

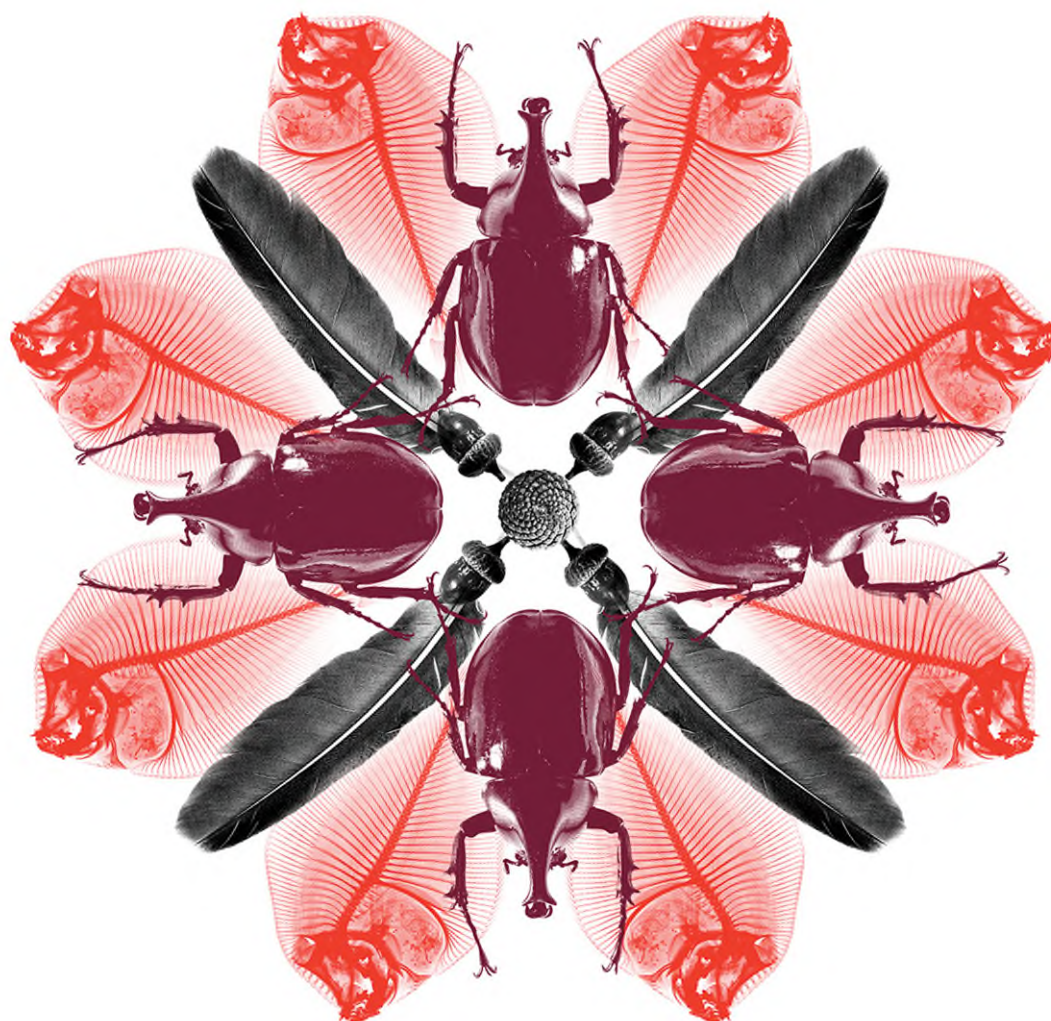


Australian Government  
Department of Agriculture,  
Water and the Environment

# Final risk analysis report for the release of *Puccinia rapipes* for the biological control of *Lycium ferocissimum*

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December 2021



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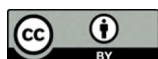
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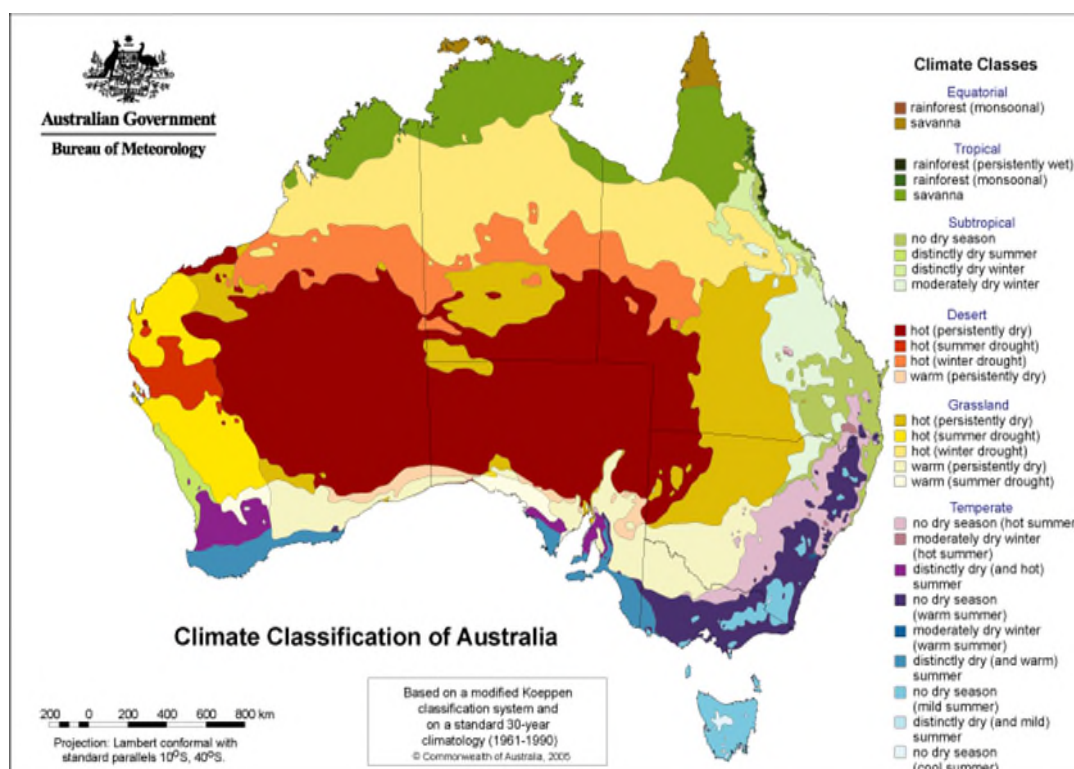
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Map 1 Map of Australia



Map 2 A guide to Australia's bio-climatic zones



## Acronyms and abbreviations

Term or abbreviation	Definition
ACT	Australian Capital Territory
ALOP	Appropriate level of protection
BA	Biosecurity Advice
BCA	Biological Control Agent
BICON	The Department of Agriculture, Water and the Environment Biosecurity Import Conditions database
BIRA	Biosecurity Import Risk Analysis
CSIRO	Commonwealth Scientific and Industrial Research Organisation
FAO	Food and Agriculture Organization of the United Nations
IPC	International Phytosanitary Certificate
IPPC	International Plant Protection Convention
ISPM	International Standard for Phytosanitary Measures
NSW	New South Wales
NPPO	National Plant Protection Organisation
NT	Northern Territory
PRA	Pest risk assessment
Qld	Queensland
SA	South Australia
SPS Agreement	WTO Agreement on the Application of Sanitary and Phytosanitary Measures
Tas.	Tasmania
the department	The Australian Government Department of Agriculture, Water and the Environment
Vic.	Victoria
WA	Western Australia
WTO	World Trade Organization

## Summary

The Department of Agriculture, Water and the Environment has prepared this final report to assess the proposal by the Commonwealth Scientific and Industrial Research Organisation (CSIRO) to release the rust fungus *Puccinia rapipes* for the biological control of African boxthorn (*Lycium ferocissimum*) in Australia.

This final report recommends that the release of *P. rapipes* should be permitted, subject to standard quarantine conditions associated with the import and release of exotic biological control agents.

This final report has determined the overall risk associated with the release of *P. rapipes* to be Very low. A risk estimate of Very low achieves Australia's appropriate level of protection (ALOP).

The assessment of risk to off-target plants included consideration of the testing methodology used and the plant species test list, including non-target species tested in described experiments. The biology of *P. rapipes*, field host-specificity studies, fungicide trials and the goji berry grower/producer consultation carried out by CSIRO were also considered.

This final report also contains details of the risk assessment process used for consideration of potential off-target effects associated with the proposed release of *P. rapipes*.

Two submissions were received from stakeholders during the consultation period for the draft report. Both submissions supported the proposal to release *P. rapipes*.

The application from CSIRO that was provided to the department has been included with this final report (Attachment 1).

# 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 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 risk analysis process is an important part of Australia's biosecurity policies. It enables the Australian Government to formally consider the level of biosecurity risk that may be associated with proposals to import goods or biological materials into Australia. If the biosecurity risks do not achieve the appropriate level of protection (ALOP) for Australia, risk management measures are proposed to reduce the risks to an acceptable level. If the risks cannot be reduced to an acceptable level, the goods or biological materials will not be imported into Australia until suitable measures are identified.

Successive Australian Governments have maintained a stringent, but not a zero risk, approach to the management of biosecurity risks. This approach is expressed in terms of the ALOP for Australia, which is defined in the *Biosecurity Act 2015* as providing a high level of protection aimed at reducing risk to a very low level, but not to zero.

Australia's risk analyses are undertaken by the Department of Agriculture, Water and the Environment, using technical and scientific experts in relevant fields, and involve consultation with stakeholders at various stages during the process.

Further information about Australia's biosecurity framework is provided in the *Biosecurity Import Risk Analysis Guidelines 2016* located on the [Department of Agriculture, Water and the Environment website](#).

## 1.2 This risk analysis

### 1.2.1 Background

An application has been submitted by CSIRO to release a biological control agent (Attachment 1). The identified biological control agent, *P. rapipes* is a rust fungus proposed for the biological control of African boxthorn (*L. ferocissimum*). The applicant has followed the steps outlined in the [Biosecurity Guidelines](#) for the Introduction of Exotic Biological Control Agents for the Control of Weeds and Plant Pests.

African boxthorn (*L. ferocissimum*) is a perennial shrub, densely branched with large spines that is native to South Africa. It does not have a wide global distribution and is only considered invasive in Australia and New Zealand. It is present in all states of Australia and is widespread in coastal and semi-arid inland areas in southern Australia (Attachment 1).

African boxthorn is a Weed of National Significance (WONS) and is a difficult and costly to control agricultural and environmental weed in Australia. It impacts the environment via native vegetation and faunal habitat displacement. Agricultural impacts include reduced access to



pasture and water in grazing areas, harbouring of pest species such as rabbits and pest birds and hosting insect pest species such as Queensland fruit fly (*Bactrocera tryoni*) and tomato-potato psyllid (*Bactericera cockerelli*) (Attachment 1).

*Puccinia rapipes* is a rust fungus, native to South Africa. The fungus is macrocyclic and infects young and old leaves, appearing to prefer young leaves. Infection is detrimental to the plant via competition for nutrients and water and the reduction of photosynthetic surface and capacity (Attachment 1).

The purified isolate of *P. rapipes* used in host specificity testing was collected in Western Cape Province, South Africa. The material proposed for release will be the same isolate that was used for host specificity testing (Attachment 1).

### 1.2.2 Scope

The scope of this risk analysis is to consider the biosecurity risk that may be associated with the release of an exotic biological control agent into the Australian environment (excluding its external territories). The primary risk associated with a release of this nature is the possibility of unwanted off-target effects on other species already present in Australia. The Department of Agriculture, Water and the Environment assesses the risk under the *Biosecurity Act 2015*.

Plants that are considered weeds are sometimes also considered to have value, for example, for purposes such as ornamental display, traditional medicine, feed for stock, etc. Considerations of the benefits, and therefore any associated concerns about eradication of the target weed species are out of the scope of this analysis.

The Department of Agriculture, Water and the Environment will not commence an assessment to release a biological control agent unless the target has been approved by an appropriate government body. *Lycium ferocissimum* was approved by the former Invasive Plants and Animals Committee (IPAC), now the Environment and Invasives Committee (EIC) in August 2016.

### 1.2.3 Associated pests

There are pests that may arrive with an imported exotic biological control agent. Section 9 of the *Biosecurity Act 2015* defines a pest as ‘a species, strain or biotype of plant or animal, or a disease agent, that has the potential to cause, either directly or indirectly, harm to: human, animal or plant health; or the environment.’ These pests may include, for example, parasitoids, mites or fungi. Should an application to release a biological control agent be approved, these pests will be addressed by existing operational procedures that apply to the importation and final release of the agent. These procedures include detailed examination of imported material, confirmation of identity, and breeding under containment conditions before release. For this reason, associated pests are not further considered in this risk analysis.

### 1.2.4 Consultation

In August 2021, a preliminary draft of this report was distributed to state and territory departments of primary industry via the Plant Health Committee. There were no suggested changes to the preliminary draft report and no objections to the proposed recommendation to release *P. rapipes* for the biological control of the weed, *L. ferocissimum*.



On 11 October 2021, Biosecurity Advice 2021-P12 informed stakeholders of the release of a draft risk analysis report for the release of *P. rapipes* for the biological control of the weed, *L. ferocissimum*. The draft report was released for a 30 day stakeholder consultation period that closed on 10 November 2021. Two stakeholder submissions were received during the consultation period, both supported the proposed recommendation to release *P. rapipes*.

### **1.2.5 Next Steps**

Publication of the final report represents the end of the risk analysis. Following the risk analysis process, if the Department of Agriculture, Water and the Environment approves release of the biological control agent, a letter will be sent to the applicant providing conditions of release.

## 2 Assessment of off-target risks

This section sets out the assessment of off-target risks that could be associated with the release of the biological control agent. Where appropriate, the methods followed those used for pest risk analysis (PRA) by the Department of Agriculture, Water and the Environment in accordance with the International Standards for Phytosanitary Measures (ISPMs), including ISPM 2: *Framework for pest risk analysis* (FAO 2019a), ISPM 3: *Guidelines for the export, shipment, import and release of biological control agents and other beneficial organisms* (FAO 2017) and ISPM 11: *Pest risk analysis for quarantine pests* (FAO 2019c) that have been developed under the World Trade Organization (WTO) Agreement on the Application of Sanitary and Phytosanitary Measures (SPS Agreement) (WTO 1995). The methodology for a commodity-based PRA is provided in Appendix A.

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.

Like many other countries, Australia expresses its ALOP in qualitative terms. The ALOP for Australia, 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 2.1, marked ‘very low risk’, represents the upper boundary of the ALOP for Australia.

The risk associated with the release of a biological control agent is a combination of the estimates of likelihood of off-target effects and the potential consequences of any off-target effects. A risk estimation matrix (Table 2.1) is used to combine these estimates.

**Table 2.1 Risk estimation matrix.**

Likelihood of off-target effects	Consequences of off-target effects					
	Negligible	Very low	Low	Moderate	High	Extreme
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

## 2.1 Stage 1: Initiation

Initiation commences when an applicant provides a submission proposing the release of a biological control agent. The Department of Agriculture, Water and the Environment will not commence an assessment to release a biological control agent unless the target pest in the submission has been approved as a biological control target by an appropriate government body.

The risk analysis area is defined as all of Australia (excluding its external territories), given that once released there will be no control of spread of the agent other than environmental constraints related to the biology of the organism.

## 2.2 Stage 2: Risk assessment

This assessment evaluates the likelihood of off-target effects and the potential economic and environmental consequences of any such effects.

The risk assessment is based primarily on consideration of the information provided by the applicant in the application package, including the results of host specificity testing, and current information in the scientific literature, where this is available. Given that the proposal is for deliberate release, the likelihood of entry, establishment and spread is assumed to be certain, and therefore the assessment relates to the host specificity of the proposed agent.

A likelihood is assigned to the estimate of occurrence of off-target effects. Six descriptors are used: high; moderate; low; very low; extremely low; and negligible. Definitions for these descriptors and their indicative ranges are given in Appendix A, Table 1.

### 2.2.1 Host specificity testing methodology

The following information regarding host specificity testing has been sourced from the application provided by CSIRO (Attachment 1). For further details please refer to the application and its appendices.

In order to predict whether any non-target species would be at risk from the candidate agent, host specificity testing was conducted with *P. rapipes* under contained conditions in Australia. Host specificity testing was carried out on 28 non-target plant species. All non-target species tested are in the family Solanaceae.

The host test list was developed using the framework of the centrifugal phylogenetic method, where an emphasis is placed on species most closely related to the target (Briese 2005). Test species included a mix of native, naturalised, ornamental and weed species.

*Lycium ferocissimum* plants used as the control in all host specificity tests were grown from seed collected at Palmer, South Australia. Non-target plant species were obtained as seeds, stem cuttings or whole plants from a range of locations across Australia.

#### **Host specificity tests**

As described in the application (Attachment 1), the single-uredinium isolate of *P. rapipes* used in host specificity testing was collected from a site in the Western Cape Province of South Africa.

Where possible, each plant species was tested in two separate experiments. Each experiment used five replicate plants per species/accession. However, there were exceptions to this, with three or four replicates used in some experiments. Where possible, different accessions were included in different experiments.

Inoculum was prepared using fresh (sometimes frozen) *P. rapipes* urediniospores in a 0.1% TWEEN® 80-deionised water solution to a final concentration of  $2 \times 10^4$  urediniospores/ml. The suspension was applied by brush to both sides of two young leaves (plus an additional third leaf for non-target plants), followed by spraying the suspension on the entire foliage (including both sides of leaves) of the plant. Plants were placed in dark, moist boxes in a Constant Temperature (CT) room set at 20°C for approximately 24 hours and then transferred to the bench in the CT room with a 14 hour photoperiod.

The viability of urediniospores used in each experiment was assessed at the beginning and end of the experiment. Experiments were considered valid if at least a third of the inoculated *L. ferocissimum* control plants had developed uredinia and assigned a disease rating of 3 or above and if a minimum of half of the young inoculated marked leaves showed a disease rating of 3 or above at 28 days after inoculation.

Assessment of non-target plant species took the form of both microscopic examination and assessment of visible symptoms. Microscopic examination of leaves of non-target species was carried out to evaluate the development of *P. rapipes*. After 5 days, the additional leaf inoculated for each non-target plant species was removed and cut into small pieces. The pieces were prepared for microscopic examination and at least 50 urediniospores per species were examined (for full details of this process see Section 2.12.2 of Attachment 1). Where chlorotic or necrotic lesions developed on some of the other two brush inoculated leaves, samples from other leaves with symptoms were also taken at 14 and 21 days and microscopically examined. The microscopic development and reproduction of *P. rapipes* on test plant species were assessed using 20 categories (Fig. 10, Attachment 1).

Assessment of visible disease symptoms on test plants took place at 14 and 28 days after inoculation. Each test plant species was classified using a rating scale (Table 5, Attachment 1). Based on the results of microscopic and visible examinations, the overall responses of each plant species/accession to *P. rapipes* were classified as either Immune (I), Highly resistant (HR), Resistant (R), Moderately Resistant (MR), Moderately Susceptible (MS), Susceptible (S) or Highly Susceptible (HS) (Table 5, Attachment 1).

### **Field host specificity study**

A field host specificity study was undertaken at the Centre for Biological Control, Waainek research facility, Rhodes University, Makhanda in the Eastern Cape Province of South Africa. The study was undertaken to investigate the potential for *P. rapipes* to infect and cause symptoms on non-target *Lycium* species under natural conditions.

The study consisted of two experimental set ups – open-field conditions and shade cloth. A mature *L. ferocissimum* plant and a potted *L. ferocissimum* plant, both naturally infected were located on the research facility grounds and these were used as the source of inoculum in the study. The open-field study was undertaken by placing potted *Lycium* plant species around the infected mature plant under open-field conditions where they were exposed to prevailing

westerly winds. The shade cloth study was undertaken using the naturally infected potted *L. ferocissimum* plant, with potted *Lycium* species placed around it and under a shade cloth. The shade cloth provided protection from prevailing winds but allowed swirling airflow. Non-target *Lycium* plants tested in the study were *L. barbarum*, *L. oxycarpum* and *L. cinereum* (shade experiment only). *Lycium ferocissimum* plants of Western Cape origin were also included in the experiments. Replicate plants of Eastern Cape provenance *L. ferocissimum* were also included in the shade experiments.

Three replicate plants were used in each experimental set up, with the exception of *L. cinereum* in the shade cloth experiment where only one replicate was used. Replicate plants were placed in a circle, 1-1.5 m from the infected plant.

Plants were assessed weekly for 6 weeks for the presence of uredinia, with a final assessment made at 11 weeks. An estimate of the percentage of all leaves on each plant infected with *P. rapipes* was recorded.

For further details regarding the field study refer to Appendix D of Attachment 1.

## 2.2.2 Host specificity testing results

During the host specificity experiments, all *L. ferocissimum* controls were infected and were categorised as Highly Susceptible, using the plant response categories outlined in Table 5, Attachment 1. Urediniospores used in suspensions in all host specificity experiments were tested and found to be highly viable.

Microscopic examination determined that urediniospores of *P. rapipes* germinated normally on all test plant species. Entry through the stomata, via a penetration hypha was observed in one or more accessions of 19 species tested. However normal intercellular infection hyphae were only observed in eight species including: *L. ferocissimum*, *L. barbarum*, *L. chinense*, *Hyoscyamus aureus*, *Datura leichhardtii*, *Nicotiana velutina*, *Anthocercis ilicifolia* and *Petunia nana compacta*. Development differences were observed following this stage, with abnormal haustoria observed in *H. aureus*, *N. velutina*, one accession of *A. ilicifolia* and *P. nana compacta*. Normal haustoria were observed in *L. ferocissimum*, *L. barbarum*, *L. chinense* and one accession of *A. ilicifolia*.

Normal uredinia developed on *L. ferocissimum* (the target weed), *L. barbarum*, *L. chinense* and *L. ruthenicum*. These species were all categorised as Highly Susceptible or Susceptible to *P. rapipes*. A few miniscule, pin-sized uredinia were observed on *A. ilicifolia* in one of two experiments, therefore this species was categorised as Moderately Susceptible in that experiment. Urediniospores produced from the pin-sized uredinia were unable to be germinated. Chlorotic flecking was observed on some leaves of some accessions of *H. aureus*, *Capsicum annum*, *D. leichhardtii*, *N. velutina*, *Nicotiana forsteri* and *P. nana compacta* and these species were categorised as Resistant. Rare necrotic spots on leaves of some replicate plants for both accessions of *Lycium australe* were observed, and also on one accession of *Solanum melongena* and these species were categorised as Moderately Resistant. All other non-target plant species did not produce any visible symptoms and were rated as Immune or Highly Resistant depending on the results of microscopic examination.

### Field host specificity study results

The results of the field study showed that *P. rapipes* was able to naturally spread and infect other nearby *L. ferocissimum* plants as well as other *Lycium* species tested (*L. barbarum* and *L. oxycarpum*). *Lycium cinereum* was not infected during the shade cloth experiment. The highest infection was found on *L. ferocissimum* and *L. barbarum* plants.

#### 2.2.3 Comments on host specificity testing

A total of 28 non-target plant species were tested during host specificity testing. The majority of non-target plant species tested were from the subfamily Solanoideae, to which the target weed belongs. Four non-target species from the *Lycium* genus within the Lycieae were tested, including the only Australian native species *L. australe*. Representative non-target species from a further 8 tribes within the Solanoideae subfamily and an additional 3 subfamilies within the Solanaceae were also tested. Given that the Solanaceae family is a large plant family, in the context of using the framework of the centrifugal phylogenetic method, it is considered appropriate to have tested non-target species exclusively from the family Solanaceae, with emphasis on the subfamily Solanoideae. The host test list includes the most closely related plant taxa to the target species in Australia. By testing these closely related non-target plant species, using the methodology outlined above and in the application (Attachment 1), the applicant is considered to have satisfactorily assessed the likelihood of off-target effects occurring in the Australian environment.

In addition to the target weed (*L. ferocissimum*), three exotic *Lycium* species (*L. barbarum*, *L. chinense* and *L. ruthenicum*) all commonly known as goji berry were found to be Highly Susceptible or Susceptible to *P. rapipes* infection.

*Puccinia rapipes* was able to produce a few miniscule, pin-sized uredinia on one accession of the Australian native species, *A. ilicifolia*, however these uredinia were unable to be germinated. This accession was rated Moderately Susceptible. The other accession tested was rated as Highly Resistant. There was no development of uredinia on any other non-target plant species tested, including the only Australian native *Lycium* species, *L. australe*.

The results of both the host specificity testing experiments and the field host specificity testing indicate that, in addition to the target weed, *P. rapipes* will be able to complete its lifecycle and cause infection on the three exotic goji berry species (*L. barbarum*, *L. chinense* and *L. ruthenicum*) present in Australia.

The application (Attachment 1) indicates that in South Africa *P. rapipes* has been recorded mainly in coastal areas, with no records indicated for inland areas (Figure 8, Attachment 1). In addition, prior to the current study where field infection experiments were undertaken, *P. rapipes* had only been recorded from *L. ferocissimum* in South Africa despite other *Lycium* species being present and widespread in its known range. South African goji berry producers contacted by the applicant have also reported that they have not observed any symptoms of *P. rapipes* at goji berry production sites. The applicant states that, as the production sites are outside of the natural distribution of *L. ferocissimum*, natural spread to these areas may rarely occur. It may also be expected that the inland environment is not as conducive to development of the rust fungus compared to more humid coastal conditions, given the biology of *P. rapipes* reported in the application (Attachment 1). It is expected that in the Australian context *P. rapipes*

may also be unlikely to naturally spread to areas where *L. ferocissimum* is not present and its development is likely to be limited by drier inland conditions.

#### 2.2.4 Likelihood of off-target effects

The likelihood of off-target effects is estimated on the basis of the outcomes of host specificity testing and other relevant information presented in the application (Attachment 1).

It is anticipated that while three exotic *Lycium* (goji berry) species are likely to be infected if exposed to *P. rapipes*, exposure via natural spread of the fungus may not occur in parts of Australia where *L. ferocissimum* is not present or at low prevalence. It is also expected that the drier and less humid inland regions of Australia will be less conducive to infection by *P. rapipes*.

On the basis of the results of host specificity testing reported in this application, including a field host specificity study and relevant information on the distribution and recorded host range of *P. rapipes* in South Africa, it is concluded that the likelihood of occurrence of off-target effects in Australia is **Moderate**.

#### 2.2.5 Assessment of potential consequences of off-target effects

The potential consequences of the off-target effects of this biological control agent have been assessed using the same methodology (Appendix A) as used in the import risk analysis process for pests associated with imported fresh produce.

Criterion	Estimate and rationale
Direct	
Plant life or health	<p>C—Significant at the local level</p> <p>Under field conditions it is anticipated that <i>P. rapipes</i> will infect the target weed, <i>L. ferocissimum</i> and the closely related <i>L. barbarum</i>, <i>L. chinense</i> and <i>L. ruthenicum</i> – all commonly known as goji berry. Release of <i>P. rapipes</i> may result in adverse plant life or health for the above three non-target exotic <i>Lycium</i> species, should they come into contact with the fungus, as they were rated as Highly Susceptible or Susceptible during host specificity testing.</p> <p>It is not anticipated that any other plant species will be affected, including the native <i>Lycium australe</i>.</p> <p>Trials conducted and reported on in the application (Attachment 1) provide evidence that fungicides are available that would successfully protect goji berry species against <i>P. rapipes</i>.</p> <p>It is anticipated that <i>P. rapipes</i> may not establish in all geographic regions in Australia, and therefore may not come into contact with goji berry in some regions.</p> <p>Prior to this application, <i>P. rapipes</i> had only been isolated from <i>L. ferocissimum</i> in its native range, despite other <i>Lycium</i> species, including goji berry being present in the recorded range of the pathogen. Commercial growers of goji berry in South Africa have not reported <i>P. rapipes</i> affecting their crops. It is assumed that this is because <i>L. ferocissimum</i> is not present in the goji berry production areas.</p> <p>It is noted that the fungus affects the leaves, petioles and green non-woody thorns of <i>L. ferocissimum</i> and has not been recorded on fruit. It is therefore anticipated that should <i>P. rapipes</i> infect the three goji berry species, that it is unlikely that the fruit will be damaged or infected. It is likely however that if a goji berry plant is heavily infected with the pathogen that the resulting impact on</p>



	<p>photosynthesis will impact the yield and potentially the quality of the fruit.</p> <p>While it is anticipated that any infection caused by <i>P. rapipes</i> will affect plant vigour, no plant death has been reported as a result of testing reported on in the application (Attachment 1). It is likely that the pathogen will have a greater impact on the plant health of young plants and seedlings.</p>
Other aspects of the environment	<p>A—Indiscernible</p> <p>There is no evidence that the introduction of <i>P. rapipes</i> would have any negative effects on any other aspects of the environment.</p> <p>The introduction of <i>P. rapipes</i> into the environment has the potential to provide control of African boxthorn (<i>L. ferocissimum</i>) which is likely to have direct beneficial effects. African boxthorn is known to displace native vegetation and degrade habitats.</p> <p>The results of host specificity testing indicate that no off-target impacts would be anticipated on any Australian native plant species.</p>
<b>Indirect</b>	
Eradication, control	<p>C—Significant at the local level</p> <p><i>P. rapipes</i> is likely to infect three exotic species of <i>Lycium</i> in addition to the target weed should they come into contact with the fungus. These species are commonly referred to as goji berry and are mainly sold as nursery/ornamental species in Australia.</p> <p>There is no commercial goji berry industry in Australia. Prior consultation by the applicant with goji berry growers indicates that growers would not be greatly impacted by the release of <i>P. rapipes</i> and would respond by either ceasing production of goji berry or treating with fungicides, therefore <i>P. rapipes</i> would be very unlikely to meet the criterion for eradication.</p> <p>There may be some additional costs associated with the use of fungicides, however many growers and nurseries already routinely apply these. There may be an impact for organic goji berry growers, as the use of fungicides may be required to manage <i>P. rapipes</i> should the rust become established in a region.</p> <p>It is noted that <i>P. rapipes</i> may not establish in all regions that goji berry are grown in Australia and hence control may not be necessary for some growers. In its native range <i>P. rapipes</i> has only ever been reported from <i>L. ferocissimum</i> despite other <i>Lycium</i> species (including native <i>Lycium</i> and goji berry species) being present. The host range testing carried out as part of the current application (see Attachment 1) is the first record of infection of goji berry in the native range.</p>
Domestic trade	<p>A—Indiscernible</p> <p>The release and spread of <i>P. rapipes</i> is considered unlikely to impact on domestic trade. Any indirect consequences would be associated with the anticipated off-target impacts on goji berry species. The majority of growers and sellers of goji berry species consulted by CSIRO have indicated that the release of <i>P. rapipes</i> would not significantly affect them. States and territories would be unlikely to impose restrictions on domestic trade unless there was a significant cost to an industry.</p>
International trade	<p>A—Indiscernible</p> <p>The primary consideration for consequences for international trade would be associated with anticipated off-target impacts on goji berry. The target weed, African boxthorn, is not a traded commodity.</p> <p>There is currently no export trade of Australian goji berries (fresh/dried fruit or nursery stock) and consultation carried out with growers by CSIRO has indicated that there is no commercial</p>

	<p>production of goji berry in Australia and this is not forecasted to change. Hence any possible off-target impacts of <i>P. rapipes</i> on goji berry are not likely to affect international trade.</p> <p>Host testing presented has demonstrated that there would be no off-target impacts associated with any plant species other than goji berries, hence there is no anticipated risk of <i>P. rapipes</i> being associated with any other traded commodities.</p> <p>It is also noted that South Africa produces goji berry commercially and there is no record of <i>P. rapipes</i> affecting goji berry production.</p>
Environmental and non-commercial	<p>B—Minor significance at the local level</p> <p><i>Lycium ferocissimum</i> (African boxthorn) is an introduced and invasive weed in Australia. The reduction of this species in the environment is not anticipated to have any negative indirect environmental effects.</p> <p>The direct off-target impact on three goji berry species is also unlikely to have any indirect environmental impacts. It should be noted that <i>L. barbarum</i> is naturalised and regarded as an environmental weed in Australia. <i>Lycium chinense</i> has also been recognised as an environmental weed in Australia but has not yet naturalised (Appendix A, Attachment 1).</p> <p>There may be some minor impacts to non-commercial growers of goji berry, such as backyard growers, particularly if they do not wish to treat their plants with fungicides.</p>

Based on this assessment the potential consequences of off-target effects are assessed as: **Very low**.

### 2.2.6 Off-target risk estimate

Unrestricted risk is the result of combining the likelihood of off-target effects with the outcome of potential consequences. Off-target effects and consequences are combined using the risk estimation matrix shown in Table 2.1.

Risk estimate for <i>Puccinia rapipes</i>	
Likelihood of off-target effects	Moderate
Consequences	Very low
Risk	Very low

As indicated, the risk estimate for release of *Puccinia rapipes* has been assessed as 'Very low', which achieves the appropriate level of protection (ALOP) for Australia.

### 3 Recommendation on release

The overall risk estimate for release of *P. rapipes* has been assessed as Very low, which achieves the ALOP for Australia. Therefore, it is recommended that this biological control agent be permitted to be released, subject to standard import and release conditions to ensure that the released material is free of other organisms.

This recommendation is made on the basis of the level of host specificity demonstrated by *P. rapipes* on *L. ferocissimum* and the potential consequences of off-target impacts on closely related *Lycium* species and is based on currently available information.

### 4 Stakeholder responses to draft risk analysis report

Two submissions were received from stakeholders. Biosecurity Tasmania and AgForce Queensland Farmers Limited supported the outcomes of the draft report.

### 5 Attachment 1

‘Information package to support the application to release the rust fungus *Puccinia rapipes* for the biological control of *Lycium ferocissimum* (African boxthorn) in Australia’

## Appendix A: Method for pest risk analysis

This chapter sets out the method used for the pest risk analysis (PRA) in this report. The Department of Agriculture, Water and the Environment has conducted this PRA in accordance with the International Standards for Phytosanitary Measures (ISPMs), including ISPM 2: *Framework for pest risk analysis* (FAO, 2019a) and ISPM 11: *Pest risk analysis for quarantine pests* (FAO, 2019c) that have been developed under the SPS Agreement (WTO, 1995).

A PRA is ‘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, 2019b). A pest is ‘any species, strain or biotype of plant, animal, or pathogenic agent injurious to plants or plant products’ (FAO, 2019b). This definition is also applied in the *Biosecurity Act 2015*.

Biosecurity risk consists of two major components: the likelihood 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 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/or spread of quarantine pests, or to limit the economic impact of regulated non-quarantine pests’ (FAO, 2019b).

A glossary of the terms used in the risk analysis is provided at the end of this report.

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

### Stage 1 Initiation

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.

For this risk analysis, 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.

For pests that had been considered by the department in other risk assessments and for which import conditions already exist, this risk analysis considered the likelihood of entry of pests on the commodity and whether existing policy is adequate to manage the risks associated with its import. Where appropriate, the previous risk assessment was taken into consideration in this risk analysis.

## 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 magnitude of the associated potential economic consequences’ (FAO, 2019b).

The following three, consecutive steps were used in pest risk assessment:

### **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 (FAO, 2019b).

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

- identity of the pest
- 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.

### **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, 2019c). The SPS Agreement (WTO 1995) uses the term ‘likelihood’ rather than ‘probability’ for these estimates. In qualitative PRAs, the department uses the term ‘likelihood’ for the descriptors it uses for its estimates of likelihood of entry, establishment and spread. The use of the term ‘probability’ is limited to the direct quotation of ISPM definitions.

A summary of this process is given here, followed by a description of the qualitative methodology used in this risk analysis.

### ***Likelihood of entry***

The likelihood of entry describes the likelihood 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 various stages.

The likelihood 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

the report. These practices are taken into consideration by the department when estimating the likelihood of entry.

For the purpose of considering the likelihood of entry, the department divides this step into two components:

- **Likelihood of importation**—the likelihood that a pest will arrive in Australia when a given commodity is imported.
- **Likelihood of distribution**— the likelihood 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 to be considered in the likelihood of importation may 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 (for example, bulk, 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 (for example, refrigeration) applied to consignments during transport and storage in the country of origin, and during transport to Australia.

Factors to be considered in the likelihood of distribution may include:

- commercial procedures (for example, 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.

***Likelihood of establishment***

Establishment is defined as the ‘perpetuation for the foreseeable future, of a pest within an area after entry’ (FAO, 2019b). In order to estimate the likelihood 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 likelihood of establishment.

Factors to be considered in the likelihood of establishment in the PRA area may 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.

***Likelihood of spread***

Spread is defined as ‘the expansion of the geographical distribution of a pest within an area’ (FAO, 2019b). The likelihood 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 likelihood 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 likelihood of spread.

Factors to be considered in the likelihood of spread may 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 likelihoods for entry, establishment and spread***

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 1). Definitions for these descriptors and their indicative probability ranges are given in Table 1. The indicative probability ranges are only provided to illustrate the boundaries of the descriptors and are not used beyond this purpose in qualitative PRAs. These indicative probability ranges provide guidance to the risk analyst and promote consistency between different pest risk assessments.



**Table 1 Nomenclature of likelihoods**

<b>Likelihood</b>	<b>Descriptive definition</b>	<b>Indicative range</b>
High	The event would be very likely to occur	$0.7 < to \leq 1$
Moderate	The event would occur with an even likelihood	$0.3 < to \leq 0.7$
Low	The event would be unlikely to occur	$0.05 < to \leq 0.3$
Very low	The event would be very unlikely to occur	$0.001 < to \leq 0.05$
Extremely low	The event would be extremely unlikely to occur	$0.000001 < to \leq 0.001$
Negligible	The event would almost certainly not occur	$0 < to \leq 0.000001$

**Combining likelihoods**

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). 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 likelihood of importation is assigned a descriptor of 'low' and the likelihood of distribution is assigned a descriptor of 'moderate', then they are combined to give a likelihood of 'low' for entry. The likelihood for entry is then combined with the likelihood assigned for establishment of 'high' to give a likelihood for entry and establishment of 'low'. The likelihood for entry and establishment is then combined with the likelihood assigned for spread of 'very low' to give the overall likelihood for entry, establishment and spread of 'very low'. This can be summarised as:

importation x distribution = entry [E]	<b>low x moderate = low</b>
entry x establishment = [EE]	<b>low x high = low</b>
[EE] x spread = [EES]	<b>low x very low = very low</b>

**Table 2 Matrix of rules for combining 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 difference 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.

The use of a one year volume of trade has been taken into account when setting up the matrix that is used to estimate the risk and 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. If there are substantial changes in the volume and nature of the trade in specific commodities then the department will review the risk analysis and, if necessary, provide updated policy advice.

**Assessment of potential consequences**

The objective of the consequence assessment is to provide a structured and transparent analysis of the potential 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, 2019b) and ISPM 11 (FAO, 2019c).

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
- non-commercial and environmental.

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) using Table 3. For example, a consequence with a magnitude of ‘significant’ at the ‘district’ level will have a consequence impact score of D.

**Table 3 Decision rules for determining the consequence impact score based on the magnitude of consequences at four geographic scales**

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

Note: In earlier qualitative PRAs, 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 to F has been 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 4 were adjusted accordingly.

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 4). These rules are mutually exclusive, and are assessed in numerical order until one applies.

**Table 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

### Estimation of the unrestricted risk

Once the assessment of the likelihood of entry, establishment and spread and for potential consequences 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 5) to combine the estimates of the likelihood of entry, establishment and spread and the overall consequences of pest establishment and spread. Therefore, risk is the combination of likelihood and consequence.

When interpreting the risk estimation matrix, note the descriptors for each axis are similar (for example, 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 5 Risk estimation matrix**

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

### The appropriate level of protection (ALOP) for Australia

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.

Like many other countries, Australia expresses its ALOP in qualitative terms. The ALOP for Australia, 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 5 marked 'very low risk' represents the upper boundary of the ALOP for Australia.

### Stage 3 Pest risk management

Pest risk management describes the process of identifying and implementing phytosanitary measures to manage risks to achieve the ALOP for Australia, 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 does not achieve the ALOP for Australia, 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 the ALOP for Australia. The effectiveness of any proposed phytosanitary measures (or combination of measures) is evaluated, using the same approach as used to evaluate the unrestricted risk, to ensure the restricted risk for the relevant pest or pests achieves the ALOP for Australia.

ISPM 11 (FAO, 2019c) 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 likelihood of entry of the pest.

Examples given of measures commonly applied to traded commodities include:

- options for consignments—for example, 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—for example, 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—for example, pest-free area, pest-free place of production or pest-free production site
- options for other types of pathways—for example, consider natural spread, measures for human travellers and their baggage, cleaning or disinfestations of contaminated machinery
- options within the importing country—for example, 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 level of biosecurity risk does not achieve the ALOP for Australia.

## Glossary

Term or abbreviation	Definition
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).
Appropriate level of protection (ALOP) for Australia	The <i>Biosecurity Act 2015</i> defines the appropriate level of protection (or ALOP) for Australia as a high level of sanitary and phytosanitary protection aimed at reducing biosecurity risks to very low, but not to zero.
Australian territory	Australian territory as referenced in the <i>Biosecurity Act 2015</i> refers to Australia, Christmas Island and Cocos (Keeling) Islands.
Biological control agent	A natural enemy, antagonist or competitor, or other organism, used for pest control (FAO 2019b).
Biosecurity	The prevention of the entry, establishment or spread of unwanted pests and infectious disease agents to protect human, animal or plant health or life, and the environment.
Biosecurity measures	The <i>Biosecurity Act 2015</i> defines biosecurity measures as measures to manage any of the following: biosecurity risk, the risk of contagion of a listed human disease, the risk of listed human diseases entering, emerging, establishing themselves or spreading in Australian territory, and biosecurity emergencies and human biosecurity emergencies.
Biosecurity import risk analysis (BIRA)	The <i>Biosecurity Act 2015</i> defines a BIRA as an evaluation of the level of biosecurity risk associated with particular goods, or a particular class of goods, that may be imported, or proposed to be imported, into Australian territory, including, if necessary, the identification of conditions that must be met to manage the level of biosecurity risk associated with the goods, or the class of goods, to a level that achieves the ALOP for Australia. The risk analysis process is regulated under legislation.
Biosecurity risk	The <i>Biosecurity Act 2015</i> refers to biosecurity risk as the likelihood of a disease or pest entering, establishing or spreading in Australian territory, and the potential for the disease or pest causing harm to human, animal or plant health, the environment, economic or community activities.
Control (of a pest)	Suppression, containment or eradication of a pest population (FAO 2019b).
The department	The Australian Government Department of Agriculture, Water and the Environment.
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 2019b).
Endemic	Belonging to, native to, or prevalent in a particular geography, area or environment.
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 2019b).
Establishment (of a pest)	Perpetuation, for the foreseeable future, of a pest within an area after entry (FAO 2019b).
Fumigation	A method of pest control that completely fills an area with gaseous pesticides to suffocate or poison the pests within.
Genus	A taxonomic category ranking below a family and above a species and generally consisting of a group of species exhibiting similar characteristics. In taxonomic nomenclature the genus name is used, either alone or followed by a Latin adjective or epithet, to form the name of a species.
Host	An organism that harbours a parasite, mutual partner, or commensal partner, typically providing nourishment and shelter.



Term or abbreviation	Definition
Host range	Species capable, under natural conditions, of sustaining a specific pest or other organism (FAO, 2019b).
Infection	The internal 'endophytic' colonisation of a plant, or plant organ, and is generally associated with the development of disease symptoms as the integrity of cells and/or biological processes are disrupted.
Infestation (of a commodity)	Presence in a commodity of a living pest of the plant or plant product concerned. Infestation includes infection (FAO 2019b).
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 2019b).
Interception (of a pest)	The detection of a pest during inspection or testing of an imported consignment (FAO 2019b).
International Plant Protection Convention (IPPC)	The IPPC is an international plant health agreement, established in 1952, that aims to protect cultivated and wild plants by preventing the introduction and spread of pests. The IPPC provides an international framework for plant protection that includes developing International Standards for Phytosanitary Measures (ISPMs) for safeguarding plant resources.
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 2019b).
Introduction (of a pest)	The entry of a pest resulting in its establishment (FAO 2019b).
Larva	A juvenile form of animal with indirect development, undergoing metamorphosis (for example, insects or amphibians).
National Plant Protection Organization (NPPO)	Official service established by a government to discharge the functions specified by the IPPC (FAO 2019b).
Non-regulated risk analysis	Refers to the process for conducting a risk analysis that is not regulated under legislation (Biosecurity import risk analysis guidelines 2016).
Nymph	The immature form of some insect species that undergoes incomplete metamorphosis. It is not to be confused with larva, as its overall form is already that of the adult.
Pathogen	A biological agent that can cause disease to its host.
Pathway	Any means that allows the entry or spread of a pest (FAO 2019b).
Pest	Any species, strain or biotype of plant, animal, or pathogenic agent injurious to plants or plant products (FAO 2019b).
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 2019b).
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 2019b).
Pest risk assessment (for quarantine pests)	Evaluation of the probability of the introduction and spread of a pest and of the magnitude of the associated potential economic consequences (FAO 2019b).
Pest risk assessment (for regulated non-quarantine pests)	Evaluation of the probability that a pest in plants for planting affects the intended use of those plants with an economically unacceptable impact (FAO 2019b).
Pest risk management (for quarantine pests)	Evaluation and selection of options to reduce the risk of introduction and spread of a pest (FAO 2019b).
Pest risk management (for regulated non-quarantine pests)	Evaluation and selection of options to reduce the risk that a pest in plants for planting causes an economically unacceptable impact on the intended use of those plants (FAO 2019b).

Term or abbreviation	Definition
Pest status (in an area)	Presence or absence, at the present time, of a pest in an area, including where appropriate its distribution, as officially determined using expert judgement on the basis of current and historical pest records and other information (FAO 2019b).
Phytosanitary certificate	An official paper document or its official electronic equivalent, consistent with the model of certificates of the IPPC, attesting that a consignment meets phytosanitary import requirements (FAO 2019b).
Phytosanitary certification	Use of phytosanitary procedures leading to the issue of a phytosanitary certificate (FAO 2019b).
Phytosanitary measure	Phytosanitary relates to the health of plants. 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 2019b). In this risk analysis the term 'phytosanitary measure' and 'risk management measure' may be used interchangeably.
Phytosanitary procedure	Any official method for implementing phytosanitary measures including the performance of inspections, tests, surveillance or treatments in connection with regulated pests (FAO 2019b).
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 2019b).
Polyphagous	Feeding on a relatively large number of hosts from different plant family and/or genera.
Practically free	Of a consignment, field or place of production, without pests (or a specific pests) in numbers or quantities in excess of those that can be expected to result from, and be consistent with good cultural and handling practices employed in the production and marketing of the commodity (FAO 2019b).
Pupa	An inactive life stage that only occurs in insects that undergo complete metamorphosis, for example butterflies and moths (Lepidoptera), beetles (Coleoptera) and bees, wasps and ants (Hymenoptera).
Quarantine	Official confinement of regulated articles for observation and research or for further inspection, testing or treatment (FAO 2019b).
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 2019b).
Regulated article	Any plant, plant product, storage place, packaging, conveyance, container, soil and any other organism, object or material capable of harbouring or spreading pests, deemed to require phytosanitary measures, particularly where international transportation is involved (FAO 2019b).
Regulated non-quarantine pest	A non-quarantine pest whose presence in plants for planting affects the intended use of those plants with an economically unacceptable impact and which is therefore regulated within the territory of the importing contracting party (FAO 2019b).
Regulated pest	A quarantine pest or a regulated non-quarantine pest (FAO 2019b).
Restricted risk	Restricted risk is the risk estimate when risk management measures are applied.
Risk analysis	Refers to the technical or scientific process for assessing the level of biosecurity risk associated with the goods, or the class of goods, and if necessary, the identification of conditions that must be met to manage the level of biosecurity risk associated with the goods, or class of goods to a level that achieves the ALOP for Australia.
Risk management measure	Are conditions that must be met to manage the level of biosecurity risk associated with the goods or the class of goods, to a level that achieves the ALOP for Australia. In this risk analysis, the term 'risk management measure' and 'phytosanitary measure' may be used interchangeably.

<b>Term or abbreviation</b>	<b>Definition</b>
Saprophyte	An organism deriving its nourishment from dead organic matter.
Spread (of a pest)	Expansion of the geographical distribution of a pest within an area (FAO 2019b).
SPS Agreement	WTO Agreement on the Application of Sanitary and Phytosanitary Measures.
Stakeholders	Government agencies, individuals, community or industry groups or organizations, whether in Australia or overseas, including the proponent/applicant for a specific proposal, who have an interest in the policy issues.
Surveillance	An official process which collects and records data on pest occurrence or absence by surveying, monitoring or other procedures (FAO 2019b).
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.
Treatment	Official procedure for the killing, inactivation or removal of pests, or for rendering pests infertile or for devitalisation (FAO 2019b).
Unrestricted risk	Unrestricted risk estimates apply in the absence of risk management measures.
Vector	An organism that does not cause disease itself, but which causes infection by conveying pathogens from one host to another.
Viable	Alive, able to germinate or capable of growth.

## References

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