover image: *Lilium* spp. flower production in Taiwan, photographed by Department of Agriculture officers, Taiwan field visit, April 2011.

Lily cut flower depicted is not necessarily indicative of the species or varieties grown in Taiwan.

Contents

Tables

Figures

Figure 1 Map of Australian states and territories

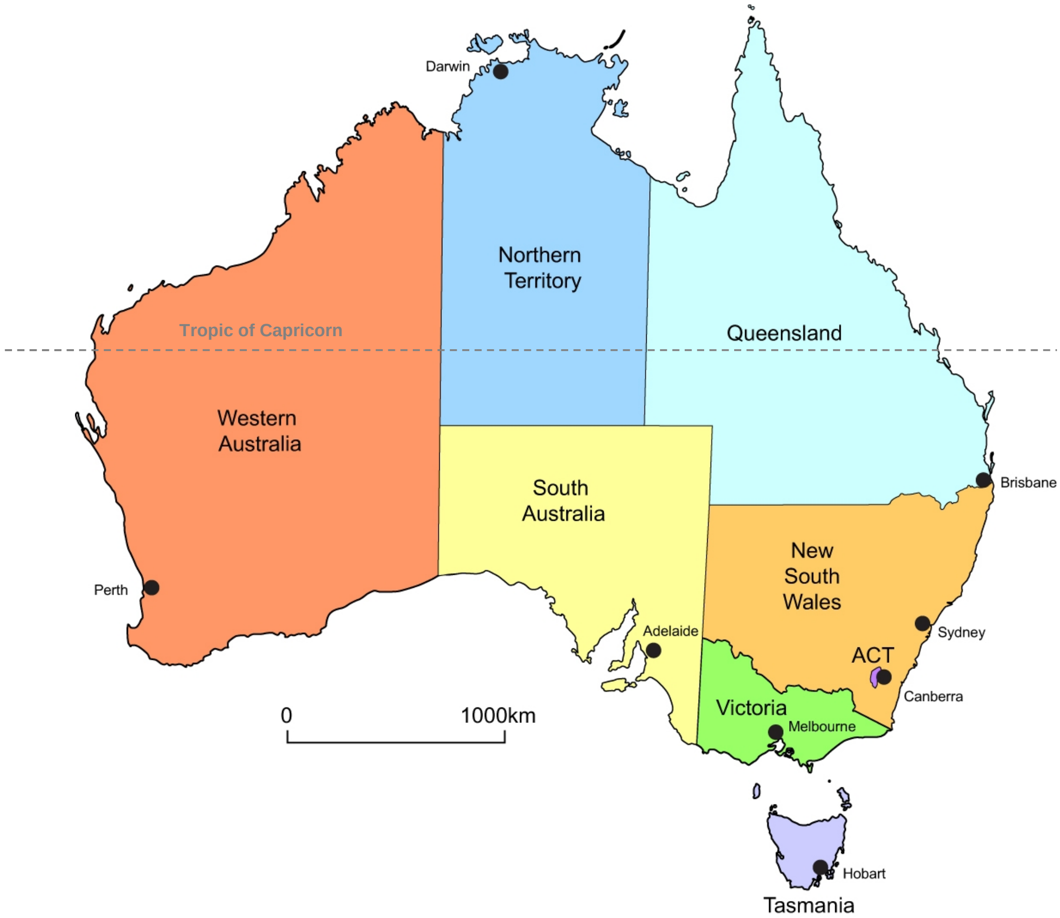
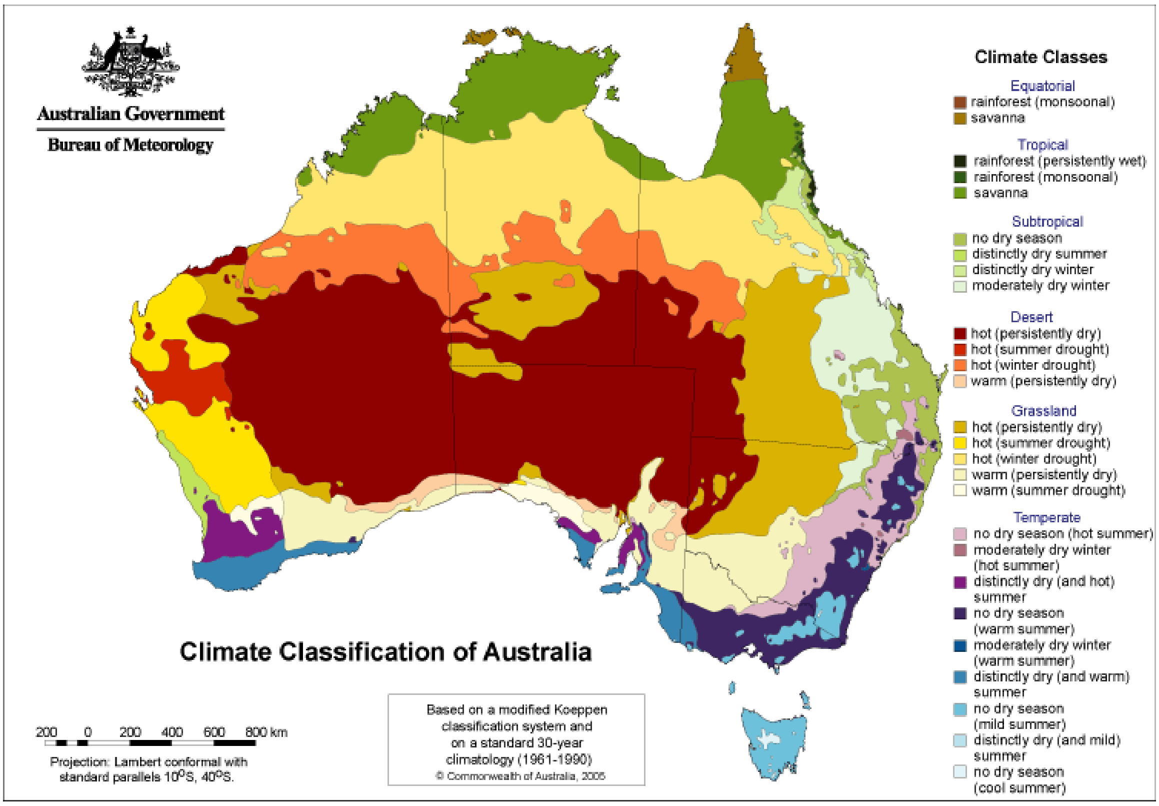


Figure 2 A guide to Australia's bio-climate zones



Acronyms and abbreviations

Term or abbreviation	Definition
ALOP	Appropriate level of protection
APPD	Australian Plant Pest Database (Plant Health Australia)
AQIS	Australian Quarantine and Inspection Service
BAPHIQ	Bureau of Animal and Plant Health Inspection and Quarantine, Taiwan
CABI	CAB International, Wallingford, UK
CMI	Commonwealth Mycological Institute
DAFF	Australian Government Department of Agriculture, Fisheries and Forestry (former title of the Department, now Department of Agriculture)
FAO	Food and Agriculture Organization of the United Nations
IPC	International Phytosanitary Certificate
IPM	Integrated Pest Management
IPPC	International Plant Protection Convention
IRA	Import Risk Analysis
ISPM	International Standard for Phytosanitary Measures
NPPO	National Plant Protection Organization
NSW	New South Wales
NT	Northern Territory
PRA	Pest Risk Analysis
Qld	Queensland
Tas.	Tasmania
Vic.	Victoria
WA	Western Australia
WTO	World Trade Organisation

Abbreviations of units

Term or abbreviation	Definition
°C	degree Celsius
°F	degree Fahrenheit
kg	kilogram
km	kilometre
m	metre
µm	micrometre (one millionth of a metre)
ml	millilitre
mm	millimetre
ppm	parts per million
s	second

Summary

The Australian Government Department of Agriculture has assessed the quarantine risks associated with the importation of lily (*Lilium* spp.) cut flowers from Taiwan.

Quarantine pests identified as requiring measures to manage the risks to a very low level in order to achieve Australia’s appropriate level of protection include several species of beetles, thrips, leafminers, moths, and viruses.

Consistent with the existing policy for the importation of cut flowers, the identified viruses will be managed through the requirement that stems be free from bulbils. This will minimise the risk of intentional propagation of the cut flowers. The risk of virus establishment was not considered to significantly differ from the current trade in cut flowers grown in Australia from imported bulbs in open quarantine. For arthropod pests either fumigation, or a systems approach, is recommended, which will minimise the risk of pests establishing in Australia.

Additionally, the department will undertake a documentation compliance examination for consignment verification purposes, at the port of entry in Australia, prior to inspection and discharge of the imported *Lilium* spp. cut flowers. All *Lilium* spp. cut flowers will be subject to on-arrival inspection by departmental officers. The detection of live insects, disease symptoms or regulated articles will result in failure of the consignment. Remedial actions for failed consignments include methyl bromide fumigation if live insects are detected, and export or destruction if stem bulbils are detected, as required.

The department considers that these measures will adequately mitigate the identified biosecurity risks. A number of changes have been made following consideration of stakeholder comments on the draft policy review and incorporated where appropriate.

1 Introduction

1.1 Australia’s biosecurity policy framework

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

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

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

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

More information about Australia’s biosecurity framework is provided in the *Import Risk Analysis Handbook 2011* located on the department’s website http://www.daff.gov.au/ba/ira/process-handbook.

1.2 This review of policy

Australia has an established policy for the import of many species of cut flowers. Imported cut flowers require mandatory on-arrival fumigation (unless exempt, Section 1.3.3). While *Lilium* spp. cut flowers are not currently permitted, Australia does permit the importation of *Lilium* bulbs from the Netherlands, and other countries, for production in open quarantine at a Quarantine Approved Premises (QAP) prior to release as cut flowers.

The purpose of this policy review is to examine a market access request from Taiwan for *Lilium* spp. cut flowers. This proposal includes a request for exemption of *Lilium* spp. from mandatory fumigation with methyl bromide.

[1] A pest is any species, strain or biotype of plant, animal, or pathogenic agent injurious to plants or plant products (FAO 2012).

1.2.1 Background

In 2009, the Bureau of Animal and Plant Health Inspection and Quarantine (BAPHIQ) requested market access for *Lilium* spp. cut flowers from Taiwan to Australia, and submitted technical information. BAPHIQ advised in September 2010 that lily cut flowers were their highest priority.

The department advised Taiwan that their request was an “A” priority on the Import Market Access Advisory Group list of October 2010.

Taiwan's plant quarantine authority (BAPHIQ) provided supplementary information on their market access request for lily cut flowers to Australia in March 2011 and proposed a field visit by officers of the department during the lily harvest season in April 2011.

Following the official request, officers from the department visited a number of *Lilium* production areas and packing houses near Houli township in April 2011. The visit was an opportunity to discuss the Taiwan proposal and to collect information and observe pest and disease prevalence first hand, as well as seek clarification from growers and BAPHIQ experts on pest and disease status and management. This assisted the department in undertaking the pest risk analysis of *Lilium* cut flowers.

In September 2011, at the 8th Agricultural Working Group between Taiwan and Australia meeting in Canberra, Australia confirmed that the PRA for lily cut flowers was being undertaken on the basis that Taiwan wishes to export without methyl bromide fumigation. Both countries agreed to look at the possibility of a systems approach and other equivalent measures, retaining fumigation as a back-up treatment option.

In June 2012, BAPHIQ proposed equivalent management measures for the treatment of cut flowers and disinfestations from arthropod pests. These include in-field sanitary measures during production involving bulb treatment with systemic pesticide at planting, application of pesticide at flower bud formation, and two weeks prior to harvest under supervision by a BAPHIQ inspector. These measures are also to be recorded and available for audit by BAPHIQ.

In June 2013, at the 10th Agricultural Working Group between Taiwan and Australia meeting in Taipei, BAPHIQ advised that they would also consider methyl bromide fumigation as a management measure.

1.2.2 Scope

This review covers market access for *Lilium* spp. of commercial varieties intended for cut flower end use. Taiwan proposes to export Oriental and Longiflorum hybrids. This review of policy has been extended to include commercial varieties/hybrids that are free of bulbils and not readily propagable. There is no evidence that commercially grown export lily cut flowers that are free of bulbils, and that have reached flowering stage in bud or bloom, are capable of producing bulbils under normal conditions. This excludes *L.* × *elegans* (Asiatic lily) and its hybrids, and *L. longiflorum* × Oriental lilies (LO hybrids) some of which are known to form axil bulbils (Roh 1992, Roh *et al.* 1996, Roh 2011). This review excludes bulbil forming species of *Lilium lancifolium* (or *L. tigrinum*), *L. sargentiae*, *L. sulphureum* (or *L. myriophyllum*) and *L. bulbiferum* (or *L. croceum*, *L. chaixii*) and their hybrids (McRae 1998, Jefferson-Brown and Howland 2002, GRIN 2012).

Taiwan's original request was for the removal of methyl bromide fumigation as a treatment for lily cut flowers originating from Taiwan for export to Australia. Taiwan has proposed to only send varieties that are free of bulbils, and thus are not readily propagable.

The scope of this review is limited to:

- identification of biosecurity risks associated with *Lilium* spp. cut flowers from Taiwan
- commercial varieties/hybrids that are free of bulbils and not readily propagable
- evaluation of alternative measures to methyl bromide fumigation that may be equally effective in meeting Australia's ALOP.

1.3 Existing policy

1.3.1 Current import policy for *Lilium* spp. bulbs as nursery stock

Currently, import conditions exist for many species of *Lilium* as bulbs imported from the Netherlands and from 'all countries' as nursery stock for cut flower production in open quarantine or for potted colour plant production. In 2007, more than 75 million bulbs were imported into Australia, the bulk of which were *Lilium* bulbs (72.5 million) (AQIS 2008). Existing import conditions for lily bulbs as nursery stock, for potted colour or cut flower production, can be accessed at http://apps.daff.gov.au/icon32/asp/ex_querycontent.asp.

Standard bulb import conditions for permitted *Lilium* species bulbs, as nursery stock for potted colour or cut flower production, are subject to:

- an import permit
- phytosanitary certification for freedom from black wart and potato cyst nematode (and freedom from rust and smut fungi if from the Netherlands)
- inspection prior to mandatory methyl bromide fumigation or hot water immersion for invertebrate pests
- growth in open quarantine (field planting or tunnel house) at a QAP, and
- crop inspections following a period of sufficient growth in quarantine to allow for development of any symptoms of pathogens (one inspection for bulbs imported from the Netherlands and certified under Bloembollenkeuringsdienst (BKD) scheme; two inspections for non-certified non-BKD bulbs), prior to release as cut flowers or potted colour.

Additional conditions apply to bulbs packaged in peat moss imported from FMD countries (ICON 2013).

Contaminated consignments (soil, plant debris, disease or quarantinable matter) are subject to cleaning, nematicide treatment, destruction, or re-export (determined by the risk associated with the contaminating material).

Table 1.1 Specific biosecurity measures for *Lilium* spp. bulbs as nursery stock (potted colour or cut flower production)

Reference number	Condition title
Condition C14922 (Netherlands) **Condition C14921** (other countries)	Lists of permitted *Lilium* spp. and hybrids as nursery stock including American, Asiatic, Candidum, Dauricum, Martagon, Oriental and Trumpet hybrids.
Condition C7416	BKD Scheme (the Netherlands)- requirements for import and growth in QAP for approved species and hybrids exported and certified under the scheme
Condition C7418	Conditions for non-certified bulbs (i.e. non-BKD generated bulbs).

1.3.2 Past policies for lily cut flowers

In 1978, trade in *Lilium* spp. cut flowers was halted due to concerns of propagability posed by bulbils on the leaf axis of bulbil-forming *Lilium*. *Lilium* was then placed on the list of prohibited cut flower species. In 1981, the prohibition was modified to allow entry of flowers of species that did not form bulbils. The species of most concern was *Lilium tigrinum* (Tiger lily) (Evans *et al.* 1998).

The prohibition was extended in 1982 to other species able to propagate by axil bulbils (*L. tigrinum*, *L. bulbiferum*, *L. sargentiae* and *L. sulphureum*) (PQS 1983, Evans *et al.* 1998). This is because of the capacity for propagation into full plantlets from stem bulbils and the increased likelihood of distribution and spread of pathogens that they may carry.

However, the importation of all *Lilium* species as cut flowers was stopped in 1983 due to operational difficulties in identifying species/hybrids at inspection and the delays this was causing at the border (PQS 1983)[2].

1.3.3 Current import policy for cut flowers

There are no import conditions for *Lilium* spp. cut flowers as these are not currently permitted entry into Australia. Conditions for permitted cut flower species can be found at: http://apps.daff.gov.au/icon32/asp/ex_querycontent.asp.

Permitted cut flower species other than *Lilium* spp. are subject to mandatory devitalisation for propagable species and mandatory methyl bromide fumigation.

Some cut flowers/foliage consignments can be exempt from mandatory fumigation on arrival through one of the following three options:

- Overseas Accreditation Schemes for flower suppliers (currently operating in Singapore and Malaysia)
- Offshore fumigation monitored by National Plant Protection Organisation (NPPO) in the country of origin (currently, only China has arrangements in place with the department)

[2] The requirement for identifying hybrids is superseded by the condition for freedom of lily cut flower stems from propagable bulbils at inspection (as described in section 2.1).

- Fumigation exemptions based on importer and supplier compliance history. The Department of Agriculture's system identifies all cut flower pathways that consistently comply with the department's requirement for freedom from live pests and other biosecurity risk materials. This approach is consistent with department's plan for managing biosecurity compliance and its enforcement under the business reform program for biosecurity business areas (DAFF 2012a). Importers are encouraged to implement measures to manage pest issues offshore as the import pathway can be exempted from mandatory fumigation once a history of compliant imports has been established. Under the system, all consignments are inspected on arrival in Australia and are subject to mandatory fumigation whenever any live pests are found and until they meet compliance requirements.

Table 1.2 Specific biosecurity measures for cut flowers other than *Lilium* spp.

Reference number	Condition title
Condition C6500	General conditions for commercial consignments of cut flowers and foliage
Condition C9658	Overseas Accreditation Scheme (Singapore and Malaysia) - requirements for exemption from fumigation for species exported and certified under the scheme

The existing policy for the importation of cut flowers is based on minimising the risk of accidental introduction of any associated pathogen and arthropod pest. The risk management measures proposed in this document are methyl bromide fumigation or a systems approach that provides equivalence to fumigation by using alternative measure which will be equally effective in meeting Australia's quarantine requirements.

1.3.4 Consultation

The draft review of policy was released on 5 November 2012 (BA 2012/22) for comment and consultation with stakeholders, for a period of 30 days. At the request of stakeholders the comment period was extended (BA 2012/25) to a total of 60 days and concluded on 4 January 2013 (DAFF 2012b).

Prior to the draft release, the department met with flower growers through the Post Entry Plant Industry Consultative Committee (PEPICC) in March 2012 to discuss the market access request and upcoming draft policy review. The industry representatives were later provided with a copy of the draft policy review for their comments. At the March 2013 meeting, PEPICC members were advised of relevant comments made to the draft policy review and that material matters raised will be addressed in the final report.

The draft review of policy was distributed to the relevant state departments for comment to identify any concerns. Submissions were received from Queensland and Western Australia.

Written submissions were received from ten other stakeholders, including BAPHIQ. Submissions have been considered and material matters raised have been included in the present report.

The department also held a teleconference in May 2013 with the Australian Flower Council to discuss the draft policy review. Departmental officers attended the Victorian Flower Growers' conference in July 2013 and discussed the lily draft policy and other cut flower issues.

Following stakeholder consultation, some amendments have been made to the final report where appropriate, including:

- Additional information has been added to Section 1.3.3 to reflect recent changes to the current import policy for all cut flowers.
- Additional information about bulbil formation and varieties has been added to Section 2.1.
- Table 2 has been updated to reflect the current cut flower and foliage quarantine conditions as listed in ICON (ICON 2013).
- One pest has been removed from Appendix A, *Lilioceris merdigera*, as requested by BAPHIQ. *Lilioceris formosana* remains listed as a quarantine pest in Appendix A and risk management measures still apply to this species.
- Additional information has been added to *Thrips palmi* in Appendix A, reflecting the regulated status of this pest for WA and SA. Additional inspection requirements exist for WA under Interstate Certification Assurance for that state.
- *Oxya intricata* is not considered a quarantine pest for lily cut flowers as indicated in the table for initiation and categorisation of pests in Appendix A, and this has now been correctly reflected in the final column of Appendix A.
- Further comments regarding viral pathogens and their transmission potential have been added (Sections 4 and 5.1.2).
- Management for virus quarantine pests under Section 5.1.2 has been updated.
- The option to import cut flowers with methyl bromide fumigation was added; exemptions from methyl bromide fumigation are possible based on importer and supplier compliance history.
- Under Section 4.1.3, additional operational requirements have been highlighted for pests of regional concern to Western Australia and South Australia. Furthermore, changes to this section have been made to clarify and reflect the difference in operational requirements between a systems approach and methyl bromide fumigation based on importer and supplier compliance history.

2 *Lilium* spp. propagation, commercial cultivation and Taiwan's commercial production practices

This chapter provides general information on varieties of *Lilium spp.* of commercial floricultural importance, and on lily propagation. It also provides specific information on the commercial production practices for *Lilium* spp. cut flowers in Taiwan and considers pre-harvest, harvest and post-harvest practices. The export capacity of Taiwan is also outlined.

2.1 *Lilium* spp. varieties, propagation and commercial cultivation

This review will cover varieties of *Lilium* of commercial floricultural importance. Lilies comprise more than 80 species belonging to several sections or divisions (Lim *et al.* 2008). The divisions have no botanical significance but are for the convenience of gardeners (Mikolajski 2004). Lilies have been divided to 10 divisions of closely related hybrids and taxa for horticultural use. These include Asiatic, Martagon, Candidum, American, Longiflorum hybrids (mostly *L. longiflorum* × Asiatic), Trumpet and Aurelian hybrids, Oriental, Orienpet (Trumpet Aurelian × Oriental) hybrids, as well as true species and miscellaneous (not included in other divisions) (Mc Rae 1998).Within the divisions, cultivars bred from *Lilium longiflorum* (Leucolirion) hybrids, Asiatic (Sinomartagon) and Oriental (Archelirion) hybrids are the most important in the commercial market (Lim *et al.* 2008). These important hybrid groups for cut flowers have distinctive characteristics. Longiflorum hybrids have trumpet-shaped, outward-facing white flowers, a distinctive fragrance with the ability for forcing year-round (Lim and Van Tuyl 2007). Asiatic hybrids have a large range of colours with upright-facing flowers and have early to late flowering types; Oriental hybrids also have early to late flowering types, a strong fragrance with pink or white flowers, sturdy stems with wide dark green leaves (Lim and Van Tuyl 2007). Many new hybrids have been introduced in recent years, interspecific hybrids of *L. longiflorum* × *L.* × *elegans* (LA hybrids), *L. longiflorum* × Oriental lilies (LO hybrids), and Oriental × Trumpet lilies (Orienpet or OT hybrids) (Roh 2011).

Lilies are propagated through seeds (providing genetic diversity and freedom from viral and other pathogens) or vegetatively (exact copies of the mother plant) predominantly through bulbs, bulb scales, bulblets, and bulbils (McRae 1998, Jefferson-Brown and Howland 2002). Bulblets are daughter bulbs that develop on the underground portion of the stem in close proximity to the mother bulb. Bulbils are adventitious bulbs formed on the stem or inflorescence above ground of some species of *Lilium*, and have a demonstrated capacity to regenerate new plant material (McRae 1998, Jefferson-Brown and Howland 2002).

Propagation from underground parts such as basal plate scales, stem bulblets (juvenile bulbs that are produced below soil level above the top of the bulb) are all vegetative methods of lily propagation that are not of concern in cut flowers. However, lily plant tissues of some species (and their cultivars) have a high generation potential and may also be propagable by bulbils, or by leaf and stem cuttings (Luo and Liu 1993, Anon. 1993, Ruffoni *et al.* 2011). Kim *et al.* (2007) induced bulbil formation by growing bulbs (of *L. longiflorum* 'Nellie White') at different temperature and photoperiod regimes, though this is undesirable as it is presumed to be detrimental to bulb production since bulbils are a competitive sink for carbohydrates from the main plant. Ruffoni *et al.* (2011) state that lilies are one of the most important bulbous crops produced in tissue culture and on an industrial scale nowadays. Commercial hybrid floricultural varieties are usually bred to maximise flower beauty and attractive cut flower features (e.g. scent). These are not known to form bulbils like the original mother species used to generate commercially viable crosses, and thus are not propagable via bulbils.

A few species of *Lilium*, such as *Lilium lancifolium* (or *L. tigrinum*), *L. sargentiae*, *L. sulphureum* (or *L. myriophyllum*) and *L. bulbiferum* (*L. croceum*, *L. chaixii*), as well as *L.* × *elegans* (an Asiatic lily), and their cultivars and hybrids, are known for producing stem or leaf axis bulbils in abundance (Roh 1992, McRae 1998, Jefferson-Brown and Howland 2002, GRIN 2012, Asker 2012). For instance, LA hybrids (LAIH) of *L. longiflorum* and *L.* × *elegans* Asiatic hybrid lilies may carry axil bulbils derived from *L.* × *elegans* in interspecific crosses (Roh *et al.* 1996). Later research by the same author describes bulbils only from *L.* × *elegans* (Asiatic hybrid) and the use of tissue culture for propagation of interhybrid crosses of Asiatics with Longiflorum (LAIH) (Roh *et al.* 2008, Roh 2011). Roh (2011) also identified some *L. longiflorum* × Oriental lilies (LO hybrids) as able to form axil bulbils. Another example is Asiatic hybrid cultivar “Brunello” (Asker 2012). It is noteworthy that the bulbil-production trait by hybrid lily varieties/cultivars can occur at a very low rate depending on the parent lineages used in the cross. If the parent/ancestor is a known bulbil producer (for example *L. sargentiae*, a Trumpet lily parent, or *L. lancifolium*, an Asiatic lily parent) crossed with non-bulbil-forming varieties, the resulting hybrid may occasionally produce bulbils. However, not all hybrids will have a bulbil-producing parent/s, or the same ancestry.

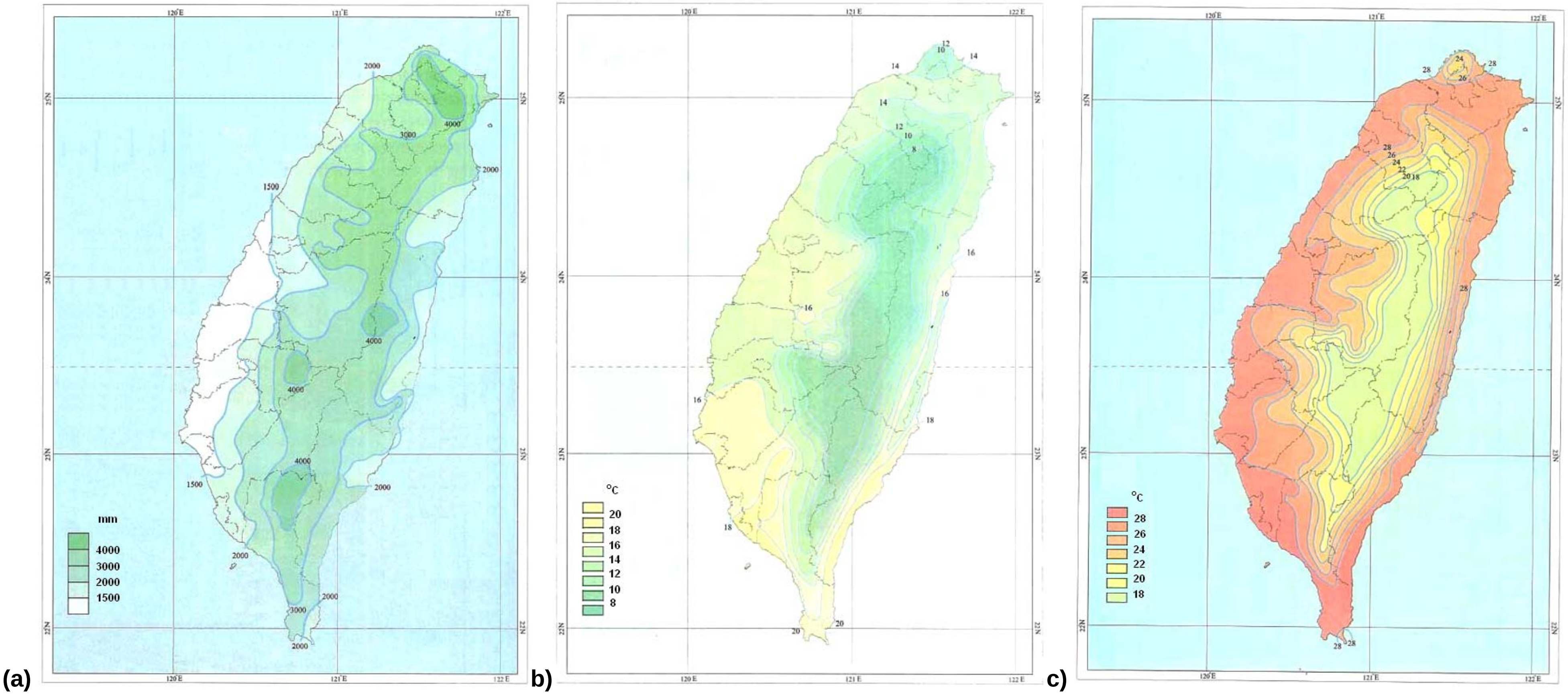
Bulbils develop early in the season and can be harvested shortly before they would drop naturally, that is when the parent plant flowers. Several studies have reported the stimulation of bulbil formation by various treatments such as flower bud removal, use of growth regulators and retardants, and use of organic acids (Asker 2012). Ryczkowski (2012) states that not all *Lilium* species form bulbils but can be forced to do so by removing flower bulbs and cutting off the upper half of stems (Ryczkowski 2012, Asker 2012), while other sources state bulbils can only be forced from the species listed above that are naturally bulbil-forming (Herbs 2000). Thus, commercially grown non-bulbil forming lilies, intended for commercial sale, that have reached flowering stage in flower bud, or in bloom, cannot be forced to produce bulbils. Furthermore, if the conditions of import require only bulbil-free flowers to be traded, the presence of bulbils will be evident upon visual inspection.

Most bulbs used for cut-flower production and sold to cut flower growers are grown in the Netherlands, Chile, France, New Zealand, South Africa, and north-western USA as commercial production of bulbs requires a cool environment (Gill *et al.* 2006). Lilies can be grown in the field in raised beds, in high tunnels, or in greenhouses (some in crates). Best conditions combine a loamy soil with good drainage, pH of 6.3–6.8, 6–8 hours of daily sun, and frequent watering. Cut flower stems are harvested when flowers are in the bud stage, when the lower-most buds show colour to allow the flowers to open after purchase by consumers. Prior to shipping, cut flowers are pulsed in sucrose solution and germicides, and stored with floral preservatives (silver thiosulphate or STS) to prolong their vase life (up to 9–14 days depending on the cultivar and the environment it is kept in), then transported in water (Balge *et al.* undated, Gill *et al.* 2006).

2.2 Climate in Taiwan’s production areas

The island of Taiwan has a climate characterised by tropical monsoon conditions. Annual rainfall is generally above 2000 mm in the lowlands and increases with altitude (Figure 3a). Rainfall occurs throughout the year, but may increase from July to September due to the typhoon season (BBC 2011). Winter in the north of the island is marked by more cloud and rain than the south of the island (BBC 2011). At lower elevations humidity increases during the summer months (BBC 2011). Lily production is concentrated, but not limited to, the middle and mid-west of the island; a number of producers grow in the mountainous interior and other parts of the island. The island shares the tropical monsoon climate experienced by the regions surrounding the South China Sea.

Figure 3 Climate in Taiwan: a) annual rainfall; b) January average temperatures; and c) July average temperatures (NICT 2009)



2.3 Taiwan's commercial production practices

2.3.1 Pre-harvest production practices

Taiwan is proposing to export mainly Longiflorum (hybrids derived from *L. longiflorum* crossed with Asiatic hybrids) and Oriental hybrid lilies which are the main commercially cultured varieties in Taiwan, due to temperature limits. Growers also plant Orienpet hybrids derived from Oriental and Trumpet varieties. *Lilium* spp. cut flowers for export are hybrid species bred for their ornamental value and specific flower colour and patterns.

Export-quality lilies are produced from bulbs imported yearly to Taiwan mainly from the Netherlands and Chile, some from France and New Zealand, and are accompanied by phytosanitary certificate, stating that the bulbs are free from *Ditylenchus dipsaci* and *Rhizoglyphus echinopus* (bulb mite) during production in the field. New quarantine requirements for lily bulbs exported to Taiwan propose lily bulbs be virus free, and inspected or tested for Plantago asiatica mosaic virus (PlAMV) during production (WTO 2013). Similar draft requirements for Arabis mosaic virus (ArMV) have also been proposed (WTO 2012).

The bulbs are inspected on-arrival by BAPHIQ for freedom from regulated pests. Some bulb samples are sent to approved virus-testing laboratories. According to the virus test reports, few viruses are rarely found on the imported bulbs, and these include Lily mottle virus (LMoV) and Lily symptomless virus (LSV).

Plants are visually inspected in the field for freedom from disease symptoms and only disease free plants should be further selected for export.

2.3.2 Cultivation practices

Growth of lily bulbs occurs in open fields under nets or in net-houses, and sometimes in glasshouses. These are not insect proof but allow for protection from direct sunlight. Lilies are grown in raised beds to prevent common rots and allow proper drainage. Watering, feeding and spraying treatments of plants are generally performed manually.

Pest management and general surveillance programs are applied for the production of *Lilium* species. Growers apply pest management measures in field as required in case a pest occurs in the field, and use chemical control or soil sterilisation for fungi and discard infected plants in case of viral infection. Growers use flooding and rotations with rice to manage soil borne diseases associated with lily bulbs. Other flowers are also grown at times in rotation with lilies (and can include *Anthurium*, *Amaryllis*, *Liatris* and other species).

BAPHIQ inspectors inspect the plants during their growth and supervise the packing of the plants for export. Exported plants are covered by BAPHIQ phytosanitary certification. BAPHIQ advised that they would not certify any plants that showed disease-like symptoms. However, no records are kept of these processes and generally rely on the grower's experience and their knowledge of the crop.

The overall procedures in the packing house (which do not follow a one-way flow of the product) entail the following; harvesting (monitoring for diseased or stunted flowers), movement to packing houses, washing of the cut flowers, de-leafing, sorting and grading, cutting to length, bunching and sleeving, placing in cool room (in preservative solution), or packing then storing in cool room for movement to market or export. After harvest, flowers are pulsed and held at low temperature to extend vase life, by applying silver thiosulphate (STS) solution (BAPHIQ 2011a), which occurs usually within 12 hours if the cut flowers are destined for export. This is followed by phytosanitary certification and inspection by BAPHIQ.

2.4 Taiwan's export capability

2.4.1 Production and exports

The total area of planted lilies in Taiwan is about 340 hectares with a total production volume of 5.8 million dozens in 2003 (CoA 2011).

Cultivation of lilies in Taiwan occurs in the cold areas of Nantou and Chiayi (1000 metres above sea level) in summer to supply local demand. During winter, lilies are produced in lowlands, primarily in Houli and Puli (CoA 2011). Taiwan's market access proposal states that lilies in 2008 were grown over 331 hectares in Taichung county (220 ha), Nantou county (66 ha), and Changhua county (18 ha) (BAPHIQ 2009).

Taiwan's export trade in lilies is well established (pers. comm. BAPHIQ). Taiwan's leading export market for *Lilium* spp. cut flowers is Japan followed by Hong Kong, Singapore and other regional markets (Malaysia, Guam, and the Philippines). The export value of lilies is expected to continue to increase.

There are no specific export protocol requirements for Taiwan's current exports to regional Asian markets other than inspection, and generally include a BAPHIQ-issued phytosanitary certificate.

Production facilities are currently able to demonstrate full trace back of exported plants to the original packing house (though some are used by more than one grower); however, flower cartons are identifiable to the packing house, allowing traceability of the pathway should any non-compliance issues be detected on arrival in Australia.

2.4.2 Export season

Lilium spp. cut flowers are produced year round (as above). Exporting season includes November through April the next year (TFEA 1997).

3 Method for pest risk analysis

This section sets out the method used for the pest risk analysis (PRA) in this report. The Department of Agriculture has conducted this PRA in accordance with the International Standards for Phytosanitary Measures (ISPMs), including ISPM 2: *Framework for Pest Risk Analysis* (FAO 2007) and ISPM 11: *Pest Risk Analysis for Quarantine Pests, including analysis of environmental risks and living modified organisms* (FAO 2013).

A PRA is 'the process of evaluating biological or other scientific and economic evidence to determine whether a pest should be regulated and the strength of any phytosanitary measures to be taken against it' (FAO 2012). A pest is 'any species, strain or biotype of plant, animal, or pathogenic agent injurious to plants or plant products' (FAO 2012).

Quarantine risk consists of two major components: the probability of a pest entering, establishing and spreading in Australia from imports; and the consequences should this happen. These two components are combined to give an overall estimate of the risk.

Unrestricted risk is estimated taking into account the existing commercial production practices of the exporting country and that, on arrival in Australia, the department will verify that the consignment received is as described on the commercial documents and that its integrity has been maintained.

Restricted risk is estimated with phytosanitary measure(s) applied. A phytosanitary measure is 'any legislation, regulation or official procedure having the purpose to prevent the introduction and spread of quarantine pests, or to limit the economic impact of regulated non-quarantine pests' (FAO 2012).

A glossary of the terms used is provided at the back of this report.

PRAs are conducted in three consecutive stages: initiation, pest risk assessment and pest risk management.

3.1 Stage 1: Initiation of the PRA

Initiation identifies the pest(s) and pathway(s) that are of quarantine concern and should be considered for risk analysis in relation to the identified PRA area.

The pests assessed for their potential to be on the exported commodity (produced using commercial production and packing procedures) are listed in column 1 of Appendix A. Appendix A does not present a comprehensive list of all the pests associated with the entire plant, but concentrates on the pests that could be on the assessed commodity. Pests that are determined to not be associated with the commodity are not considered further in the PRA. Contaminating pests that have no specific relation to the commodity or the export pathway have not been listed and would be addressed by Australia's current approach to contaminating pests.

The identity of the pests is given in Appendix A. The species name is used in most instances but a lower taxonomic level is used where appropriate. Synonyms are provided where the current scientific name differs from that provided by the exporting countries NPPO or where the cited literature uses a different scientific name.

For this PRA, the 'PRA area' is defined as Australia for pests that are absent, or of limited distribution and under official control. For areas with regional freedom from a pest, the 'PRA area' may be defined on the basis of a state or territory of Australia or may be defined as a region of Australia consisting of parts of a state or territory or several states or territories.

3.2 Stage 2: Pest Risk Assessment

A pest risk assessment (for quarantine pests) is: 'the evaluation of the probability of the introduction and spread of a pest and of the likelihood of associated potential economic consequences' (FAO 2012).

In this PRA, pest risk assessment was divided into the following interrelated processes:

3.2.1 Pest categorisation

Pest categorisation identifies which of the pests with the potential to be on the commodity are quarantine pests for Australia and require pest risk assessment. A 'quarantine pest' is a pest of potential economic importance to the area endangered thereby and not yet present there, or present but not widely distributed and being officially controlled, as defined in ISPM 5: *Glossary of phytosanitary terms* (FAO 2012).

The pests identified in Stage 1 were categorised using the following primary elements to identify the quarantine pests for the commodity being assessed:

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

The results of pest categorisation are set out in Appendix A. The quarantine pests identified during pest categorisation were carried forward for pest risk assessment and are listed in Table 4.1.

3.2.2 Assessment of the probability of entry, establishment and spread

Details of how to assess the 'probability of entry', 'probability of establishment' and 'probability of spread' of a pest are given in ISPM 11 (FAO 2013). A summary of this process is given below, followed by a description of the qualitative methodology used in this IRA.

Probability of entry

The probability of entry describes the probability that a quarantine pest will enter Australia as a result of trade in a given commodity, be distributed in a viable state in the PRA area and subsequently be transferred to a host. It is based on pathway scenarios depicting necessary steps in the sourcing of the commodity for export, its processing, transport and storage, its use in Australia and the generation and disposal of waste. In particular, the ability of the pest to survive is considered for each of these stages.

The probability of entry estimates for the quarantine pests for a commodity are based on the use of the existing commercial production, packaging and shipping practices of the exporting country. Details of the existing commercial production practices for the commodity are set out in Section 3. These practices are taken into consideration by the department when estimating the probability of entry.

For the purpose of considering the probability of entry, the department divides this step of this stage of the PRA into two components:

- **Probability of importation**: the probability that a pest will arrive in Australia when a given commodity is imported
- **Probability of distribution**: the probability that the pest will be distributed, as a result of the processing, sale or disposal of the commodity, in the PRA area and subsequently transfer to a susceptible part of a host.

Factors considered in the probability of importation include:

- distribution and incidence of the pest in the source area
- occurrence of the pest in a life-stage that would be associated with the commodity
- mode of trade (such as bulk or packed)
- volume and frequency of movement of the commodity along each pathway
- seasonal timing of imports
- pest management, cultural and commercial procedures applied at the place of origin
- speed of transport and conditions of storage compared with the duration of the lifecycle of the pest
- vulnerability of the life-stages of the pest during transport or storage
- incidence of the pest likely to be associated with a consignment
- commercial procedures (such as refrigeration) applied to consignments during transport and storage in the country of origin, and during transport to Australia.

Factors considered in the probability of distribution include:

- commercial procedures (such as refrigeration) applied to consignments during distribution in Australia
- dispersal mechanisms of the pest, including vectors, to allow movement from the pathway to a host
- whether the imported commodity is to be sent to a few or many destination points in the PRA area
- proximity of entry, transit and destination points to hosts
- time of year at which import takes place
- intended use of the commodity (for example for planting, processing or consumption)
- risks from by-products and waste.

Probability of establishment

Establishment is defined as the ‘perpetuation for the foreseeable future, of a pest within an area after entry’ (FAO 2012). In order to estimate the probability of establishment of a pest, reliable biological information (for example, lifecycle, host range, epidemiology, survival) is obtained from the areas where the pest currently occurs. The situation in the PRA area can then be compared with that in the areas where it currently occurs and expert judgement used to assess the probability of establishment.

Factors considered in the probability of establishment in the PRA area include:

- availability of hosts, alternative hosts and vectors
- suitability of the environment
- reproductive strategy and potential for adaptation
- minimum population needed for establishment
- cultural practices and control measures.

Probability of spread

Spread is defined as 'the expansion of the geographical distribution of a pest within an area' (FAO 2012). The probability of spread considers the factors relevant to the movement of the pest, after establishment on a host plant or plants, to other susceptible host plants of the same or different species in other areas. In order to estimate the probability of spread of the pest, reliable biological information is obtained from areas where the pest currently occurs. The situation in the PRA area is then carefully compared with that in the areas where the pest currently occurs and expert judgement used to assess the probability of spread.

Factors considered in the probability of spread include:

- suitability of the natural and/or managed environment for natural spread of the pest
- presence of natural barriers
- potential for movement with commodities, conveyances or by vectors
- intended use of the commodity
- potential vectors of the pest in the PRA area
- potential natural enemies of the pest in the PRA area.

Assigning qualitative likelihoods for the probability of entry, establishment and spread

In its qualitative PRAs, the department uses the term 'likelihood' for the descriptors it uses for its estimates of probability of entry, establishment and spread. Qualitative likelihoods are assigned to each step of entry, establishment and spread. Six descriptors are used: high; moderate; low; very low; extremely low; and negligible (Table 2.1). Descriptive definitions for these descriptors and their indicative probability ranges are given in Table 2.1. The indicative probability ranges are only provided to illustrate the boundaries of the descriptors. These indicative probability ranges are not used beyond this purpose in qualitative PRAs. The standardised likelihood descriptors and the associated indicative probability ranges provide guidance to the risk analyst and promote consistency between different risk analyses.

Table 3.1 Nomenclature for qualitative likelihoods

Likelihood	Descriptive definition	Indicative probability (P) range
High	The event would be very likely to occur	0.7 < P ≤ 1
Moderate	The event would occur with an even probability	0.3 < P ≤ 0.7
Low	The event would be unlikely to occur	0.05 < P ≤ 0.3
Very low	The event would be very unlikely to occur	0.001 < P ≤ 0.05
Extremely low	The event would be extremely unlikely to occur	0.000001 < P ≤ 0.001
Negligible	The event would almost certainly not occur	0 ≤ P ≤ 0.000001

The likelihood of entry is determined by combining the likelihood that the pest will be imported into the PRA area and the likelihood that the pest will be distributed within the PRA area, using a matrix of rules (Table 2.2). This matrix is then used to combine the likelihood of entry and the likelihood of establishment, and the likelihood of entry and establishment is then combined with the likelihood of spread to determine the overall likelihood of entry, establishment and spread.

For example, if the probability of importation is assigned a likelihood of ‘low’ and the probability of distribution is assigned a likelihood of ‘moderate’, then they are combined to give a likelihood of ‘low’ for the probability of entry. The likelihood for the probability of entry is then combined with the likelihood assigned to the probability of establishment (for example ‘high’) to give a likelihood for the probability of entry and establishment of ‘low’. The likelihood for the probability of entry and establishment is then combined with the likelihood assigned to the probability of spread (for example ‘very low’) to give the overall likelihood for the probability of entry, establishment and spread of ‘very low’.

Table 3.2 Matrix of rules for combining qualitative likelihoods

	High	Moderate	Low	Very low	Extremely low	Negligible
High	High	Moderate	Low	Very low	Extremely low	Negligible
Moderate		Low	Low	Very low	Extremely low	Negligible
Low			Very low	Very low	Extremely low	Negligible
Very low				Extremely low	Extremely low	Negligible
Extremely low					Negligible	Negligible
Negligible						Negligible

Time and volume of trade

One factor affecting the likelihood of entry is the volume and duration of trade. If all other conditions remain the same, the overall likelihood of entry will increase as time passes and the overall volume of trade increases.

The department normally considers the likelihood of entry on the basis of the estimated volume of one year’s trade. This is a convenient value for the analysis that is relatively easy to estimate and allows for expert consideration of seasonal variations in pest presence, incidence and behaviour to be taken into account. The consideration of the likelihood of entry, establishment and spread and subsequent consequences takes into account events that might happen over a number of years even though only one year’s volume of trade is being considered. This reflects biological and ecological facts, for example where a pest or disease may establish in the year of import but spread may take many years.

These considerations have been taken into account when setting up the matrix. Therefore any policy based on this analysis does not simply apply to one year of trade. Policy decisions that are based on the department's method that uses the estimated volume of one year's trade are consistent with Australia's policy on appropriate level of protection and meet the Australian Government's requirement for ongoing quarantine protection. Of course, if there are substantial changes in the volume and nature of the trade in specific commodities then the department has an obligation to review the risk analysis and, if necessary, provide updated policy advice.

In assessing the volume of trade in this PRA, the department assumed that a substantial volume of trade will occur.

3.2.3 Assessment of potential consequences

The objective of the consequence assessment is to provide a structured and transparent analysis of the likely consequences if the pests or disease agents were to enter, establish and spread in Australia. The assessment considers direct and indirect pest effects and their economic and environmental consequences. The requirements for assessing potential consequences are given in Article 5.3 of the SPS Agreement (WTO 1995), ISPM 5 (FAO 2012) and ISPM 11 (FAO 2004).

Direct pest effects are considered in the context of the effects on:

- plant life or health
- other aspects of the environment.

Indirect pest effects are considered in the context of the effects on:

- eradication, control
- domestic trade
- international trade
- environment.

For each of these six criteria, the consequences were estimated over four geographic levels, defined as:

- **Local**: an aggregate of households or enterprises (a rural community, a town or a local government area).
- **District**: a geographically or geopolitically associated collection of aggregates (generally a recognised section of a state or territory, such as 'Far North Queensland').
- **Regional**: a geographically or geopolitically associated collection of districts in a geographic area (generally a state or territory, although there may be exceptions with larger states such as Western Australia).
- **National**: Australia wide (Australian mainland states and territories and Tasmania).

For each criterion, the magnitude of the potential consequence at each of these levels was described using four categories, defined as:

- **Indiscernible**: pest impact unlikely to be noticeable.

- **Minor significance**: expected to lead to a minor increase in mortality/morbidity of hosts or a minor decrease in production but not expected to threaten the economic viability of production. Expected to decrease the value of non-commercial criteria but not threaten the criterion's intrinsic value. Effects would generally be reversible.
- **Significant**: expected to threaten the economic viability of production through a moderate increase in mortality/morbidity of hosts, or a moderate decrease in production. Expected to significantly diminish or threaten the intrinsic value of non-commercial criteria. Effects may not be reversible.
- **Major significance**: expected to threaten the economic viability through a large increase in mortality/morbidity of hosts, or a large decrease in production. Expected to severely or irreversibly damage the intrinsic 'value' of non-commercial criteria.

The estimates of the magnitude of the potential consequences over the four geographic levels were translated into a qualitative impact score (A–G)[3] using Table 2.3[4]. For example, a consequence with a magnitude of 'significant' at the 'district' level will have a consequence impact score of D.

Table 3.3 Decision rules for determining the consequence impact score based on the magnitude of consequences at four geographic scales

		Geographic scale			
		Local	District	Region	Nation
Magnitude	Indiscernible	A	A	A	A
	Minor significance	B	C	D	E
	Significant	C	D	E	F
	Major significance	D	E	F	G

The overall consequence for each pest is achieved by combining the qualitative impact scores (A–G) for each direct and indirect consequence using a series of decision rules (Table 2.4). These rules are mutually exclusive, and are assessed in numerical order until one applies.

3.2.4 Estimation of the unrestricted risk

Once the above assessments are completed, the unrestricted risk can be determined for each pest or groups of pests. This is determined by using a risk estimation matrix (Table 2.5) to combine the estimates of the probability of entry, establishment and spread and the overall consequences of pest establishment and spread. Therefore, risk is the product of likelihood and consequence.

[3] In earlier qualitative IRAs, the scale for the impact scores went from A to F and did not explicitly allow for the rating 'indiscernible' at all four levels. This combination might be applicable for some criteria. In this report, the impact scale of A-F has changed to become B-G and a new lowest category A ('indiscernible' at all four levels) was added. The rules for combining impacts in Table 2.4 were adjusted accordingly.
[4] The decision rules for determining the consequence impact score are presented in a simpler form in Table 2.3 from earlier IRAs, to make the table easier to use. The outcome of the decision rules is the same as the previous table and makes no difference to the final impact score.

Table 3.4 Decision rules for determining the overall consequence rating for each pest

Rule	The impact scores for consequences of direct and indirect criteria	Overall consequence rating
1	Any criterion has an impact of 'G'; or more than one criterion has an impact of 'F'; or a single criterion has an impact of 'F' and each remaining criterion an 'E'.	Extreme
2	A single criterion has an impact of 'F'; or all criteria have an impact of 'E'.	High
3	One or more criteria have an impact of 'E'; or all criteria have an impact of 'D'.	Moderate
4	One or more criteria have an impact of 'D'; or all criteria have an impact of 'C'.	Low
5	One or more criteria have an impact of 'C'; or all criteria have an impact of 'B'.	Very Low
6	One or more but not all criteria have an impact of 'B', and all remaining criteria have an impact of 'A'.	Negligible

When interpreting the risk estimation matrix, note the descriptors for each axis are similar (such as low, moderate, high) but the vertical axis refers to likelihood and the horizontal axis refers to consequences. Accordingly, a 'low' likelihood combined with 'high' consequences, is not the same as a 'high' likelihood combined with 'low' consequences – the matrix is not symmetrical. For example, the former combination would give an unrestricted risk rating of 'moderate', whereas, the latter would be rated as a 'low' unrestricted risk.

Table 3.5 Risk estimation matrix

Likelihood of pest entry, establishment and spread							
	High	Negligible risk	Very low risk	Low risk	Moderate risk	High risk	Extreme risk
	Moderate	Negligible risk	Very low risk	Low risk	Moderate risk	High risk	Extreme risk
	Low	Negligible risk	Negligible risk	Very low risk	Low risk	Moderate risk	High risk
	Very low	Negligible risk	Negligible risk	Negligible risk	Very low risk	Low risk	Moderate risk
	Extremely low	Negligible risk	Negligible risk	Negligible risk	Negligible risk	Very low risk	Low risk
	Negligible	Negligible risk	Negligible risk	Negligible risk	Negligible risk	Negligible risk	Very low risk
		Negligible	Very low	Low	Moderate	High	Extreme
		Consequences of pest entry, establishment and spread					

3.2.5 Australia's appropriate level of protection (ALOP)

The SPS Agreement defines the concept of an 'appropriate level of sanitary or phytosanitary protection (ALOP)' as the level of protection deemed appropriate by the WTO Member establishing a sanitary or phytosanitary measure to protect human, animal or plant life or health within its territory.

Australia expresses its ALOP in qualitative terms. Australia's ALOP, which reflects community expectations through government policy, is currently expressed as providing a high level of sanitary or phytosanitary protection aimed at reducing risk to a very low level, but not to zero. The band of cells in Table 2.5 marked 'very low risk' represents Australia's ALOP.

3.3 Stage 3: Pest risk management

Pest risk management describes the process of identifying and implementing phytosanitary measures to manage risks to achieve Australia's ALOP, while ensuring that any negative effects on trade are minimised.

The conclusions from pest risk assessment are used to decide whether risk management is required and if so, the appropriate measures to be used. Where the unrestricted risk estimate exceeds Australia's ALOP, risk management measures are required to reduce this risk to a very low level. The guiding principle for risk management is to manage risk to achieve Australia's ALOP. The effectiveness of any proposed phytosanitary measure (or combination of measures) is evaluated, using the same approach as used to evaluate the unrestricted risk, to ensure it reduces the restricted risk for the relevant pest or pests to meet Australia's ALOP.

ISPM 11 (FAO 2004) provides details on the identification and selection of appropriate risk management options and notes that the choice of measures should be based on their effectiveness in reducing the probability of entry of the pest.

Examples given of measures commonly applied to traded commodities include:

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

Risk management measures are identified for each quarantine pest where the risk exceeds Australia's ALOP. These are presented in the 'Pest Risk Management' section of this report.

4 Pest risk assessments for quarantine pests

Pest categorisation identified twenty quarantine pests associated with *Lilium* spp. from Taiwan. These pests are listed in Table 4.1. Full details of the pest categorisation are provided in Appendix A. Pests are listed according to their taxonomic classification, consistent with Appendix A.

Table 4.1 Quarantine pests for *Lilium* spp. cut flowers from Taiwan

Pest	Common name
ARTHROPODS	
COLEOPTERA (beetles, weevils)	
Harmonia axyridis (Pallas) [Coccinellidae]	Harlequin ladybird
Lilioceris formosana Heinze [Chrysomelidae]	Leaf beetle
Sangariola punctatostriata (Motschulsky) [Chrysomelidae]	Lily leaf flea beetle
DIPTERA (flies, gnats, midges)	
Chromatomyia horticola Goureau [Agromyzidae]	Leafminer
Liriomyza huidobrensis (Blanchard) [Agromyzidae]	Leafminer
Liriomyza trifolii (Burgess) [Agromyzidae]	Leafminer
HEMIPTERA (aphids, leafhoppers, mealybugs, psyllids, scales, true bugs, whiteflies)	
Pseudococcus comstocki (Kuwana) [Pseudococcidae]	Comstock's mealybug
LEPIDOPTERA (moths, butterflies)	
Agrotis segetum Denis & Schiffermüller [Noctuidae]	Cutworm, dark moth
Euproctis taiwana (Shiraki) [Lymantriidae]	Tussock moth
Kaniska canace Linnaeus [Nymphalidae]	Blue admiral
Orgyia postica Walker [Lymantidae]	Tussock moth
Xylena formosa (Butler) [Noctuidae]	Cutworm
THYSANOPTERA (thrips)	
Frankliniella intonsa (Trybom) [Thripidae]	Flower thrips
Haplothrips chinensis Priesner [Phlaeothripidae]	Chinese thrips
Megalurothrips distalis (Karny) [Thripidae]	Bean blossom thrips
VIRUSES	
Lily mottle virus LMoV [Potyviridae: Potyvirus]	
Lily virus X LVX [Flexiviridae : Potexvirus] (synonym *Lily X potexvirus*)	
Plantago asiatica mosaic virus PlAMV [Alphaflexiviridae : Potexvirus]	
Strawberry latent ringspot virus SLRSV [Secoviridae : Genus Unassigned]	
Tobacco ringspot nepovirus TRSV [Secoviridae : Nepovirus]	

4.1.1 Quarantine pests assessed in previous policies

The pests in Table 4.1 were considered in relation to the existing policy for the importation of cut flowers, which requires flowers to be non-propagable and free of arthropod pests. As the existing policy addresses the risk of arthropods and pathogens generally, a number of pests from Table 4.1 were examined in more detail.

The following pests have been assessed previously by the Department of Agriculture:

Harlequin ladybird (*Harmonia axyridis*) and Comstock's mealybug (*Pseudococcus comstocki*) have previously been assessed for the importation of table grapes from China (Biosecurity Australia 2011).

Flower thrips (*Frankliniella intonsa*) has previously been assessed for the importation of stone fruit from California, Idaho, Oregon and Washington (Biosecurity Australia 2010a).

Strawberry latent ringspot virus has previously been assessed for the importation of hop propagative material (Biosecurity Australia 2010b).

The policy for these four pests was reviewed taking the following information into consideration, to determine if pest risk management measures are required for *Lilium* cut flowers from Taiwan.

4.1.2 Probability of entry

The probability of entry describes the probability that a quarantine pest will enter Australia as a result of trade in a given commodity, be distributed in a viable state in the PRA area and subsequently be transferred to a host.

Probability of importation

- *Lilium* spp. flowers are assumed to come from areas where the above pests occur and are, therefore, likely to enter on imported lily cut flowers.
- The pests' ability to survive on host cut flowers that are maintained in healthy condition during transport acts to assist their viability en route to, and during distribution across, Australia.
- Viruses, as a rule, systemically infect all parts of host plants. Therefore, cut flowers provide a pathway for viruses.
- The bulk of Taiwan's imports of certified bulbs for planting are from the Netherlands. Planting stock is of high health status and certified for freedom from viruses of quarantine concern for Taiwan by the Netherlands. Additionally, new quarantine requirements for lily bulbs imported into Taiwan from many lily bulb producing countries (section 2.3.1) require that all imported bulbs be inspected or tested for Plantago asiatica mosaic virus (PlAMV) and found to be virus free during production (WTO 2013). Similar requirements are proposed for Arabis mosaic virus (ArMV) (WTO 2012). Therefore, the probability of infected mother plants in Taiwan will be reduced and the entry of infected cut flowers into Australia through cut flower importations will be similarly reduced.
- Commercially grown lily cut flowers that are visibly infected with viruses or showing obvious pest damage would not be picked or suitable for sale.
- Due to their short shelf life, *Lilium* spp. cut flowers will be transported in cool conditions, which are unlikely to adversely affect survival of arthropod pests and viruses.
- Cut flowers may contain arthropod pests which may be hidden in stem sheaths or closed flowers. These pests may not be detected by inspection.
- Due to the nature of packaging arthropod pests are likely to remain associated with the commodity.

The above information supports the estimates for the pests previously considered in the existing policies listed above. The probabilities of importation for *Harmonia axyridis, Pseudococcus comstocki*, *Frankliniella intonsa* and *Strawberry latent ringspot virus* were assessed as: **HIGH**.

Probability of distribution

- Upon arrival in Australia, arthropod pests may readily be distributed to susceptible hosts. Identified pests such as thrips and coleopterans are quite mobile with wide host ranges and are likely to readily find a suitable host species. *Lilium* spp. cut flowers are likely to be widely distributed through florists and other points of sale. Due to the short shelf life of lily cut flowers, their distribution is likely to occur soon after importation, which will assist the probability of arthropods being distributed in a viable state.
- *Lilium* spp. cut flowers may be disposed of via municipal waste systems, or could be discarded as green waste in backyard compost heaps, or on roadsides or in other locations. The disposal of lily cut flowers in municipal waste is likely to reduce the probability of arthropod pests locating a suitable host plant. However, disposal in other locations may place infested material in close proximity to suitable hosts.

The above information supports the estimates for the pests previously considered in the existing policies listed above. The probabilities of distribution for *Harmonia axyridis* and *Strawberry latent ringspot virus* were assessed as: **HIGH**. *Pseudococcus comstocki* and *Frankliniella intonsa* were assessed as: **MODERATE**.

Overall probability of entry

The overall probability of entry is determined by combining the probability of importation and the probability of distribution. The likelihood that these pests will enter Australia as a result of trade in lily cut flowers is **HIGH** for *Harmonia axyridis* and *Strawberry latent ringspot virus,* and **MODERATE** for *Pseudococcus comstocki* and *Frankliniella intonsa*.

4.1.3 Probability of establishment

Establishment is defined as the ‘perpetuation for the foreseeable future, of a pest within an area after entry’ (FAO 2012).

- The categorisation process has not highlighted any fungal or stramenopile pests that are associated with *Lilium* spp. cut flower imports from Taiwan. The pests of concern are viruses and arthropods.
- Once arthropod pests have been distributed to a susceptible host, the likelihood of establishment is considered high.
- Due to the systemic nature of viruses, propagative material is typically a major pathway for establishment. However, lily cut flowers that are free of bulbils are not readily propagable; therefore, systemic pests are unlikely to establish via propagation.
- Australia currently permits the entry of millions of certified and non-certified bulbs imported mostly from the Netherlands, but also from New Zealand, Chile and the USA for production in open quarantine. Bulbs for production in Taiwan are also sourced from the Netherlands and other countries. The risk of establishment of viruses from imported cut flowers is not considered to be higher than from existing open quarantine production and subsequent retail sale of bulbs imported into Australia.

The above information supports the estimates for the pests previously considered in the existing policies listed above. The probabilities of establishment for *Harmonia axyridis, Pseudococcus comstocki*, *Frankliniella intonsa* and *Strawberry latent ringspot virus* were assessed as: **HIGH**.

Probability of spread

Spread is defined as 'the expansion of the geographical distribution of a pest within an area' (FAO 2012). The probability of spread considers the factors relevant to the movement of the pest, after establishment on a host plant or plants, to other susceptible host plants of the same or different species in other areas.

- Some lily pests are polyphagous, so suitable hosts are likely to be widely available, increasing the likelihood of spread.
- Gradual unassisted expansion of arthropod pest populations into new areas would be expected where favoured hosts are available and suitable environmental conditions are present. Some pests are capable of flying, or being carried by wind, for considerable distances.
- Long distance dispersal of arthropod pests is likely to occur through movement of infested plant material such as nursery stock and garden waste.
- Propagative material is a potential pathway for the dispersal of systemic pests (such as viruses). However, lily cut flowers that are free of bulbils are not readily propagable.

The above information supports the estimates for the pests previously considered in the existing policies listed above. The probabilities of spread for *Harmonia axyridis*, *Pseudococcus comstocki* and *Frankliniella intonsa* were assessed as: **HIGH**. *Strawberry latent ringspot virus* was assessed as: **MODERATE**.

Overall probability of entry, establishment and spread

The probability of entry, establishment and spread is determined by combining the probabilities of entry, of establishment and of spread. The overall probability that these pests will enter Australia as a result of trade in lily cut flowers, establish and subsequently spread was estimated to be **HIGH** for *Harmonia axyridis*, and **MODERATE** for *Pseudococcus comstocki*, *Frankliniella intonsa* and *Strawberry latent ringspot virus*.

4.1.4 Consequences

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

- Direct impacts of the introduction and spread of multi-host pests in Australia will not only affect the imported host but also other hosts. Introduction and establishment of quarantine pests in Australia would not only result in phytosanitary regulations imposed by foreign or domestic trading partners, but also in increased costs of production including control costs.
- Quarantine pest introduction and establishment would also be likely to result in industry adjustment. The potential economic impact for cut flowers is high. Without controls these pests have the potential to spread further in the trade network and could potentially expand their host range.
- Arthropod pests such as flower thrips can cause damage to ornamental flower buds, and to flowers of many leguminous plants or fruit crops, which will not only require control if

they establish and spread; they will affect cut flower trade as phytosanitary restrictions can apply.

- Most viruses of quarantine concern on lilies affect ornamentals and can cause deformation, asymmetrical opening of flowers, or necrosis and discolouration leading to decreased flower value and potential loss of markets locally and internationally. Others such as Tobacco ringspot nepovirus and Strawberry latent ringspot virus have a wide host range and can affect different crop species and ornamentals.
- Viruses are considered important as they cause a variety of direct and indirect economic impacts, such as reduced yield, reduced commodity value and loss of foreign or domestic markets. Therefore, these pests have a potential for economic consequences in the PRA area. Cut flowers do not present a direct pathway for viruses, which need to be vectored into suitable hosts. However, the presence of these pathogens in Australia would impact upon Australia's ability to access overseas markets.

The above information supports the estimates for the pests previously considered in the existing policies listed above. The consequences for *Harmonia axyridis* were assessed as: **MODERATE**. *Pseudococcus comstocki*, *Frankliniella intonsa* and *Strawberry latent ringspot virus* were assessed as: **LOW**.

4.1.5 Unrestricted risk estimate

Unrestricted risk is the result of combining the probability of entry, establishment and spread with the outcome of overall consequences.

For the four pests reviewed above, the unrestricted risk was previously estimated to be **MODERATE** for *Harmonia axyridis* and **LOW** for *Pseudococcus comstocki, Frankliniella intonsa* and *Strawberry latent ringspot virus.*

The review of existing policy identified that these four pests had an unrestricted risk for *Lilium* spp. cut flowers above Australia's appropriate level of protection (ALOP), a rating of greater than 'very low', and require pest risk management measures. These pest risk management measures will also address the risk posed by the quarantine pests listed in Table 4.1.

Table 4.2 Summary of unrestricted risk estimates for example quarantine pests

Pest name	Likelihood of						Consequences	URE
	Entry			Establishment	Spread	P[EES]		
	Importation	Distribution	Overall					
Beetles [Coleoptera: Coccinellidae]								
Harmonia axyridis	H	H	H	H	H	H	M	**M**
Mealybugs [Hemiptera: Pseudococcidae]								
Pseudococcus comstocki	H	M	M	H	H	M	L	**L**
Thrips [Thysanoptera: Thripidae]								
Frankliniella intonsa	H	M	M	H	H	M	L	**L**
Viruses								
Strawberry latent ringspot virus	H	H	H	H	M	M	L	**L**

5 Pest risk management

This chapter describes the phytosanitary procedures associated with the importation of *Lilium* spp. cut flowers from Taiwan, and provides information on the management of quarantine pests identified with an unrestricted risk exceeding Australia’s appropriate level of protection (ALOP). The proposed phytosanitary measures are described below.

5.1 Pest risk management measures and phytosanitary procedures

Pest risk management evaluates and selects options for measures to reduce the risk of entry, establishment or spread of quarantine pests for Australia where they have been assessed to have an unrestricted risk above Australia’s ALOP. In examining the unrestricted risk, existing commercial production practices in Taiwan have been considered, including harvest, postharvest and transport procedures and the packing of *Lilium* spp. cut flowers.

In addition to Taiwan’s existing commercial production practices for the production of *Lilium* spp. cut flowers and border procedures in Australia, specific pest risk management measures are proposed to achieve Australia's ALOP. Finalisation of the quarantine conditions may be undertaken with input from the department and the Australian states and territories as appropriate.

5.1.1 Management for arthropod quarantine pests

Arthropod pests of concern to Australia associated with *Lilium* spp. cut flowers from Taiwan have been assessed as requiring phytosanitary measures.

The existing conditions for cut flower imports stipulate mandatory methyl bromide treatment, or the alternatives detailed in Section 1.3.3. Taiwan has requested the option of a systems approach as an equivalent measure to methyl bromide.

The proposed risk management measure options are:

1. Methyl bromide fumigation, OR
2. A systems approach administered by BAPHIQ, including pre-export phytosanitary inspection and certification, to ensure that *Lilium* spp. cut flowers are free of arthropod pests of concern and bulbils (Table 4.1).

Consignments will be subject to onshore inspection and verification by the department. These risk management measures are consistent with Australia’s quarantine policy for arthropod pests on other cut flower imported commodities.

Any measures equivalent with the above will be considered.

5.1.2 Management for virus quarantine pests

The standard import conditions for cut flowers include mandatory devitalisation for propagable species. The purpose of this measure is to render the risk from certain viruses and obligate fungi equivalent to that of non-propagable species. As an equivalent measure imported lilies from Taiwan are required to be free of bulbils. Imported lilies will be inspected for presence of bulbils by BAPHIQ prior to export, and again on arrival in Australia by Biosecurity officers. Furthermore, the requirement for management of arthropod pests will mitigate risks of vectoring of viral diseases. Thus, the risk for virus transmission is similar to other cut flower pathways currently permitted.

In addition, *Lilium* spp. bulbs are currently permitted from all countries for production in open quarantine. Open quarantine is subject to monitoring and inspection for pests and disease. Therefore, no additional phytosanitary measures are recommended to manage the risk of quarantine virus pests.

5.1.3 Operational system for the maintenance and verification of phytosanitary status

A system of operational procedures is necessary to maintain and verify the phytosanitary status of *Lilium* spp. cut flowers from Taiwan. Lily cut flowers may be imported either under a systems approach or with methyl bromide fumigation after inspection at the border (exemption may occur based on compliance history similar to current import requirements for other cut flowers).

Recognition of the competent authority

BAPHIQ is the designated NPPO for Taiwan under the IPPC.

The objectives of the NPPO are to ensure that:

- recommended conditions and certification standards are met by all relevant agencies participating in this program
- recommended administrative processes are established to provide assurance that the recommended requirements of the program are being met.

Provisions for traceability

All consignments must have adequate labelling or other means of identification so that they can be traced to critical points of the pathway.

Packaging and labelling

The objective of the requirement for packaging and labelling are to ensure that secure packaging that meets Australia’s import conditions is used.

Specific conditions for storage and transport

The objective of the requirement for storage and transport are to ensure that:

- product for export to Australia is secure to prevent mixing or cross-contamination with produce destined elsewhere
- maintain the quarantine integrity of the commodity during storage and movement.

Pre-export phytosanitary inspection and certification

All consignments must be accompanied by an International Phytosanitary Certificate (IPC).

The objectives of phytosanitary certification are to ensure that:

- an IPC is issued for each consignment, consistent with ISPM No. 12 Phytosanitary Certificates (FAO 2011), to provide formal documentation to the department verifying the relevant measures have been undertaken offshore
- ensure the goods have been inspected for quarantine pests and other regulated articles by the NPPO
- each IPC includes a description of the consignment (including grower number and packing house details).

Consignments of lily cut flowers imported from Taiwan must be accompanied by an original IPC issued by BAPHIQ with the following additional declaration:

> *This consignment of lily (Lilium spp.) cut flowers has been inspected by BAPHIQ and contains commercial hybrid varieties, found free of quarantine pests and stem bulbils.*

On-arrival inspection by the Department of Agriculture

The department's officers will undertake an inspection of all *Lilium* spp. cut flowers consignments covered by separate phytosanitary certificates issued by the NPPO on arrival of consignments in Australia. The inspection will be conducted using the standard inspection regime for the type of commodity and may involve specific techniques or use of optical enhancement where necessary.

Additional regional conditions may apply to cut flower consignments. For instance, *Thrips palmi* is an actionable pest for Western Australia, and inspection is required under Interstate Certification Assurance. Fumigation may apply if any consignment contaminated with this viral transmitting *Thrips* spp. is detected.

The detection of live quarantine pests or regulated articles during an inspection will result in the failure of the inspection lot.

The objective of this procedure is to ensure that each consignment, as defined by a single phytosanitary certificate, is verified at the first port of entry to confirm that the consignment meets Australia's import requirements.

If no live quarantine pests, disease symptoms or other regulated articles are detected in the inspection lot, the consignment will be released from quarantine.

Consignments will fail if quarantine pests and/or regulated articles are detected during on-arrival inspections. Remedial action is to be taken when this occurs.

The department will advise BAPHIQ about non-compliance so that BAPHIQ can apply appropriate corrective action with suppliers.

Systems approach

In addition to the operational system and verification procedures stated above, lily cut flowers produced under a systems approach must comply with the following additional requirements.

Audit and verification

Where a systems approach is adopted for the management of arthropod pests, as an alternative to methyl bromide fumigation, the pathway may be subject to audit and verification.

BAPHIQ is responsible for establishing a system for *Lilium* spp. production that meets the phytosanitary requirements of Australia and for the audit of their system. The department may undertake an audit of the BAPHIQ system.

The objectives of the recommended requirement for audit and verification are to ensure that:

- an effective approved documented system for the net houses, the packing houses and during transport is in operation.

Additional Phytosanitary Certificate declaration

Each consignment must be accompanied by an original IPC as detailed above and endorsed with the following additional declaration:

> *Cut flowers are sourced from an accredited supplier under the required systems approach for lily cut flower production in Taiwan.*

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

Where inspection lots are found to be non-compliant with requirements on-arrival in Australia, remedial action must be taken. The detection of live insects, disease symptoms or regulated articles will result in failure of the consignment. Remedial actions for failed consignments include methyl bromide fumigation if live insects are detected, and export or destruction if stem bulbils are detected, as required.

5.3 Uncategorised pests

If an organism that has not been categorised is detected on *Lilium* spp. cut flowers during inspection, it will require assessment by the department to determine its quarantine status and if phytosanitary action is required. The detection of any pests of quarantine concern not already identified in the analysis may result in remedial action, as appropriate.

5.4 Review of policy

The department may audit the phytosanitary procedures prior to trade commencing.

Australia reserves the right to review and amend the import policy if circumstances change. Australia is prepared to review the policy after a substantial volume of trade has occurred. The department may review the import policy after the first year of trade.

6 Conclusion

The findings of this final policy review are based on a comprehensive analysis of relevant scientific literature. The Department of Agriculture considers that the risk management measures and operational system for the maintenance and verification of phytosanitary status proposed in this final policy review will provide an appropriate level of protection against the pests identified in the risk analysis.

Appendixes

Appendix A: Initiation and categorisation of pests associated with *Lilium* spp. cut flowers from Taiwan

Initiation identifies the pests which occur on *Lilium* spp. cut flowers, their status in Taiwan and Australia and their pathway association. In this assessment, **pathway** is defined as commercially grown *Lilium* spp. cut flowers that are free of bulbils.

Pest categorisation identifies the potential for pests to enter, establish, spread and cause economic consequences in Australia to determine if they qualify as quarantine pests.

Pest	Present in Taiwan	Present within Australia	Potential to be on pathway	Potential for establishment and spread	Potential for economic consequences[1]	Quarantine pest (Yes/No)
MOLLUSCA (slugs, snails)						
Bradybaena similaris (Ferussac) [Eupulmonata : Bradybaenidae]	Yes (Wang and Lin 1997)	Yes (ABRS 2009)	Assessment not required			
ARTHROPODS						
ACARI (mites)						
Rhizoglyphus echinopus (Fumouze & Robin) [Sarcoptiformes] [synonym *R. hyacinthi* (Diaz *et al.* 2000, ABRS 2009), *R. callae* Oudemans, *R. zachvatkini* (Volgin) (Diaz *et al.* 2000, Klimov and Tolstikov 2011)] bulb mite	No (Wang and Lin 1997, BAPHIQ 2011b, BAPHIQ 2012)[2]	Unresolved presence (ABRS 2009)[3]	**Yes:** Bulb mites attack roots and subterranean plant parts, they tunnel the stems at the ground level, causing them to lean or break (Diaz *et al.* 2000). They are occasionally collected on leaves and stems of infested Liliaceae (Latta 1939, Diaz *et al.* 2000).	**Yes:** Host plants are present in Australia. Should infested flowers be occasionally selected, cut flower refuse is likely to end up in municipal waste where it is buried, or in household compost, where it could be spread locally in infested plant debris.	**No:** Economic consequences for the introduction of this pest from cut flowers are minor. The most likely pathway for introduction of live mites that will induce economic loss is through importation of bulbs for planting or nursery stock of the many host species including onions, carrots and garlic, and ornamental bulbs including lilies, gladiolus and hyacinths (Diaz *et al.* 2000).	No

[1] In this pest categorisation the potential for economic consequences is assessed in relation to the pest's likelihood to meet the ISPM 5 definition of a quarantine pest. Namely, that the pest is potentially economically important. Consequently, any pest which is considered a minor pest or is not known to be economically important and which is not considered to be an emerging pest problem does not meet the definition of a quarantine pest.
[2] Taiwan's NPPO, BAPHIQ, has indicated this pest does not occur in Taiwan (BAPHIQ 2011b, 2012). Other references state it is present in Taiwan (Fan and Zhang 2003, 2004, Fan *et al.* 2010, Klimov and Tolstikov 2011).
[3] The following references indicate this species is present in Australia (Fan and Zhang 2003, 2004).

Pest	Present in Taiwan	Present within Australia	Potential to be on pathway	Potential for establishment and spread	Potential for economic consequences[1]	Quarantine pest (Yes/No)
Rhizoglyphus robini Claparede [Sarcoptiformes] bulb mite	Yes (Wang and Lin 1997, Liu 1998, Ho and Chen 2000, Fan *et al.* 2010, Klimov and Tolstikov 2011)	Yes (Fan and Zhang 2003, ABRS 2009, APPD 2011)	Assessment not required			
Rhizoglyphus setosus Manson [Sarcoptiformes] bulb mite	Yes (Wang and Lin 1997, Ho and Chen 2000, Chen *et al.* 2002, Capinera 2008, Klimov and Tolstikov 2011)	Yes (Fan and Zhang 2004)	Assessment not required			
Rhizoglyphus tsutienensis Ho & Chen [Sarcoptiformes] (synonym *Rhizoglyphus singularis* Manson) bulb mite	Yes (Ho and Chen 2000, Capinera 2008, Fan *et al.* 2010, Klimov and Tolstikov 2011, TaiBNET 2012)[4]	No (ABRS 2009)	**No:** Recorded as a pest of *Lilium* spp. bulb (Capinera 2008). First described by Ho and Chen (2000) from Tsutien in Taiwan.	Assessment not required		
Schwiebea cuncta Ho [Sarcoptiformes]	Yes (Ho 1993, Wang and Lin 1997, Fan *et al.* 2010, Klimov and Tolstikov 2011)	No (ABRS 2009)	**No:** recorded as pest of *Lilium* spp. bulb (Ho 1993). Also a common inhabitant of decaying wood (Wurst and Frank 1999).	Assessment not required		
Schwiebea taiwanensis Ho [Sarcoptiformes]	Yes (Ho 1993, Wang and Lin 1997, Fan *et al.* 2010, Klimov and Tolstikov 2011)	No (ABRS 2009)	**No:** recorded as pest of *Lilium* spp. bulb (Ho 1993). Also a common inhabitant of decaying wood (Wurst and Frank 1999).	Assessment not required		
Tetranychus cinnabarinus (Boisduval) [Trombidiformes] carmine spider mite	Yes (Wang and Lin 1997, TaiBNET 2012)	Yes (ABRS 2009)	Assessment not required			

[4] Taiwan's NPPO, BAPHIQ, has indicated this pest does not occur in Taiwan (BAPHIQ 2012). Other references state it is present as indicated.

Pest	Present in Taiwan	Present within Australia	Potential to be on pathway	Potential for establishment and spread	Potential for economic consequences[1]	Quarantine pest (Yes/No)
Tetranychus urticae Koch [Trombidiformes] two-spotted spider mite	Yes (Wang and Lin 1997, TaiBNET 2012)	Yes (ABRS 2009)	Assessment not required			
COLEOPTERA (beetles, weevils)						
Harmonia axyridis (Pallas) [Coccinellidae] harlequin ladybird	Yes (TaiBNET 2012)	No (ABRS 2009)	**Yes:** *H. axyridis* is known as a predator of aphids and other soft-bodied insects as well as pollen and nectar (Koch 2003), and can be imported and moved over long distances on cut flowers as well as other traded commodities including fruit (Koch 2003).	**Yes:** This species has demonstrated its ability to spread rapidly in Europe, Africa and the Americas (Brown *et al.* 2011, Nedvěd *et al.* 2011).	**Yes:** *H. axyridis* causes 'ladybug taint' in wines after processing if found on grapes (Brown *et al.* 2011), which may limit or restrict access of such goods into overseas markets and require additional measures to be undertaken. Can also infest buildings (Huelsman *et al.* 2010).	**Yes**
Lasioderma serricorne (Fabricius) [Anobiidae] tobacco beetle	Yes (TaiBNET 2012, BAPHIQ 2012)	Yes (ABRS 2009)	Assessment not required			
Lilioceris formosana Heinze [Chrysomelidae] (synonym *Lilioceris neptis* subsp. *formosana* Heinze, *Lilioceris impressa* subsp. *loochooana* Nakane, *formosana* = bona species: Kimoto et Takizawa, *loochooana = formosana*: Kimoto et Takizawa) leaf beetle	Yes (Wang and Lin 1997, Warchalowski 2011)	No (AICN 2004, ABRS 2009)	**Yes:** This species is native to Taiwan. *Lilioceris* spp. beetles feed on lilies and other hosts (Kroon 2009). Both adult and larval stages cause foliar damage to host plants (Salisbury 2008). It is likely to be on the pathway and transported internationally.	**Yes:** Some *Lilioceris* spp. have established in many countries where accidentally introduced, indicating potential as an invasive species (Kenis *et al.* 2003). *Lilium* bulbs are popular in backyards, and grown by local industry. The Australian climate is likely to be conducive for the spread of this pest.	**Yes:** Adults and larvae of *Lilioceris* spp. cause economic damage by attacking foliage and flowers of many cultivated and native *Lilium* plant species and other hosts (Salisbury 2008, Casagrande and Kenis 2004). *Lilioceris formosana* are herbivores but their host plant association is not fully elucidated.	**Yes**
Sangariola punctatostriata (Motschulsky) [Chrysomelidae] lily leaf flea beetle	Yes (Wang and Lin 1997, TaiBNET 2012)	No (AICN 2004, ABRS 2009)	**Yes:** Associated with *Lilium* spp. (Wang and Lin 1997). Larvae eat *Lilium* spp. leaves (Maddison 1993).	**Yes:** This species has a limited distribution internationally though it has established in areas with a wide range of climatic conditions. Hosts of this species including *Smilax* spp. are widespread in Australia (APNI 2012).	**Yes:** This species could cause economic damage by attacking foliage and flowers of many cultivated and native plant species, including *Smilax* spp. and *Lilium* spp. (APNI 2012).	**Yes**

Pest	Present in Taiwan	Present within Australia	Potential to be on pathway	Potential for establishment and spread	Potential for economic consequences[1]	Quarantine pest (Yes/No)
Sitophilus oryzae (Linnaeus) [Curculionidae] rice weevil	Yes (Lo 1986, Lyal 2011)	Yes (ABRS 2009)	Assessment not required			
Sitophilus zeamais Motschulsky [Curculionidae] maize weevil	Yes (Lo 1986)	Yes (ABRS 2009)	Assessment not required			
Tenebroides mauritanicus (Linnaeus) [Trogossitidae] cadelle beetle	Yes (Lo 1986)	Yes (ABRS 2009)	Assessment not required			
DIPTERA (flies, gnats, midges)						
Chromatomyia horticola Goureau (synonym *Phytomiza horticola*) [Agromyzidae] leafminer	Yes (CABI 2012, TaiBNET 2012)	No (ABRS 2009, CABI 2012)	**Yes:** Highly polyphagous (Malipatil and Ridland 2008). Liliaceae are hosts (Spencer 1973).	**Yes:** This pest has established and spread in areas with a wide range of climatic conditions. It is found throughout Africa, Asia, and Europe (CABI 2012) and is polyphagous, thus, has the potential for establishment and spread in Australia.	**Yes:** Leafminers cause economic loss to many crops as they reduce yield, leaf photosynthetic areas, aesthetic value of ornamentals, and are pesticide resistant (Minkenberg 1988, Wei *et al.* 2000, Shiao 2004).	**Yes**
Liriomyza huidobrensis (Blanchard) [Agromyzidae] leafminer	Yes (CABI 2012, TaiBNET 2012)	No (ABRS 2009, CABI 2012)	**Yes:** Highly polyphagous leafminers (Malipatil and Ridland 2008). Different hosts include aster, begonia, dahlia, impatiens, lily, marigold, petunia, and verbena (UC IPM 2008). Liliaceae are hosts (Spencer 1973).	**Yes:** This species has demonstrated its ability to spread rapidly in tropical and sub-tropical areas in Asia and Africa, as well as Europe and nearctic regions (Minkenberg 1988, Wei *et al.* 2000). Host plants are present in Australia, as are similar climatic regions.	**Yes:** Leafminers cause economic loss to many crops as they reduce yield, leaf photosynthetic areas, aesthetic value of ornamentals, and are pesticide resistant (Minkenberg 1988, Wei *et al.* 2000, Shiao 2004).	**Yes**
Liriomyza trifolii (Burgess) [Agromyzidae] leafminer	Yes (CABI 2012, TaiBNET 2012)	No (ABRS 2009, CABI 2012)				**Yes**
Eumerus figurans Walker [Syrphidae] (synonym *E. marginatus* Grimshaw) bulb fly	Yes (Thompson and Vockeroth 1989)	Yes (Thompson and Vockeroth 1989)	**No:** Larvae of this genus bore into bulbs (Maddison 1993, Mau and Kessing 1992). Not known to be associated with flowers and foliage.	Assessment not required		
Eumerus okinawaensis Shiraki [Syrphidae] hover fly	Yes (Maddison 1993, Wang and Lin 1997, TaiBNET 2012)	No (Maddison 1993, ABRS 2009, ALA 2011)	**No:** Larvae of this genus bore into *Lilium* spp. bulbs (Maddison 1993). Not known to be associated with flowers and foliage.	Assessment not required		

Pest	Present in Taiwan	Present within Australia	Potential to be on pathway	Potential for establishment and spread	Potential for economic consequences[1]	Quarantine pest (Yes/No)
Eumerus strigatus (Fallen) [Syrphidae] onion bulb fly	Yes (CABI 2012)/Unconfirmed	No (CABI 2012)/ Unconfirmed (AICN 2004, APPD 2011)	**No:** Larvae bore in *Lilium* spp. bulbs (Maddison 1993). Not known to be associated with flowers and foliage.	Assessment not required		
HEMIPTERA (aphids, leafhoppers, mealybugs, psyllids, scales, true bugs, whiteflies)						
Abgrallaspis cyanophylli (Signoret) [Diaspididae] cyanophyllum scale	Yes (Takagi 1969, Lee 1988, Ben-Dov *et al.* 2012)	Yes (ABRS 2009)	Assessment not required			
Aonidiella orientalis (Newstead) [Diaspididae] oriental scale	Yes (Miller and Davidson 2005, BAPHIQ 2012)	Yes (ABRS 2009)	Assessment not required			
Aphis gosspyii Glover [Aphididae] cotton aphid	Yes (Wang and Lin 1997, BAPHIQ 2009)	Yes (ABRS 2009, CABI 2012)	Assessment not required			
Aulacorthum circumflexum (Buckton) [Aphididae] (synonym *Neomyzus circumflexum*) lily aphid	Yes (TaiBNET 2012, BAPHIQ 2012)	Yes (ABRS 2009)	Assessment not required			
Aulacorthum solani (Kaltenbach) [Aphididae] foxglove aphid	Yes (Wang and Lin 1997, TaiBNET 2012)	Yes (Berlandier 1997, APPD 2011)	Assessment not required			
Chrysomphalus aonidum (Linnaeus) [Diaspididae] Florida red scale, circular black scale	Yes (Lee 1988, EPPO 2007, Ben-Dov *et al.* 2012)	Yes (ABRS 2009, Ben-Dov *et al.* 2012)	Assessment not required			
Coccus hesperidum Linnaeus [Coccidae] brown soft scale	Yes (Lee 1988, Wang and Lin 1997, Ben-Dov *et al.* 2012)	Yes (Ben-Dov *et al.* 2012)	Assessment not required			
Dysmicoccus brevipes (Cockerell) [Pseudococcidae] pineapple mealy bug	Yes (BAPHIQ 2009, Ben-Dov *et al.* 2012)	Yes (Ben-Dov *et al.* 2012)	Assessment not required			
Ferrisia virgata (Cockerell) [Pseudococcidae] striped mealybug	Yes (Wang and Lin 1997, Ben-Dov *et al.* 2012)	Yes (Ben-Dov *et al.* 2012)	Assessment not required			

Pest	Present in Taiwan	Present within Australia	Potential to be on pathway	Potential for establishment and spread	Potential for economic consequences[1]	Quarantine pest (Yes/No)
Hemiberlesia lataniae (Signoret) [Diaspididae] latania scale	Yes (Ben-Dov *et al.* 2012)	Yes (Ben-Dov *et al.* 2012)	Assessment not required			
Myzus persicae (Sulzer) [Aphididae] green peach aphid	Yes (Wang and Lin 1997, BAPHIQ 2009)	Yes (Berlandier 1997, APPD 2011)	Assessment not required			
Parlatoria proteus (Curtis) [Diaspididae] brown scale	Yes (Takagi 1969, Ben-Dov *et al.* 2012)	Yes (ABRS 2009, Ben-Dov *et al.* 2012)	Assessment not required			
*Pinnaspis aspidistrae aspidistrae (*Signoret) [Diaspididae] aspidistra scale	Yes (Takagi 1969, Wang and Lin 1997, Ben-Dov *et al.* 2012)	Yes (Ben-Dov *et al.* 2012)	Assessment not required			
Planococcus citri (Risso) [Pseudococcidae] citrus mealybug	Yes (Lee 1988, Wang and Lin 1997, Ben-Dov *et al.* 2012)	Yes (Ben-Dov *et al.* 2012)	Assessment not required			
Pseudococcus comstocki (Kuwana) [Pseudococcidae] Comstock's mealybug	Yes (Wang and Lin 1997, TaiBNET 2012)	No (ABRS 2009, Ben-Dov *et al.* 2012)	**Yes:** recorded as pest of *Lilium* spp. (Maddison 1993, Wang and Lin 1997). Occurs on the aerial parts of the host plant (Ben-Dov *et al*. 2012).	**Yes:** The Australian climate is likely to be conducive for the spread of this pest. It is polyphagous and has a wide host range including commercial fruit trees, ornamental shrubs and creepers, amenity trees and natives (CABI 2012).	**Yes:** This is an economically significant pest of many crops (Ben-Dov *et al.* 2012). The introduction of these pests in commercial production areas may limit access to overseas markets.	**Yes**
Pseudococcus longispinus (Targioni) [Pseudococcidae] longtail mealybug	Yes (Lee 1988, Wang and Lin 1997)	Yes (ABRS 2009, Ben-Dov *et al.* 2012)	Assessment not required			
Saissetia coffeae (Walker) [Coccidae] hemispherical scale	Yes (Lee 1988, Ben-Dov *et al.* 2012)	Yes (ABRS 2009, Ben-Dov *et al.* 2012)	Assessment not required			
LEPIDOPTERA (moths, butterflies)						
Acrolepiopsis incertella (Chambers) [Acrolepiidae] carrionflower moth	Yes (BAPHIQ 2012)	No (AICN 2004, Landry 2007, ABRS 2009)	**No:** recorded as feeding on *Lilium* spp. by boring into the bulbs (Ellis 2004, Landry 2007). Not known to be associated with flowers and foliage.	Assessment not required		

Pest	Present in Taiwan	Present within Australia	Potential to be on pathway	Potential for establishment and spread	Potential for economic consequences[1]	Quarantine pest (Yes/No)
Agrotis segetum Denis & Schiffermüller [Noctuidae] cutworm, dark moth	Yes (Wang and Lin 1997, EPPO 2007, TaiBNET 2012)	No (ABRS 2009, CABI 2012)	**Yes:** *A. segetum* is a highly polyphagous pest that attacks a wide range of important crop plants and ornamentals including bulbaceous species (CABI 2012).	**Yes:** Association with the cut flower host provides opportunity for establishment and spread as this pest is polyphagous. It is established in areas with a wide range of climatic conditions (CABI 2012), and therefore, has the potential to establish and spread in Australia.	**Yes:** Cutworms cause economic loss to many crops as they affects leaves, stems and roots of hosts (CABI 2012) including cotton, maize, potato, oilseeds, vegetable and root crops (CABI 2012).	**Yes**
Brithys crini Fabricius [Noctuidae] borer moth	Yes (BAPHIQ 2012)	Yes (Common 1990, Maddison 1993, ALA 2011)	Assessment not required			
Chrysodeixis eriosoma (Doubleday) [Noctuidae] green looper caterpillar	Yes (Wang and Lin 1997, TaiBNET 2012)	Yes (AICN 2004, EPPO 2007)	Assessment not required			
Euproctis taiwana (Shiraki) [Lymantriidae] (basionym *Porthesia taiwana* Shiraki) tussock moth	Yes (Lee 1988, Wang and Lin 1997, Liu 1998)	No (Nielsen *et al.* 1996)	**Yes:** This species feeds on the leaves of many flowers, including lilies (Liu 1998, Kuo 2005).	**Yes:** This species feeds on the leaves of gladiolus and lily plants (Liu 1998), the leaves of soybean (Talekar *et al.* 1988), grapevine (Chang 1988) and of rose in Taiwan (Biosecurity Australia 2006). The Australian climate is likely to be conducive for the spread of this pest.	**Yes:** This moth feeds on several hosts and can affect commercial crops through feeding on leaves, including flowers, fruit trees, vegetables and cereals. Larval hairs cause allergic reactions (Kuo 2005).	**Yes**
Helicoverpa armigera (Hübner) [Noctuidae] corn earworm	Yes (Wang and Lin 1997, EPPO 2007, CABI 2012)	Yes (ABRS 2009)	Assessment not required			
Kaniska canace Linnaeus [Nymphalidae] (synonym *Nymphalis canace* Linnaeus) blue admiral	Yes (Khramov *et al.* 2011, TaiBNET 2012)	No (Khramov *et al.* 2011)	**Yes:** Its distinctive larvae feed on hosts of the order Liliales including *Smilax*, *Tricyrtis*, *Streptopus* and *Lilium* spp. plants (Robinson *et al.* 2012).	**Yes:** Association with the host provides opportunity for establishment and spread of this species where cut flowers are sold and hosts are grown throughout Australia. Spreads in regions with similar climatic range as Australia.	**Yes:** The species is considered a minor pest of *Lilium* spp. However, *Smilax* spp. are widely spread in Australia (APNI 2012), and consequently its establishment and spread has potential for economic consequences in parts of Australia.	**Yes**

Pest	Present in Taiwan	Present within Australia	Potential to be on pathway	Potential for establishment and spread	Potential for economic consequences[1]	Quarantine pest (Yes/No)
Lampides boeticus (Linnaeus) [Lycaenidae] longtailed pea-blue	Yes (TaiBNET 2012, Robinson *et al.* 2012)	Yes (ABRS 2009)	Assessment not required			
Orgyia postica (Walker) [Lymantidae] tussock moth	Yes (Lee 1988, Liu 1998, TaiBNET 2012)	No (CABI 2012)	**Yes:** This species has been recorded on *Lilium* species, larvae feed on leaves and flower buds (CoA undated - a). A pest of flowers in Taiwan (Liu 1998).	**Yes:** This species currently occurs from Japan to southern China (Nasu *et al.* 2004, Zhu and Zhang 2004). It established in areas with a wide range of climatic conditions and therefore has the potential to establish and spread in Australia.	**Yes:** This species is polyphagous (CABI 2012). It has been recorded as a pest of *Eucalyptus* plantations in Japan (Nasu *et al.* 2004). It is also considered to be one of the ten most important moths attacking tropical fruits in Southern China (Zhu and Zhang 2004). Hosts include durian, eucalypts, longan, lychee, mango, mangosteen, poplar, rambutan, roses, table grapes (CABI 2012), and soybean, cocoa, red beans and pear (Biosecurity Australia 2006).	**Yes**
Spodoptera litura (Fabricius) [Noctuidae] oriental leafworm moth	Yes (Lee 1988, TaiBNET 2012)	Yes (ABRS 2009)	Assessment not required			
Xylena formosa (Butler) [Noctuidae] (synonym *Xylena plumbeopaca* Hreblay & Ronkay) cutworm	Yes (Wang and Lin 1997, TaiBNET 2012)	No (Nielsen *et al.* 1996, ABRS 2009)	**Yes:** Recorded on lilies (Maddison 1993). This species is a generalist floral herbivore common in Japan, China, and Taiwan (Oguro and Sakai 2009).	**Yes:** The limited distribution of this species internationally suggests that it is not invasive; however, current reported distribution suggests that there are similar environments in parts of Australia that would be suitable for its establishment and spread.	**Yes:** This species is considered a minor pest of *Lilium* spp, though it has been recorded as feeding on sap of *Citrus* spp. and other fruit trees (Biosecurity Australia 2009). Therefore, this species has potential for economic consequences in parts of Australia and would impact upon overseas markets.	**Yes**

Pest	Present in Taiwan	Present within Australia	Potential to be on pathway	Potential for establishment and spread	Potential for economic consequences[1]	Quarantine pest (Yes/No)
ORTHOPTERA (grasshoppers, crickets, locusts)						
Oxya intricata (Stal) [Acrididae] [synonym *Oxya hyla intricata* (Stal)] small rice grasshopper	Yes (BAPHIQ 2009)	No (ABRS 2009)	**Yes:** Recorded on *Lilium* spp. (BAPHIQ 2009, CoA undated - b). Generally, this is a rice pest that consumes foliage of grassy species (Heinrichs and Barrion 2004). On *Lilium* spp., it is likely a contaminant pest from nearby rice fields or previous crop rotations.	**No:** Adults are the most likely stage associated with minor hosts such as *Lilium* spp. *Oxya* lay their eggs behind rice leaves and stems, and when dry in the soil (Heinrichs and Barrion 2004). Its limited distribution internationally suggests that it is not an invasive species.	**Yes:** The species is not considered a major pest of *Lilium* spp. Adults and nymph damage and their feeding are easy to spot (Heinrichs and Barrion 2004). However, it is a pest of rice and consequently its establishment and spread has potential for economic consequences in parts of Australia.	No
THYSANOPTERA (thrips)						
Frankliniella intonsa (Trybom) [Thripidae] flower thrips	Yes (Tang 1976, Wang and Lin 1997, BAPHIQ 2009)	No (Mound 2005, ABRS 2009)[5]	**Yes:** Thrips are sap-sucking insects that feed on foliage or flowers (Lewis 1997). *Frankliniella intonsa* is associated with the leaves and flowers of *Lilium* (Maddison 1993, BAPHIQ 2009).	**Yes:** This species is polyphagous and its current reported distribution suggests that there are similar environments in parts of Australia that would be suitable for its establishment and spread.	**Yes:** Flower thrips cause distortion of fruit and reductions in quality (Buxton and Easterbrook 1988); discolouration resulting in sales losses on ornamental and cut flower varieties (Sauer 1997). Flower thrips will affect cut flower trade as phytosanitary restrictions can apply.	**Yes**
Haplothrips chinensis Priesner [Phlaeothripidae] Chinese thrips	Yes (Liu 1998, TaiBNET 2012)	No (ABRS 2009)	**Yes:** This species has been recorded as a pest of rose, hibiscus, gladiolus and lily in Taiwan (Liu 1998, Kakimoto *et al.* 2006).	**Yes:** This species occurs on flowers but is also a predatory thrips (Kakimoto *et al.* 2006). It is recorded on several flower species in Japan (Kudo 1977), citrus (Biosecurity Australia 2009) and other fruit crops (GAAS 2012), and on vegetable crops in Korea and Taiwan (Woo 1988, Chang 1991).	**Yes:** This pest is listed as an invasive species by the USDA (Invasive.org 2010). It has a wide host range and can cause damage to several fruit and vegetable crops. Flower thrips will also affect cut flower trade and other commodities as phytosanitary restrictions can apply.	**Yes**
Heliothrips haemorrhoidalis (Bouché) [Panchaetothripinae] greenhouse thrips	Yes (Wang and Lin 1997, TaiBNET 2012)	Yes (ABRS 2009, Denmark and Fasulo 2010)	Assessment not required			

Pest	Present in Taiwan	Present within Australia	Potential to be on pathway	Potential for establishment and spread	Potential for economic consequences[1]	Quarantine pest (Yes/No)
Liothrips vaneeckei (Priesner) [Phaleothripidae] lily bulb thrips	Yes (Wang and Lin 1997, TaiBNET 2012)	Yes (Malipatil *et al.* 2002)	Assessment not required			
Megalurothrips distalis (Karny) [Thripidae] bean blossom thrips	Yes (Wang and Lin 1997, TaiBNET 2012)	No (Maddison 1993, ABRS 2009)	**Yes:** Thrips are sap-sucking insects that feed on foliage or flowers (Lewis 1997). Found in *Lilium* spp. flowers in Asia and Pacific Islands (Maddison 1993).	**Yes:** The host range for this species includes legumes, groundnut and ornamentals (Reitz *et al.* 2011). It is likely to find environments in parts of Australia that would be suitable for its establishment and spread.	**Yes:** Flower thrips cause discolouration resulting in sales losses on ornamental and cut flower varieties (Sauer 1997). Damages buds of flowers of many leguminous plants (Ananthakrishnan 1993). Flower thrips will affect cut flower trade as phytosanitary restrictions can apply.	**Yes**
Scirtothrips dorsalis Hood [Thripidae] strawberry thrips	Yes (TaiBNET 2012)	Yes (ABRS 2009)[5]	Assessment not required			
Thrips hawaiiensis (Morgan) [Thripidae] banana flower thrips	Yes (Lee 1988, Wang and Lin 1997)	Yes (ABRS 2009)	Assessment not required			
Thrips palmi Karny [Thripidae] melon thrips	Yes (Wang and Lin1997, TaiBNET 2012)	Yes (ABRS 2009)[5,6]	Assessment not required			
Thrips simplex (Morison) [Thripidae] *Gladiolus* thrips	Yes (Wang and Lin 1997, TaiBNET 2012)	Yes (ABRS 2009)	Assessment not required			
Thrips tabaci Lindeman [Thripidae] onion thrips	Yes (Wang and Lin 1997, TaiBNET 2012)	Yes (ABRS 2009)[5]	Assessment not required			

[5] These thrips species are known virus vectors (Reitz *et al*. 2011).
[6] Additional inspection requirements under Interstate Certification Assurance apply to this pest for Western Australia (ICA-38 2013, ICA-WI-05 2013); regulated quarantine pest for South Australia (Biosecurity SA 2013).

Pest	Present in Taiwan	Present within Australia	Potential to be on pathway	Potential for establishment and spread	Potential for economic consequences[1]	Quarantine pest (Yes/No)
PATHOGENS						
BACTERIA						
Erwinia carotovora (Jones) Bergey *et al.* [Enterobacteriales : Enterobacteriaceae] (synonym *Erwinia carotovora* subsp. *carotovora* (Jones) Bergey *et al.* *Pectobacterium carotovorum* subsp. *carotovorum* (Jones) Hauben *et al.* emend. Gardan *et al.*) bacterial soft rot	Yes (Hsu and Tzeng 1981, Hseu *et al.* 2004)	Yes (Bradbury 1977, Chandrashekar and Diriwaechter 1983, Toth *et al.* 2001)	Assessment not required			
Pseudomonas gladioli Severini [Pseudomonadales : Pseudomonadaceae] (synonym *P. antimicrobica* Attafuah & Bradbury, *P. cocovenenans* van Damme et al, *Burkholderia gladioli* (Severini) Yabuuchi *et al.*, *B. cocovenenans* (van Damme) Gillis) stem rot, bacterial leaf spot	Yes (Chiou and Wu 2001)	Yes (Tesoriero *et al.* 1982, Saddler 1994)	Assessment not required			
Pseudomonas marginalis (Brown) Stevens [Pseudomonadales : Pseudomonadaceae] (synonym *Pseudomonas marginalis* pv *marginalis* (Brown) Stevens)	Yes (Tzeng *et al.* 1994)	Yes (Wimalajeewa and Price 1985, CABI 1993, EPPO 2007, CABI 2012)	Assessment not required			
FUNGI						
Alternaria tenuissima (Kunze) Wiltshire [Pleosporales : Pleosporaceae] (basionym *Helminthosporium tenuissimum* Kunze) (synonym *Clasterosporium tenuissimum* (Nees & T. Nees) Sacc.)	Yes (Farr and Rossman 2011, TaiBNET 2012)	Yes (APPD 2011, Farr and Rossman 2011)	Assessment not required			

Pest	Present in Taiwan	Present within Australia	Potential to be on pathway	Potential for establishment and spread	Potential for economic consequences[1]	Quarantine pest (Yes/No)
Aspergillus niger Tiegh. [Eurotiales : Trichocomaceae] (synonym *Sterigmatocystis nigra* (Tiegh.) Tiegh., *Aspergillopsis nigra* (Tiegh.) Speg., *Rhopalocystis nigra* (Tiegh.) Grove) black mould	Yes (CABI 2012, TaiBNET 2012)	Yes (Simmonds 1966, Cook and Dubé 1989, Shivas 1989, Walker 2001)	Assessment not required			
Athelia rolfsii (Curzi) Tu & Kimbr. [Atheliales : Atheliaceae] (anamorph *Sclerotium rolfsii* Sacc.) (synonym, *S. rolfsii* var. *delphinii* (Welch) Boerema & Hamers, *S. delphinii* Welch, *Corticium rolfsii* Curzi, *C. centrifugum*, *Pellicularia rolfsii* (Curzi) E. West, *Botryobasidium rolfsii* (Curzi) Venkatar.) blight, stem and root rot	Yes (Chen *et al.* 1998, CABI 2012)	Yes (Simmonds 1966, Sampson and Walker 1982, Shivas 1989, Lenné 1990)	Assessment not required			
Botrytis elliptica (Berk.) Cooke [Helotiales : Sclerotiniaceae] (basionym *Ovularia elliptica* Berk.) (synonym *Botrytis liliorum* Fujikiro, *Polyactis cana* Corda , *Spicularia cana* (Corda) Bonord., *Botrytis canescens* Sacc., *Peronospora elliptica* (Berk.) W.G. Sm.) grey mould, leaf blight	Yes (Lu and Chen 2005, BAPHIQ 2009)	Yes (Sampson and Walker 1982, Shivas 1989, Cunnington 2003)	Assessment not required			
Botrytis tulipae (Lib.) Lind [Helotiales : Sclerotiniaceae] (teleomorph *Sclerotium tulipae* Lib.) (synonym *Botrytis parasitica* Cavara, *Peronospora parasitica* (Pers.: Ft.) Fr., *Sclerotium entogenum* Westendorp) blight, neck rot	Yes (Sawada 1959, TaiBNET 2012) (as *P. parasitica, B. parasitica*)	Yes (Sampson and Walker 1982, Shivas 1989, Cook and Dubé 1989, Cunnington 2003)	Assessment not required			

Pest	Present in Taiwan	Present within Australia	Potential to be on pathway	Potential for establishment and spread	Potential for economic consequences[1]	Quarantine pest (Yes/No)
Colletotrichum dematium (Pers. : Fr.) Grove [Glomerellaceae : Incertae sedis] (synonym *Exosporium dematium* (Pers.) Link, *Colletotrichum omnivorum* Halst., *Vermicularia dematium* (Pers.) Fr., *Lasiella dematium* (Pers.) Quél.) anthracnose, leaf spot	Yes (Hong *et al.* 2006)	Yes (Simmonds 1966, Sampson and Walker 1982, Shivas 1989, Cook and Dubé 1989)	Assessment not required			
Epicoccum nigrum Link [Ascomycetes : Incertae sedis] (synonym *Epicoccum purpurascens* Ehrenb., *E.asterinum* Pat., *Phoma epicoccina* Punith., Tulloch & J.G. Leach)	Yes (TaiBNET 2012, Farr and Rossman 2011)	Yes (APPD 2011, Farr and Rossman 2011)	Assessment not required			
Fusarium oxysporum Schltdl. [Hypocreales : Nectriaceae] (synonym *Fusarium angustum* Sherb.) blights, wilts, rots	Yes (TaiBNET 2012, Farr and Rossman 2011)	Yes (Simmonds 1966, Sampson and Walker 1982, Shivas 1989, Cook and Dubé 1989, Lenné 1990)	Assessment not required			
Fusarium oxysporum Schlecht. f. sp. *lilii* Imle. [Hypocreales : Nectriaceae] vascular wilt	Yes (BAPHIQ 2009)	No (Brake *et al.* 2002, APPD 2011, Farr and Rossman 2011)	**Yes:** This species causes brown basal rot of *Lilium* spp. bulbs. Affected stem and lower leaves become yellow and die. Plants become stunted and of poor quality (UC IPM 2009).	**No:** This fungus is disseminated by mycelia, conidia and/or chlamydospores carried in soil, on bulbs, dust, equipment, shoes, packing crates, by surface drainage water, and rarely by seed (Burgess 1981, Linderman 1981, Smith *et al.* 1988). The likelihood it will be distributed from cut flowers in a viable state to a susceptible host is low.	**Yes:** *F. oxysporum* f. sp. *lilii* host range extends to *Lilium*, *Freesia*, *Crocus* and *Cereus* spp. (Horst 2008).	No
Fusarium proliferatum (Matsush.) Nirenberg [Hypocreales : Nectriaceae] basal rot	Yes (Huang *et al.* 1992, Wu *et al.* 1998)	Yes (Summerell *et al.* 1993, Elmer *et al.* 1999)	Assessment not required			

Pest	Present in Taiwan	Present within Australia	Potential to be on pathway	Potential for establishment and spread	Potential for economic consequences[1]	Quarantine pest (Yes/No)
Fusarium solani (Mart.) Sacc [Hypocreales : Nectriaceae] (teleomorph *Haematonectria haematococca* (Berk. & Broome) Samuels & Rossman) (synonym *Nectria haematococca* Berk. & Broome) root and stem rot, wilt	Yes (BAPHIQ 2009, TaiBNET 2012)	Yes (Simmonds 1966, Sampson and Walker 1982, Shivas 1989, Cook and Dubé 1989)	Assessment not required			
Helicobasidium mompa Tanaka [Helicobasidiales : Helicobasidiaceae] (synonym *Septobasidium mompa* (Tanaka) Racib.) root rot	Yes (BAPHIQ 2012)	No (Farr and Rossman 2011)	**No:** This species causes root rot and is associated with the bulbous part of *Lilium* spp. (Farr and Rossman 2011). Not known to be associated with flowers and foliage.	Assessment not required	Assessment not required	No
Macrophomina phaseolina (Tassi) Goid. [Ascomycota : Incertae sedis] (basionym *Macrophoma phaseolina* Tassi) (synonym *Macrophoma phaseoli* Maubl., *Sclerotium bataticola* Taubenh., *Rhizoctonia bataticola* (Taubenh.) E.J. Butler) charcoal rot, ashy stem blight, damping-off	Yes (Wu 1985)	Yes (Simmonds 1966, Cook and Dubé 1989, Shivas 1989, Lenné 1990, Khangura and Aberra 2009).	Assessment not required			
Magnaporthe grisea (Hebert) Barr [Magnaporthaceae : Incertae sedis] (synonym *Pyricularia grisea* Sacc., *Ceratosphaeria grisea* Hebert) grey leaf spot	Yes (EPPO 2007)	Yes (Simmonds 1966, Lenné 1990)	Assessment not required			
Penicillium aurantiogriseum Dierckx [Eurotiales : Trichocomaceae] (synonym *P. cyclopium* Westling, *P. martensii* Biourge, *P. solitum* Westling) bulb rot	Yes (Tzean *et al.* 2009, TaiBNET 2012)	Yes (Pitt *et al.* 1991)	Assessment not required			

Pest	Present in Taiwan	Present within Australia	Potential to be on pathway	Potential for establishment and spread	Potential for economic consequences[1]	Quarantine pest (Yes/No)
Penicillium hirsutum Dierckx [Eurotiales : Trichocomaceae] (synonym *P. hirsutum* var. *hirsutum* Dierckx, *P. verrucosum* var. *corymbiferum* (Westling), *P. corymbiferum* Westling) bulb rot	Yes (Tzean *et al.* 2009, TaiBNET 2012)	Yes (APPD 2011, Herb IMI 2012)	Assessment not required			
Rhizoctonia solani Kuhn [Cantharellales : Ceratobasidiaceae] (teleomorph *Thanatephorus cucumeris* (Frank) Donk) (synonym *Pellicularia filamentosa* (Pat.) Rogers, *Hypochnus cucumeris* Frank, *Corticium solani* (Prill. & Delacr.) Bourdot & Galzin, *Moniliopsis solani* (Kfihn) R.T.Moore) *Rhizoctonia* blight, stem rot, stem canker	Yes (BAPHIQ 2009)	Yes (Simmonds 1966, Sampson and Walker 1982, Shivas 1989)	Assessment not required			
Sclerotinia sclerotiorum (Lib.) de Bary [Helotiales : Sclerotiniaceae] (basionym *Peziza sclerotiorum* Lib.) (synonym *Hymenoscyphus sclerotiorum* (Lib.) W. Phillips, *Sclerotinia libertiana* Fuckel, *Sclerotium varium* Pers., *Whetzelinia sclerotiorum* (Lib.) Korf & Dumont) stem blight, head rot	Yes (Sawada 1959)	Yes (Shivas 1989, Lenné 1990)	Assessment not required			
STRAMINOPILA						
Phytophthora cactorum (L. &L.) Schroeter [Peronosporales : Peronosporaceae] (synonym *Phytophthora omnivora* de Bary, *Peronospora cactorum* Lebert & Cohn) leaf, stem and root rot	Yes (Ho 1990, BAPHIQ 2009)	Yes (Sampson and Walker 1982, Shivas 1989)	Assessment not required			

Pest	Present in Taiwan	Present within Australia	Potential to be on pathway	Potential for establishment and spread	Potential for economic consequences[1]	Quarantine pest (Yes/No)
Phytophthora capsici Leonian [Peronosporales : Peronosporaceae] (synonym *P. parasitica* var. *capsici* (Leonian) Sarej., *P. hydrophila* Curzi) stem and fruit rot	Yes (Ho 1990, Hartman 1993)	Yes (Shivas 1989, APPD 2011)	Assessment not required			
Phytophthora cinnamomi Rands [Peronosporales : Peronosporaceae] Phytophthora root rot	Yes (BAPHIQ 2009)	Yes (Simmonds 1966, Sampson and Walker 1982, Cook and Dubé 1989, Shivas 1989)	Assessment not required			
Phytophthora nicotianae Breda de Haan [Peronosporales : Peronosporaceae] (synonym *P. parasitica* Dastur, *P. parasitica* var. *nicotianae* (Breda de Haan) Tucker, *P. melongenae* var. *ananaphthoros* Sideris , *P. manoana* Sideris *, P. melongenae* Sawada, *P. nicotianae* var. *parasitica* (Dastur) Waterh, *P. parasitica* var. *rhei* Godfrey, *P. tabaci* Sawada, P. terrestris Sherb.) black shank	Yes (Ho 1990, TaiBNET 2012)	Yes (Simmonds 1966, Sampson and Walker 1982, Shivas 1989)	Assessment not required			
Pythium irregulare Buisman [Pythiales : Pythiaceae] (synonym *Globisporangium irregulare* (Buisman) Uzuhashi, Tojo & Kakish, *P. fabae* Cheney, *P. irregulare var. hawaiiense Sideris, P. polymorphon* Sideris) downy mildew, blight, damping off, root and other rots	Yes (Ho 2009, TaiBNET 2012)	Yes (APPD 2011, Farr and Rossman 2011)	Assessment not required			
Pythium ultimum Trow [Pythiales : Pythiaceae] (synonym *Globisporangium ultimum* (Trow) Uzuhashi, Tojo & Kakish, *Pythium haplomitri* Lilienfeld) black-leg of seedlings	Yes (BAPHIQ 2006, Ho 2009, TaiBNET 2012)	Yes (Simmonds 1966, Sampson and Walker 1982, Shivas 1989, Lenné 1990)	Assessment not required			

Pest	Present in Taiwan	Present within Australia	Potential to be on pathway	Potential for establishment and spread	Potential for economic consequences[1]	Quarantine pest (Yes/No)
VIRUSES						
Apple stem grooving virus ASGV [Flexiviridae : Capillovirus] [synonym Citrus tatter leaf virus CTLV - CTLV isolates are now recognised as strains of Apple stem grooving virus (Lovisolo *et al*. 2003)]	Yes (CABI/EPPO 2000, EPPO 2007, Wu *et al.* 2010)	Yes (CABI/EPPO 2000, APPD 2011)	Assessment not required			
Broad bean wilt virus BBWV [Comoviridae : Fabavirus]	Yes (BAPHIQ 2012)	Yes (Shukla and Gough 1983, CABI 2012)	Assessment not required			
Cucumber mosaic virus CMV [Bromoviridae: Cucumovirus]	Yes (BAPHIQ 2009, TaiBNET 2012)	Yes (Brunt *et al.* 1996, CABI 2012)	Assessment not required			
Lily mottle virus LMoV [Potyviridae: Potyvirus] (synonym Tulip breaking virus - lily strain)	Yes (BAPHIQ 2009, TaiBNET 2012)	No. Although there are records of TBV in Australia (ICTVdB 2006, CABI 2012), there are no records of LMoV, now characterised as a distinct species rather than a synonym of TBV (Dekker *et al*. 1993; Derks *et al*. 1994).	**Yes:** LMoV is transmitted in a non-persistent manner by aphids (Asjes and Blom-Barnhoorn 2002). It may cause a mosaic pattern on leaves and flowers; flowers may also be malformed depending on the cultivar (EPPO 2002).	**Yes:** LMoV can be detected in the leaves of infected *Lilium* plants (Chinestra and Facchinette 2010). Aphids which become viruleferous after feeding on *Lilium* leaves may transmit the virus to susceptible host plants. The virus can also be transmitted mechanically (Navalinskienė and Samuitienė 2001).	**Yes:** Lily plants infected with LMoV are stunted and may die prematurely. Flower quality is reduced, with shorter vase life, and flowers may be malformed or exhibit colour-breaking (Pearson *et al.* 2009).	**Yes**
Lily symptomless virus LSV [Flexiviridae : Carlavirus] (synonym lily rosette virus, lily curl stripe virus, lily yellow flat virus, virus and marmor mite) (Asjes 2000) (synonym lily curl stripe virus, lily streak virus) (Brunt *et al.* 1996)	Yes (BAPHIQ 2009, TaiBNET 2012)	Yes (Brunt *et al.* 1996, Blake and Wilson 1996, CABI 2012)	Assessment not required			

Pest	Present in Taiwan	Present within Australia	Potential to be on pathway	Potential for establishment and spread	Potential for economic consequences[1]	Quarantine pest (Yes/No)
Lily virus X LVX [Flexiviridae : Potexvirus] (synomyn *Lily X potexvirus*)	Uncertain/No (Brunt *et al*. 1996). However, lily bulbs are sourced from The Netherlands where this virus is known to occur.	No (Brunt *et al.* 1996)	**Yes:** Recorded on *Lilium* spp. in the UK (Stone 1980), the Netherlands (Memelink *et al*. 1990) and Lithuania (Dapkūniene *et al.* 2004).	**Yes:** No vector is known for LVX (Adams *et al*. 2004), although spread of LVX was reduced by insecticides but not by mineral-oil spraying. The mode of transmission is possibly by an insect in a persistent or semi-persistent manner (Asjes 1991).	**Yes:** LVX has not been shown to cause symptom expression in *Lilium* (EPPO 2002), although it causes symptoms of necrosis in edible lily when associated with TBV (Takashi *et al*. 2000).	**Yes**
Plantago asiatica mosaic virus PlAMV [Alphaflexiviridae : Potexvirus] (synonym Nandina mosaic virus) (Hughes *et al.* 2005).	No (PPSN 2010)/ Uncertain. However, lily bulbs are sourced from The Netherlands where this virus is known to occur.	No (PPSN 2010) Australian records are PEQ interceptions on bulbs grown in open quarantine	**Yes:** The virus was first detected in lily flower production facilities (indoor) then in production fields. Recorded in Japan, Russia, US, and possibly Chile, New Zealand and South Korea (Komatsu *et al*. 2008; PPSN 2010).	**Yes:** PlAMV is able to infect a wider host range than other Potexvirus species, and induce various symptoms such as necrosis (Ozeki *et al.* 2006, Komatsu *et al*. 2008). Like other Potexvirus species, the virus may be spread mechanically (PPSN 2010).	**Yes:** The leaves develop severe symptoms of necrosis and discolouration, which may result in the loss of flower value of up to 80% (PPSN 2010).	**Yes**
Strawberry latent ringspot virus SLRSV [Secoviridae : Genus Unassigned]	Yes (Chang *et al.* 2001)	No. One record from SA, with no evidence of establishment or spread (CABI/EPPO undated-a, CABI 2012)	**Yes:** although more likely to arrive on infected bulbs, or contaminating nematodes or soil (CABI/EPPO undated – a).	**Yes:** SLRSV is transmitted by the nematode *Xiphinema diversicaudatum*, which has been recorded on roses in Australia (APPD 2011), but may be eradicated (CABI/EPPO 2001), and *X. coxi* (Tzanetakis *et al.* 2006). It is also mechanically transmissible (CABI/EPPO undated – a). However, most cut flowers will eventually be disposed of in waste or compost. The virus is not likely to survive and be transmitted to a suitable host by a nematode vector.	**Yes:** Has a wide host range including many different crop species such as ornamentals (*Delphinium*, *Gladiolus*, *Narcissus, Rosa*) and apricot, asparagus, celery, peach, cherry, currants , grapevine, hop, raspberry, strawberry, rhubarb, oleander, olive, parsley, and parsnip (CABI/EPPO undated – a, CABI 2012). In Israel SLRSV is associated with asymmetrical opening of flowers (Cohen *et al.* 1995).	**Yes**

Pest	Present in Taiwan	Present within Australia	Potential to be on pathway	Potential for establishment and spread	Potential for economic consequences[1]	Quarantine pest (Yes/No)
Tobacco ringspot nepovirus TRSV [Secoviridae : Nepovirus]	Yes (EPPO 2007, CABI 2012)	Yes (EPPO 2007, CABI 2012) - isolated records from Qld, SA and WA (Randles and Francki 1965; CABI/EPPO undated - b). However, there are several biologically distinct strains of TRSV; and it is uncertain which are present in Australia.	**Yes**: TRSV may be transmitted in cuttings, pollen and seed (CABI/EPPO undated – b; Card *et al*. 2007).	**Yes:** TRSV is spread by the nematodes *Xiphinema americanum, X. rivesi and X. californicum* (Brown *et al.* 1995). It can also be spread non-specifically by aphids, thrips and the beetle *Epilachna varivestis*; and by dodder (*Cuscuta gronovii*) in cuttings, by pollen and seed, and by mechanical inoculation (Field *et al*., 1994; Card *et al.* 2007; CABI/EPPO undated – b).	**Yes:** TRSV has a very wide host range, and there are several biologically distinct strains (Stace-Smith 1985). There is potential for further spread in important crops for novel strains. TRSV causes symptoms in flowers, leaves, roots and seeds. TRSV has varying economic impact on different crops, with the most severely affected being soybeans, grapevine and some ornamentals (CABI/EPPO undated –b).	**Yes**
Tomato aspermy cucumovirus TAV [Bromoviridae : Cucumovirus]	Yes (TaiBNET 2012, BAPHIQ 2012)	Yes (Hill *et al.* 1996)	Assessment not required			
Tomato spotted wilt tospovirus TSWV [Bunyaviridae : Tospovirus] (synonym *Impatiens necrotic spot virus* (INSV), Tomato spotted wilt tospovirus, impatiens strain)	Yes (EPPO 2007, TaiBNET 2012, CABI 2012)	Yes (Latham and Jones 1997, APPD 2011, CABI 2012)	Assessment not required			
Tulip breaking potyvirus TBV [Potivyridae: Potyvirus] (synonym brown ring virus) (Derks 1976)	Yes (TaiBNET 2012, CABI 2012)	Yes (ICTVdB 2006, CABI 2012)	Assessment not required			

Pest	Present in Taiwan	Present within Australia	Potential to be on pathway	Potential for establishment and spread	Potential for economic consequences[1]	Quarantine pest (Yes/No)
NEMATODES						
Helicotylenchus dihystera (Cobb) Sher. [Tylenchida : Hoplolaimidae] spiral nematode	Yes (CABI/EPPO 2010)[7]	Yes (McLeod *et al*. 1994, CABI/EPPO 2010)	Assessment not required			
Heterodera spp. Schmidt [Telenchida : Heteroderidae] cyst nematode	Yes (BAPHIQ 2012)	Yes (McLeod *et al.* 1994)	Assessment not required			
Meloidogyne hapla Chitwood [Tylenchida : Meloidogynidae] root knot nematode	Yes (Chen and Tsay 2006)	Yes (McLeod *et al.* 1994)	Assessment not required			
Meloidogyne incognita (Kofoid and White) Chitwood [Tylenchida : Meloidogynidae] root knot nematode	Yes (Chen and Tsay 2006)	Yes (McLeod *et al.* 1994, Stirling and Stanton 1997)	Assessment not required			
Paratrichodorus spp. Siddiqi [Triplonchida : Trichodoridae] stubby-root nematode	Yes (BAPHIQ 2012)	Yes (McLeod *et al.* 1994)	Assessment not required			
Pratylenchus coffeae Goodey [Tylenchida : Pratylenchidae] lesion nematode	Yes (Chen and Tsay 2006, EPPO 2007)	Yes (ABRS 2009, APPD 2011)	Assessment not required			
Pratylenchus penetrans Cobb [Tylenchida : Pratylenchidae] root lesion nematode	Yes (Chen and Tsay 2006, EPPO 2007)	Yes (ABRS 2009, APPD 2011)	Assessment not required			
Pratylenchus pratensis (de Man) Filipjev [Tylenchida : Pratylenchidae] meadow nematode	Yes (BAPHIQ 2012)	Yes (ABRS 2009, APPD 2011)	Assessment not required			
Rotylenchulus reniformis Linford and Oliveira [Tylenchida : Hoplolaimidae] reniform nematode	Yes (EPPO 2007)	Yes (McLeod *et al.* 1994)	Assessment not required			

[7] Taiwan's NPPO, BAPHIQ, has indicated this pest does not occur in Taiwan (BAPHIQ 2012). Other references state it is present.

Pest	Present in Taiwan	Present within Australia	Potential to be on pathway	Potential for establishment and spread	Potential for economic consequences[1]	Quarantine pest (Yes/No)
Rotylenchus robustus de Man [Tylenchoidea : Hoplolaimidae] (synonym *Tylenchus robustus, Hoplolaimus uniformis, Rotylenchus uniformis, Anguillulina robusta, Rotylenchus goodeyi, Rotylenchus fallorobustus*) lance nematode	Yes (BAPHIQ 2012)	Yes (McLeod *et al.* 1994)	Assessment not required			
Trichodorus spp. [Triplonchida: Trichodoridae] stubby root nematodes	Yes (CABI 2012)	Yes (APPD 2011, CABI 2012)	Assessment not required			
Xiphinema insigne Loos [Dorylaimida : Longidoridae] (synonym *X. indicum* Siddiqi) dagger nematode	Yes (Ni *et al.* 2003, Chen *et al.* 2004)	Yes (McLeod *et al.* 1994)	Assessment not required			

Appendix B Additional quarantine pest data

COLEOPTERA (beetles, weevils)	
Quarantine pest	***Harmonia axyridis* (Pallas)**
Synonyms	None
Common name(s)	Harlequin ladybird, Multicoloured Asian lady beetle
Main hosts	Predator of soft bodied insects (e.g. aphids, scales) (Koch 2003, Brown *et al*. 2008) in a wide range of habitats (arboreal, herbaceous, and crop systems) (Brown *et al*. 2008). Hosts include *Cucurbita moschata* (pumpkin), *Malus domestica* (apple), *Pyrus communis* (pear), *Prunus domestica* (plum), *Prunus persica* (peach), *Rubus* (raspberry) and *Vitis vinifera* (grape) (EPPO 2009, CABI 2012).
Distribution	Argentina, Austria, Belarus, Belgium, Brazil, Canada, Chile, China, Czech Republic, Denmark, France, Germany, Greece, Hungary, Italy, Japan, Jersey, Korea, Latvia, Liechtenstein, Luxemburg, Mexico, Netherlands, Norway, Poland, Portugal, Romania, Russia, Serbia, Slovakia, Spain, Sweden, Switzerland, Ukraine, United Kingdom and USA (CABI 2012).
Quarantine pest	***Lilioceris formosana* Heinze**
Synonyms	*Lilioceris neptis* subsp. *formosana* Heinze (Wrocław) *Lilioceris impressa* subsp. *loochooana* Nakane (Wrocław)
Common name(s)	Leaf beetle
Main hosts	herbivorous, no details found
Distribution	Taiwan, Tokara Is., Ryukyu Isl., Japan (Wrocław 2011).
Quarantine pest	***Sangariola punctatostriata* (Motschulsky)**
Synonyms	*Galeruca? punctato-striata* Motschulsky *Sangariola punctato-striata* subsp, *aequicostata* Chujo
Common name(s)	Lily leaf flea beetle
Main hosts	*Cardiocrinum cordatum* (giant lily), *Cardiocrinum glehni*, *Erythronium dens-canis* (dog's-tooth violet), *Erythronium japonicum*, *Lilium cordatum*, *Lilium leichtlinii* var. *tigrinum* (Leichtlins' lily), *Smilax china* (Chujo and Kimoto 1961; Maddison 1993)
Distribution	Asia, Russia, Japan (Hokkaido, Honshu, Shikoku, Kyushu, Okinawa), Korean Peninsula, Taiwan (Chujo and Kimoto 1961, Maddison 1993).
DIPTERA (flies, gnats, midges)	
Quarantine pest	***Chromatomyia horticola* Goureau**
Synonyms	*Agromyza atricornis* *Chromatomyia atricornis* *Phytomyza atricornis* (partim.) Meigen *Phytomyza bidensivora* Séguy *Phytomyza fediae* Kaltenbach *Phytomyza horticola* Goureau *Phytomyza lactucae* Vimmer *Phytomyza linariae* Kaltenbach *Phytomyza nainiensis* Garg *Phytomyza pisi* Kaltenbach *Phytomyza subaffinis* Malloch *Phytomyza tropaeoli* Dufour
Common name(s)	Pea leaf miner
Main hosts	Alliaceae, *Allium* (onions, garlic, leek, etc.), *Allium cepa* (onion), Amaranthaceae, Anacardiaceae, Asteraceae, *Brassica*, *Brassica campestris*, *Brassica oleracea* var. *gongylodes* (kohlrabi), *Brassica oleracea* var. *viridis* (collards), Brassicaceae (cruciferous crops), Caryophyllaceae, Chenopodiaceae, *Chrysanthemum* (daisy), *Cicer*, Convolvulaceae, *Cucurbita* (pumpkin), Cucurbitaceae (cucurbits), Euphorbiaceae, Fabaceae, *Lactuca sativa* (lettuce), Liliaceae, Malvaceae, *Mentha* (mints), Onagraceae, *Phaseolus* (beans), *Pisum* (pea), *Pisum sativum* (pea), Ranunculaceae, *Raphanus sativus* (radish), Rutaceae, Solanaceae, *Solanum lycopersicum* (tomato), Umbelliferae, *Vicia* (vetch) (Spencer 1973, CABI 2012).

Distribution	This species is found throughout Africa, Asia, and Europe (CABI 2012).
Quarantine pest	***Liriomyza huidobrensis* (Blanchard)**
Synonyms	*Agromyza huidobrensis* Blanchard *Liriomyza cucumifoliae* Blanchard *Liriomyza decora* Blanchard *Liriomyza dianthi* Frick *Liriomyza langei* Frick
Common name(s)	Serpentine leafminer, pea leafminer, South American leafminer
Main hosts	*Allium cepa* (onion), *Allium sativum* (garlic), *Amaranthus* (grain amaranth), *Amaranthus retroflexus* (redroot pigweed), *Apium graveolens* (celery), *Beta vulgaris* (beetroot), *Bidens pilosa* (blackjack), *Brassica rapa*, *Calendula* (marigolds), *Capsicum annuum* (bell pepper), *Chenopodium quinoa* (quinoa), *Chrysanthemum morifolium* (chrysanthemum (florists')), *Cucumis melo* (melon), *Cucumis sativus* (cucumber), *Cucurbita pepo* (ornamental gourd), *Datura* (thorn-apple), *Emilia sonchifolia* (red tasselflower), *Galinsoga parviflora* (gallant soldier), *Gerbera* (Barbeton daisy), *Gypsophila paniculata* (babysbreath), *Lactuca sativa* (lettuce), *Lathyrus* (Vetchling), Liliaceae, *Linum* (flax), *Medicago sativa* (lucerne), *Melilotus* (melilots), *Oxalis* (wood sorrels), *Petunia*, *Phaseolus vulgaris* (common bean), *Pisum sativum* (pea), *Portulaca oleracea* (purslane), *Solanum lycopersicum* (tomato), *Solanum melongena* (aubergine), *Solanum tuberosum* (potato), *Sonchus* (Sowthistle) (Spencer 1973, CABI 2012).
Distribution	Argentina, Austria, Belgium, Belize, Brazil, Bulgaria, Canada, Chile, China, Colombia, Comoros, Costa Rica, Croatia, Cyprus, Czech Republic, Dominican Republic, Ecuador, El Salvador, Finland, France, French Guiana, Germany, Greece, Guadeloupe, Guam, Guatemala, Honduras, Hungary, India, Indonesia, Israel, Italy, Japan, Jordan, Korea DPR, Lebanon, Malaysia, Malta, Mauritius, Montenegro, Morocco, Netherlands, Nicaragua, Norway, Panama, Peru, Philippines, Poland, Portugal, Réunion, Saudi Arabia, Serbia, Seychelles, Singapore, South Africa, Spain, Sri Lanka, Switzerland, Syria, Taiwan, Thailand, Turkey, Uruguay, USA (California, Hawaii), Venezuela, Vietnam (CABI 2012).
Quarantine pest	***Liriomyza trifolii* (Burgess)**
Synonyms	*Agromyza phaseolunata* Frost *Liriomyza alliivora* Frick *Liriomyza alliovora* Frick *Liriomyza phaseolunata* (Frost) *Oscinis trifolii* Burgess
Common name(s)	American serpentine leafminer, chrysanthemum leaf miner
Main hosts	*Abelmoschus esculentus* (okra), *Ageratum* (whiteweed), *Allium cepa* (onion), *Allium sativum* (garlic), *Allium schoenoprasum* (chives), *Alstroemeria* (Inca lily), *Ambrosia* (Ragweed), *Antirrhinum* (snapdragon), *Apium graveolens* var. *dulce* (celery), *Arachis hypogaea* (groundnut), *Artemisia* (wormwoods), *Aster*, *Avena sativa* (oats), *Baccharis*, *Basella*, *Bellis*, *Beta vulgaris* var. *saccharifera* (sugarbeet), *Bidens* (Burmarigold), *Brassica rapa*, *Brassica rapa* subsp. *chinensis* (Chinese cabbage), *Callistephus chinensis* (China Aster), *Capsicum annuum* (bell pepper), *Carthamus*, *Cassia* (sennas), *Centaurea* (Knapweed), *Cestrum* (jessamine), *Chenopodium* (Goosefoot), *Chrysanthemum indicum* (chrysanthemum), *Chrysanthemum morifolium* (chrysanthemum (florists')), *Citrullus lanatus* (watermelon), *Crataegus* (hawthorns), *Crotalaria*, *Cucumis melo* (melon),*Cucumis sativus* (cucumber), *Cucurbita maxima* (giant pumpkin), *Cucurbita moschata* (pumpkin), *Cucurbita pepo* (ornamental gourd), Cucurbitaceae (cucurbits), *Dahlia*, *Daucus carota* (carrot), *Dianthus* (carnation), *Erigeron* (Fleabane), *Eupatorium*, *Gaillardia*, *Gazania* (treasure-flower), *Gerbera* (Barbeton daisy), *Gladiolus* hybrids (sword lily), *Glycine max* (soyabean), *Gossypium* (cotton), *Gypsophila* (baby's breath), *Helianthus* (sunflower), *Hordeum* (barleys), *Ipomoea* (morning glory), *Lactuca sativa* (lettuce), *Lagenaria siceraria* (bottle gourd), *Lathyrus* (Vetchling), Liliaceae, *Linaria* (Toadflax), *Luffa acutangula* (angled luffa), *Luffa aegyptiaca* (loofah), *Lycopersicon*, *Macrotyloma*, *Malva* (mallow), *Medicago* (medic), *Medicago sativa* (lucerne), *Melilotus* (melilots), *Mollucella*, *Ocimum*, *Phaseolus* (beans), *Phaseolus lunatus* (lima bean), *Phaseolus vulgaris* (common bean), *Phlox*, *Physalis* (Groundcherry), *Pisum sativum* (pea), *Polyphagous* (polyphagous), *Primula* (Primrose), *Ricinus communis* (castor bean), *Salvia* (sage), *Senecio* (Groundsel), *Solanum lycopersicum* (tomato), *Solanum melongena* (aubergine), *Solanum tuberosum* (potato), *Sonchus* (Sowthistle), *Spinacia oleracea* (spinach), *Tagetes* (marigold), *Taraxacum* (dandelion), *Tithonia*, *Tragopogon* (goat's-beard),*Tribulus* (caltrop), *Trifolium* (clovers), *Trifolium repens* (white clover), *Trigonella*, *Tropaeolum*, *Typha* (reedmace), *Verbena* (vervain), *Vicia* (vetch), *Vigna unguiculata* (cowpea), *Xanthium* (Cocklebur), *Zinnia* (Spencer 1973, CABI 2012).
Distribution	This species is found throughout Africa, Asia, Europe, North America and South America (CABI 2012).

HEMIPTERA (aphids, leafhoppers, mealybugs, psyllids, scales, true bugs, whiteflies)	
Quarantine pest	***Pseudococcus comstocki*** **(Kuwana)**
Synonyms	*Dactylopius comstocki* Kuwana
Common name(s)	Comstock's mealybug
Main hosts	*Acer, Aesculus* spp. (horse chestnut), *Aglaia odorata* (Chinese perfume tree), *Alnus japonica* (Japanese alder), *Amaryllis vittata*, *Artemisia*, *Buxus microphylla* (littleleaf boxwood), *Camellia japonica* (camellia), *Castanea* (chestnut), *Catalpa* (northern catalpa), *Celtis willdenowiana* (enoki), *Cinnamomum camphorae* (camphor tree), *Citrus* (citrus), *Crassula tetragona* (miniature pine tree), *Cydonia oblonga* (quince), *Cydonia sinensis* (Chinese quince), *Deutzia parviflora typical* (gaura), *Dieffenbachia picta* (dumb cane), *Erythrina indica* (rainbow eucalyptus), *Euonymus alatus* (winged euonymus), *Fatsia japonica* (Japanese aralia), *Ficus carica* (fig), *Fiwa japonica*, *Forsythia koreana* (forsythia), *Gardenia jasminoides* (gardenia), *Ginkgo biloba* (ginkgo), *Hydrangea* (hydrangea), *Ilex cornuta* (Chinese holly), *Ilex crenata microphylla* (Korean gem), *Kraunhia*, *Lagerstroemia indica* (crepe myrtle), *Ligustrum ibota angustifolium*, *Lilium* spp. (lily), *Lonicera* (honeysuckle), *Loranthus* (mistletoe), *Malus pumila* (paradise apple), *Malus sylvestris* (crab apple), *Masakia japonica* (Japanese euonymus), *Monstera deliciosa* (monstera), *Morus alba* (white mulberry), *Morus kagayamae* (mulberry), *Musa* (bananas), *Nephelium lappaceum* (rambutan), *Opuntia dillenii* (prickly pear), *Orixa japonica* (Japanese orixa), *Pandanus* (screwpines), *Persica vulgaris* (peach), *Pinus thunbergiana* (Japanese black pine), *Populus* (poplar), *Prunus mume* (Japanese apricot), *Punica granatum* (pomegranate), *Pyrus communis* (European pear), *Pyrus serotina culta* (black cherry), *Rhamnus* (buckthorn), *Rhododendron mucronulatum* (Korean Rhododendron), *Sasamorpha* (bamboo), *Taxus* (yew), *Torreya nucifera* (Japanese torreya), *Trema orientalis* (nalita), *Viburnum awabucki* (acacia confuse), *Zinnia elegans* (zinnia) (Maddison 1993, Ben-Dov 2012).
Distribution	Afghanistan, Argentina, Armenia, Azerbaijan, Brazil, Canada, Canary Islands, China, Columbia, Federated States of Micronesia, Indonesia, Iran, Italy, Japan, Kampuchea, Kazakhstan, Kyrgyzstan, Madeira Islands, Malaysia, Mexico, Moldova, Northern Mariana Islands, Russia, Saint Helena, South Korea, Sri Lanka, Taiwan, Tajikistan, Turkmenistan, USA, Uzbekistan, Vietnam (Wang and Lin 1997, Ben-Dov 2012).
LEPIDOPTERA (moths, butterflies)	
Quarantine pest	***Agrotis segetum*** **Denis & Schiffermüller**
Synonyms	*Agrotis fucosa* Butler *Agrotis segetis* Hübner *Euxoa segetis* *Euxoa segetum* Denis & Schiffermüller *Euxoa segetum* form *albiptera* Turati *Feltia segetum* Denis & Schiffermüller *Noctua segetum* Denis & Schiffermüller *Scotia segetum* Denis & Schiffermüller
Common name(s)	Turnip moth, black cutworm, common cutworm, cutworm, dark moth, dart moth, tobacco cutworm, turnip dart moth.
Main hosts	*Abelmoschus esculentus* (okra), *Allium porrum* (leek), *Allium sphaerocephalon* (Roundhead garlic), *Amaranthus* (grain amaranth), *Anethum graveolens* (dill), *Apium graveolens* var. *dulce* (celery), *Arachis hypogaea* (groundnut), *Asparagus officinalis* (asparagus), *Aster*, *Atropa belladonna* (deadly nightshade), *Avena sativa* (oats), *Beta vulgaris* var. *saccharifera* (sugarbeet), *Boehmeria nivea* (ramie), *Brassica juncea* var. *juncea* (Indian mustard), *Brassica napus* var. *napobrassica* (swede), *Brassica napus* var. *napus* (rape), *Brassica oleracea* (cabbages, cauliflowers), *Brassica oleracea* var. *botrytis* (cauliflower), *Brassica oleracea* var. *capitata* (cabbage), *Brassica rapa* subsp. *chinensis* (Chinese cabbage), *Brassica rapa* subsp. *oleifera* (turnip rape), *Camellia sinensis* (tea), *Cannabis sativa* (hemp), *Capsicum annuum* (bell pepper), *Carum carvi* (caraway), *Chrysanthemum* (daisy), *Cicer arietinum* (chickpea), *Cichorium endivia* (endives), *Coffea arabica* (arabica coffee), *Cucumis melo* (melon), *Cucurbita pepo* (ornamental gourd), *Cyperus esculentus* (yellow nutsedge), *Daucus carota* (carrot), *Dianthus caryophyllus* (carnation), *Foeniculum vulgare* (fennel), *Fragaria vesca* (wild strawberry), *Freesia refracta* (common freesia), *Gladiolus* hybrids (sword lily), *Glycine max* (soyabean), *Gossypium* (cotton), *Gossypium hirsutum* (Bourbon cotton), *Guizotia abyssinica* (niger), *Helianthus annuus* (sunflower), *Hevea brasiliensis* (rubber), *Hibiscus cannabinus* (kenaf), *Hordeum vulgare* (barley), *Ipomoea batatas* (sweet potato), *Lactuca sativa* (lettuce), *Lilium* spp. (lily), *Linum* (flax), *Lupinus luteus* (yellow lupin), *Malus sylvestris* (crab-apple tree), *Medicago sativa* (lucerne), *Mentha* (mints), *Nicotiana rustica* (wild tobacco), *Nicotiana tabacum* (tobacco), *Oryza sativa* (rice), *Paeonia officinalis* (common paeony), *Papaver somniferum* (Opium poppy), *Petroselinum crispum* (parsley), *Picea sitchensis* (Sitka spruce), *Pinus sylvestris* (Scots pine), *Raphanus sativus* (radish), *Ribes nigrum* (blackcurrant), *Ricinus communis* (castor bean), *Secale cereale* (rye), *Sesamum indicum* (sesame), *Solanum laciniatum* (kangaroo apple), *Solanum lycopersicum* (tomato), *Solanum tuberosum* (potato), *Spinacia oleracea* (spinach), *Trifolium* (clovers), *Trifolium incarnatum* (Crimson clover), *Triticum aestivum* (wheat), *Vitis vinifera* (grapevine), *Zea mays* (maize) (CABI 2012).

Distribution	This species is distributed across Africa, Asia, and Europe (Wang and Lin 1997, CABI 2012).
Quarantine pest	***Euproctis taiwana* (Shiraki)**
Synonyms	*Lymantria taiwana* *Porthesia taiwana* Shiraki
Common name(s)	Yellow tailed moth, tussock moth
Main hosts	*Gladiolus, Glycine max* (soyabean), *Lilium* spp. (lily), *Mangifera indica* (mango), *Rosa* spp. (rose), *Vigna radiata* (mung bean), *Vitis vinifera* (grape), *Ziziphus mauritiana* (jujube) as well as many fruit trees, flowers, vegetable and cereal crops (Liu 1998, Chang 1988, Kuo 2005, Biosecurity Australia 2006, CABI 2012).
Distribution	Japan (Honshu, Ryukyu Archipelago), Taiwan (CABI 2012).
Quarantine pest	***Kaniska canace* (Linnaeus)**
Synonyms	*Nymphalis canace* Linnaeus *Papilio canace* Linnaeus *Vanessa canace* Fruhstorfer
Common name(s)	Blue admiral
Main hosts	*Heterosmilax japonica*, Liliales, *Lilium* (lily), *Lilium lancifolium* (tiger lily), *Smilax china*, *Streptopus amplexifolius* (clasping twisted-stalk), *Tricyrtis hirta* (toad lily) (Iwase 1954, Robinson *et al.* 2012).
Distribution	Burma, China, India, Japan, Korea, Malaysia, Russia, Sri Lanka, Taiwan (Iwase 1954, Khramov *et al.* 2011, TaiBNET 2012).
Quarantine pest	***Orgyia postica* Walker**
Synonyms	*Lacida postica* (Walker) *Notolophus australis posticus* (Walker) *Notolophus postica* (Walker) *Notolophus posticus* (Walker) *Orgyia australis postica* (Walker) *Orgyia ceylanica* Nietner *Orgyia ocularis* Moore *Orgyia posticus* (Walker)
Common name(s)	Cocoa tussock moth, tussock moth, small tussock moth
Main hosts	*Amherstia nobilis*, *Camellia sinensis* (tea), *Cinchona*, *Cinnamomum*, *Coffea* (coffee), *Durio zibethinus* (durian), *Erythrina* spp., *Euphorbia longana* (longan), *Garcinia mangostana* (mangosteen), *Glycine max* (soyabean), *Hevea brasiliensis* (rubber), *Lablab purpureus* (hyacinth bean), *Leucaena leucocephala* (leucaena), *Lilium* spp. (lily), *Litchi chinensis* (lichi), *Malpighia glabra* (acerola), *Mangifera indica* (mango), *Nephelium lappaceum* (rambutan), Orchidaceae (orchids), *Populus deltoides* (poplar), *Pyrus communis* (European pear), *Ricinus communis* (castor bean), *Rosa* (roses), *Syzygium cumini* (black plum), *Theobroma cacao* (cocoa), *Vigna radiata* (mung bean), *Vitis vinifera* (grapevine), *Ziziphus jujuba* (common jujube) (CABI 2012, CoA undated - a).
Distribution	Bangladesh, Brunei Darussalam, China, India, Indonesia, Japan, Laos, Malaysia, Myanmar, Papua New Guinea, Philippines, Sri Lanka, Taiwan, Thailand, Vietnam (CABI 2012).
Quarantine pest	***Xylena formosa* (Butler)**
Synonyms	*Calocampa formosa* Butler *Xylena plumbeopaca* Hreblay & Ronkay
Common name(s)	Cutworm
Main hosts	*Lilium* spp. (lily), *Prunus mume* (Chinese plum), *Quercus acutissima, Quercus cerris, Quercus serrata, Quercus variabilis,* (Ikeda and Fukuyo 1985, Maddison 1993, HOSTS 2012).
Distribution	Japan, China, and Taiwan (Oguro and Sakai 2009).
THYSANOPTERA (thrips)	
Quarantine pest	***Frankliniella intonsa* Trybom**
Synonyms	*Frankliniella intonsa* f. *norashensis* Yakhontov and Jurbanov *Thrips intonsa* Trybom *Frankliniella formosae* Moulton
Common name(s)	Flower thrips

Main hosts	*Abelmoschus esculentus* (okra), *Arachis hypogaea* (groundnut), *Asparagus officinalis* (asparagus), *Capsicum annuum* (capsicum), *Chrysanthemum indicum* (chrysanthemum), *Fragaria* (strawberry), *Glycine max* (soyabean), *Gossypium* (cotton), *Lilium* spp. (lily), *Lycopersicon esculentum* (tomato), *Medicago sativa* (lucerne), *Oryza sativa* (rice), *Phaseolus vulgaris* (common bean), *Pisum sativum* (pea), *Prunus persica* (peach), *Rosa* (roses), *Solanum lycopersicum* (tomato), *Vigna angularis* (adzuki bean) (Maddison 1993, CABI 2012).
Distribution	This species is distributed across Asia, Europe and North America (CABI 2012).
Quarantine pest	***Haplothrips chinensis* Priesner**
Synonyms	None
Common name(s)	Chinese thrips
Main hosts	Buckwheat (*Fagopyrum esculentum*), *Capsicum* sp. Carrot (*Daucus carota*), Chinese cabbage (*Brassica rapa*, var. *chinensis*), Chrysanthemum (*Chrysanthemum morifolium*), *Convolvulus* spp., Corn(*Zea mays*), Cotton (*Gossypium hirsutum*), *Cupressus* spp., Dandelion (*Taraxacum officinale*), Hyacinth bean (*Lablab purpureus*), Kiwi (*Actinidia deliciosa*), Lily (*Lilium* spp.), *Lobelia* spp., *Lysimachia* spp., Mandarin Orange (*Citrus reticulata*), Mango (*Mangifera indica*), Onion (*Allium cepa*), Peach (*Prunus persica*), Plum (*Prunus* spp.), Pomegranate (*Punica granatum*), Potato (*Solanum tuberosum*), Red Clover (*Trifolium pratense*), Rose (*Rosa chinensis*), *Solidago* sp., Spinach (*Spinacia oleracea*), Tea (*Camellia sinensis*), Wheat (*Triticum aestivum*), White Clover (*Trifolium repens*), Willow (*Salix* spp.), Wolfberry (*Lycium chinense*) (Chang 1991, Hua *et al.* 1997 , Huang 2010, Liu *et al.* 2010, Qin *et al.* 2010, GAAS 2012).
Distribution	China, Korea, Japan, Taiwan (Chang 1991, GAAS 2012).
Quarantine pest	***Megalurothrips distalis* (Karny)**
Synonyms	*Megalurothrips morosus* Bhatti *Physothrips brunneicarnis* Bagnall *Taeniothrips brunneicornis* Hood *Taeniothrips distalis* Karny *Taeniothrips ditissimus* Anantha. & Jagd. *Taeniothrips infernalis* Priesner *Taeniothrips morosus* Priesner *Taeniothrips nigricornis* Priesner
Common name(s)	Bean blossom thrips
Main hosts	*Acacia nilotica* (gum arabic tree), *Anacardium occidentale* (cashew nut), *Arachis hypogaea* (groundnut), *Areca catechu* (betelnut palm), *Azadirachta indica* (neem tree), *Bauhinia racemosa* (bidi leaf tree), *Butea monosperma* (flame of the forest), *Cajanus cajan* (pigeon pea), *Camellia sinensis* (tea) *Canavalia ensiformis* (gotani bean) *Canavalia gladiata* (horse bean), *Coffea arabica* (arabica coffee), *Crotalaria juncea* (sunn hemp), *Cyamopsis tetragonoloba* (guar), *Flemingia macrophylla* (large leaf flemingia), *Gladiolus* hybrids (sword lily), *Gliricidia maculata*, *Glycine max* (soyabean), *Gomphrena globosa* (Globe amaranth), *Hibiscus rosa-sinensis* (China-rose), *Lablab purpureus* (hyacinth bean), *Lathyrus odoratus* (sweet pea), *Lathyrus sativus* (grasspea), *Lens culinaris* ssp. *culinaris* (lentil), *Lilium* spp. (lily), *Litchi chinensis* (lichi), *Macrotyloma uniflorum* (horsegram), *Mangifera indica* (mango), *Medicago sativa* (lucerne), *Mimosa pudica* (sensitive plant), *Moringa oleifera* (horse-radish tree), *Morus alba* (mora), *Morus nigra* (black mulberry), *Papaver somniferum* (Opium poppy), *Phaseolus vulgaris* (common bean), *Pisum sativum* (pea), *Pongamia pinnata* (Indian beech), *Punica granatum* (pomegranate), *Rosa chinensis* (China rose), *Santalum album* (Indian sandalwood), *Sesbania cannabina* (corkwood tree), *Sesbania grandiflora* (agati), *Sesbania sesban* (sesban), *Tephrosia purpurea* (purple tephrosia), *Vigna mungo* (black gram), *Vigna radiata* (mung bean), *Vigna umbellata* (Rice- bean), *Vigna unguiculata* (cowpea) (Maddison 1993, CABI 2012).
Distribution	Bangladesh, Bhutan, China, India, Indonesia, Japan, Korea, Mongolia, Myanmar, Nepal, Oman, Pakistan, Philippines, Singapore, Sri Lanka, Taiwan, Thailand (CABI 2012).
VIRUSES	
Quarantine pest	**Lily mottle virus LMoV**
Synonyms	Lily mosaic virus Lily mottle potyvirus Tulip breaking virus
Common name(s)	Lily mottle virus
Main hosts	*Alstroemeria brasiliensis* (Peruvian lily), *Lilium* spp. (lily), *Narcissus pseudonarcissus* (wild lent lily), *Tulipa* (tulip) (CABI 2012).
Distribution	China, Israel, Japan, Korea, USA, Italy, Netherlands, Poland (CABI 2012).

Quarantine pest	**Lily virus X LVX**
Synonyms	Lily potexvirus
Common name(s)	Lily virus X
Main hosts	*Lilium formosanum, Tetragonia expansa*, *Tricyrtis formosana* (Brunt *et al.* 1996, Jordan *et al.* 2008).
Distribution	Netherlands, United Kingdom, USA (Chen *et al.* 2005, Brunt *et al.* 1996, Jordan *et al.* 2008).
Quarantine pest	**Plantago asiatica mosaic virus PlAMV**
Synonyms	None found
Common name(s)	Plantago asiatica mosaic virus
Main hosts	*Lilium* spp. (lily), *Nandina domestica* (nandina, bamboo), *Plantago asiatica* (plantago), *Primula* spp. (primula), *Vigna sinensis* (cow pea) (Komatsu *et al.* 2008, PPSN 2010).
Distribution	Japan, Netherlands, Russia, USA (Komatsu *et al.* 2008, PPSN 2010).
Quarantine pest	**Strawberry latent ringspot virus SLRSV**
Synonyms	Rhubarb virus 5 *Aesculus* line pattern virus
Common name(s)	Latent ringspot of strawberry
Main hosts	*Aesculus* (buckeye) , *Apium graveolens* (celery), *Asparagus officinalis* (asparagus), *Capsella bursa-pastoris* (shepherd's purse), *Fragaria ananassa* (strawberry), *Fragaria vesca* (wild strawberry), *Humulus lupulus* (hop), *Lamium amplexicaule* (henbit deadnettle), *Lilium* spp. (lily), *Narcissus* (daffodil), *Pastinaca sativa* (parsnip), *Prunus armeniaca* (apricot), *Prunus avium* (sweet cherry), *Prunus domestica* (plum), *Prunus persica* (peach), *Prunus salicina* (Japanese plum), *Rheum hybridum* (rhubarb), *Ribes nigrum* (blackcurrant), *Ribes rubrum* (red currant), *Rosa* (roses) , *Rubus fruticosus* (blackberry), *Stellaria media* (common chickweed), *Trifolium repens* (white clover), *Urtica dioica* (stinging nettle), *Vitis vinifera* (grapevine) (CABI 2012).
Distribution	India, Lebanon, Syria, Turkey, Canada, USA, Albania, Austria, Belarus, Belgium, Croatia, Czech Republic, Finland, France, Germany, Hungary, Ireland, Italy, Luxembourg, Netherlands, Poland, Portugal, Romania, Serbia, Spain, Switzerland, Taiwan, United Kingdom, Yugoslavia (Serbia and Montenegro), Australia (South Australia- few occurrences), New Zealand (CABI/EPPO undated-a, EPPO 2009, Chang *et al.* 2001, CABI 2012).
Quarantine pest	**Tobacco ringspot nepovirus TRSV**
Synonyms	Anemone necrosis virus, Blueberry necrotic ringspot virus, Tobacco ringspot virus 1, Tulip veinal streak virus.
Common name(s)	Tobacco ringspot nepovirus
Main hosts	*Amaranthus caudatus* (tassel flower), *Amaranthus hybridus* (smooth amaranth), *Anemone coronaria* (poppy anemone), *Armoracia rusticana* (horseradish), *Astilbe chinensis, Impatiens hostie* (Impatiens), *Ilex crenata* (holly), *Begonia semperflorens* (begonia), *Brassica campestris* (turnip), *Beta vulgaris* (beetroot), *Brassica spp., Calendula officinalis* (pot marigold), *Cornus racemosa* (dogwood), *Cornus stolonifera* (dogwood), *Coronopus didymus* (Lesser swine-cress), *Capsicum* (peppers), *Capsicum annuum* (bell pepper), *Carica papaya* (paw paw), *Caryopteris spp.* (bluebeard), *Crataegus spp., Crocus spp., Cucumis melo* (melon), *Citrullus lanatus* (watermelon), *Cornus florida* (dogwood), *Cucumis sativus* (cucumber), *Cucurbita pepo* (ornamental gourd), *Cucurbita spp., Cyamopsis tetragonoloba* (cluster bean), *Cymbidium* (orchid), *Daucus carota* (corrot), *Eupatorium purpureum* (trumpet weed), *Gladiolus hybrids* (sword lily), *Glycine max* (soyabean), *Hyacinthus orientalis* (Hyacinth), *Hydrangea* spp., *Daphne* spp., *Iris hollandica* (Iris), *Lablab purpureus* (Hyacinth bean), *Lactuca sativa* (lettuce), *Lilium longiflorum* (lily), *Lycopersicon esculentum* (tomato), *Malus domestica* (apple), *Medicago sativa* (alfalfa), *Melilotus alba* (sweet clover), *Nicotiana tabacum* (tobacco), *Osmunda cinnamomea* (cinnamon fern), *Pastinaca sativa* (parsnip), *Pelargonium spp., Petunia × hybrida, Phaseolus lunatus* (lima bean), *Phaseolus vulgaris* (common bean), *Phlox drummondii* (annual Phlox), *Phlox subulata* (creeping Phlox), *Plantago lanceolata* (ribwort), *Populus tremuloides* (aspen), *Potentilla spp., Prunus* (stone fruit), *Rubus* (blackberry, raspberry), *Rumex spp.* (sorrel), *Solanum lycopersicum* (tomato), *Solanum melongena* (aubergine), *Solanum nigrum* (black nightshade), *Solanum tuberosum* (potato), *Sophora microphylla* (Kowhai), *Spinacia oleracea* (spinach), *Taraxacum officinale* (common dandelion), *Tulipa spp., Vaccinium* (blueberries), *Vicia* spp., *Vitis vinifera (grapevine) Viola cornuta* (horned violet), *Zea mays* (corn), *Zinnia elegans* (zinnia) (Gibbs and Gibbs 2002, CABI 2012).
Distribution	Distribution probably worldwide. Found in Africa, Central Asia, East and South-East Asia, Eurasia, the Mediterranean, the Middle East, North America, Australasia and Oceania, South and Central America; Australia, Brazil, Bulgaria, Canada, China, Denmark, France, Hungary, India, Indonesia,

	Iran, Italy, Japan, Korea Republic, Lithuania, Nigeria, Oman, Peru, Poland, Saudi Arabia, Sri Lanka, Taiwan, Turkey, United States of America. Found, but with no evidence of spread, in Australia, the U.K., Germany and New Zealand (Gibbs and Gibbs 2002).

Glossary

Term or abbreviation	Definition
Additional declaration	A statement that is required by an importing country to be entered on a phytosanitary certificate and which provides specific additional information on a consignment in relation to regulated pests (FAO 2012).
Appropriate level of protection (ALOP)	The level of protection deemed appropriate by the Member establishing a sanitary or phytosanitary measure to protect human, animal or plant life or health within its territory (WTO 1995).
Area	An officially defined country, part of a country or all or parts of several countries (FAO 2012).
Area of low pest prevalence	An area, whether all of a country, part of a country, or all parts of several countries, as identified by the competent authorities, in which a specific pest occurs at low levels and which is subject to effective surveillance, control or eradication measures (FAO 2012).
Consignment	A quantity of plants, plant products or other articles being moved from one country to another and covered, when required, by a single phytosanitary certificate (a consignment may be composed of one or more commodities or lots) (FAO 2012).
Control (of a pest)	Suppression, containment or eradication of a pest population (FAO 2012).
DAFF	Australian Government Department of Agriculture, Fisheries and Forestry (former title of the Department, now Department of Agriculture)
ELISA	Enzyme-linked immuno-sorbent assay.
Endangered area	An area where ecological factors favour the establishment of a pest whose presence in the area will result in economically important loss (FAO 2012).
Entry (of a pest)	Movement of a pest into an area where it is not yet present, or present but not widely distributed and being officially controlled (FAO 2012).
Establishment	Perpetuation, for the foreseeable future, of a pest within an area after entry (FAO 2012).
Equivalence (of phytosanitary terms)	The situation where, for a specified pest, different phytosanitary measures achieve a contracting party's appropriate level of protection (FAO 2012).
Host range	Species capable, under natural conditions, of sustaining a specific pest or other organism (FAO 2012).
Import permit	Official document authorising importation of a commodity in accordance with specified phytosanitary import requirements (FAO 2012).
Import risk analysis	An administrative process through which quarantine policy is developed or reviewed, incorporating risk assessment, risk management and risk communication.
Infestation (of a commodity)	Presence in a commodity of a living pest of the plant or plant product concerned. Infestation includes infection (FAO 2012).
Inspection	Official visual examination of plants, plant products or other regulated articles to determine if pests are present or to determine compliance with phytosanitary regulations (FAO 2012).
Intended use	Declared purpose for which plants, plant products, or other regulated articles are imported, produced, or used (FAO 2012).
Interception (of a pest)	The detection of a pest during inspection or testing of an imported consignment (FAO 2012).
International Standard for Phytosanitary Measures (ISPM)	An international standard adopted by the Conference of the Food and Agriculture Organization, the Interim Commission on phytosanitary measures or the Commission on phytosanitary measures, established under the IPPC (FAO 2012).
Introduction	The entry of a pest resulting in its establishment (FAO 2012).
National Plant Protection Organization (NPPO)	Official service established by a government to discharge the functions specified by the IPPC (FAO 2012).
Official control	The active enforcement of mandatory phytosanitary regulations and the application of mandatory phytosanitary procedures with the objective of eradication or containment of quarantine pests or for the management of regulated non-quarantine pests (FAO 2012).
Pathway	Any means that allows the entry or spread of a pest (FAO 2012).

Term or abbreviation	Definition
Pest	Any species, strain or biotype of plant, animal, or pathogenic agent injurious to plants or plant products (FAO 2012).
Pest categorisation	The process for determining whether a pest has or has not the characteristics of a quarantine pest or those of a regulated non-quarantine pest (FAO 2012).
Pest free area (PFA)	An area in which a specific pest does not occur as demonstrated by scientific evidence and in which, where appropriate, this condition is being officially maintained (FAO 2012).
Pest free place of production	Place of production in which a specific pest does not occur as demonstrated by scientific evidence and in which, where appropriate, this condition is being officially maintained for a defined period (FAO 2010).
Pest free production site	A defined portion of a place of production in which a specific pest does not occur as demonstrated by scientific evidence and in which, where appropriate, this condition is being officially maintained for a defined period and that is managed as a separate unit in the same way as a pest free place of production (FAO 2012).
Pest risk analysis (PRA)	The process of evaluating biological or other scientific and economic evidence to determine whether an organism is a pest, whether it should be regulated, and the strength of any phytosanitary measures to be taken against it (FAO 2012).
Pest risk assessment (for quarantine pests)	Evaluation of the probability of the introduction and spread of a pest and of the associated potential economic consequences (FAO 2012).
Pest risk management (for quarantine pests)	Evaluation and selection of options to reduce the risk of introduction and spread of a pest (FAO 2012).
Phytosanitary certificate	An official paper document or its official electronic equivalent, consistent with the model certificates of the IPPC, attesting that a consignment meets phytosanitary import requirements (FAO 2012).
Phytosanitary measure	Any legislation, regulation or official procedure having the purpose to prevent the introduction and/or spread of quarantine pests, or to limit the economic impact of regulated non-quarantine pests (FAO 2012).
Phytosanitary regulation	Official rule to prevent the introduction and/or spread of quarantine pests, or to limit the economic impact of regulated non-quarantine pests, including establishment of procedures for phytosanitary certification (FAO 2012).
Polyphagous	Feeding on a relatively large number of hosts from different genera.
PRA area	Area in relation to which a pest risk analysis is conducted (FAO 2012).
Quarantine pest	A pest of potential economic importance to the area endangered thereby and not yet present there, or present but not widely distributed and being officially controlled (FAO 2012).
Regulated article	Any plant, plant product, storage place, packing, conveyance, container, soil and any other organism, object or material capable of harbouring or spreading pests, deemed to require phytosanitary measures, particularly where international transportation is involved (FAO 2012).
Restricted risk	Risk estimate with phytosanitary measure(s) applied.
Spread	Expansion of the geographical distribution of a pest within an area (FAO 2012).
SPS Agreement	WTO Agreement on the Application of Sanitary and Phytosanitary Measures (WTO 1995).
Stakeholders	Government agencies, individuals, community or industry groups or organisations, whether in Australia or overseas, including the proponent/applicant for a specific proposal, who have an interest in the policy issues.
Systems approach(es)	The integration of different risk management measures, at least two of which act independently, and which cumulatively achieve the appropriate level of protection against regulated pests (FAO 2012).
Unrestricted risk	Unrestricted risk estimates apply in the absence of risk mitigation measures.

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